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THE RUBBER BOARD
KOTTAYAM 686 001 INDIA

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THE QUARTER

It was for the first time in India that scientists and industrialists met in a common forum at the 'national seminar on rubber wood' held at Kottayam on 12th December 1989 to discuss the importance of a material which was considered only as secondary importance in the rubber plantations. But now rubber wood has shown a great potential for considering it as an important factor in the overall economy of the plantation as a whole. In all the three sessions of the seminar, leading Researchers, Scientists and Industrialists presented about 30 papers covering pathological and entamological problems, treatment and preservation and prospects of rubber wood.

Shri PC Cyriac, IAS, Chairman, Rubber Board inaugurated the Seminar. The three sessions were chaired by Shri P. Mukundan Menon, Dr. L. N. Shantakumaran and Dr. M. R. Sethuraj. Shri A. C. Sekhar, Retired Director, Forest Research Institute, Dehra Dun delivered the key note address (Report published elsewhere)

Although the present utilization of rubber wood is largely in packing industry with more than 40%of the present production being absorbed in the same, its potential in other fields also is duly recognised. No doubt, various rubber wood using industries have been confronted with problems in storing and processing due to insects, fungal attacks etc. Appropriate technological innovations could eliminate or minimise them. There have been several suggestions in the Seminar for an integrated approach to get optimum economy from rubber wood.

On the quality of rubber wood, anatomical studies so far have made some contribution to decide suitability of rubber wood for some industries like pulping, plywood etc., but studies like possible influence of clonal origin, location of growth plantation techniques etc., on the structural defects become necessary to understand and improve the quality of wood.

Rubber wood compares quite well with other hard woods for pulping, particularly by the sulphate process inspite of some residual latex particles. But some more work seems necessary to fully establish its technoeconomic feasibility on a sustained basis for industries like paper, fibre board, rayons etc.

All the papers presented at the Seminar are being scheduled to be published in the Rubber Board Bulletin starting with this issue.

The first national seminar on rubber wood held on 12th December 1989 at Hotel Aida, Kottayam discussed every aspect of rubber wood in its application for various uses and termed it as the future commercial wood of India. Being cheaper among the available semi hard woods, rubber wood could be made still cheaper if a comparatively cheaper processing technique is evolved. This was the consensus of the assembly of experts.

Countries like Thailand, Malaysia and Indonesia are already producing treated rubber wood and successfully exporting it to Japan, Western Europe, USA etc. These exports are mainly in the from of high value furniture and mouldings for furniture. In India a large part of 1 million c. ft. of rubber wood is used for packing case and the rest for high value added products.

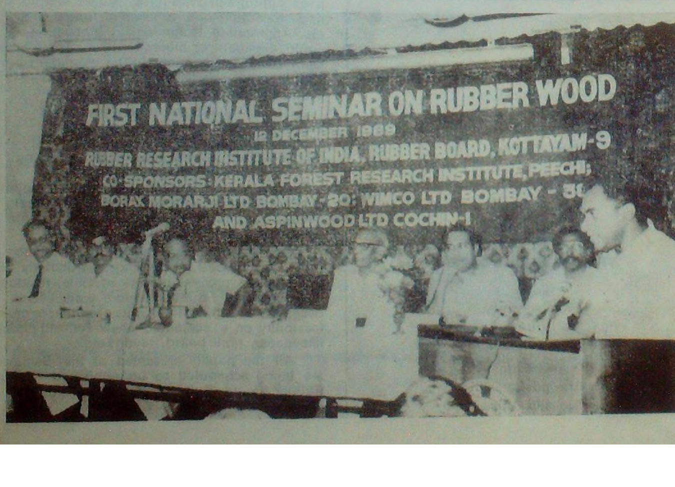
Rubber wood in its natural form is classified as non-durable, as it is susceptible to attacks by fungi, insects and borers. It needs treatment with suitable wood preservatives for end uses where high quality durable timber is required. Several preservative formulations can be used for treating rubber wood. Of these, boron based preservative is found to be effective and popular. It can be impregnated into rubber wood either by dip-fusion process or by vaccum-pressure impregnation process.

With its excellent wood working properties, medium density, high colour and attractive appearance rubber wood is ideally suited for manufacturing furniture, toys, panellings etc. Short length pieces can be finger jointed and glue-laminated to produce wooden staircases, railings, balusters, door and window components, to mention a few.

Future wood

More than one million cubic metres of rubber wood available annually, if exploited successfully by the wood industry, would be instrumental to arresting the cutting down of forest trees resulting in depletion of forests, said Shri PC Cyriac, IAS, Chairman, Rubber Board. He was inaugurating the first national seminar on rubber wood, organised by the Rubber Board. He said that though rubber wood

FIRST NATIONAL SEMINAR



ON 'RUBBER WOOD'

was classified as non-durable in its natural form, if suitably treated and seasoned, it has the potential to replace conventional hard woods in application of quality material for high value furniture and mouldings.

The seminar was co-sponsored by the Kerala Forest Research Institute, Borax Morarji Ltd, WIMCO and Aspinwood. The inaugural session was presided over by Dr. MR Sethuraj Director, Rubber Research Institute of India. A book on rubber wood written by Shri A. C. Sekhar, was formally released at the inaugural session by Shri PC Cyriac, presenting the first copy to Shri C. Bhaskaran Nair of South Indian Timber Industries, Kottayam. Those who made felicitation address on the occasion included Dr. R. Gnanaharan, Scientist, Kerala Forest Research Institute, Peechi, S/S SB Sukla, General Manager, Borax Morarjee Ltd, Bombay, JS Sharma, Chief Forestry Manager, WIMCO Ltd. Bombay and GK Prakash, Executive, Aspinwood Ltd, Cochin. Dr. V. Haridasan proposed the vote of thanks.

Shri P Mukundan Menon, Rubber Production Commissioner presided over the first session on prospects of rubber wood. Shri AC Sekhar, Retired Director, Forest Research Institute delivered the key note address. Ten papers were presented at the session.

The second session on pathological and entomological problems was chaired by Dr. LN Santhakumaran, Scientist Institute of wood Science and Technology, Bangalore. Six papers were presented. Dr. MR Sethuraj presided over the third session on treatment and preservation which witnessed the presentation of more than 11 papers. This was followed by the concluding session. Shri AC Sekhar summed up the day's discussions highlighting relevant points that came up for detailed consideration.

Concept of utilization in wood technology

As against conventional meanings as commonly understood, Shri Sekhar in his key-note address made special mention about the wood science and technology. The word utilization covers a very wide field of research, development, design and ultimate use of wood as well as wood products.

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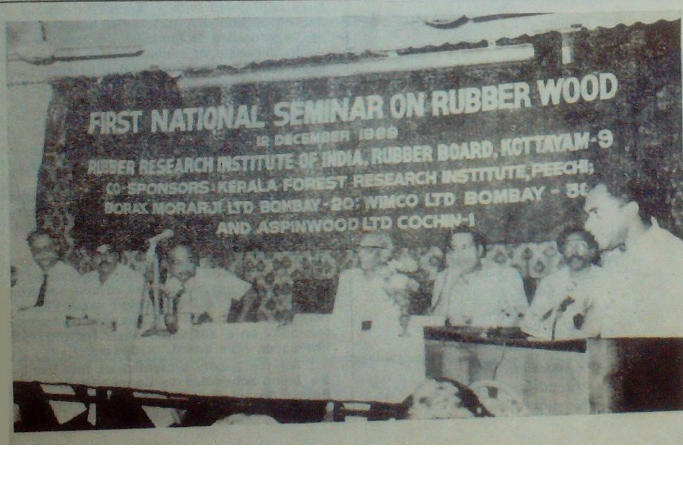

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It includes not only evaluation of technical properties but also all types of process technologies in converting wood to useful products.

Elaborating the present status of rubber wood utilization he said that various rubber wood using units have been facing problems in storing and processing due to insects and fungal attacks, warping, raised grain, cracks etc. On the quality of rubber wood, anatomical studies have made some contribution to decide suitability of rubber wood for some industries like pulping, plywood etc. He pointed out that seasoning of rubber wood does not pose serious problems, and that diffusion techniques although successful in the laboratories require to be popularised and the economics have to be worked out on commercial scale.

To increase the popularity and to fully establish a scientific and technological base for utilizing rubber wood in joinery furniture and cabinet-vase, the concerned industry may bring out pictorial brochures, books and pamphlets.

Sri Sekhar made it clear that rubber wood comparas quite well with other hardwoods for pulping, particularly by the sulphate process, inspite of some residual latex particles. Coutioning the new entrepreneurs he stated that a wood that came from renewable resource had the inherent capability for self adjusting economy if appropriate technique was adopted and that it has got the efficiency of converting low-tech areas into high or highly skilled areas.

Future needs

The paper presented by Shri R Gnanaharan on rubber wood research in India outlined the work that needs to be carried out in India for effective utilization of this raw material from non-conventional source to save our forests. Dr. V. Haridasan and P Rajasekharan presented their paper on production and consumption of rubber wood by 2000 AD. R. Vijendra Rao and T. R. Hemavathi of the Institute of wood Science and Technology, Bangalore presented their studies on natural defect in rubber wood. P. Ananthakrishnan Nadar of the Annamalai University in his paper on the versatile furniture timber of the future defined it as good for furniture, panelling etc. An account of tension wood with special reference to hevea brasiliensis was the title given by C. P. Reghu, D. Premakumari and Dr, A. O. N. Panikker to their paper, which focussed attention on the practical problems with the ultimate objective of minimising the extent of loss of this abnormal wood in the final shaping of the end products. The paper entitled, 'Industrial wood use in Kerala: the role of rubber wood' was presented by C. N. Krishnan kutty, Kerala Forest Research Institute, Peechi. V. R. Sivaramakrishnan, H. A. Ananthapadmanabha and H. C. Nagaveni jointly presented their paper on 'control of bio deterioration in rubber (Hevea brasiliensis) wood' which felt useful to carry out investigation on protection of logs by fumigation and drip diffusion to planks using cost effective techniques. Another paper presented was 'Differential natural decay resistance of Hevea Brasiliensis (Rubber) wood' prepared by H. A. Ananthapadmanabha, H. C. Nagaveni and V. C. Srinivasan, Institute of wood Science & Technology, Bangalore. The paper on mushroom cultivation on rubber was jointly written by R. Kothandaraman, Kochuthresiamma Joseph, Jacob Mathew and K. Jayarathnam.

The paper holds the view that the rubber wood and saw dust available in the country could be used for mushroom cultivation. Three species of Oyster mushrooms were inoculated on rubber wood. The paper says that detailed investigations are required. George Mathew of Kerala Forest Research Institute, Peechi presented his paper on 'Insect pests of rubber wood in Kerala.'

New hopes

The work undertaken by Smt. L. Thankamma of the RRI of India has opened up new possibilities towards improving the quality of wood by wood preservation and also by imparting different desired colours and patterns to the wood.

Studies carried out by earlier workers on physical and mechnaical properties of rubber wood have been reviewed and its various end uses enumerated as explained by Shri BS Kamala and PV Krishna Rao, Institute of Wood Science and Technology, Bangalore in their paper on 'Physical and mechanical properties of rubbr wood : a review.

M Balasundaram and R Gnanaharan presented a paper on Laboratory evaluations of preservative treated rubber wood against brown rot and white rot fungi'. In the context of acute shortage of wood and increasing timber prices, rubber wood was the only timber available in plenty at moderate cost to the public.
This was the view expressed by T. K. Damodaran and R. Gnanaharan, Kerala Forest Research Institute, Peechi.
V. Kuppuswamy and V. V. Srinivasan presented their paper on 'Copper-chrome-

(Contd. on Page 29)

Rubber Wood-Polymer Composite By Gama-Radiation Processing

A. K. KADERKUTTY
The Western India Plywoods Ltd., Baliapatam.

The past decade has witnessed the greatest resource crisis in the forestry sector and forest based industries, with the rapid dwindling of our valuable tropical forests. According to FAO, these forests are disappearing at an alarming rate of 15 million hectares a year and if this trend continues unchecked the entire resource will be wiped out in the next 50 years. Deforestation for a number of reasons without commensurate regeneration of forests has been responsible for the forest death. Wherever new plantations are raised these are in fact not forests but monocultures. Acid rains caused by emission from automobiles and factories have created substantial damage to forests particularly in the developed countries. According to Mr. Edward Goldsmith (U.K) an internationally recognised campaigner, lecturer and writer, "the third world war has already been declared and is deing waged against nature and nature is being overwhelmed". According to the National Remote Sensing Agency, Kerala the home town of the evergreens has suffered a 14% loss of its total forest cover over the seven year period. Encroachments, unchecked forest fires, submergence in aid of hydel projects are primarily responsible for the heavy loss. Government of India rightly adopted the policy of banning the felling of trees. This in turn has resulted in great hardships for the woodbased industries. Since industrial development is also equally important, it is imperative that efforts are intensified to locate alternative source of rawmaterials and develop technologies appropriate to the available resources. Short rotation plantation species like rubber-wood assume great importance. Technologies must be developed for efficient conversion of these resources into final reconstituted products. Hundred percent utilisation of wood by extending the durability of the products is the inevitable solution to the present crisis. Technological sophistication should be the byword for ensuring both our industrial and economic development and resource conservation.

Applications

In this context the plantation species like rubberwood (*Hevea brasiliensis*) which can be cultivated in perpetuity on a short rotation basis would be ideal to resolve the present rawmaterial crunch. It is estimated that about 1.2 million cubic metres of rubberwood will be available every year. It is reported to be presently used for making plywood. However, more value added products can be produced for transforming rubberwood into a wood-polymer composite which can replace primary high quality timbers like teak and rosewood in a number of decorative and structural applications.

The unique application of ionizing radiation is one such method. The high energy radiation causes a virtual metamorphosis by a process known as radiation grafting. The wood is first impregnated with special class of chemicals called vinyl monomers that could be polymerized into the solid polymer by means of high energy radiation when gamma radiation passes through a material such as wood and a vinyl monomer, it leaves behind a series of ions and excited states due to the energy of the gamma ray being absorbed through photoelectric Comton and pair production collisions. Cobalt-60 for example, produces two gamma rays of 1.17 and 1.33 million electron volt. Upto 30 Kev are required to rupture covalent bonds and to cause ionization. The ions and excited states generated in the absorbing material re-arrange to form free radicals which in turn initiate polymerization process.

Before subjecting wood to irradiation, the wood is impregnated with vinyl monomers. The impregnation is carried out by first evacuating the airfrom the wood vessels and cell lumens. This process is carried out in an impregnation chamber. Air in the cellular structure of wood is removed as the pressure in the evacuation vessel is reduced by a vacuum pump. Half an hour pumping at 1 mm mercury is required to remove the air. The vacuum pump is isolated from the system at this point and monomer is introduced into the evacuted chamber.

Aftter the monomer impregnation is complete the wood monomer is removed and placed in a Panbit Cobalt-60 irradiation source. This facility was established at The Western India plywoods Ltd. in collaboration with the Bhabha Atomic Research Centre, Bombay.

Many different vinyl monomers have been used to make wood polymer composites. The vinyl monomers normally employed will result in a polymeric system which is thermoplastic. But we have developed a unique combination of monomers so that the irradiation produces a thermosetting plastic at the end. This system results in a nonmelting wood polymer composite and imparts excellent machining and sanding properties not achievable by conventional monomeric systems.

Rubberwood was subjected to the above process and has produced an excellent composite. The physical and mechanical properties are enhanced after treatment as also the dimensional stability. The undesirable swelling and shrinkage characteristic of untreated wood is totally eliminated. In the un-treated wood the swelling and shrinkage are caused by the hydroxyl groups present in cellulose and lignin molecules. As a result of bulking and grafting with wood polymer system, the accessibility of the hydroxyl groups to moisture is prevented and can therefore no longer interact with moisture. Thus a composite of excellent dimensional stability is produced. This improved property in turn enhances the electrical properties. Basically dry wood is an excellent electrical insulator. The electrical resistance however reduces markedly as the material picks up moisture when exposed to high humidity conditions. Inertness to the effect of moisture in wood-polymer composite results in continued retention of high electrical resistance. In fact the final product is highly hydrophobic. Similarly wood polymer system becomes impervious to several aqueous chemicals and is therefore not affected by chemicals environment. Because of cross-linked structure in the final product developed by us the material is unaffected by organic solvents.

Ideally Suited

As a result of superior mehanical and electrical properties and outstanding chemical and solvent resistance the rubber wood polymer composite is ideally suited for parquet flooring, textile components like picking sticks, bobbins' etc. As a result of excellent chemical resistance, the material can be used in chemical industries, as flooring material, filter presses frames, laboratory tables. etc Because of aesthetic superiority over untreated wood, the rubber wood polymer composite is an outstanding material for making furniture. The wood polymer can have natural colour or can be dyed to any desired colour. Window frames, door steps, stair case rails, steps for stair case, are some of the applications of the material.

Because of outstanding durability, rubber wood polymer system can substitute any primary timber. As has been already pointed out a technologically upgraded material like rubber wood polymer composite would help preserving our forest resource. Incessant pressure on the forest resourced to meet ever increasing demand by the swelling population can be reduce only by technological means. Combination of short-rotation plant like rubber wood and superior technology of conversion is the only answer to meet the future challenge. □

Latest Rubber Statistics

	April to Oct. 89 (tonnes)	April to Oct. 89 (tonnes)	Increase	Estimate for 1989–90 (tonnes)
Production				
Natural	160.115	132,163	21.7%	292,000
Synthetic	27,881	28,365	–	50,000
Total	188,696	160,530	17.5%	342,000
Consumption				
Natural	193,925	179,705	7.9%	340,000
Synthetic	52,880	58,160	9.8%	90,000
Total	265.805	227,865	8.3%	430,000

Research Perspectives for Rubberwood Utilisation

S. N. SHARMA

Head of Division, Forest Products Research Forest Research Institute, Dehra Dun

Abstract

While the strength, shrinkage, hygroscopicity and wood working behaviour of rubber wood are favourable for more sophisticated and uses like furniture, doors, windows, and joinery, susceptibility to rapid bio-degradation and the high incidence of wraping during drying are the major bottlenecks. F. R. I.' S work on timely prophylactic treatment of freshly felled or sawn timber has enabled almost complete control of stain, decay and insect attack.

The incidence of tension wood and associated growth stresses appears to aggravate wraping in this species. Studies on their distribution within the stem would help evolve sawing procedures that may ensure better balancing of growth stresses and the differential longitudinal shrinkage of tension and normal wood within the converted section during sawing and drying.

The Saw-Dry-Rip procedure, optimisation of stack top weighting and correction of warping by steaming dried timber under restraint are worth trying for control of warping.

The bulk of converted timber from logs, except that from near the pith, can be kiln dried fast without surface checking degrade. Rubberwood is a short rotation (25-30 yrs) crop with higher percentages of juvenile core wood in the stem that is liable to surface check during drying. At present "boxing out" the pith appears to be the only alternative for avoiding this degrade.

Introduction

Timber from spent rubber trees has a confirmed availability in the country for use as timber. As per position reported for 1978-79, a total area of 236814 ha was under plantations in Kerala, Tamil Nadu, Karnataka, A&N, Assam, Tripura, Goa, A.P. and Maharashtra, in that order according to covered area. Plantations are reported to have been undertaken recently in Orissa and some eastern states. At the stage of slaughter tapping, 185-200 trees exist per ha, with an expected average 0.6m³ wood availability from the trunk and 0.4 m³ branch wood from each tree.

Utilisation of rubber wood for various end uses as timber including sophisticated ones like export furniture is reported to be already well advanced in Malaysia. Data on its properties, sawing, seasoning and preservative treatment behaviour, and suitability for plywood manufacture have been published by the Forest Research Institute, Kepong (Grant 1952, Sulaiman 1968, Grewal 1979 Salleh et al 1979, Anon, 1980)

Review of research data on India Grown Rubberwood

The Forest Research Institute, Dehra Dun has published data on strength properties, suitability for various end uses from the mechanical strength point of view, seasoning behaviour, shrinkage, hygroscopicity, steam bending properties, working and finishing qualities, and pattern of distribution of tension wood for rubberwood from Indian plantations. The results are briefly summarized below, along with certain field observations of sawn and air dried material.

Kiln Drying

(Sharma et al 1981)

Kiln drying schedule

If normal mode of plain or live sawing is adopted for logs, Schedule No V of IS:1141-1973 (Anon 1973) as given in Table I is recommended, as such, for planking 25-35mm thick and with the initial stage RH values increased by 7% for thicker planks and scantlings.

Table 1

Schedule V (IS: 1141-1973) recommended for 25-35 mm rubberwood planks

Moisture content cf the wettest timber on air inlet side	Temperature Dry Bulb oC	Wet Bulb oC	Relative Humidity %
Green	42	38.5	80
40%	45	40	72
35%	46	40	68
30%	48	40	60
25%	50	40	53
20%	52	40	47
15%	55	40	39

Note: For thicker 63x105 mm scantlings the RH from green to 25% m.c. should be increased by 7%at each step and by 5% thereafter

It appears probable that a faster Schdule No. III or IV instead of Schedule No. V may be applicable without cracking and splitting fof bulk of the sawn timber if modified sawing pattern is adopted after growth stress distribution studies.

Drying times

For 28 mm planks under Schedule IV : 4 d

For 63x105 mm scantlings under Schedule V, with 7% increased initial RH : 13 d

Drying degrade

Planks containing pith, heartshakes or centre heart region near the pith invariably showed opening of shakes (with only slight extension) and extensive surface cracking in the included patches of wood from near the pith. Twist and bow of 10-16mm over 2-2.3m length developed in almost all such planks Cupping was mild.

A notable observation was that while amongst full-width (live) sawn planks only those containing pith, heart-shake or region near the pith developed severe warping scantlings sawn from all positions, including middle and outer positions, in the log developed spring, bow and twist. It appears that this difference in warping arose from differences in geometry of the plank and scantling sections (Maeglin et al 1981), though it may as well have been due to the inherent variation in proportion of tension wood between logs.

Planks or scantlings taken from middle radial positions in the log, including tangentially sawn pieces, were remarkably free from surface cracking or warping.

Planks or scantlings taken from uttermost position in the log in most cases surface cracked on the outer face but were clear on the interior face.

End splitting was negligible and collapse absent. The timber is remarkably free from knits.

Field observations of sawn, air dried timber

Crook, twist and extensive surface checking in patches of included wood from near the pith are the drying defects commonly observed in sawn planks and scantlings left for air drying in sawmills. The behaviour is similar to that reported above for kiln dried timber

Tension wood

(Rao et al 1983)

Differentiation of tension wood in this species is not easy even after staining. Tension wood occurs as narrow or broad bands extending to several millimeters and also as scattered or diffuse. Its proportion varies widely in sawn timber obtained from different trees, as the limited data on planks obtained from three different trees illustrates.

Table 2

Plank from Tree No.	Proportion of tension wood Max	Min	Avg.
1	54%	1%	27.5%
2	47%	6%	16.5%
3	75%	43%	58%

Shrinkage & Hygroscopicity

(Sharma et al 1982)

Basic sp. gr.

0.463 ± 0.029

Total shrinkage (green to O. D.)

Tangential : $6.080 \pm 0.294\%$

Radial : $2.847 \pm 0.125\%$

Volumetric : $10.963 \pm 0.770\%$

Longitudinal : $0.481 \pm 0.295\%$

Amongst timbers of comparable sp. gr. (0.424-0.516), shrinkage of rubberwood is comparable to that of kanju (Holoptelea integrifolia), bonsum (Phoebe spp.) thitmin (Podocarpus neriifolius)and hathipaila (Pterospermum acerifolium); and also comparable to some heavier woods like chikrassy (Chukrasia tabularis), badam (Terminalia procera) and kokko (Albizia lebbeck), which are in common use for furniture and joinery. It can be classed as a moderately steady timber.

Hygroscopicity

EMC at different RH levels (20-87%) is given in Table 3. Rubberwood has rather high hygroscopicity comparable to timbers like bonsum (Phoebe (pp) and fir (Abies pindrow) (Rehman 1942).

Table 3

Equilibrium moisture contenst of rubberwood at six R. H. levels.

R. H. (3)	E.M.C (%)
86.6	19.6
74.2	14.3
62.5	10.1
52.0	9.2
37.3	6.2
20.3	3.8

Intersection point values as determined by shrinkage–m. c. plots were as follows:-

Tangential shrinkage – m. c. plot	25%
Radial shrinkage – m. c. plot	21%
Volumetric shrinkage – m. c. plot	29%

Working qualities

(Shukla et al 1984)

Rubberwood saws and works easily. Narrow gauge saw with teeth having front rake of 20° and top clearance angle 15° is recommended. For planing, cutters set at 30° angle give smooth surface. While rubberwood is good in turning, in mortising and boring fuzziness, tearing off of grains and crushing occur.

Steam Bending

(Sharma et al 1982)

Rubberwood is comparable to rosewood (Dalbergia latifolia) and better than white cedar (Dysoxylum malabaricum), khadsu oak, (Quercus semicarpifolia), pyinma (Lagerstroemia hypoleuca), mango (Mangifera indica), pali Dichopsis elliptica) and hathipaila (Pterospermum acerifolium) in steam bending property (Rehman et al 1955). A minimum bending radius of 7.5 cm in 1.3 cm thickness can be achieved.

This species compares very well without folding and wrinkling and with very little change in section.

More recently, rubberwood has been successfully bent in the cold for novel design of easy chairs after ammonia plasticization.

Strength Properties

(Anon 1980, Gupta et al 1989 Shukla et al 1984)

From strength point of view, rubberwood is considered suitable for packing cases, crates, dunnage pallets and door and window shutters. Its use in the country has however so far been largely limited to packing cases, crates and dunnage pallets only. It is also being used for match boxes and splints besides compressed wood shuttle blocks (Sharma et al 1977). At least one manufacturer has however recently started using it for sewing machine furniture and its wider use for more sophisticated uses is gradually picking up.

Technical Bottlenecks in utilisation

The main bottlenecks in the utilization of rubberwood for more sophisticated end uses are:

(i) Its high susceptibility to fungal stain and decay, when green, and low durability to insect attack.

(ii) Liability to warping in general, and to surface checking and splitting in wood from near the pith in particular.

Fungal stain, decay & insect attack

Felled logs and green sawn timber are known to develop stain and get infected with decay fungi within a few hours of felling and sawing.

It has howerver been possible to prevent stain and decay almost completely by adopting green conversion of logs promptly (within 24-48 hrs) after felling followed by quick surface drying of the converted timber in air (if the weather permits) or in a kiln. Alternatively, converted timber should be promptly given a prophylactic dip, spray or brush treatment with 5% soln. of the following Chemicals:

Sodium pentachlorophenate	- 2 parts by wt.
Borax	- 1.5 parts by wt.
Boric acid	- 1.5 parts by wt.

This treatment is effective for temporary protection only and the converted timber should be air or kiln dried to final low m. c. within a week or fortnight of giving the prophylactic treatment. The treatment also provides temporary protection against insect attack-

If logs have to be stored for some time pending conversion, they should be debarked, sprayed or brush coated on all surfaces (including the ends) with prophylactic preservative and end coated with bituminous paint. Conversion however should not be delayed beyond about 2 weeks.

To ensure permanent protection, the converted timber has to be more thoroughly treated with a standard preservative to desired absorption and penetration for the given end use as prescribed under IS:401-1982 (Anon. 1982) The conventional vacuum-pressure treatment achieves excellent results, if applied after partially air drying the timber.

An alternative method of green treatment such as the oscillatory pressure method (OPM) is ideal, as permanent protection is possible in a single step immediately after green conversion, thus obviating the need for temporary prophylactic protection and partial air drying of the converted timber before giving vacuum- pressure treatment. But it involves more expensive equipment.

The success of these measures has been demonstrated in a unit manufacturing sewing machine furniture.

Warp control

The propensity of rubberwood to warp and develop surface checking is included wood from near the pith are traceable to:

(i) Occurrence of tension wood in this species.

(ii) Possibility of high growth stresses associated with tension wood (Nicholson et al 1975).

(iii) Higher percentage of Juvenile wood, being a short rotation (25-30 yrs) crop.

No studies have yet been attempted on the patterns of distribution of growth stresses and tension wood in logs of this species. Also no data exist on the extent of warping if any that occurs during sawing of logs. Such studies could help evolve sawing patterns, other than normal plain or live sawing, that reduce warp on the saw and during subsequent drying.

The Saw-Dry-Rip procedure (Maeglin et al 1981) of sawing full-width planks or flitches of the desired thickness (live sawing), drying in flitch form, and finally ripping into desired widths, should permit growth stresses and the differential longitudinal shrinkage between tension wood and normal wood to remain better balanced within the piece during sawing and drying, and may be helpful to control warp in scnatling sections. Direct sawing of the log into desired scantling sections is likely to increase the chance of disbalancing of growth stresses during sawing as also the chance of tension wood being located asymmetrically to the sides of the section. The higher incidence of warp in kiln dried scantlings than in full-width (live sawn) planks in the studies described above is likely to have arisen from this effect of section geometry.

In case of direct sawn scantlings, the effectiveness of a steaming treatment under mechanical restraint for correcting warp, particulary bow, twist and cup, in seasoned scantlings may be worth exploring.

The surface checking in included wood from near the pith is difficult to avoid as it is probably traeable to juvenile wood. At present "boxing" of pith during sawing would appear to be the only solution.

Conclusions

Strength properties, shrinkage hygroscopicity, and wood working behaviour of rubberwood are quite favourable to its wider use for sophisticated end uses, particularly furniture, doors and windows, and joinery. The bulk of sawn wood from logs, except that near the pith, is not prne to surface checking. Warping is a major drawback (besides susceptibility to stain; decay and insect attack) to better use of this timber. Warp control is a priority area of research for its efficient utilisation. Amongst the promising measures for wars control are :

(i) Saw-Dry-Rip procedure

(ii) Optimization of stack top weighting, and

(iii) Correction of warp by steaming dried timber under restraint.

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Space age rubber in Malaysia.

The Rubber Research Institute of Malaysia plans to set up a pilot plant to produce space age rubber on a commercial scale at Sungaoi Buloh next year. This is none other than deproteinised natural rubber (DPNR), a chemically altered NR with proteins removed, to give extra qualities such as low water absorption and low creep ie, an ability to return to its natural shape. These qualities make it ideal for speciality application as in the case of precision components used in helicopters and space ships.

There are also plans in Malaysia to set up a plant in the private sector to produce thermoplastic natural rubber (TPNR). Its advantages include a wider service temperature range than synthetics, lower processing cost than vulcanised rubber and low manufacturing cost esepcially for rubber and plastic processors. Currently there are only two plants producing the material in the world, one in UK and the other in US. The TPNR cuts down processing time as it does away with the vulcanisation stage. It can be reprocessed upto ten times and prospective uses include car bumpers, rub strips, pipe joints and tank linings.

UPGRADATION OF RUBBER WOOD THROUGH BORON DIFFUSION TREATMENT

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Abstract

In the context of acute shortage of wood and increasing timber prices rubberwood is the only timber available in plenty at moderate cost to the public. But its, susceptibility to insect borer, and fungal attack limits its use. To overcome this limitation boron diffusion treatment was attempted. Immersing 25mm thick material in a 10%b oric acid equivalent solution containing 0.5% sodium Pentachloro phenoxide at ambient temperature for 40 minutes give adequate loading of chemicals into the wood. The method of treatment has been standardised for various thicknesses of wood. It was found that increasing the immersion time does not increase the loading of chemicals appreciably. Instead, keeping the samples for longer periods of diffusion storage improves the penetration of chemicals. The present research activities for upgrading rubberwood through chemical treatment for its better utilisation is briefly described.

Introduction

Because of the drastic depletion of forests. currently an acute shortage of wood is being experienced. This has resulted in increase in the prices of conventional timbers. In this context exploration of non-conventional timber resources will not only help to reduce the pressure on forests, but also will help to reduce the cost of timber utilization. Rubberwood is an important non-conventional source of wood available at moderate cost in Kerala. The use of this wood is limited due to the lack of adequate utilisation teehnology. Because of this rubberwood has been traditionally used for firewood, low cost packing cases and match veneers and splints.

Rubberwood is light to moderately heavy with a density of 523–610kg/m³ at 12% moisture content. It is a diffuseporous wood with thin walled fibres. The wood has a yellowish-white colour when freshly cut which will turn to brownish or creamy on exposure. Sapwood and heartwood are not distinct. The wood is soft to moderately hard' straight grained, with medium texture. The wood can be seasoned with relative ease. However, during air-seaoning it is lible to end-splitting, while in kiln-seasoning there is a tendency to warp. Radial shrinkage is 1.2% and tangential shrinkage is 1.8%' from green to 12% moisture content. Rubberwood is easy to saw and it works well with hand tools and machines. Nail holding copacity is good (Nazma et. al.. 1981). Many studies have established the suitability of rubberwood for the manufacture of hard board, particle board, pulp and paper (RRIM 1972; wong and ong, 1979); Plywood (Wong. 1979) bentwood (Ser and Lim' 1980) furniture and joinery (Sharma et. al., 1982 and Sonti et. al., 1982) However. its susceptibility to insect borers and fungal attack is the factor that limits its wider utilization for solid wood uses. In order to facilitate wider and better utilisation of rubberwood, upgradation of rubberwood through preservative treatments is therefore essential.

Fungi and insects attacking rubberwood

Tan et al., 1980; Hong et. al (1980) MC Quire (1959) and Tisseverasinghe (1969; 1970) have reported fungal problems in rubberwood. Ali et. al. (1980) reported the occurrence of common blue stain fungus, Boetrydiplodia theopromae along with surface moulds like Aspergillus spp. and Penicillum spp. in the infected rubberwood. Among eight Basidiomycetes isolated from rubberwood, Lenzites palisotii and Ganoderma applantum caused severe deterioration. Tisseverasinghe (1970) found that Heterobostrychus spp. and Sinoxylon conigerun were the most destructive insect borers of rubberwood in Sri Lanka. Norhara (1981) has listed a total of 25 beetle species as pests associated with standing trees, felled logs and seasoned timber in Malaysia. The common species are *Minthea rugicollis, Heterobostrychus aequlis, Sinoxlon anale and Xylothrips flavipes*. Gnanaharan et. al. (1983) recorded a total of 10 species of insect, attacking rubberwood in Kerala. Out of these, it was found that *Sinoxylon anale* cause serious economic loss.

Treatment methods

Among the various wood treatment methods available the most common methods are the vacuum-pressure treatment and diffusion treatment (including not immersion method and hot and cold immersion method). Momentry dipping, spraying or brushing and application of end coats are also practised as the simplest and prophylactic treatments. The selection of the treatment method and preservative chemical depends on the end use of the treated material as well as convenience.

Each method has its own advantages and disadvantages which are detailed in the table.

Method of Treatment	Advantages	Disadvantages
1) Vacuum-pressure process	(a) Enough Dry Salt Retention (DSR) can be achieved within short time.	(a) Air-dried wood or wood with low moisture content alone can be treated. (b) Vacuum-pressure impregnation plant (equipments) needed. (c) Consumes more chemicals and electrical energy.
2) Diffusion treatment a) Simple diffusion treatment	(a) No sophisticated equipments or pumps are needed. (b) Any small scale industrial unit or consumer can directly make use of the method. (c) No heat energy requirements.	(a) Required diffusion storage period. (b) Possibility of mould attack during the diffusion storage period.
b) Hot immersion method & c) Hot and cold immersion method.	(a) Rate of diffusion can be increased. (b) Diffusion storage period could be reduced. (eg. for one inch thick material the diffusion storage period could be reduced to 1/2 week in this method, from 4 weeks in the simple diffusion method)	(a) Additional energy input is required to heat the solution.

The momentry dipping, spraying or brush coating are applied to give protection for a short period.

The selection of chemicals to treat the wood by any of the above-mantioned treatment methods also depends upon the end use of the treated timber, the type of method and nature of chemical. Formulations of CCA (copper-chrome-arsenate) or similar chemicals are non-leachable in water, but can be used in pressure treatment only. They will affect the original colour of wood. Timber treated with these chemicals is suitable for outdoor uses, whereas chemicals like boric acid, borax or sodium pentachlorophenoxide are water leachable and can be made use of only for interior purposes and furniture work.

Because of the simplicity of operation, the simple diffusion treatment is chosen for detailed study for rubberwood preservation. In addition, boric acid and borax are cost effective and non-toxic to mammals, a detailed study was planned to develop and standaraise the treatment. Further, it has the added advantage that this treatment will not change the original colour of wood. The gluability or paintability of wood will also not change by this treatment.

Experimental procedure

A 10% Boric Acid Equivalent (BAE) solution containing 0.5% sodium pentachlorophenoxide ($N_{\bar{a}}$ PCP) were used as the preservative chemicals for all the trials. This solution was prepared by mixing 5 kg of Boric Acid, 7.5 kg of Borax and 0.5 kg of $N_{\bar{a}}$PCP (ratio 1:1.5:0.1) in 100 litres of water. The concentration of BAE was fixed at 10% because this could be prepared at ambient temperature (about 30°C) without external application of heat to dissolve the chemicals.

The objectives were:

(i) to evolve a treatment schedule for 1 inch thick material;

(ii) to determine the effect of immersion time on loading and distribution of boric acid;

and

(iii) to standardise the treatment schedule for various thicknesses of rubberwood

Five specimens of freshly sawn green rubberwood samples of size 2.5 cm × 2.5 cm × 30 cm were treated for immersion periods of 40, 50, 60, 80 and 100 minutes.

The weight of specimen before and after the treatment was determined and from the solution pick up the dry salt retention (DSR) was calaulated in terms of BAE (kg/m^3), as

$$DSR\ (kg/m3) = \frac{\text{Difference in weight (kg)}}{\text{Volume of wood (m3)}} \cdot \frac{\text{Concentration of solution (\%)}}{100}\text{; and}$$

$$\frac{\text{average BAE percentage}}{\text{(on oven dry wood basis)}} = \frac{DSR}{Density} \times 100$$

To determine the effect of immersion time on loading of chemicals, treatment trials were carried out with freshly sawn green rubberwood samples (5 Samples) of 2, 3 and 5 cm cross section and 30 cm length. The immersion times for 2 cm specimens were 20, 30 and 60 minutes, for 3 cm, 45, 60 and 70 minutes and for 5 cm, 60, 125 and 230 minutes.

After treatment all the specimens were kept for diffusion storage. The specimens were tightly packed in a polythene sheet and kept for diffusion-to facilitate the penetration of the chemicals into the wood. 2.0 cm thick samples were kept for 3 weeks 2.5 cm thick samples for 4 weeks, 3 cm thick samples for 5 weeks and 5 cm thick samples for 8 weeks. After diffusion storage the specimens were air dried. Chemical analysis of the treated samples were done by leaching the boron compounds from the wood by refluxing the wood shavings with a mixture of distilled water and dilute hydrochloric acid. The extract was titrated against standard alkaly in the presence of neutral mannitol, using Pyrocate chol violet as indicator (Wilson, 1959).

For chemical analysis, three samples of about 5 to 6 mm thickness were taken from the middle portion of the treated specimen. One sample was used to analyse the core and surface and the other for net average retention. The third sample was used for moisture content determination. The core was taken as the 1/9th of the area of cross-section taken at the geometrical centre of the wood piece, as defined by BCL (1972). From the remaining portion, about 3 mm strip from the periphery was taken as surface and analysed. To find out overall retention, two diagonal portions of about 5mm wide were taken and analysed.

Results and Discussion

Table 1 shows effect of immersion time on DSK of 2.5 cm × 2.5 cm × 30 cm rubberwood samples.

The loading increased with increase in immersion time, but the rate of increase was very low. A possible explanation is that the excess $N_{\bar{a}}$ PCP would have precipitated and adhered to the timber su face which would have inhibited the additional loading of boron chemicals with increased immersion time.

Table 1. Effect of immersion time on DSR of 2.5×2.5×30 cm rubberwood samples treated with 10% BAE solution.

Duration of immersion time (minutes)	Average BAE; DSR (kg/m³)	Average BAE %	Average BAE (%), by chemical analysis
40	3.06	0.57	0.43
50	3.84	0.71	0.50
60	4 20	0,79	0.49
80	X	X	0.56
100	X	X	0.63

X = Not determined

So the increase in immersion time does not increase the loading of chemicals appreciably. If the solution is stirred periodically, precipitate adhering to the timber surface can be checked. The British Wood Preservers' Association's (BWPA) specification is that the avarage total net dry salt retention (DSR) of 0.4% BAE is adequate (BCL, 1972). The New Zealand specification for hardwoods susceptible to insect borer is 0.2% BAE in the core (Mc Quire, 1962). It is seen from Table 1 that even a 40 minute immersion is sufficient to give a net average DSR greater than the specified requirement of 0.4%. A sample subjected to chemical analysis showed a surface retention of 0.58% BAE and core retention of 0 30% BAE. The core loading is higher than the specified requirement of 0.2% BAE. So this study clearly showed that for 2.5 cm (one inch) thick material 40 minutes immersion in a 10%BAE solution (containing 0.5% $N_{\bar{a}}$ PCP) at ambient temperature will give adequtre loading of chemicals. Further, it was proved earlier that a net average DSR of 0.4% BAE gave protection against sinoxylon anale, the insect borer causing serious damages to rubberwood (Gnanaharan et. al , 1983).

With regard to the quantity of $N_{\bar{a}}$ PCP required for the treatment, a concentration of 0.40 to 0.5% is suggested (BCL, 1972) to control sapstain which can develop during diffusion storage. But Tisseverasinghe (1969) noticed fungal growth on rubberwood planks kept for diffusion in spite of the addition of 1% $N_{\bar{a}}$ PCP to the treatment solution of 25-35% BAE. According to Butcher (1980), the relatively low alkalinity of the concentrated boron salt solution limits the solubility of $N_{\bar{a}}$ PCP to about 0.2%. This explains why even when 0.5 to 1% $N_{\bar{a}}$ PCP was used, sapstain could not be controlled completely. If solutions of higher concentrations are used, control of sapstain through $N_{\bar{a}}$ PCP will not be effective. Further, increasing the amount of $N_{\bar{a}}$ PCP may cause more and more quantity of $N_{\bar{a}}$ PCP to get precipitated in the treatment solution, which inhibits the easy penetration of boron compounds into wood. Hence a treatment solution of 10% BAE (no heating is needed to dissolve the salts) with 0.5% $N_{\bar{a}}$ PCP is the most compromising when all other factors are taken into consideration. It was found that $N_{\bar{a}}$ PCP is a much effective chemical than 'Busan'a fungicide recently introduced in India (Gnanaharan and George Mathew, 1982). So even though $N_{\bar{a}}$ PCP has high mammalian toxicity, safer and cost effective alternatives have not been identified in spite of screening of many chemicals (Ali et. al., 1980; Butcher, 1980; Milano 1981, Plackett, 1982). Till costeffective alternative is found $N_{\bar{a}}$ PCP may continue to be used, Hence research is required to find out alternatives to this chemical.

Table 2 shows the values of the retention of chemicals, as analysed chemically, for various thicknesses of wood and for various immersion times. For 2 cm thick specimens the average retention of chemicals increased with immersion time and it exceeds the BWPA requirement of 0.4% BAE as the net average DSR. There was no marked difference in the retention of chemicals in the 3 cm thick specimens with the increase in immersion time, although all the values exceeded the BWPA specification.

Table 2. Average, core and surface dry salt retention (DSR) (% BAE) of chemicals in treated rubberwood specimens of different thickness with different immersion times.

Dimension cms	Immersion time (Minutes)	DSR, % BAE (by chemical analysis) Average	Core	Surface
2×2×30	20	0.63	0.55	0,67
	30	0.70	0.69	0.75
	60	0.85	0.84	0.96
3×3×30	45	0.42	0.36	0.50
	60	0.42	0.30	0.49
	70	0.45	0.33	0.47
5×5×30	60	0.16	0.0	0.30
	125	0.43	0.12	0.50
	230	0.38	0.13	0.50

For 5 cm thick specimens the retention increased with immersion time from 60 to 125 minutes, however, there was a little reduction in the average retention with prolonged immersion. Immersion time of 60 minutes was too low for 5 cm thick wood as evidenced by the retention of chemicals. In general, the rate of increase in loading tended to decrease with the increase in immersion time (Damodaran and Gnanaharan, 1984) A similar trend can be seen from Table 1 also. For 2 and 3 cm thick material, the average and core retention values are found to be higher than the requirements of New Zealand and Australian specifications. The effect of a specific immersion time of 60 minutes on different thicknesses wss compared. While 2 cm thick specimens had a net DSR of 0.85% BAE, 3 cm thick specimens had 0.42% BAE and 5 cm thick specimens had 0,16 % BAE (Table 2)

Harrow (1952) suggested that the diffusion of chemicals into wood is governed by the following formula :

$$\frac{\text{Solution concentration (\%)} \times \sqrt{\text{time (hours)}}}{\text{loading (\%)} \times \text{thickness of wood (cm)}} = \text{K (a constant)}$$

Damodaran and Gnanaharan (1984) found that an average K value of 7,5 to 8 can predict approximately the immersion time required to give a net average loading of 0.4% BAE up to 3 cm thick wood, For higher thicknesses, immersion time can be calculated by assuming a K value of 8 and after analysing chemically the actual net DSR, immersion time can be suitably modified. Harrow (1952) showed that diffusion process was particularly suitable for 2.5 cm boards, though it could be used for wood up to 7.5 cm thick. For higher thickness, diffusion rate will depend on many factors besides concentration of the treatment solution and duration of immersion.

Assuming K to be 8 for rubberwood, to get a net average loading of 0. 4% BAE (the BWPA specification), the immersion time needed can be calculated from tne Harrow's formula:

$$\text{Immersion time (hours)} = \left\{ \frac{8 \times 0.4 \times \text{thickness of wood (cm)}}{\text{Concentration of treatment solution (\% BAE)}} \right\}^2$$

This could be briefly represented as,

$$T = \left(\frac{3.2\ t}{c} \right)^2$$

Where T = immersion time (hours)
t = thickness (cm)
c = concentration of treatment solution (% BAE)

This standardises the schedule of treatment for different thicknesses of wood,

Further, studies are going on to determine the maximum thickness of wood that can be treated, methods to increase the diffusion rate in wood, pressure treatment of rubberwood in the air-dried and green condition, the optimum moisture content required for pressure treatment with boron chemicals as well as CCA, and the effect of addition of different concentrations of cypermethrin in the treatment mixture. Attempts are going on to find out suitale method of storage of rubberwood to protect it from deteriorating organisms.

Conclusion

– The optimum concentration of boron solution required to treat green rubberwood by the simple diffusion treatment is 10% boric acid equivalent (BAE) solution.

(Contd on Page 19)

Addition of 0.5% sodium pentachlorophenoxide ($N_{\bar{a}}$ PCP) is needed to control fungal growth during diffusion storage period.

Immersing 2.5 cm (one inch) thick material in 10% BAE solution for 40 minutes gives adequate loading of chemicals to prevent the rubberwood from borer and fungal attack.

Increasing the immersion time will not help much in increasing the rate of loading of chemicals.

For one inch thick material a diffusion storage period of 4 weeks under polythene cover is necessary to get a uniform penetration and distribution of chemicals throughout the cross-section. For higher thickness of wood, for every 1/4 inch an additional one week diffusion storage is necessary.

To improve the penetration and distribution of chemicals, rather than increasing the immersion time, longer periods of diffusion storage will be useful.

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(Contd on P. 19)

Some Physical and mechanical properties of ·plywood made from Hevea brasiliensis

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1, Introduction

1. 1 With shortage of plywood species from the regular forests of India, a need has been felt to explore possiblities of using available species from plantations and other sources. In this connection it is understood that Hevea brasiliensis (Ruber wood) would be available on a sustained basis as some trees are felled ragularly every year after slaughter tapping and before replantation. It is estimated that(Haridasan. V. & Sreenivasan K. G. -1985) about 1.2 million eubic metres of rubber wood will be avilable every year, of which nearly 40% is at present being used for packing cases and about 20% is already in use for some sort of 3-ply sheets mostly for seats and backs of chairs, for some types of boxes, and for internally transported tea-chests. (Haridasan. T-1986). Thus with a promising potential of rubber wood for panel products, it was felt that some studies on physical and mechanical properties, and also on glue strength would be useful as only meagre information is available so far on the subject.

2. Manufacture of plywood and preparation of test specimens

2.1 Large size veneers of rubber wood of thickness 1.25 mm, 1.5 mm, 2.0 mm, were received from the Rubber Research Institute of India Kottayam–These were conditioned to 8-10% moisture content. They were glued, assembied and pressed for making 9-ply, 15 mm plywood under the following specifications so as to examine its usefulness for a medium size panel fro general use. The finish of the plywood was fairly smooth after sanding, though some raised grains were observed at a few places

a)	Adhesive used;	Lignin extended phenol-formaldehyde resin conforming to BWR grade of I. S; 898–1974.
b)	Assembly :	Open type for 4 to 6 hours
c)	Pressure :	14 Kg/om²
d)	Temperature :	140° to 150° c
e)	Treatment :	CCA after trimming and sanding the finished plywood
f)	Constructions :	1.25 : 2.0 : 2.0 : 1.5 : 2.0 : 1.5 : 2.0 : 2.0 : 1.25. (9-ply 15 mm)
g)	final sizes :	1.22 mmx 1.22 mmx 15 mm.

2.2 From the above sheets, samples were cut and final test specimens were prepared both in the direction of face veneers and perpendicular to the same, as required for the various tests given below. For each test five specimens were taken and the test results are indicated in table 1.

a)	Glue shear strength in dry state, water resistance test and mycological tests	as per I. S ;803-1975
b)	Density :	as per I.s:1734-1983 Pt I
c)	Tensile strength :	as per I,S: 1734-1983 Pt 9
d)	Compressive strength	as per I.S. 1734-1983 Pt.10
e)	Bending strength :	as per I.S: 1734-1983Pt.11
f)	Shear strength :	as per I.S: 1734-1983 Pt.14
g)	Impact strength : (on Izod machine)	as per I,S. 1998-1983

* The Western India Plywoods Ltd., Bahipatam, Cannanore-670 010

3. Results and discussions

3.1 It is seen from the test results given in table 1, that the values obtained for glue shear strength in dry state, water resistance test, and mycological tests do not come upto the requirements of BWR plywood as per I. S: 303-1975. But the physical and mechanical properties of plywood made from rubberwood seem to compare favourably with properties of plywood made from other commercially available timbers. However in order to evaluate the suitability of rubber wood plywood for stress bearing components, further tests seem to be necessary with different types of constructions and thicknesses also.

3. 2 Some of the strength figures under tension, compression and bending were also theoretically evaluated by the scheme of formulae suggested by Vijayasaradhi. G.& Sekhar. A. C. (1978), and these are given in the same table. It is found that the calulated values are slightly lower than the observed values. No conclusions can be drawn at this stage because of uncommon type of construction of plwood obtained in the present experiments. However the nearness values between the calulated and observed, gives hope for pre-designing a construction as required for any specific end use.

3.3 Because of the nature of construction in the present plywood with nearly equal amount of timber in both the directions of face veneer of the plywood the strength in both directions in all cases is nearly the same, unlike in solid wood in which case the strength along the grain is nearly 3 to 10 times the strength across the grain. However comparing the strength of plywood with that of solid rubber wood (Shukla. N. K. & Mohan Lal-1985) it is obvious that the plywood has more uniform properties in both dircctions of face veneer even though its strength is less than the strenght of solid wood along the grain. Solid rubber wood across the grain is very weak compared with strength along the grain.

4. Conclusions

4.1 From an overall analysis of the present investigation and by comparison with other available information, it is felt that rubber wood can be well tried for different types of panel products. Where as the solid wood is already reported to be in good use for packing cases, plywood is expected to improve the performance of packing cases, for heavy loads and re-usable trade. By further experiments on WWR & CWR grade plywood, the economy and optimum requirements for different end uses can be established. However as it is known that wood grown in different parts have indicated some differences the relative effects of these variations with reference to specific end uses will have to be studied more intensely.

Acknowledgement

Authors are thankful to Sri A. K. Kaderkutty, Managing Director, The Western India Plywoods Ltd., Baliapatam, Cannanore-670 010 for his keen interest in the work and for providing the facilities for carrying out this investigation. The authors are also thankful to the Rubber Research Institute of India, Kottayam 686 009 for supplying the veneers.

(*Contd. from Page 17*)

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Table 1
Properties of plywood and solid rubber wood

Sr. no.	Properties/units		Results of Plywood tests	calculated Values	Date on Solid wood
1.	Glue shear strength (Kg)				
	a) Dry state	Average	103		
		Individual	86		
	b) Water resistance	Average	97		
		Individual	57		
	c) Mycological test	Average	79		
		Individual	75		
2.	Physical & Machenical properties:				
	a) Density (grms/oc)		0.69	—	0.629
	b) Tensile strength (Kg/cm²)				
	along the face grain		444	441.7	727
	across the face grain		400	375.0	63.1
	c) Compressive strength (Kg/cm²)				
	along the face grain		283	233.3	331
	across the face grain		252	210.0	98
	d) Bending strength (Kg/cm²)				
	M of R along the face grain		463	460	587
	Mof E along the face grain		51890	47219*	60700
	M of E across the face grain		38448	34988*	—
	e) Shear strength (Kg/cm²)				
	Edge wise		98	—	102.8
	Flatwise		275	—	—
	f) Impact strength (Kg/cm²)				
	along the face grain		0.29		
	across the face grain		0.22		

Note: Construction of plywood: 1.25, 2.0, 2.0, 1.5, 2.0, 1.5, 2.0, 2.0, 1.25. 9-ply 15 mm.
Number of test specimens : 5 for each test.
* computed from otber known ratios of Specific gravity and strength in both directions of face grain.

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RESEARCH NEEDS IN THE UTILIZATION OF RUBBER WOOD

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Abstract

Rubber wood which posed a disposal problem at one time has now come to the rescue of wood industry in a big way. Due to the replanting programme, sustained availability of rubber wood is assured and currently, about 600,000 m^3 of round wood is produced annually. The work carried out in India and elsewhere has clearly demonstrated the potential uses of rubber wood for furniture, joinery, household articles, etc. The advantages as well as the limitations of rubber wood are discussed in this paper. The physical and strength properties of rubber wood in comparison with other timbers are presented. The paper also points out areas where work is needed to be carried out for effective utilization of this raw material from a non-conventional source to save our forests.

Introduction

In India, commercial plantation of Hevea brasiliensis a native of South American forests, started in the 1900 s. As of 1986-'87, Kerala has about 350,000 ha of rubber plantations (Anonymous 1988a) and the rest of the country accounts for about 34,000 ha (Anonymous, 1988 b). The area under rubber has increased tremendously in the last decade. For example, between 1978-79 and 1986-87, there was an increase in area by 125,000 ha in Kerala and 23,000 ha in the rest of the country.

At one time, as the plantations were less accessible, rubber trees posed a disposal problem at the time of replanting the area. The scene has changed now. Rubber plantations, a non-conventional source, have become the source of timber in a big way. Felling trees after their economic life of latex production yields about 1 million m^3 of rubber wood annually (Anonymous 1988 b) of which about 600,000 m^3 are round wood, the rest being branchwood used mainly as firewood. This is a substantial quantity of wood, even greater than the annual harvest of round wood from Kerala forests in the 1980 s (a maximum of about 530,000 m^3 in 1980–81) (Anonymous, 1984)

As the area under rubber has to be replanted once in 30 to 35 years, and with increased area under rubber, we can soon expect that about 10,000 ha would be replanted every year. This will ensure a sustained availability of rubber wood. In contrast to this, the prospect of wood availability from natural forests and forest plantations in the coming decades is very small. At present, Kerala imports over 350,000 m^3 of wood from other States or Countries (KFRI Statistics Division, unpublished) but this source may dry up suddenly. It is in this context of acute wood shortage, better utilization of the available wood becomes not only relevant, but also inevitable.

Limitations and present uses

Rubber wood is a light, cream-coloured, medium density (500 to 600 kg/m^3) wood. It has straight to shallowly interlocked grains with medium texture. The wood is easy to work with and can be finished to a smooth surface. It can be stained to any colour. All though rubber wood has such good qualities, the major problem limiting its use is its susceptibility to attack by fungi and insects.

The sapstaining fungi will discolour the light-coloured wood, thus affecting the appearance. During the monsoon when the humidity is very high, the sapstaining fungi and mould can attack the wood in less than 24 hours after felling tree. They enter the wood through the cut ends of the logs. If the moisture content of the wood continues to remain high (above 20%), then decay fungi will attack the wood. Unlike sapstaining fungi decay fungi will weaken the structure of wood, thus resulting in loss of strength.

While the fungi attack green wood, insects will attack both drying and dry wood. A small beetle, *Sinoxylon anale*, which bores into dry wood and wood products and riddles them with numerous prominent holes is the most serious borer.

Another factor which affects the quality of rubber wood is its tendency to warp when tension wood is present. Generally, as rubber trees grow in hills with steep gradient, presence of tension wood is common. Appearance of a woolly surface in planks that are sawn green indicates the presence of tension wood. Tension wood contains higher cellulose and lower lignin than normal wood and therefore is more pliable and prone to higher tangential and longitudinal shrinkage.

Nearly 75% of the current round wood production of rubber wood (about 450,000m^3) goes for packing-cases. The service life expected of packing-cases is only 6 to 18 months, rubber wood has more or less replaced mango wood in this field. There are hundreds of small scales sawmills in Kerala operating with rubber wood as the only source of raw material.

About 100,000 m^3 of wood goes for producing low-grade plywood (for tea-chest, chair seats, etc.) and, match splints and veneers. Even here, non-availability of other suitable species has resulted in, rubber wood for the purpose.

A small quantity of rubber wood is also used after preservative treatment for some purposes as noted below.

Textile shuttle blocks: Till recently, most of the shuttle blocks were made of imported hornbeam (Carpinus sp.). However, it has now been replaced by rubber wood treated with boron chemicals under pressure and densified by compression,

Cable drums: Rubber wood planks, 35 to 50 mm thickness, after treating with CCA chemicals under pressure, have been used for making drums for carrying high tension cables.

Furniture and joinery items: A very smally quantity of treated rubber wood is used for furniture, furniture components, joinery, TV cabinets, etc.

The Potential

Studies in India and elsewhere have shown the potential uses of rubber wood which include furniture, panels, flooring, joinery, mouldings, bent articles, turnery items, composite panel products, household utility items such as salad bowls, cheese boards, knife blocks, trays, etc. These uses of rubber wood have been made possible by appropriate chemical tretment to overcome the fungal and insect attack. The chemicals can be applied to wood by pressure or non-pressure methods.

In 1987, Malaysia exported rubber wood to the tune of 240,000m^3, mainly to Taiwan and Singapore for manufacture of furniture. Seeing the prospects of rubber wood in furniture trade, the Malyasian Forest Research Institute has initiated experiments to grow rubber trees not for tapping latex but solely for wood

Comparison of rubber wood with other timbers

The table I gives physical and strength properties of rubber wood at 12% moisture content. It can be seen that rubber wood is weaker than teak in a number of important properties.

For furniture items, density (specific gravity) should not be too high and shrinkage should be low. This shows that rubber wood is suitable for making furniture items and that it compares quite well with teak. However, it is important to note that presence of tension wood will make rubber wood to warp.

The table I shows that rubber wood fares well with silver oak but it is slightly inferior to mango wood in strength properties. As the availability of mango wood has become scarce, rubber wood can take its place for heavy packing-cases.

Table I

Physical and strength properties of rubber wood

Property		Teak	Rubber	Silver oak	Mango
Specific gravity		0.604	0.557		
Shrinkage (green to oven-dry)					
radial,	%	2.3	2.6		
tangential	,,	4.8	6.1		
Static bending					
Modulus of rupture,	kg/cm^2	959	756	633	904
Modulus of elasticity, × 1000	,,	119.6	82.0	83.0	111.8
Impact bending	cm	71	43	51	66
Compression					
Parallel to grain,	kg/cm^2	532	374	389	448
Perpendicular,	,,	101	101	82	96
Hardness					
Side,	kg	513	538		
End,	,,	488	627		
Shear					
Parallel to grain,	kg/cm^2	102	114		
Perpendicular,	,,	62	60		

Cost considerations

Rubber wood, even after chemical treatment, will cost much less than other timbers. Treatment with chemicals does not increase the density or strength properties. Boron-treated rubber wood will retain the natural colour and is meant for indoor use. The CCA or CCB treated rubber wood can be used outdoors. The treated rubber wood will have a service life of 20 to 25 years.

Research needs

The constraints faced in processing rubber wood and the gaps in knowledge which exist are presented here. The work that is being carried out at the Kerala Forest Research Institute is also explained.

Storage of raw material

A rubber wood processing industry has to stock raw material required for at least six months. Also, rubber trees are not generally felled during the heavy monsoon seasons, due to practical difficulties. Also, running the industry throughout the year calls for storing raw material required during seasonal and off-seasonal periods. The sapstaining fungi enter the green wood through the cut ends and spread inside. Especially, when humidity is high, the wood is highly susceptible to the attack of sapstain fungi. If the rubber logs are not processed within a few days after felling, they are prone to this attack. Tan-etal. (1980) found that storing rubber logs under water is the most effective method to protect them from sapstaining fungi.

In a processing industry, generally sawing operation is not the limiting factor. Also storing the material in log form will need more space. One possibility is sawing the material and storing the sizes under water. However, when we are sawing the logs into sizes, more area is exposed to fungal pathogen. Even though the sizes are subsequently immersed in water, will there be problem due to fungal pathogen which would have entered the wood? How long can we keep the logs/sizes under water without deterioration? What will be the effect of bacteria on the material stored under water? What will be the effect of the chemicals leaching out of bark/wood on the stored material? We don't have ready answers for some of these questions. An experiment has been initiated in the Institute in this line.

Preservative treatment

Treatment by vaccum-pressure method calls for drying the wood to about fibre saturation point (25-30% moisture content) or below and then impregnating with the chemicals followed by another drying to a moisture level of 10 to 12%. If the initial drying could be avoided, it will not only reduce the cost of processing but also facilitate the flow of material. The study carried out by Tan et al. (1983) showed that green rubber wood, within a few days of conversion, can be treated with 3% borax solution. In treating wood, both the dry salt retention of chemicals and the penetration of chemicals are important. What is the optimum moisture content that will ensure both the above factors? As boric acid or borax does not get fixed to the wood, will there be diffusion of the chemical from periphery to core even after the treatment? What is the maximum thickness of wood that can be treated adequately by pressure process, if the wood is in green condition, and in dry condition? If water-borne chemicals like CCA or CCB are used, can green rubber wood be treated adequately? Will the chemicals react with wood and get precipitated blocking the further movement of chemicals? What is the optimum moisture content for treatment with water-borne chemicals? Work has been initiated on these lines in the Institute.

If we go for diffusion treatment, a non-pressure method, addition of a fungicide to the preservative chemical solution is essential because certain fungi can attack the treated wood during diffusion storage. Sodium-pentachlorophenoxide (NaPCP) has proved to be the most effective chemical to contain the sapstaining fungi. However, the toxic NaPCP has been banned in a number of countries. Exporting rubber wood, treated with preservative chemicals which include NaPCP also, to these countries will not be possible. Even though NaPCP has not been banned in India, we should have alternatives to NaPCP, especially keeping the export market in view. The fungicide methylene-bis-thiocyanate (MBT), is widely used in other countries for this purpose but this chemical is not being manufactured in India. So a cost-effective, locally manufactured chemical will be more desirable than going for importing chemicals. This also applies to insecticide. Cypermethrin, a synthetic pyrethroide, has given encouraging results. What concentration to use, in what combination with other chemicals to use, these are all questions which need answers. Steps have been taken in the Institute to generate information.

Though diffusion treatment has proved to be effective especially for species which are impermeable to pressure treatment, it has disadvantages like that it needs longer diffusion storage period. If the rate of diffusion could be increased, diffusion treatment will become attractive. Work is needed in this area also although some methods are already available (Mc Quire and Goudie, 1972, Tisseverasinghe, 1975).

What are the cost-effective chemicals and treatment method for packing-case material, to be stored under cover, to be stored outdoors etc.? We need to generate data:

Efficacy of treatment

The preservative chemicals should provide adequate service life for rubber wood. The treated rubber wood should be tested against insect borers, decay fungi and termites. Boron-treated rubber wood has been tested against the above organisms in the Institute. Rubber wood treated with other chemicals also will have to be tested for their efficacy.

Drying

Rubber tree is a fairly fast-growing tree, It is harvested at the age of 30-35 years. Mostly the trees grow in hills. All these explain the presence of juvenile wood and tension wood in rubber wood. So care should be taken while drying rubber wood. Kiln drying, where temperature and humidity can be controlled, is essential to get quality sizes. What is the drying schedule to be followed for drying rubber wood if a conventional steam-heated drying kiln is used? What should be the drying schedule if a solar kiln is supplemented by a dehumidifier? What should be done to reduce drying degrade? How much weight should be used to weigh down the stack? These information gaps need to be filled up.

Other areas

Presence of tension wood is a serious problem in rubber wood. Genetic improvement of wood quality by selection to eliminate or to reduce the occurrence of tension wood should be looked into.

How the presence of latex in the wood affects pulping, gluing, etc. needs to be investigated.

The effect of clonal variation locality, etc. on the anatomical, physical, chemical and mechanical properties of rubber wood has to be studied.

As all these work cannot be carried out in one place, the institutions engaged in rubber wood utilization research should co-operate with each other so as to avoid duplication of work.

Conclusion

Although rubber wood products have gained acceptance in the world market, and rubber wood is replacing conventional types of wood for many applications, in India its potential has not been fully realized. Manufacturing value-added products out of chemically treated rubber wood will be of great economic benefit to Kerala. If rubber wood is put to effective use, to that extent, pressure on our natural forests can be reduced and our dependence on imported timber brought down. What has been achieved by Malaysia recently in the field of rubber wood utilization can be repeated in Kerala.

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Do Advanced Rubber Planting Materials Shorten Immaturity? Analysis of Further Data

P. P. CHERIAN

"Shri. Cherian's following article is in continuation to his earlier one on the subject published in Volume 23 No. 3 (January, March, 1988) of this Bulletin together with our comments. The comments published earlier cover all the substantial points brought out by Shri. Cherian in both the articles."

—Editor.

Since the publication in the Board's Bulletin (Vol 23 No.3, 1988) the conclusions of the earlier statistical experiments in Ceylon and Malaya pertaining to the advantages and drawbacks in the utilization of different planting methods linked with the latest trials in India, other data have come to light.

The most authoritative figures relate to the growth and tappability of the RRII 105 clone planted under different methods in 1.8 ha at 6½ years in the Rubber Board's statistical trial at the Chetackal Experiment Station though published in 1983 (1) remained overlooked. They not only indicated the growth superiority of polybag plants over stumped buddings and others as summarised in the Table A but also higher initial yield when brought under tapping later in the same order of growth as previously published in the Bulletin under reference.

Table A

Growth & Tappability at 6½ Years

Planting materials	Girth (cms)	Tappability (per cent)
a) Seed-at-stake brown budded	31.02	Nil
b) Polybag green budded & planted at 2/3 whorl stage	53.46	73.36
c) Brown budded stumps	47.20	39.50
d) Stumped buddings	43.13	40.18

Climatic Impact

According to another publication in 1988 (2) the lower growth of the stumped buddings is ascribed to the improper development of branching due to unfavourable weather during the planting year (1976). But the latter should equally apply to all the planting methods. If the stumped buddings suffered the worst, the same underlines their risk when cheaper and more reliable methods are available. Doubts also seem to persist as to the possibility of errors in statistical trials (2). By disclosing number of trees involved, the annual average yield per tapping per tree, tapping days, brown bast cases, if any, and the stand per ha based in the calculation of the yield per ha. statistical results should reflect the actualities beyond doubts and controversies. It is also brought out that stumped buddings especially the maxi contain enormous reserve food readily available at the time of planting to induce rapid girthing enabling earlier tapping along with higher initial yield. But both the ceylon and Malayan statistical trials which the writer had the occasions to visit the latter repeatedly, and the statistical and comparative trials in India hardly substantiate pronounced higher percentage of girth increase after planting of stumped buddings over others as under:-

a) In the Ceylon trial, the girth increment rate of stumped buddings from the 2 nd to the 16 th year of planting works out to only 275.1 per cent (21.7&81.4 cms) against 412.6 percent (15.8 & 81.0) in respect of brown buddings.

b) Though the growth rate of different years unavailable in the Malayan experiment, the girth of stumped buddings at the 12th year of planting is narrowly closer to budded stumps at66.6 & 64.5cms respectively.

c) The higher girth rate of polybag plants over the stumped buddings in the RRII trial is evident in Table A. Despite greater food reserve, the stumped buddings were markedly affacted by unfavourable weather in the planting year. The growth increment from the second year is not worked out as the girth for that year has not been published.

d) With regard to the comparative trial at shaliacary estate, the growth increment from the 2nd to the 6 th year after planting worked out to the least for stumped buddings as in Table B.

Table B

Girth Increment Trends

Planting material	From 2nd to 6th year (percent)
1979 GTI polybag	219.6
1980 GTI polybag	180.5
1981 GTI/RRII 105 polybag	267.2
1979 GTI budded stumps	273.7
1981 PB 235 budded stumps	323.2
1981 GTI stumped buddings	178·1

The claim in respect of shorter immaturity with early yield for stumped buddings could be due to the unaccounting of the period retained in the nursery before transplanting. This extended to about three years in the case of Shaliacary 1981 estate trial (3). Inclusive of another five years in the field before becoming tappable the immaturity of eight years is no less than of the conventional methods. The field immaturity of the latter is also reducible by the proper selection of planting materials and adoption of newer cultural methods. As the total economic and productive phase of all types of planting materials should be the same, the claim for the earlier and additional crop by the utilization of stumped buddings tends to mislead realities. Hevea rubber is neither an annual or a biennial nor triennial plant for short term immediate gain but a perennial tree with economy span from 20 to 30 years the overall yield and expenditure to be accounted for scientific and proper evaluation.

Another Trial

No less interesting had been another earlier comparative trial in the same Shaliacary estate with field budding of 3,098 plants and planting of 10,619 budded stumps in 1959 under the Rubber Board's subsidised replanting scheme (No. RP 71/59 L) in about 80 acres with clones M/K 3/2, AV 255 and GL. 1. By the end of 1960, the average height of field budding hovered below the budded stumps by 9.2 cms (15.2 & 24.4) but the difference during the next two years narrowed down to 3.5 cms. From 1963 onwards, separate measurements were not recorded officially due to uniformity of growth in both fields. In 1968 when visited last the trees in both fields were indistinguishable from the visual growth appearance and tapping had been started simultaneously.

Despite many such plantings in company and other estates from time to time including of stumped buddings, budded stumps in bamboo baskets, field planting of green buddings along with normal practices in the same year, separate records are seldom maintained and where kept remained unknown and unexploited. Against this background, the initiative of the AV. Thomas Group of estates in the dissemination of their practical experience deserves appreciation and encouragement.

(Contd. on page 30)

OBITUARY

K. S VARMA

We report with deep sorrow the sudden demise of K. S. Varma (50), Secretary of the Rubber Board on 27th December 1989. He died of a massive heart attack at the Medical College Hospital, Kottayam.

His body was cremated the following day at the N. S. S. cremation grounds in the presence of a large gathering of friends and relatives. Earlier the body was kept at the Board's Central Office, Kottayam when a number of people paid homage to him. A condolence meeting was held the same day. The Chairman Shri P. C. Cyriac presided. S/s. P. Mukundan Menon, Rubber Producton Commissioner and M. K. Vidyadharan, Member Rubber Board spoke on the occasion.

He joined the Rubber Board as Economist/Financial Analyst in the Department of Rubber Processing in June 1977. Under the Kerala Agricultural Development Project financed by the World Bank, he had undergone training

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NEWS AND NOTES

New synergistic fire retardants for natural rubber

The Regional Research Laboratory (RRL), Trivandrum has developed a new fire retardant natural rubber composition using a synergistic combination of antimony oxide and ANORIN 44, a phosphorus and halogen containing prepolymer from CNSL. These compositions (patent filed) have been found to be self-extinguishing in vertical burning tests, and have high limiting oxygen index (LOI, a measure of fire retardancy). The LOI value of 42 obtained is the best ever reported on fire retardant natural rubber. The flammability characteristics and mechanical properties of typical fire retardant natural rubber composition have been found to be: time for self-extinction, 0.5 to ls; weight loss on burning, 1. 085%; LOI 42: hardness, 58 Shore A; tensile strength, 224.06 N/cm² and elongation at break, 400%. The corresponding values for an untreated natural rubber sample are LOI, 15; time for self extinction, 145s; weight loss, 35.6%; hardness, 39 Shore A; tensile strength, 139 N/cm² and percentage elongation at break, 160. Besides, these formulations are also found to be easily processable on the roll mill and amenable for compression moulding in to desired shapes improving their commercial appeal.

ANORIN 44 is prepared by ANORIN 38—a phosphorus containing prepolymer developed from CNSL, the technology of which is being jointly released by RRL-Trivandrum and the Vikram Sarabhai Space Centre Trivandrum. Being based on CNSL which is obtaned from the cashew tree (*Anacardium occidentale* L.) ANORIN 38 and ANORIN 44 are very cost efective compared to other phosphorus and bromine-based fire retardants available in the international market. The presence of both hydrophobic hydrocarbon side chain and the hydrophillic polar groups in the same molecule makes these resins compatible with a wide range of plastics and elastomers.

ANORIN 38 has been already found to give adequate fire retardancy to polyurethane polymers and thermo plastics. Since these resins are high viscous liquids, they do not bloom. The presence of reactive sites gives them the choice of use as reactive fire retardants whereby they can be permanently coupled to the main polymer chain either by direct reactions or by inter penetration through instite cross-linking reactions. It was also found that the problem of generation of smoke due to the presence of the halogen can be easily overcome by incorporating smoke suppressant such as boric acid which itself is a fire-retardant.

R. K. Krishna Kumar UPASI President

Shri R. K Krishna Kumar has been elected as President of the United Planters' Association of Southern India, for the year 1989-90. Shri G. G. Muthanna is Vice-President. There are 21 other Members in the Executive Committee representing various interests.

Neem for farm pest control

Hawaii in the U. S. which faces the problem of ecological imbalance and poor health due to excessive use of chemical pesticides has sought help from India and other South Asian countries in using products of the neem tree for combating the pests and diseases afflicting its cropping system.

The Hawaiian State Senate in a resolution adopted recently called upon the Governor to commission a study of the neem tree for agricultural pest control in Hawaii as well as the Asia Pacific region in general. According to the resolution about ten to 30 per cent of Hawaii's agricultural production is devastated by insects and other pests despite widespread use of synthetic pesticides. Such use of pesticides is threatening the ecological balance and human health because it causes contamination of ground water supplies, toxic residues in produce and general dispersion into the atmosphere. The Senate hopes that by using natural pesticides crop growers may find an alternative that is safe and more economical.

The Indian neem tree or margosa (*Azadirachta indica*) and its allied species such as gora neem or persian lilac or Chinaberry (*Melia azedarach*) are grown extensively in many Asian and African countries. Neem has found its way into Australia and Central and South America This multi-purpose tree or "medicine tree of India" is tolerant to soil salinity, alkalinity and acidity and therefore thrives well in all types of soils besides establishing well even in severe drought-prone areas. It is also raised to arrest desertification and soil erosion and its thick foliage releases a large amount of oxygen into the atmosphere absorbing carbon dioxide. Its leaves, bark twigs and oil are extensively used in indigenous medicine. The neem seed contains 45 per cent non-edible oil and its germicidal property is well known. Most of the neem oil produced in India is used for soap making

The latest research on neem has brought into focus its importance in biological control or pests and diseases in agriculture. The neem products have been found to be highly effective in controlling more than 200 species of insect pests belonging to different orders. It is an ageold practice to mix neem leaves with stored grains and keep dried leaves between folds of clothes to protect them against various storage insects. The neem-leaf mix is now used in the manufacture of mosquito-repellents.

Nuisance weed disposes of nuisance pest

Once considered a nuisance weed, water hyacinth has added one more property to its list of beneficial qualities, that is, insecticidal potential. Scientists at the Regional Research Laboratory in Hyderabad have isolated a compound from the extract of the aquatic weed. This compound kills the rice moth *(Corcyra cephalonica)* at the larval stage at a dose less than a millionth of a gram. The team of scientists headed by Kaiser Jamil observed that the larvae first became black, then exuded their body fluids and finally died before reaching the pupal stage.

Larvae treated with even a crude extract of water hyacinth died or developed into deformed adults lacking the ability to procreate. According to Jamil, the extract contains sterols that have the potentiality to disrupt the growth and reproduction of the rice moth. The compound extracted from water hyacinth could thus be very useful in combating rice moth which is a serious pest of stored grains.

World Rubber Position

Forecasts made by the World Bank reveal that the world price of natural rubber may continue to remain low during 1990. Earlier the Bank had projected a price rise of 3.4% in NR during the year, but the current projection is that prices may fall by 3.6%

The Bank had predicted prices to go down by 10% in 1989. But in real terms NR prices the world over have declined by about 15% relative to the averages in 1988. □

(*Contd. from page 4*)

Arsenic treated rubber wood - a case study'.

The present policy of the Government not to fell the timber has necessitated the import of timber involving considerable amount of foreign exchange. Until forest resources are not indentified, plywood industry would have to find lesser known species. The paper presented by KR Birje, R. N. Kumar and A. C. Sekhar highlighted that the species attractive for the purpose was the rubber tree, VI Jose, VK. Rajalekshmy, K Jayarathnam and CR Nehru presented their paper entitled 'Preliminary studies on the preservation of rubber wood by diffusion treatment'. 'Use of rubber wood for the manufacture of safety matches' was the paper presented by S Joseph and N. M. Mathew. V. R. Santi, Suraj Santi and B. Chatterjee presented their paper on 'A brief review of commercial preservatives for rubber wood'.

N. K. Shukla presented his study in the paper entitled 'Hevea Brasiliensis (Rubber wood) - Its strength, properties and utilization'. 'Rubber wood-problems and prospects' was another paper read out by G. K. Prakash of Aspinwood Ltd., Cochin. Sanjiv J Sunu presented his paper entitled 'An integrated modern approach for better utilization of rubber wood - an under utilised non-conventional timber in India'. K. Damodaran prepared his 'note on sawing characteristics of rubber wood' C Bhaskaran Nair of South Indian Timber Industries made an exhaustive evaluation of his three decade's experiment with rubber wood.

The seminar, while discussing the prospects and problems of rubber wood made an attempt in evaluating the processing techniques being followed at present. As put it by A. C Sekhar let us avoid a 'wait and see' attitude in rubber wood utilization and go ahead with multipronged programmes. The wood from rubber tree would be regarded more important than rubber itself as both rubber and wood are indispensible for human progress

—ARAVINDAN

Rats in space!

A *Cosmos* satellite which took to space in October 1987 had on board a few rats as its passengers. After 12 days in space the bones of the rats lost upto-fifths of their strength. The rats returned with weakened muscles, suppressed immune systems, and a drop of 60 percent in production of a growth hormone. These were some of the results of the 28 experiments made on the effects of microgravity on mammals presented at NASA's Ames Research Center in Mountain View, California. The results indicated that countermeasures including, regular exercise and treatment with hormones would have to be taken by humans involved in prolonged space flight.

On *Cosmos* humerus bones of the rats became 40 per cent more brittle and the strengh of the vertebrae in the spinal column decreased by 27 per cent. Fluid accumulated between muscle fibres of the rats. Mitochon- dria in the heart musle degenerated and skeletal muscles shrank in size. Proportions of helper and suppresser T cells changed in the blood, thereby weakening the immune system. Levels of cholesterol and triglycerids increased while size of testes and magnitude of sperm production decreased.

Indonesia to adopt futures trading

Indonesia, with the largest Muslim population compared to any other country, has been all along regardig forward trading un-Islamic, considering it a form of gambling. But of late there has been a rethinking. The country is now drafting legislation in favour of futures trading in commodities. Rubber may be the first item to commence trading in futures. The existing commodity exchange contracts spot trading in rubber.

New glove unit in USA

North Coast Latex Corporation in Akron plans to set up a latex glove factory with annual capacity of 2600 lakh medical gloves. The production may commence during the summer of 1990. Mr Daniel Myers, Chairman of the Corporation hopes to cash the great demand for gloves in the US fuelled mainly by fears about AIDS. Automation in the electronics industry has also spurred growth in the glove market.

(Contd. from Page 26)

With the advent of green budding, another method that calls for investigation being selected green budding of at least two plants per pit out of some 4/5 seedlings established followed by subsequent cutting back and thinning out. Indonesian experimental data *had revealed the technical advantages of seedlings' selection raised in pits in the field as against in the nursery*. Such trials may be taking place in some estates in which case their dissemination should reveal valuable practical experience.

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Rubber Production Commissioner
P. Mukundan Menon

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THE QUARTER

Shri P. C. Cyriac, Chairman, Rubber Board has recently revealed that the rubber production in the country during 1989-90 might touch an all time high of 3 lakh tonnes, surpassing the earlier estimate of 292,000 tonnes for the year. Though there are so many contributing factors for this achievement, the improved production during the first quarter of 1990 was the consequence of sporadic rains in the rubber growing areas. A review of the position during the VII Plan would bring forth the fact that consistent growth has been recorded throughout the years as is evident from the following figures:

Year	*Target (in m.tonnes)*	*Achievement (In m. tonnes)*
1985-86	196,000	200,465
1986-87	209,000	219,520
1987-88	225,000	235,197
1988-89	244,000	259,172
1989-90	265,000	300,000 (estimate)

Eighth Five year Plan envisages large scale expansion of rubber cultivation in the North eastern region and other non-traditional areas where 65,000 hectares is expected to be brought under rubber cultivation. We will also get a glossy picture regarding the projections for the year 1990-91. It has been estimated that production during 1990-91 would be 335,000 tonnes, which is 38,000 tonnes higher than the production during 1989-90. The average annual growth rate of consumption of NR during the last five years was 8.4%. The Ministry of Industry projects a growth rate of 8% for 1990-91. It ensures that the consumption during 1990-91 would be around 370,000 tonnes.

The production and consumption during the last 5 years surpassed all the previous estimates and the pattern of growth consistently recorded all these years is indicative of the fact that the Board's estimates are not only realistic but capable of higher attainments. It is also hoped that the non-traditional areas will spare no efforts in its contribution to national need for more NR production.

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Accept Rubber as Afforestation Plant— Chief Minister, Tripura

Sri Sudhir Ranjan Majumdar, Chief Minister of Tripura has made a fervent appeal to the Government to accept rubber as an afforestation plant and allow its cultivation on degraded and abandoned tillas (uplands) outside the forest belt in the north-east region. He was delivering the inaugural address at the 114th meeting of the Rubber Board at Agartala. "Unless this is done, the biggest impediment to expand rubber on a large scale will remain untouched in the region", he said and added that the State Government would be shortly forwarding suitable proposals to the Government of India in this regard.

Tracing history of rubber plantations in the State the Chief Minister observed that in just over a decade Tripura has been squarely placed in the rubber map of India. It has come up now as the 4th largest rubber growing State in the country. Out of 26,630 hectares of rubber plantations so far developed in the north-easten States, Tripura accounts for as much as 62%. Yet, this is quite behind the national target of raising one lakh hectares of rubber in the non-traditional region. After the initial breakthrough the law and order situation in the State became a major constraint in expansion of rubber cultivation for a considerable time. That is now fortunately over and he hoped that the deck would be soon cleared for a much faster growth of the crop.

In Tripura rubber cultivation has been successfully linked to tribal resettlement for which the Tripura Rehabilitation Plantation Corporation was set up. The State has a large scheme for giving scheduled castes and scheduled tribes a settled life through rubber cultivation. After successfully implementing the first project of raising 5,000 hectares under rubber linked to tribal resettlement, the State has formulated a second project for raising 10,000 hectares of rubber at an estimated cost of Rs. 300 crores. Though institutional credit could be a major source to finance the project, he emphasised the need for Central assistance in this tribal resettlment programme and urged upon the Government of India to accept rubber as a forest crop in order to utilise the degraded tillas for the successful implemetation of the project.

Speaking on the role rubber has come to occupy, the Chief Minister stated that its cultivation has become a really popular activity in the State. A large number of small farmers are taking up rubber cultivation successfully. This enthusiasm has to be kept up through providing essential inputs and encouragement to the growers. In this regard he wanted the Rubber Board to consider the following points, gratefully acknowledging at the same time the constant encouragement and technical guidance given by the Board at all levels for the success of rubber cultivation in the State.

1 The scale of assistance for plantation development may be revised keeping in view the escalations in the cultivation and maintenance costs of rubber.

2 The fiscal assistance for barbed wire fencing, installation of rubber rollers, creation of processing facilities like construction of smoke house etc may be suitably enhanced for the small farmers.

3 The grant for house construction by the rubber plantation workers may be raised.

4 More training facilities may be created for the tappers and rubber processing workers in the State.

Earlier, welcoming the Chief Minister and members of his Council of Ministers in charge of Agriculture and Forests, the Chairman, Tripura Rehabilitation Plantation and other dstinguished guests, State officials and members of the Board, Sri P. C. Cyriac, Chairman, Rubber Board stated with extreme satisfaction that during the visits to the rubber growing areas the previous day, the members of the Rubber Board were convinced that rubber plantations have come up in the State very well, especially in the small farmers' sector, largely owing to the keen interest taken by the Government of Tripura. The Board's members were fully satisfied with the assimilation of technology for raising the rubber plantations. But the

(Contd. on page 4)

Mushroom Cultivation

R. KOTHANDARAMAN

Mushrooms are the fruiting body of a group of fungi called Basidiomycetes. Though mushrooms are known to man from time immemorial its cultivation started only a few hundred years ago. The major mushroom growing countries are U. S. A. France, Taiwan, Netherlands, U. K., South Korea, Japan and China. In India, mushroom cultivation, research and development started about two decades back. Now a days mushroom cultivation becomes more popular.

The reasons for the popularity of mushrooms are many. It is one of the very nutritious crops rich in proteins and contains all essential amino acids particularly lysine and tryptophan. It is a good source of vitamin B, folic acid–blood building vitamin useful in anaemic conditions and also contains pantothenic acid, biotin vitamin B12 and ascorbic acid. Mushrooms are reported to contain polysaccharides with cancer inhibiting properties and compounds which reduce cholestrol level in blood of human being. It is a good source of minerals like, phosphorus, potassium, iron and copper. With increasing food and population problems in developing countries mushrooms can play an important role to enrich human diet particularly in India where a majority of the population are vegetarians. It has got vast employment potential both for the educated unemployed and landless labourers. Mushrooms are also helpful in converting ligno-cellulose rich agricultural wastes into nutritious food there by reducing pollution through solid wastes.

Out of millions only 2000 varieties of mushrooms are reported to be edible among which about 70 of them are cultivated. In India only 3 types of mushrooms are cultivated. They are (1) European button mushroom (*Agaricus bisporus*) (2) Paddy straw mushroom (*Volvariella volvaceae*) and (3) Oyster mushroom(*Pleurotus sajor-caju*) Cultivation of button mushroom is laborious and involve much labour and finance. Eventhough, paddy straw mushroom cultivation is simple the yield is less and keeping quality is very poor. Oyster mushroom cultivation is very simple and could be done throughout the year in all parts of our country with least investment and experience.

Cultivation of oyster mushroom

A number of species of oyster mushrooms are reported. The most popular ones in our country are (1) Grey oyster mushroom (*Pleurotus sajor-caju*) and (2) White oyster mushroom (*p. florida* and *P. Citrinopileatus*) All of them grow well at atmospheric temperature from 20 to 33° C. Paddy straw as well as wheat straw are widely used for oyster mushroom cultivation. Recently they are found to grow well on waste rubber wood and rubber wood saw dust.

Good quality paddy straw is chopped into 3–5 cm pieces and soaked in fresh water for 8–12 hrs. This wet substrate is pasteurised by dipping in boiling water (80°C) for 30 minutes and air dried under shade till they attain about 70 percent moisture. This can be tested by taking and twisting a few pieces of straw by fingers. If water comes out and does not fall from fingers it is an indication of 70 per cent moisture level. The shade dried paddy straw is charged into polythene bags or tubes of 80-100 gaugethick and having two holds of about 1 cm diameter in the middle. Spawn or seed material collected from Agricultural Reseatch Institutes or RRII can be used for small scale mushroom production. First a layer of 7-10 cm paddy straw is prepared and inoculated with 15-20 gr. of spawn grains. This is followed by another 5 cm layer of straw and 15-20 gr. spawn. Likhwise 4 layers of straw is prepared and the bag/tube is tied well. The inoculated straw beds are kept for spawn running for 12-15 days in a room free from insects.

After the incubation period the bags are opened and left as such for 24 hrs. Watering in the form of spray is given both in the morning and evening. Now the mushroom beds require high humidity. So they can be placed on bricks kept in trays with little water. After 4 days the typical oyster mushrooms form on the entire surface of the bed (Fig). They are harvested and either cooked or stored in perforated polythene bags under refrigerator conditions for 4-5 days. They may be stored in freezers for months together.

From one bottle of spawn two mushroom beds each with 1 kg. paddy straw can be prepared. Average yield from each bed will be 300-400 gm. mushroom, the cost of which is Rs. 9.00 to 12.00.

Climatic conditions prevailing in rubber plantation is much ideal for oyster mushroom cultivation. Rubber growers can conveniently carry out mushroom cultivation during the immaturity period of rubber growth and get some return.

However rat damage and insect attack may take place during rainy season and affect mushroom development. These can be avoided by giving adequate protection with nylon mosquito net. □

(Contd. from Page 2)

area of crop exploitation and processing needs further attention. An appropriate marketing network has also to be developed. He assured to assist the State to overcome the problems. Already, a Tappers Training School has been started at Pathicherry, where modern techniques of crop exploitation and processing are disseminated. The team of Board members who visited the school saw that the trainees were enthusiastic in learning the tapping techniques. He promised to open shortly a few more training schools in the State. Regarding the scale of assistance for plantation devllopmet, he disclosed that upward revision of the plantation subsidy and of other measures have been included in the 8 th plan proposals for rubber.

Sri Cyriac thanked the Chief Minister and Ministers in charge of Agriculture and Forests in allotting to the Board 1,000 acres of land near Harimangal for establishing a Nucleus Rubber Estate cum Training Centre, and assured that the Board would not be found wanting in developing the area into a training centre for educating the planters in Tripura the scientific methods in natural rubber production and processing.

Explaining in a nutshell the ecological advantages of rubber cultivation he said that by growing rubber in association with leguminous cover crops, taking contour bunding and silt pits, soil erosion can be effectively checked. These measures can also control surface water run off. In this way the jhumed and denuded lands can be reclaimed. The environment will also get improved as rubber trees would do the climate moderating functions of the forest trees. Once the jhumias start cultivating the crop, they would get settled on the land and start earning a regular income.

—Thomas Ouseph □

RUBBER WOOD - PROMISE OF THE FUTURE

Dr. V. HARIDASAN

With the fast depletion of forests, there is acute scarcity for wood. In this context rubber wood can claim as a reasonable alternative raw material for wood based industries.

The Rubber Board had made two studies in the past with a view to estimating the total availability of rubber wood in India. The studies covered around 20,000 hectares and the findings were that at the time of clear felling there would be an average of around 200 trees per hectare, although the initial stand at the time of planting may be 450 per hectare. The wood available is placed at about one cubic metre per tree.

Similar studies have been undertaken in Malaysia, Sri Lanka and Nigeria. From Malaysia it has been reported that around 180 cubic metres of rubber wood can be obiained per hectare, if branches of 5 centimetre diameter are also included. There can be a wastage of 15 to 20 per cent. Another report from Malaysia indicates that a maximum of 260 cubic metres of rubber wood is available from a hectare of rubber plantation. In Nigeria, upto 300 cubic metres of rubber wood was obtained from 1 hectare. Therefore, the estimate of 200 cubic metres as the average per hectare in India is reasonable.

Properties of rubber wood

Rubber wood has very attractive grains. Its normal colour is similar to white cedar. Some times it may be light brown but invariably it is light yellow. The hard wood has a density of around 560 to 650 kilograms per cubic metre. Its strength properties are favourably comparable to medium hard woods. It has good machining properties, reasonable bonding, planing, turning, shaping and sanding properties. It can be made to good finishes also. It is good for laminating with normal industrial adhesives.

At the time of clear felling, there can be a moisture content of around 60 percent, but the percentage can be reduced by air drying to around 15. If kiln drying is adopted, the percentage can be brought down to the same level within 10 days. Air drying may take a longer time to achieve that percentage,

Defects of rubber wood

The two enemies of rubber wood are various types of blue and sap stain fungus and also certain borer beetles. Further the logs can be had only with the size of around 2 feet in diameter. The lengths of the logs are usually between 6 to 8 feet. Termites can also attack rubber wood. However, these difficulties can be got over by chemical treatment at the appropriate time. In addition to the above defects, rubber wood is suceptible to warping. This occurs during sawing and drying. Some times raised grains occur in rubber wood during machining. This is due to the presence of tension wood. These problems can be got over to some extent by glue lamination and finger jointing. Due to these deficiencies, there is widespread prejudice against rubber wood.

Treatment of rubber wood

The choice of treatment of rubber wood will depend upon the use to which the wood is finally subjected to.. There are two common methods of treatment. One is the diffusion method and the other chemical impregnation under pressure and vacuum. The diffusion method is common to other wood as well. However, if the rubber wood is exposed and there is a possibility of leaching, the diffusion method may not be successful. However, the chemical impregnation method will give guarantee against the borer and and fungi attack if the treatment is thorough.

The process of diffusion consists of either spraying freshly sawn rubber wood with a concentration of borax, boric acid and sodium penta chlorophenate. The treated rubber wood should be stacked in an air-tight chamber or should be covered with polyethylene sheets to allow the diffusion to take place after dipping. Afterwards, the wood may be kiln dried.

Under the vacuum method a chemical solution is forced into the wood by means of pressure and vacuum. The chemical is a mixture of copper cromium and arsenic. Under this method the moisture content should be around 30 percent. This is some what costly compared to the diffuison method. It is also desirable to treat the wood immediately after felling by spraying the chemical or painting the open ends of the log.

Uses of rubber wood.

The traditional use of rubber wood has been as fire-wood. In a study conducted by the Rubber Board it has been found that around 40 per cent of the wood (the entire branch wood) is consumed in the State of Kerala, Karnataka and Tamil Nadu as fire wood. The annual production of rubber wood is currently placed at 45 million cft (1.2 million cmt). The firewood finds uses not only in the household but also in the brick kilns, tile factories, tobacco curing centres and rubber mokehouses. In the study mentioned above it has been found that out of the total production of 45 million cft, around 15.5 million cft is used in manufacturing packing cases. Out of the rest, 3 million cft is used for manufacturing veneers and splints for safety matches, another 3 million is used by small-scale plywood manufacturers, 0.5 million cft by furniture factories and 0.5 million by others. It has been estimated that around 500 units are engaged in various lines of rubber wood processing in Kerala. In addtiion to that, nearly thousand saw mills handle rubber wood logs. A study conducted by the Rubber Board found that 67 percent of the annual requirement of the wood-based industries in the State of Kerala was met by rubber wood.

Other areas where rubber wood is used in a small measure are for manufacturing chip board' accessories for textile mills and building materials. The building materials include doors and windows and scaffolding and shuttering materials for concreting. A large number of plywood manufacturers, some of them fairly big, use rubber wood for inside ply of flush doors. Some manufacturers make frames from small pieces of rubber wood which would have otherwise been used as fire wood.

Future areas of use.

In many countries rubber wood furniture has become a standard item. Malaysia is reported to have been exporting knock-down furniture to Japan and the United States. Similarly rubber wood chips are being exported from Malaysia to Japan for manufacturing paper pulp. In the sphere of furniture-manufacturing many countries have developed such items as folding chairs, rocking chairs, lunch sets, dining sets, bed room sets, garden sets, benches' stools etc. In addition, attractive mouldings can be produced from rubber wood for household uses. Rubber wood is also being used for panelling and laminated flooring.

Glue laminated rubber wood can be of use in various household articles and building materials. Glue laminated and finger jointed rubber wood can be used in the construction of beams'. columns and panels.

A new promising development is the rubber wood polymer-composite. This is an extension of polymerisation developed in western countries. In India a large plywood manufacturer has developed rubber wood polymer composites a few years ago and has started commercial production in a small way. Under this method a monomer is impregnated into rubber wood and polymerisation is achieved by irradiation. As a result, the quality of rubber wood will be very much enhanced. It will acquire greater resistance to decay, improved mechanical properties and dimensional stability. The above manufacturer has produced some pieces of furniture out of rubber wood polymer-composites. Unfortunately, at the present stage of development the polymer used in the rubber is costly. A minimum of 6 to 7 kilograms of polymer will have to be impregnated into a cubic foot of rubber wood, adding to the cost of processing and raw material. As a result, the finished product will not be able to withstand competition from good quality wood at their current level of prices. But there is a promising future for this line of activity.

In India, rubber wood has also been used for manufacturing particle boards. In addition to that rubber wood can be u sed for manufacturing cement board. In Malaysia one factory has already marketed cement board. In Kerala an important plywood manufacturer tried to

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COPPER - CHROME - ARSENIC TREATED RUBBER WOOD - A CASE STUDY

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Introduction

Hevea brasiliensis (Rubber wood) is grown in about four lakh hectares in India. About 5000 ha of old plantation is cleared for replantation every year which yield an estimated 10 lakh m^3 of wood for industrial use (Habash, 1989), Not all this quantity is utilised for such industrial applications as plywood, veneer and splints for match industry, packing cases, door and window shutters, etc. ; a major portion of it is being utilised as firewood even now.

Studies have shown that this wood is suitable for furniture, panel products, veneers etc. (Gupta *et al* 1989. Sharma & Kukreti, 1981, Sonti *et al*.1982). Its susceptibility to fungal and insect attack, howevr limits its wider utilisation. Gnanaharan *et al*. (1983), Sonti *et al*. (1982) have made studies on the toxic effect of preservative chemical against insect and fungal attack.

Boric acid : Borax mixture has been suggested to give better protection where leaching is not a problem (Gnanaharan, 1982). CCA, which is a fixed type and hence more permanent, may prove to be more effective in all types of situations. Sonti *et al* (1982) have suggested fifty percent more retention for this timber than usually specified for other species.

An important aspect that should merit attention is the required penetration and absorption of the toxic components in the entire cross section of the treated wood. In a recent study, Kuppusamy and Sharma (1987) have shown that PH of the solution increases from about 2 when freshly prepared to more than 2.5 or 3.0 when the same CCA treating solution is repeatedly used for treatment, resulting in the formation of sludge. More arsenic than copper and chromium get precipitated and a progressive reduction in the strength of the preservative solution after each treatment charge was observed as a consequence. The treated timber contained less arsenic than expected. Hartford (1986) has given a comprehensive account on the importance of PH, sludge, impurities, plant housekeeping, etc. in treatment of timber with CCA preservative.

In view of the above, it was thought useful, as a case study to examine whether in commercial treatment practices the treated wood contains the chemical components of the preservative composition in the required ratio. A CCA treated door shutter received from a commercial source was analysed for penetration and absorption of the components of CCA for this purpose and the findings are reported in this paper.

Material and methods

Details of the dimensions of the CCA treated panelled door shutter made out of seasoned rubber wood received from a commercial source are given below:

Thickness	—40mm
Overall height	—1955mm
Overall width	—810mm
Size of the top rail	—100mm
Size of the frieze rail	—100mm
Size of the intermediate rail	—100mm
Size of the lock rail	—200mm
Size of the bottom rail	—200mm
Panel inserts	—12mm thick Anchor Board commercial veneered.

The different members of the door shutter were disassembled and samples of 10cm in length from mid-section of each member were sawn and taken and tested for the penetration of the preservative as per IS-401 and analysis of the CCA components as per IS-2753 were made. In all, 8 samples were obtained from 8 different members of the door shutter. Each sample was divided into two portions—one portion for penetration test and other for an analysis of the components of CCA. In addition, two samples from each member were also taken as per standard procedure, to study the moisture content in different members of the door shutter.

Results and discussion

Penetration of preservative throughout the cross section was observed to be very good in all the members of the shutter, except the top rail, in which it was observed to be uniformly mottled. Through and through penetration in a 40 mm cross section of rubber wood is therefore, easy to achieve with proper pressure and time schedule as has been adopted in the treatment of door shutter reported in the the present study. This species has been included in 'b' category of treatability by Gupta *et al.* (1989) and hence complete penetration as observed in the present study is possible in commercial treatment practices.

Data obtained on the retention of preservative from all the eight members of the door shutter are presented in Table 1. The retention of the total salts varied from 5.85 kg/m^3 in the top rail (which is reflected in the penetration test) to 21.80 kg/m^3 in the stile. The average absorption of 14.2 kg/m^3 is well above the recommended retention of 8 kg/m^3 (IS-401) for door and window shutters. However, Sonti *et al.* (1982) favour an absorption of about fifty percent more CCA for this timber than normally specified for other species of wood based on their observations. Since the retention of 14.2 kg/m^3 obtained in the present case is higher than that recommended for door and window shutters by IS I, as a cost effective measure, it is suggested that a solution of lesser strength is used but keeping the same treatment schedule, to achieve the desired absorption.

Also, the individual components of CCA in all the members of the door shutter was observed to be not in the desired ratio. As against the normal proportion of 1:3:4 of As, Cu and Cr in the treating solution, the proportion of salts in the treated members varied from 1:5.8:4.2 to 1:10.6:7.5, the average being 1:7.1:5.3, indicating a very low arsenic retention compared to copper and chromium.

Table 2 gives the extent of deviation of the observed from the expected values for the components of CCA in all the eight members of the treated specimens .The observed values were found to be significantly different from the expected values at 5% probability level' arsenic and chromium being significantly lower and copper higher than the expected.

Kuppusamy and Sharma (1987) have reported that when the same preservative solution is repeatedly used for treatment, the PH of the treating solution slowly increases from around 2 to more than 3 causing heavy sludging of the components of CCA and disproportionate retention of the components in the treated wood. The sludge was observed to contain more arsenic than copper and chromium. Formation of sludge also resulted in loss of these components from solution and concomitant reduction in the strength of the treating solution. As a consequence treated timber showed a disproportionate retention of the components. The proportions of the components of CCA in treated timber increased from 1:2.9:3.5 (As:Cu:Cr) in the first charge to 1:4.4:5 in the fifth charge, the retention of arsenic being much lower compared to copper and chromium during the fifth treatment charge.

One method of avoiding this kind of loss of preservative in the form of sludge is to monitor the PH of the treating solution at every stage of treatment and correcting it with chromic acid whenever it exceeds 2.5, which incidently may bring back into solution the portion of the preservative that has sedimented out. Another method of solving

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(*Contd. from page 6*)

produce wood-cement board and succeeded in that experimentally. Commercial production is yet to be started. Rubber wood saw dust can be used for manufacturing briquette. Some research on producing paper pulp from rubber wood has also been carried out in India, but this has not been commercially successful so far.

Although large quantities of rubber wood are used in the safety match industry, the consumers have reported problems like warping and lower absorption of wax. Another recent development is the manufacturing of activated carbon from rubber wood. Attempts are going on to set up a factory in Kerala to produce activated carbon with American technology.

The production of rubber wood is expected to touch 61 million cft by 2000 AD. There is no need to worry about the supply of this promising raw material. With appropriate taeatment and preservation, rubber wood can stand on its own with other commercial wood. □

the problem is to chemically analyse the treating solution after every treatment charge and make good the loss of the components observed, to keep the treating solution in the proper proportion. Unless the steps outlined above are taken it is possible that the strength of the solution may get reduced considerably after few charges which may not only result in poor retention than expected based on either weight or volume measurements but also inadequate distribution of the toxic components in the treated timber.

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Summary

An estimated 10 lakh m³ of rubber wood is reported to be available for industrial utilisation from about 5000 ha of old plantation cleared for replantation every year. Available figures show that not even fifty percent of it is utilised industrially, firewood forming a major portion of its utilisation. Inspite of its suitability for different end uses, this timber remains under-utilised because of its high susceptibity to fungal and insect attack.

Impregnation with toxic chemicals like Boric acid : Borax, Copper: Chrome: Arsenic composition are known to protect timber from biodeteriorating organisms. In a recent study it has been shown that if proper precautions to maintain the PH of the CCA preservative used for treatment are not taken, it is likely that, treated timber may become deficient in Arsenic component of the preservative. A CCA treated door shutter received from a commercial source was analysed, as a case study for penetration and absorption of the components to see whether all the three components are present in specified levels. Although the penetration of the preservative was found to be good, data on the absorption of individual components show a significantly low arsenic and high copper retention. Methods to restore the deficiencies are suggested.

TABLE 1

CCA content in different members of the door shutter

Shutter member	CCA components Kg/m³			Total salts kg/m³	Proportion of components*
	Arsenic	Copper	Chromium		
Stile (L)	1.60	11.20	9.0	21.80	1:7:5.6
Stile (R)	1.55	9.28	7.73	18.56	1:6:5.0
Bottom rail	0.55	5.40	3.60	9.55	1:9.8:6.5
Intermediate rail	0.93	5.40	3.92	10.25	1:5.8 4.2
Lock rail	0.65	6.90	4.90	12.45	1:10.6:7.5
Frieze rail	1.45	8.54	6.90	16.89	1:5.9:4.8
Frieze rail	1.47	10.00	6.80	18.27	1:6.8:4.6
Top rail	0.32	3.40	2.13	5.85	1:10.6:6.7
Average	1.06	7.51	5.60	14.20	1:7.1:5.3

* Normal proportion of CCA 1:3:4 of Arsenic:Copper: Chromium

TABLE 2

Data showing the observed, the expected and the deviation of the observed (absolute and percent) from the expected values of components of CCA in different members of CCA treated door shutter.

Shutter Member	CCA Components Kg/m³								
	Arsenic			Copper			Chromium		
	Observed	Expected	Deviation	Obs:	Exp:	Devi:	Obs:	Exp:	Devi:
Stile (L)	1.60	2.73	—1.13 (—41.28)	11.20	8.18	+3.03 (+27.01)	9.00	10.90	—1.9 (—17.43)
Stile (R)	1.55	2.32	—0.77 (—33.19)	9.28	6.96	+2.32 (+25.00)	7.73	9.28	—1.55 (—16.70)
Bottom rail	0.55	1.19	—0.64 (—53.78)	5.40	3.58	+1.82 (+33.70)	3.60	4.78	—1.18 (—24.61)
In termediate rail	0.93	1.28	—0.35 (—27.34)	5.40	3.84	+1.56 (+28.89)	3.92	5.13	—1.21 (—23.51)
Lock rail	0.65	1.56	—0.91 (—58.33)	6.90	4.67	+2.23 (+32.32)	4.90	6.23	—1.33 (—21.35)
Frieze rail	1.45	2.11	—0.66 (—28.95)	8.54	6.33	+2.21 (+25.88)	6.90	8.45	—1.55 (—18.34)
Frieze rail	1.47	2.28	—0.81 (—35.53)	10.00	6.85	+3.15 (+31.50)	6.80	9.14	—2.34 (—25.60)
Top rail	0.32	0.73	—0.41 (—56.16)	3.40	2.19	+1.21 (+35.59)	2.13	2.93	—0.80 (—27.30)
Average	1.06	1.78	—0.72 (—40.45)	7.51	5.33	+2.18 (+29.03)	5.60	7.10	—1.48 (—20.85)

The Observed values are significantly different from the calculated at 5% probability level. □

Preliminary Studies on the Preservation of Rubberwood by Diffusion Treatment

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The rubber tree, *Hevea brasiliensis* (Muell. Arg.) mainly cultivated for the production of latex, is also an important source of wood. As a semi-hard wood, the utilisation of rubber wood for different purposes depends primarily on its durability against fungal and insect attacks. A large number of beetle borers were reported on rubber wood (Tissevera singhe, 1970; Yan *et al.* 1979 Norhara, 1981 and Gnanaharan 1983). The most common among the fungi found associated in the deterioration of rubberwood are the blue stain fungus *Botryodiplodia theobromae* Pat. and the associated moulds *Aspergillus* spp. and *Penicillium* spp, (Ali *et al*; 1980). The brown rot fungus, *Coniophora puteana* and the white rot fungus *Polystictus versicolor* were found to cause the degradation when rubber wood is exposed to those fungi (Ali, 1977). Other natural invaders of rubber wood in the field include *Ganoderma applanatum*, *Lenzites Palisotii*, *Poria* spp; *Schizophyllum commune*, *Trametes corrugata* (Hong, 1982).

At Rubber Rasearch Institute of India, Kottayam a number of wood destroying insects have been collected from rubber wood and identified. These are; *Sinoxylon conigerum* Gerstaecker Family: Bostrychidae (2) *Heterobostychus aequalis* (Waterhouse) Family; Bostrychidae (3) *Dinoderus bifoveolatus* (Wollaston) Family: Bostrychidae (4) *Mynthea rugicollis* (Walker) Family: Lyctidae (5) *Xyleborus perforans* (Wollaston) Family: Scolytidae (6) *Platypus solidus* Walker Family; Platypodidae (7) *Carpophilus* (*Eidocolastus*) *plagiatipennis* (Motschulsky) Family: Nitidulidae (8) *Europs* sp. Family: Rhizophagidae (9) *Cryptolestus* sp. Family : Rhizophagidae (10) *Araecerus fasciculatus* (Degeer) Family : Anthribidae.

The fungi isolated were, *Botryodiplodia theobromae* (sap stain) *Fusarium* spp; *Trichoderma* spp; and the moulds *Aspergillus* spp and *Penicillium* spp.

The natural durability of rubber wood against fungal and insect attack can be enhanced only by improving the quality by chemical treatment. Different methods have been developed to achieve this goal. The most successful among them are the chemical impregnation under vacuum and pressure. The diffusion method by dipping the wood in a preservative chemical and allowing the diffusion to take place for a long period of 4 to 8 weeks is moderately successful. An important limiting factor while treating the rubber wood by the diffusion method is the development of fungi during the diffusion storage period. The present study is conducted to select a suitable and cheaper substitute to N aPCP which is the most widely used preservative for the control of fungi developing during the diffusion storage period and to screen other water soluble insecticides and fungicides for the control of insect borers and fungi that attack during the storage period.

Materials and Methods:

The rubber wood was sawn to planks of required sizes viz; (1) 30 cm, × 4 cm, × 2.5 cm, and (2) 30 cm × 4 cm × 5 cm as early as the trees are felled and immediately used for diffusion treatment. There were 15 treatments in total including the untreated planks which remained as the control. The treatments include both fungicides and insecticides alone or in combination as furnished in table 1.

Table 1 Preservatives used

T 1	NaPCP 0.5%
T 2	Borax 7.5%
T 3	Boric Acid 5.0%+ Borax 7.5%
T 4	Boric Acid 5.0%+ Borax 7.5%+NaPCP 0.5%
T 5	Boric Acid 5.9%+Borax 7.5%+NaPCP 0.5% + Phosphamidon 0.2% +Tridemorph 0.5%
T 6	Monocrotophos 0.2%+Tridemorph 0.5%
T 7	Phosphamidon 0.2%+ Tridemorph 0.5%
T 8	Dimethoate 0.2%+ Tridemorph 0.5%
T 9	Monocrotophos 0.2%+Oxycarbooxin 0.4%
T10	Phosphamidon 0.2%+Oxycarboxin 0.4%
T11	Dimethoate 0.2%+Oxycarboxin 0.4%
T12	Copper Sulphate 10%
T13	Copper Sulphate 10%+Borax 7.5%
T14	Water treatment
T15	Untreated

The diffusion treatment was carried out as per the method followed by Tisseverasinghe (1969) and as per the methods given vide; KFRI information Bull 7:1—4.

A plastic trough of 60 litre capacity having a surface area of 60 cm containing 30 litres of the preservative was used for dipping the planks. In each size, 15 planks were treated in three replications. The planks having 2,50 cm thickness were taken out after 40 minutes and the planks having 5 cm. thickness were taken out after 160 minutes. The planks were then wrapped in polythene sheets. The diffusion storage period was 4 weeks and 8 weeks respectively for planks of 2.50 cm and 5 cm. thickness respectively. After diffusion storage for the specific period, the planks were taken out for observations of fungal attack and they were kept for air drying under shade in a slanting position and stored. During storage period the planks were again air dried under shade every 15 days until the planks were completely dried. Observations were again recorded on fungal and insect borer attack after two months of storage.

The fungal attack and insect attack was assessed as per the following ratings. In the case of insect boreres, the ratings was different for the three insects. The percentage attack was calculated as per the formula.

$$PDI = \frac{\text{Sum of all disease ratings}}{\text{No. of observations} \times \text{Max. grade}} \times 100$$

(Horsfall and Heuberger 1942) Table 2. a & 2. b.

Table 2 (a) Disease ratings for fungi

0	No attack
1	Slight growth, 1 to 10% of the area of the plank attacked
2	Medium growth, 11 to 25% of the area of the plank attacked
3	Medium growth, 26 to 50% of the area of the plank attacked
4	Hevy growth, 51 to 75% of the area of the plank attacked
5	Heavy growth, completely covering the planks.

Table 2 (b) Ratings for Insect attack

	Xyleborus perforans	*Sinoxylon conigerum*	*Heterobostrychus aequalis*
0	No attack	No attack	No attack
1	Upto 4 pinholes	Upto 2 boreholes	Upto 1 borehole
2	Upto 12 pinholes	Upto 6 boreholes	Upto 3 boreholes
3	Upto 40 pinholes	Upto 10 poreholes	Upto 5 boreholes
4	Upto 80 pinholes	Upto 20 boreholes	Upto 10 boreholes
5	Above 80 pinholes	Above 20 boreholes	Above 10 boreholes

Results

During the diffusion storage period in treatments with Na PCP alone or in combination with insecticides there was complete control of all the common fungi viz; *Botryodiplodia theobromae* *Fusarium* spp, *Aspergillus* spp, *Trichoderma* spp and *penicillium* spp. All the planks were practically free from fungus. In tridemorph treated planks the growth of sapstain and *Fusarium* was generally high and the surface mould low or absent. When oxycarboxin was used sapstain and Fusarium development was low in planks of both sizes, but fairgrowth of *Fusarium* sp. was noticed in planks of 5 cm thickness. In planks which were free from sap stain and *Fusarium* considerable growth of *Aspergillus* spp or *Trichoderma* spp was noticed. In copper sulphate treatment both stain development and *Fusarium* development were very high. Mould growth was comparatively low. In water dipped treatment *Fusarium* was very high while stain was absent. In untreated control both stain and *Fusarium* was low, but *Aspergillus* was predominant. Insecticides alone do not have any effect on control of fungi (Table 3 a.)

Table 3 (a) Fungal development during diffusion storage (Percent intensity)

Treatments	Botryodiplodia theobromae		Fusarium sp.		Aspergillus sp.		Trichoderma sp.		Penicillium sp.	
	2.5cm	5.0cm	2.5 cm	5.0 cm	2.5 cm	5.0cm	2.5cm	5.0cm	2.5cm	5.0cm
T 1	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00
T 2	55.70	48.10	45.50	73.60	26.50	00.00	00.00	00.00	00.00	00 00
T 3	100.00	86.20	00.00	55.60	00.00	00.00	00.00	00.00	00.00	00 00
T 4	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	66 60
T 5	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00 00	00 00	44.40
T 6	26.50	65.50	00.00	63.00	00.00	00.00	00.00	00.00	00.00	00.00
T 7	6.70	20.00	60.50	74.50	00.00	00 00	00.00	00 00	00.00	00.00
T 8	13.30	80.00	86.50	77.80	33.30	00 00	0u.00	00.00	00 00	00.00
T 9	00.00	26.60	00.00	53.30	53.50	00,00	00 00	55.70	00.00	00.00
T 10	13.30	00.00	33.30	55.70	00.00	00.00	00.00	60 50	00.00	00.00
T 11	6.70	13.30	33.30	55.60	00.00	00.00	00.00	25.00	00.00	00.00
T 12	85.60	86.70	33 30	54.50	00.00	00.00	10.00	20.50	00.00	00.00
T 13	93.50	95.00	00.00	93.80	24.60	00.00	01.00	00.00	00.00	00.00
T 14	00.00	00.00	85.60	100.00	00.00	00.00	00.00	00.00	00.00	00 00
T 15	00.00	00.00	6.70	00.00	45.50	75.30	00.00	00.00	00.00	00.00

After two months of storage subsequent to diffusion treatment, Na PCP treated planks still remained free from sap stain attack. But considerable attack of *Aspergillus* spp. was noticed in planks of 5 cm thickness. With tridemorph, sap stain attack was low in general but on planks of 5 cm thickness the attack was high and the planks were almost free from *Aspergillus* spp. Oxycarboxin had better control of sapstain than tridemorph, but the intensity of *Asperdillus* was found to be increasing under storage. Copper Sulphate has no effect on sapstain, the fungus almost covering the planks as a thick cover. In water dipped planks the sap stain was low in the beginning in 5 cm planks, but intensity was high later on. In untreated control both stain and *Fusarium* was low and attack of *Aspergillus* was high. *Trichoderma* was found to be not at all a serious problem. In all the treatments the growth was almost absent or very low.

Develeopment of *Penicillum* was found to be more in Na PCP treated planks and oxycarboxin treated planks as compared to other treatments (Table 3 b)

Table 3 (b) Fungal development after 2 months of storage subseguent to diffusion treatments (Percent intensity)

Treatments	Botryodiplodia theobromae		Fusarium sp.		Aspergillus sp.		Trichoderma sp.		Penicillium sp.	
	2.5cm	5.0cm	2.5cm	5,0cm	2.5cm	5.0cm	2,5cm	5.0cm	2.5cm	5.0cm
T 1	00.00	8.30	00.00	8.30	8.30	33.30	58.30	00.00	16.70	8.30
T 2	77.80	69.[illegible]0	00.00	55.70	8.30	73.60	56.70	13.30	00.00	00.00
T 3	93.30	88.40	00.00	55.50	00.00	44 40	33.30	55.60	00.00	00.00
T 4	00.00	6.70	00.00	00.00	00.00	33.30	13.30	20.00	00.00	62.00
T 5	6.70	13.30	00 00	00.00	6.70	00.00	00.00	40.00	00.00	53.30
T 6	26.70	88.30	62.20	66 70	44.40	00.00	20.00	20.00	00.00	00.00
T 7	6.70	20.00	66.70	73.60	00.00	00 00	53.30	13.30	46 70	20.00
T 8	20.00	80.00	85.00	77.80	40.00	00.00	36.70	13.30	6.70	00.00
T 9	00.00	33.30	11.10	25.00	55 60	40.00	11.10	33.30	00.00	66.70
T 10	33.30	43.10	33.30	55.70	00.00	59.30	44.30	59.30	11.10	33.30
T 11	66.70	11.10	33.30	44 40	00.00	66.70	00.00	33.30	00.00	00.00
T 12	88 90	93.80	8.30	25.00	69.40	00 00	58 30	26.60	00.00	00.00
T 13	93.30	95.00	00.00	93.80	25.00	00.00	16.70	00.00	00.00	00.00
T 14	6.70	64.50	40.00	00.00	13.30	86.60	00.00	33.30	6.70	00.00
T 15	00.00	00.00	20.00	00.00	60.00	100.00	00.00	00.00	00,00	00 00

Preliminary observation on insect borer attack during the storage period after diffusion treatment showed that three insect boreres viz; *Xyleborus Perfoarns*; *Sinoxylon conigerum* and *Heterobostrychus aequalis* predominated after two months. These three insect borers, *X Perforans* (Size: 2mm length and 0.5 mm, width) *S conigerum* (size: 4 mm. length and 2 mm, width) and *H. aequalis* (size: 10 mm. length and 4 mm. width) made holes 0.5 mm, 2 mm, and 4 mm, diametres respectivy.

Borer attack was totally absent on planks treated with borax; monocrotophos + oxycarboxin; phosphamidon + oxycarboxin; Copper sulphate + borax; and copper sulphate (Table 4).

Table 4 Attack of different insect borers after 2 months of storage subsequent to diffusion treatment (Percent intensity)

Treatments	Xyleborus perforans		Sinyxylon conigerum		Heterobostrychus aequalis	
	2,5cm	5·0cm	2.5cm	5.0 cm	2.5 cm	5.0 cm
T 1	16.67	00.00	8.33	00 00	16.67	00.00
T 2	00.00	00.00	0 00	00.00	00.00	00 00
T 3	16.67	00.00	0.00	00.00	00.00	00.00
T 4	00.00	30.00	0 00	00.00	00.00	10.00
T 5	00.00	00.90	0 00	00.00	00.00	6.67
T 6	00.00	33.33	0 00	00.00	00.00	00.00
T 7	00.00	53.33	0.00	13.33	00.00	13.33
T 8	00.00	20.00	0.00	00.00	00.00	00.00
T 9	00.00	00 00	0.00	00.00	00.00	00.00
T 10	00.00	00.00	0.00	00.00	00.00	00.00
T 11	00.00	22.22	0.0.	00.00	00.00	00.00
T 12	00.00	00.00	0.00	00.00	00.00	00.00
T 13	00.00	00 00	0.00	00.00	00.00	00.00
T 14	00.00	6.67	0 00	00.00	00.00	00.00
T 15	00.00	62.67	0.00	26.67	6.67	52.00

Borer attack was considerably low in treatments viz; boric acid+borax+Na PCP; boric acid+borax; boric acid+borax+Na PCP+ phosphamidon+tridemorph; monocrotophos+tridemorph; dimethoate+tridemorph; dimethoate+oxscarbox in etc.

Attack of the three borers was observed but less on planks treated with Na PCP and phosphamidon+tridemorph

Maximum attack was found on the untreated planks, *X Perfoans* 62.20% *S conigerum* 26,67% and *H. aequalis* 52%. But the attack was absent on the water dipped planks kept under cover except on a few 5 cm thick planks on which 6.67% attack of *X perforans* was noticed.

Discussion

Sodium pentachlorophenate (Na PCP) is the widely accepted preservative for the control of fungi on wood especially sap stain (Tisseverasinghe 1969; 1970) Na PCP is well miscible with insecticides and can be used for protection against insect pests also. However, this fungicide is found to be toxic to human beings (Dickon, 1980). So a constant search for equally effective but cheaper alternative which is free from mammalian toxicity is made. A large number of preservatives have been screened but so far no alternative could be spotted out (Ali *et al.* 1980; Plackett 1982). Incorporation of 10% boric acid equivalent (B A E) solution in Na PCP (0. 5%) solution was reported to give protection against *Sinoxylon anale* attack on rubber wood (Gnanaharan, 1983).

In the present study also Na PCP proved to be the best antifungal preservative and in combination with insecticides borax, boric acid or phosphamidon completely checks. insect borer attack. Among the other fungicides oxycarboxin is found to be good in controlling sap stain and Fusarium to some extent though not equal to Na PCP. In this case also artack of *Asperqillus* spp and *Trichoderma* spp was more.

Borer attack was completely absent when insecticides like phosphamidon or monocrotophos was incorporated with oxycarboxin. Copper sulphate solution also had complete control of insect borer attack, but had no effect on sapstain and *Fusarium*. In the water dipped planks stain and insect attack was low, because the planks were almost covered by Fusarium spp. In untreated planks, since moisture was low. both stain and Fusarium development were low, but later heavy attack of Aspergillus was noticed. These planks were showing maximum attack of insects.

Conclusion

Na PCP still remains to be the best preservative and in combination with insecticides, borax and boric acid controls fungal and insect borer attack. Oxycarboxin shows promise in controlling fungi next to Na PCP and incorporation of insecticide viz; monocrotophos and phosphamidon is effective against insect borer. Copper sulphate solution was also found to be effective against insect borer attack for two months. Further observations are required for confirming their effectiveness in the long-term.

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Rubber septa for weevil control

The Scientists of the Regional Research Laporatary and the Central Tuber Crops Research Institute have developed a rubber septa to be used in the "sex pheremone trap" that is laid for the effective control of sweet potato weevil. The rubber septa, developed indigenously, is claimed to be qualitatively superior and far less costly than the ones available now. The research work by the scientists was based on the findings of an American Scientist, Dr. Robert Heath, in 1986.

Mushroom cultivation on rubber wood wastes: A new approach

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Abstract

A feeler trial was conducted to find out whether rubber wood and its saw dust could be used for growing mushroom and production of spawn. The results indicated the possibilities of growing mushroom on rubber wood. The need for perfecting the technique and selecting a suitable mushroom is emphasised in the paper.

Introduction

Increasing population in India is creating an alarming situation in the food front. Malnutrition in terms of 'Protein' deficiency is becoming a major problem. Exploiting non-traditional food sources can make a substantial contribution to meet the serious food and malnutritional deficit. Mushrooms are rich in proteins, vitamins, amino acids and minerals. Mushrooms also have many medicinal properties and recommended in cases of anaemic condition, diabetics, hypertension and maliganant tumer growth. In these circumstances, popularising mushroom as part and parcel of every day food is of importance especially for vegetarians. Therefore the production of mushrooms from domestic, agricultural and industrial wastes and other ligno-cellulosic materials has assumed importance (Birch et al., 1976; Pettipher, 1988 and Lavie 1988). In countries like Japan, China and Korea varieties of mushrooms are grown using soft wood, hard wood and saw dust. Some of the important mushrooms cultivated on wood are (1)

(1) *Flammulina velupties*
(2) *Kuchneromyces mutabilis*
(3) *Lentinus edodes*,
(4) *Pholiota mameko*
(5) *Pleurotus ostreatus*,
(6) *Auricularia* spp
(7) *Tremella fusiformis*

Some other mushrooms are grown on partlally decomposed wood and wood products (Chang and Hayes 1978). Rubber wood being a light hard wood may meet the requirement of ligno-cellulosic material for mushroom production. It is available regularly in plenty. The availability of rubber wood in our country is estimated to be around 1.2 million cubic metre out of which the rubber wood waste is 0.18 million cubic metre (Haridasan 1989). Saw dust from rubber wood is also available in plenty. With a view to using rubber wood waste for mushroom cultivation and rubber wood saw dust for spawn production, a preliminary study was carried out and the results are presented in this report.

Materials and Methods: Growing mushroom on rubber logs

Rubber wood logs of 6 to 8 cm diameter and 25 cm length were split longitudinally into four equal pieces, soaked overnight in water and sterilized using autoclave for 2 hrs. After cooling they were aseptically charged with 150 gms of spawn made from cholam grains. Three species of oyster mushroom viz *Pleurotus sajor-caju; P. citrinopileatus P. florida* were used. Four logs of rubber wood were used for each species of mushroom. The inoculated wood logs were tied firmly and covered on all the sides with 100 gauge transparant polythene sheet and kept in dark at room temperature 26 ± 2 °c for spawn running. Spawn running was continued till white encrustations were noticed which is an indication of completion of spawn running. The polythene covering of such logs was removed. Watering was done twice daily from 24 hrs of opening. The growth of mycelium, spawn running time and mushroom development were recorded.

Spawn production using saw dust

Rubber wood saw-dust was soaked in water for 24 hrs. Wet saw dust was squeezed and dried under shade to about 70% moisture level. Calcium carbonate was mixed with semi dried saw dust at 5% level and half filled in saline drip bottles and sterilized in autoclave for 2 hrs. After cooling they were inoculated with 10 grams of mother spawn of three species of mushroom separately. The growth was observed upto 10 days and recorded.

Results and Discussion

All the three species of mushroom started growing on wood logs from the third day of inoculation and the growth was confined to the split surface of the wood only. White encrustations appeared after 10, 12 and 15 days in *P. florida P. citrinopileatus* and *P. sajor-caju* respectively. Two logs in each of *p. citrinopileatus* and *p. sajor-caju* and one log in *p. florida* got contaminated by *Trichoderma* sp. Small mushroom buttons developed on the remaining logs on 4th day. All the buttons on the logs of *p. sajor-caju* and *p. citrinopileatus* and over 90% buttons in P. florida dried on 5th day. Only 5 small mushrooms developed in *p. florida*. All the mushrooms showed typical colour and shape.

The mycelia of all the three fungi grew on saw dust. But it ceased to grow at about 3/4 of the depth. The mycelial mass is also less when compared to grain spawn. The growth of the mycelia of oyster mushroom at split surfaces of the rubber wood indicates that it is capable of supporting wood decaying fungi like *pleurotus* sp.

Failure of mushroom mycelium to grow on the entire surface of wood log might be due to lack of drying before sampling or the compactness of the wood. Augmented percentage of contamination can be attributed to readily available nutrients on wood surface which could be overcome by selecting completely dried wethered wood or by carrying out pre-fermentation by various methods as done for other types of mushrooms (Chang and Hayes 1978). Mushroom formation and opening depends on temperature, moisture and carbondioxide concentration in the substrate on which they develop (Zadrazil 1975). Limited number of mushroom that developed in the logs indicate that the conditions in the logs are not favourable and modification of the method is required. Arvind Krishna (1978) reported a new method of producing oyster mushroom on wood logs is worth trying. The drill hole method adopted for growing *Lentinus edodes* (Campbell and Slee 1986) needs testing. This study indicates that various species of oyster mushroom differ with regard to the formation of mushroom on rubber wood.

Besides the three species tested a number of other species are also available which on testing may prove better. *p. ostreatus* is a species mainly grown on stumps, logs and saw dust in Japan (Sang and Hayes 1978) and might be more suitable for rubber wood. The failure of the saw dust to support the mycelial growth of three species of mushroom may be due to non-availability of readily availiable sugar and proteins as found in grains and needs addition of other ingredients like grains. The present study shows an indication of growing mushroom on rubber wood. However a detailed investigation on the technique of mushroom cultivation and selecting most suitable species of mushroom are to be carried out before arriving at a conclusion. At this stage we can say that rubber wood does not inhibit mushroom growth. In addition to getting mushroom, we may get good organic manure by using spent solid wastes of mushroom cultivation on wood and saw dust.

Acknowledgement

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USE OF RUBBER WOOD FOR THE MANUFACTURE OF SAFETY MATCHES

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Introduction

The most important raw material for the manufacture of safety matches is wood, although substitutes like paper and bamboo have been introduced occasionally. As many as seventy Indian species of wood have been indentified as raw material for the match industry. However, the Bureau of Indian Standards have included only 29 species in IS:1140 (Specification for logs and matches). But commercially only about ten species are favoured and are widely used. These species together are able to meet only a part of the total demand for wood by the match industry. The gap between demand and availability of wood for matches is likely to get widened as the production of matches is to increase from the present figure of over 20 billion boxes to about 40 billion boxes by the turn of the century. The perenial shortage of wood, has prompted Maheswaran [1] to suggest use of rubber wood for the manufacture of matches. Although it is not widely accepted, it is a fact that considerable quantities of this wood are presently being used by match manufacturers in the small scale sector.

Quality requirement of wood for match industry

Aspen wood (Populus tremala) was the most popular wood used in the early match industry. The creamy white colour of this wood has since then been accepted as an important requirement. In addition to colour, the wood must be easily peelable giving smooth veneers for the boxes. The wood must be easily choppable and contain straight grains for the splints. The wood must readily absorb wax to enable the splint take up flame properly. The head composition must be held strongly at the tip of the match stick. The splints should be strong enough for handling in the machines and other mechanical handling devices used in the small scale sector for waxing and head fixing.

Problems with rubber wood

Various problems have been reported regarding the use of rubber wood for the match industry. The most important among them are :

1. warping of splints during storage,
2. lower wax pick-up
3. discolouration during storage and
4. lower adhesion of head composition

The presence of considerable quantities of tension wood is responsible for the longitudinal shrinkage and consequent warping. Only through possible mechanical innovations and controlled drying techniques, it may be possible to minimise the problem of warping. It is also widely believed that some of the problems like lower wax pick-up and resistance to burn etc. are due to the presence of latex in rubber wood. However it is to be pointed out here that these are arising from prejudice and wrong notions about rubber wood. In fact only that portion of the rubber wood, which is close the bark, contains some rubber. The bulk of the wood remains largely free from rubber. Moreover, if at all the wood contains some rubber, it is not all likely to resist burning, rubber itself being more inflammable than cellulose and lignin.

Attempts for improvement

In the present work an attempt was made to improve the wax pick-up and colour of splints made from rubber wood. Wax is generally used as a flame transfer agent in matches. In the absence of a flame transfer agent, on ignition, a match will burn only until the head composition has been fully consumed, and then the flame goes out. The reason for this is that the head does not supply sufficient heat to kindle the wood fibres. However, when a readily Inflammable material like wax is applied to the splint, the heat from the burning head composition will be sufficient to vapourise and ignite it and as burning continues, additional heat is developed to ignite the splint. Therefore, the pick-up of wax by the splints is of great significance in deciding the quality of matches.

Different chemical treatments were tried to improve colour and wax pick-up. The colour of the splints was assessed visually and its wax pick-up gravimetrically. The results as given in Table-1 indicate that wax pick-up of the splints is improved by treatment with bleaching powder.

Table–1

Wax Pick-up of Treated Rubber Wood Splints

Sl. No.	Material	Treatment	Wax pick-up 95° C 15 seconds (%)
1.	Rubber wood	Nil	21.05
2.	,,	1% Na_2CO_3 (Unwashed)	27.01
3.	,,	1% Na_2CO_3 (Washed)	23.96
4.	,,	1% Na_2CO_3 (Bleached)	26.72
5.	,,	1% NaOH (Unwashed)	23.23
6.	,,	1% NaOH (Washed)	21.61
7.	,,	1% NaOH (Bleached)	24.25
8.	,,	Bleaching with 2% bleaching powder	28.40
9.	Vatta	Nil	28.07

Splints made of Vatta wood (Macaranga Indica) was used as control. The colour of rubber wood splints was found to improve as a result of treatment with bleaching powder. The other treatments were found to be less effective in improving wax pick-up and colour.

The effect duration of treatment was also studied in a separate experiment. It was found that an immersion period of 1 hr in 2% bleaching powder was sufficient to improve colour and wax pick-up.

Further trials, especially on commercial scale, are required to confirm these results and to work out economics.

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An Account of Tension Wood with Special Reference to Hevea Brasiliensis

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Introduction

When the equilibrium state of a tree is changed in nature it begins to produce a specific tissue, referred to as reaction wood, in the branches and the trunk by which the tree tries to restore the displaced position (Sinnot 1952; Sjostrom, 1981). Reaction wood is usually formed on the upper side of inclined or crooked trunks and branches of angiosperms and on lower side of gymnosperms, designated as tension wood and compression wood respectively (Wardrop, 1964; Westing 1968; Scurfield, 1973). However, the formation of tension wood has also been reported on the lower side of inclined stems and branches (Wardrop 1964; Kucera and Philipson, 1977) as well as in upright trunks and branches (Kaeiser, 1955; Wardrop 1956, 1964; Hughes, 1965; Scurfield 1973; Fahn, 1982; Patel *et al*; 1984). Occurrence of tension wood has also been reported in underground and areal roots and buttresses (Patel, 1964; Zimmermann *et al*., 1968; Fisher, 1982). The degree of modification of wood anatomy involved in tension wood is extremely variable between different species as well as within indivdual plants (Cote and Day, 1965) and its formation is more prevalent in those families where the wood is less specialised (Necesany, 1958; Hoster and Leise, 1966) Natural defects of wood like abnormalities are brought about by growth irregularities and environmental conditions and hence tension wood formation in broad-leaved trees is one of such serious defects (Tsoumis, 1968; Isenberg, 1963):

Formation of tension wood is a common phenomenon in the rubber tree, *Hevea brasiliensis*, and detailed information on its structure, properties and practical implications is still obscure. The present paper is a compilation of available informations on various aspects of tension wood in broad-leaved trees and also tries to analyse the status of tension wood in *Hevea*.

Factors affecting tension wood formation

Tension wood formation in stems and branches of hardwoods is considered as a developmental response which maintains the reoriented or bent axis in its new position (Casperson 1960, 1961). It has an active part in normal architectural development of a tree (Fisher and Stevenson 1981). Extensive work has been done to prove that mechanical stress response is the actual cause of tension wood formation (Metzger, 1908; Munch, 1938; Sinnot, 1952; Scurfield and wardrop, 1962; Reich and Ching' 1970). Jaccard (1919, 1938), Onaka (1949), Hartmann (1949) and Robards (1965, 1966) maintained that gravitational response of the tree is the major cause of tension wood formation. Boyd (1977) suggested that an initial internal strain may be the active inductive mechanism operative in tension wood formation. Tomlinson (1978) and Fisher and Stevenson (1981) opined that the angle of inclination of stems and branches is the prime cause of tension wood formation. The uneven distribution of auxin or an upset in the auxin balance in stems and branches while leaning have also been assumed as the causative factor of tension wood formation (Necesany, 1958; Cronshaw and Morey, 1965;

Leach and Wareing, 1967; Robnett and Morey, 1973; Kennedy and Farrar (1965). Moreyo and Cronshaw (1968) and Reghu (1983) studied the possibility of artificial induction and inhibition of tension wood in various hardwoods and concluded that exogeneous application of indol-3-acetic acid (IAA) and morphactin inhibits tension wood formation whereas the application of 2, 3, 5-triiodobenzoic acid (TIBA) induced its formation. Formation of tension wood has also been attributed to fast growth. Both the amount of tension wood and the speed of movement of leaning trees towards their vertical position were reported to depend on vigour of growth (Tsoumis, 1952; Westing, 1965). It has also been proved that a displacement as small as 2° and as short as a period of 24 hrs or less have produced this abnormal tissue (Casperson, 1960; Kennedy and Farrar, 1965; Westing, 1965). The mechanism of tension wood formation is tricky and complex and cannot be linked with a single factor.

Physical properties

Generally tension wood differs from normal wood in many physical properties. The surface of a freshly sawn lumber containing tension wood displays a 'wooly' or lustrous appearance whereas the dried and finished surface gives a silvery appearance being more reflective than the adjacent normal wood (Cote and Day 1965). The specific gravity of tension wood is greater than that of normal wood (Panshin and de Zeeuw, 1970). Jane (1956) and Arganbright *et al* (1970) reported that the longitudinal shrinkage of tension wood is greater than that of normal hard wood. The high moisture content in tension wood in green sawn condition makes it more weaker than normal wood (Marra, 1942; Ponshin and de Zeeuw; 1970). High tensile strength and occurrence of slip planes and compression failures in tension wood fibres create serious seasoning defects like warping, tearing, buckling and collapse of lumber (Dadswell, 1958; Patel, 1964; Cote and Day, 1965; Trenard and Gueneau 1975) Tsoumis (1968) opined that the strength of tension wood is higher, comparable or lower than normal wood depending on the type of loading. While sawing, the saws become pinched and overheated and the surfaces sawn longittudinally develop wooliness or fuzziness which in turn seriously affect the proper finishing of end products (Dadswell and Wardrop, 1949; Wardrop and Dadswell, 1955).

Pulping properties

Tension wood in general is a useful raw material for pulp and paper industry due to its high cellulose content. It yields greater amount of chemical pulp than normal wood. However, the strength of paper produced from pulp of tension wood is inferior to that made from normal wood pulp (panish and de Zeeuw, 1970). In chemical pulping, however, tension wood causes difficulties in cooking and beating although the quantity of pulp is high (Jayme and Steinhaustar, 1953). Dadswelly and Wardrop (1960) reported that tension wood is less objectionable in mechanical pulping because of its lesser lignification which makes grinding easier.

Anatomy

Anatomically tension wood differs from normal wood in many respects, most of the differences being mainly associated with fibres. Wood fibres are structurally specialised in tension wood and are usually termed as gelatinous fibres (G-fibres). Some layers of the secondary wall of these fibres are replaced by unlignified or partially lignified translucent gelatinuous layer. The G-layer is variable in thickness and normally replaces the S3 layer of the secondary wall. Nonetheless, it may also replace the S2 layer or get incorporated with the S3 layer (Scurfield and Wardrop. 1963: Scurfield, 1973). Hence, three types of G-layer formation is possible in tension wood fibres,

1) P+S1+S2+S3+G or SG
2) P+S1+S2+G or SG
3) P+S1+G or SG,

where P is primary wall and S1, S2 and S3 are secondary walls. Some times the G-layer may be partially or completely detached from the adjacent wall and convoluted with undulating inner boundaries. Due to continued thickening of the G-layer, the entire lumen of these fibres may get filled. Optical, X-ray diffraction and electron microscopic studies reveal that the microfibrils are oriented parallel to the long axis at around 5° (Wardrop and Dadswell, 1955; Robards, 1967; Mia, 1967, 1978; Bentum *et al.*, 1969; Cote, 1977).

Reduction in the number and size of vessels and volume occupied by them was observed in tension wood as compared to those in normal wood (Chow 1946;

Onaka, 1949; Kaeiser and Boyce, 1965; Cote *et al*, 1969). An increase or decrease of fibre length, decrease in the amount and size of axial parenchyma and variation in morphology, distribution and dimension of rays etc., have also been reported in tension wood (Hillis *et al.*, 1962; Hoster, 1972; Kucera and Necesany, 1970; Reghu *et al.*, 1982; Jayan Mohan Rao *et al*, 1982)

Chemical properties

The G-layer of tension wood fibres is composed of highly crystalline cellulose moicrofibrils, virtually free from lignin depostion. The cellulose content varies from species to species and may range from 40% to 98.5% (Norberg and Meier, 1966; Cote, *et al.*, 1969; Timell, 1969 Wilson, 1981). Non-cellulosic polysacchasides have also been reported in G-layer (Mia 1967, 1968).

Occurrence of reduced starch reserves, hemicellulose, xylose, mannose, pentosan (Jayme, 1951; Timell, 1969; Meier, 1962; Chow, 1946; Wardrop and Dadswell, 1948; Reghu and Patel, 1984) and increase in the amount of cellulose, galactan, phenolics, ethylene and ash content (Norber and Meier, 1966; Furuya *et al.* 1970; Scurfield, 1972; Cote 1977; Gustafsson *et al.*, 1952; Scurfield, 1973 Hillis 1977) have been reported in tension wood. Scurfield (1972) further proved that the secondary gelatinuous layer of tension wood fibres is histochemically heterogeneous. In the structural and histochemical studies of tension wood in *Azadirachta indica*, *Mangifera indica* and *polyalthia longifolia*. Reghu (1983) concluded that major fractions of photosynthates required for the synthesis of lignin may be diverted to the synthesis of cellulose needed for G-layer formation.

Tension wood in Hevea brasiliensis.

Tisseverasinghe (1970) and Panikkar (1971) reported the occurrence of tension wood in the rubber tree (*Hevea brasiliensis*) Fisher and Stevenson (1981) demonstrated 18 architectural models in broad-leaved trees with respect to the orientation of trunk and branch axes caused by tension wood formation and placed *Hevea* under Rauh's model of tree architecture. He further pointed out that orientation of axes takes place due to angle of lean with respect to gravity resulting in to the initiation of tension wood formation first on the lower side of leaned axes and its formation is correlated with the angle of inclination.

As in the case of many other hardwood species, occurrence of tension wood in *Hevea* alsa is associated with growth eccentricity. The tension wood is usually the compact type with distinct band like or shaped arcs termed as 'tension arcs'. In certain cases tension wood is also found formed around the pith (Reghu *et al.*, 1989). Vijendra Rao *et al.* (1983) reported a higher amount of tension wood in the early wood than the late wood regions. In fact the growth rings are indistinct or illdefined in *Hevea*, but the formation of tension wood in the form of concentric rings displays a ring like appearance.

Tension wood is characterised by the development of well defined gelatinous fibres and the G-layer gets incorporated into the S3 layer of gelatinous fibres (Vijendra Rao *et al.* 1983). Hence, the fibre wall in the gelatinous fibres of *Hevea* is formed of P+S1+S2+S3 (G). The G-layer is unlignified and usually convoluted. It also shows a tendency to curl and come out by partial or total detachment from the adjacent walls towards the cutting edge during microtomy.

The proportion of tension wood shows tree to tree variation and it also varies due to height positions of the tree (Vijendra Rao *et al.* 1983) and the proportion vary from 15% to 65% in the same plank (Sharma and Kukreti, 1981). Studies on clone PB 86 indicated that the proportion of tension wood increased from base to top of the tree trunk with a maximum percentage (36%) at 360 cm height from the bud union. The percentage of tension wood at 210 cm height level was found to range from 29-33% whereas at 60 cm the range was only 8-11.5% (Reghu *et al.* 1989). Studies on the dimensional variation of normal and tension wood fibres in the same clone revealed that at all height levels the tension wood fibres were shorter and broader than normal wood fibres and the difference in length and width between them was significant.

A preliminary investigation was made for understanding the proportion of tension wood in seedling trees and budded trees. It was found that the area occupied by tension wood and their percentage were greater in seedling trees compared to that of the corresponding budded trees at all height levels.

Problems caused by tension wood in Hevea

The survey on the technical facilities available with and the problems contronted by various rubber wood consuming units situated in Kerala (Viju Ipe et all 1987) revealed that tension wood creates a variety of wood working problems during sawing, plaining, machining and finishing of end products with rubber.

In the manufacture of packing case, on sawing rubber wood the gelatinous fibres often came out and stuck to the saw blade preventing its free movement. On plaining the planks, tension wood fibres made the surface rough and fuzzy. Problems caused by tension wood are very severe in the case of match industry. The veneers peeled from tension wood zones are very rough and hence, while folding the gelatinous fibres project out creating problems during paper pasting. Severe warping and twisting of the outer and inner veneers will prevent free movement of the inner veneer of the match in which the splints are placed. Distortion of splints due to warping is another problem affecting this industry seriously.

In this context it may be recalled that tension wood has really been a 'woody' problem for wood biologists and perhaps the present knowledge about it is a collection of fragmentary information which needs reinvestigation, rethinking and co-ordinated review. This is mainly due to the heterogeneous nature of the wood and wood elements, which have different orientation, architecture, chemical composition and physical properties. It has been found that tension wood is largely unavoidable in steep slopes (Kienholz, 1930). This natural defect in wood may be reduced to certain extent through application of silvicultural measures that protect trees from becoming displayed from vertical. Such measures include proper spacing of plantation, establishment of wind barriers and timely thinning to proper stand for proper growth and development. Only a thorough understanding of the various causes, effects and practical problems could indicate any solution in ultimately minimising the extent of loss due to tension wood in the final recovery of end products.

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(*Contd. on page 28*)

Physical and Mechanical Properties of *Hevea Brasiliensis* (Rubber Wood) - A Review

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Introduction

Hevea brasiliensis (rubber wood) is one of the important timbers among the secondary species. It has been raised in large scale plantations in many parts of the country, specially in South India, mainly for latex. When tapping for latex is no longer economical i. e. approximately 30 years after planting the trees are felled to make room for replanting. It is estimated that about 80,000 cu. m. round wood is available presently from spent rubber trees annually and the availability is likely to increase with the increase in the planted area. Among the states, Kerala accounts for maximum cultivated area. India is the 5th largest producer of rubber after Malaysia, Indonesia, Thailand and China with a share of only 4.7% of world production (Rapa Monograph 1985/8).

Utilisation of rubber wood

Rubber wood has been hitherto used mainly as fuel wood has captured the place of good scrapwood and has become a potential foreign exchange earner. It was used in wood working in the middle of 1970 as a substitute (Nielson 1980) for light coloured domestic wood ware and subsequently for furniture. Owing to its low shrinkage, good dimensional stability, attractive colour (Chew 1982, HO. and Choo 1982 and Lew, Sim 1982), the wood is preferred in Malaysia for furniture and also as an alternative species in the mass production of knock-down furniture. Operational trials carried out at Sri Lanka (Rajkouic 1974) with the assistance from Czechoslovakia have shown that it is a commercially promising wood for manufaturing of particle boards. It has potential as cellulosic material (F. R. I. Report 1980) and inferior quality paper can be made from rubber wood Pulp. It has a very good gluing property. A comparative study was made on the gluing property of rubber wood with mengkulang, Kapur and Keruing species. Wood specimens were planed and laminated (glued in Pairs face to face) with U. F. or PF/RF adhesive under pressure. Under vacuum pressure tests of water resistance, delamination was low and shear strength of laminates was highest compared to other three species (Mohd. Shukuvi et. al 1987).

Locally it has been reported that, it can be used for Packing cases, compressed wood, low cost furniture and cabinet making (after proper seasoning) crates, block board, cores, chipboard, fibre board, bobbins, shuttles, foot wear, match splints etc. (Sharma and Kukmeti 1981, Sanyal and Dongwal 1983 and Shukla and Lal 1985).

Strength Properties

The strength properties of rubber wood from 5 logs 22 year old tree were evaluted (Shukla and Lal 1985). This log was obtained from Quilon, Kerala state in green and air dry condition according to the results obtained, the species was classified as heavy,' weak, moderately hard and easy to work and take polish satisfactorily. Similar types of studies were also carried out (Sanyal and Dongwal 1983) in Kiln dry condition on rubber wood procured from Kottayam, Kerala State and recommended for various end uses.

The seasoning behaviour of plantation grown rubber wood from Kottayam, Kerala, has been studied (Sharma and Kukreti 1981). Only a tentative schedule V has been formulated according to I. S. 1141-1973. Schedule V was recommended for kiln drying of 288 mm thick planks and for 63×105 mm scantlings, the same scuedule was employed by increasing relative humidity by 7% and giving initial steaming for 2 hours at 45°C and 100% R. H. and final steaming for 3 hours at 55,C and 100% R. H. The authors report that this study was not conclusive and need to reconfirmed as regards propensity of timber species to surface crack on the faces sawn from the outer most portions of logs, as timber initially free from surface cracks on these faces could not be ensured for tests.

Conclusion

Based on the informarion on physical and mechanical properties and various end uses carried out by earlier workers, it is felt that the studies on the following lines need to be under taken to have a complete knowledge on the optimum utilisation of rubber wood.

1. Full scale testing of rubbbr wood for its physical and mechanical properties in green and air-dry condition to know the behaviour of the species for its beatter utilisation and as the material was procured from the same leoality there is a need to evaluate the physical and mechanical properties from other places i.e. variation of properties in relation to (1) ecological and soil condition, (ii) height and (iii) age. (*Contd. on Page 30*)

(*Contd. from page 26*)

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NEWS AND NOTES

Rubber Seminar organised by Association of Planters of Kerala

The Association of Planters of Kerala, the foremost fraternity of its kind in India celebrated its golden golden jubilee on 29 the and 30th December 1989 at Trivandrum. As part of the celebrations, a rubber Seminar was also organised.

The Seminar discussed among other things the proper method of transfering the new technology to the nearby small rubber growers also in a bid to improve the production and productivity of their holdings. To prepare a forum for this, delegates from 70 selected Rubber Producers' Societies had also been invited as special invitees. Thus the venue of the seminar became a common ground for both large and small growers. No such meeting had been held earlier in Kerala as the one arranged by APK with the active participation of both estate as well as small hodling sectors.

Shri PC Cyriac, Chairman, Rubber Board inaugurated the seminar. Shri E. B. Unni presided. Dr. M. R. Sethuraj and Shri P. Mukundan Menon presented their papers. The paper entitled 'Scientific aspects of planting material selection' by Dr. Sethuraj concluded with a call for more breeding efforts that concentrated on generation of location specific clones, clones tolerant to different diseases etc. The paper presented by Shri Menon analysed the various measures to be adopted to render service to the planting community as a whole. Several experienced persons belonging to the managerial cadre of various plantations presented their follow-up papers. The discussions that followed could find out solutions to number of technical problems. The meeting proved to be a creative exercise for interaction between small and large rubber growers. □

(*Contd. from page 28*)

2. Since there is a demand for heavy packing cases earlier workers have recommended the wood for packing cases, the wood can be tried for heavy packing cases after preservative treatment, as rubber wood in untreated condition is not suitable and it is easily attacked by termites, fungi and consequent rotting. The timber can be tried for constructional purpose after proper seasoning and preservative treatment. It can be tried in handicrafts industry and as a decorative veneer since the grains stand out after treatment with NaPcP, boric acid and mercuric chloride.

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Rubber output may touch 3 lakh tonnes

Sri P. C. Cyriac, Chairman, Rubber Board has stated in Kottayam recently that the output of natural rubber during 1989/90 may touch an all-time high of 3 lakh tonnes, surpassing the earlier estimate of 292,000 tonnes for the year. Improved production during the first quarter of 1990 consequent on receipt of sporadic rains in the rubber growing areas was the reason for this surprising jump in the quantum of production. He pointed out that NR consumption would also go up slightly to 342,000 tonnes during the year against 340,000 tonnes originally estimated. The production during 1990/91 is expected to touch 3.3 lakh tonnes.

RUBBER BOARD BULLETIN

Vol. 25 Number 3 Jan - March, 1990

Chairman
(Mrs.) J. Lalithambika I. A. S.

Rubber Production Commissioner
P. Mukundan Menon

Director of Research
Dr. M. R. Sethuraj

Project Officer
C. M. George

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Cover:

Natural rubber is defined as nature's most versatile vegetable product. The tree which yields rubber latex is both a 'Kalpavriksha' and 'Kamadhenu'. Every part of this tree is usable tomankind. It yields honey, oil, oilcake and timber besides latex. To those who grow rubber it is a 'KALPA DHENU'.

The cover picture is the conceptualisation of these virtues of the rubber tree by the artist.

Design : 2 CREATIVE MINDS.

THE QUARTER

Rubber is traditionally cultivated on both sides of the equator between 8° and 10° latitudes. The main rubber producing countries that lie within this region are Malaysia, Indonesia, Thailand and the traditional rubber growing areas in India. Agro climatic conditions are quite favourable for rubber in these belts.

Consumption of rubber in India goes on increasing every year. This is an eloquent pointer for added efforts to improve production. We are now importing rubber to meet our increasing domestic consumption. There is hardly any scope for further expansion of rubber cultivation in traditional areas due to non-availability of land.. Having been aware of the limitations, the Board has spared no efforts in identifying new areas in non-traditional regions for rubber cultivation. Though not totally ideal, rubber can be profitably cultivated in many parts of the country as this crop can withstand unfavourable climatic variations to a certain extent. The non-traditional areas have been divided into 3 regions viz. North Eastern, Eastern and Western regions.

Considering the immense potential for expansion in North Eastern region, many schemes have been drawn up for extension of rubber cultivation. North Eastern region consists of 7 States namely Assam, Meghalaya, Arunachal Pradesh, Nagaland, Manipur, Mizoram and Tripura. Rubber cultivation which started 30 years ago on an experimental basis in different parts of Assam has proved to be successful. The exploratory surveys undertaken in the north-east identified Tripura, Assam, Manipur, Mizoram, Nagaland and parts of Meghalaya as suitable for rubber cultivation. The respective State Governments have also come up with enthusiasm to plant rubber. In Tripura and Assam separate state owned plantation corporations have been organised to undertake large scale rubber plantation. About 4.5 lakh hectares of land has been identified as suitable for rubber cultivation in this zone.

With the aim of bringing faster development on a massive scale the Board has established a Zonal Office in Guwahati and opened 7 Regional Offices in the North Eastern region.

The Eastern region consists of Northern Bengal, Orissa and certain parts of Madhya Pradesh and Andhra Pradesh. It is estimated that this region may offer about 6 lakh hectares of land suitable for rubber.

Another suitable belt for rubber cultivation is Western region, consisting of the long stretches of Konkan extending from Goa to the Northern part of Maharashtra on the Western side of the western Ghats. Though Konkan faces a long spell of drought period, Goa is quite suited and rubber has extensively come up in this State.

It is hoped that these new zones will substantially contribute to the production of natural rubber in India.

SEMINAR ON "MODERN TRENDS AND GROWTH OPPORTUNITIES IN RUBBER INDUSTRY"

SEMINAR ORGANIZERS

A seminar on "Modern trends and growth opportunities in Rubber Industry" jointly organised by All India Rubber Industries Association, Small Industries Service Institute (Bombay) and Indian Rubber Institute (Bombay Branch) will be held on 31st August and Ist September 1990, at New Centaur Hotel, Juhu, Bombay.

PURPOSE OF SEMINAR

In order to highlight the potentials and prospects of the non-tyre sector, and, in particular, the small scale units, as also to identify the modern trends in technology required to be adopted and the problems required to be eliminated to help these units in realising the significant contribution that the small scale sector can make to the national economy, the Western Region of All India Rubber Industries Association, Small Industries Service Institute, Bombay and Indian Rubber Institute, Bombay Branch, have jointly organised this seminar.

APPROACH

At the seminar, endeavours would be made to tackle the twin aspects, concerned with the non-tyre sector and the small scale units. On the one hand assessment would be made to find the technology gap and how to update it to keep pace with the development taking place world-over and on the other hand the commercial aspects including marketing, financial assistance, procedural difficulties, exports etc, will be deliberated so that problems of technology as also commercial difficulties in day today operation, are identified and measures suggested to the Government for providing overall solution to help the industry maintain and accelerate its growth. The seminar would also bring into focus the vital information for the benefit of the concerned departments and institutions so that they can extend required and adequate help to the industry to achieve the goal.

SPEAKERS

For the seminar the organisers have selected eminent rubber technologists and experts from the financial and other Government institutions, who would be making presentation of papers on subjects of vital interest to the non-tyre sector. This prestigious gathering will provide a rare opportunity to interact, share and exchange views and opinions, besides valuable fellowship with the cross-section of the rubber industry and trade.

ORGANIZERS

The organizers of the seminar are the Western Region, All India Rubber Industries Association, the apex body representing the entire rubber goods manufacturing industry in India, the Small Industries Service Institute, Bombay, looking after the interests of the small scale industries under the Union Ministry of Industry and the Indian Rubber Institute, Bombay Branch, engaged in training personnel for the rubber industry. The joint efforts of all these organizers would bring in delegates from the rubber industry and trade connected with it, the consumers of rubber goods, the education institutions and organisation as also from the Government to jointly consider and assess the situation for planned development of the rubber industry, the non-tyre sector, and in particular, the small scale units.

The seminar will be inaugurated by Shri Srikanta Jena, Minister of State for Small Scale, Agro and Rural Industry, Ministry of Industry, Government of India, New Delhi.The organizers, AIRIA-SISI-IRI invite all those who are concerned with the industry, directly or indirectly, to take an active interest in the forthcoming seminar and participate in its deliberations as effectively as possible.

SPONSORSHIP

Individual or organisation may sponsor any of the major seminar activity/item as part of their business promotion. The following activities/items of the seminar are available for sponsorship : luncheons for two days, tea/coffee for two days - morning/evening and seminar document bags etc. The sponsorships will be duly acknowledged and publicised during the seminar in a suitable manner. Each sponsor will be entitled to nominate one delegate to the seminar.Participants coming from outside Bombay will be required to make their own arrangement for their stay in Bombay. However, if they need any assistance from the AIRIA, the Association shall be pleased to extend the same to them.

For further enquiries contact : The Secretary General, All India Rubber Industries Association, 3/8, Navjivan Society, Lamington Road, Bombay - 400 008 (Phone : 395032/892174)

(Continued on P - 4)

PROSPECTS BRIGHTER FOR NATURAL RUBBER

Rubber has its due contribution in the economic progress of the country. From the very beginning of its cultivation during the early part of this century Rubber has consistently played its imperative role in the economic and industrial growth of the country. The beginning of the century witnessed the hard work put in by the early pioneers. Small holders appeared only later. The Indian Rubber Board came into being in 1947 by an Act of Parliament as a corporate body to look after the rubber industry. To undertake scientific, technological and economic research, the Board set up the Rubber Research Institute of India in 1955.

The research activities made significant contributions to the rubber plantation industry with sustained research and development activities coupled with extension and advisory services for transfer of new technology to the field, the rubber producing sector had a quick change over from the traditional methods to modern cultivation practices.

India evolved the high yielding clone RRII 105 with yield potential of about 2500 kg per hectare. The various steps taken by the research as well as developmental activities enhanced rubber production from a meagre 15,000 tonnes at the time of independence to nearly 300,000 tonnes in 89/90. Productivity in terms of yield per hectare increased from 300 kg to 1000 kg during the same period.

India has now become the fourth largest natural rubber producer in the world followed by Malaysia, Indonesia and Thailand.

Performance during 1989-90

Natural rubber industry performed well during 1989-90. The production increased from 259,172 tonnes in 88/89 to 297,300 tonnes in 1989/90 registering nearly 14.7% growth. The growth in consumption was impressive at 341,840 tonnes in 1989/90 compared to 313,830 tonnes in the previous year. In order to meet the gap between demand and supply, 44,871 tonnes of natural rubber was imported of which 17,896 tonnes was under the export incentive scheme.

World production

The world production of natural rubber during 1989 increased by 2.4% over 1988 to reach a record level of 5.16 million tonnes. However, there was a drop in production in the world's largest producer - Malaysia by 12.3 % or 240,000 tonnes. Bulk of the decline was counterbalanced by the rise in production in Thailand upto 22.4% or 220,000 tonnes.

Production of Indonesia improved by 2 %. World consumption of natural rubber during 1989 grew by 4.4 per cent to 5.34 million tonnes.

Rubber price : International Scene

International price of rubber showed a downward trend in 1989. In Kuala Lumpur market average price in January 1989 was 290.6 Malaysia Ringgits which gradually declined to 214.0 Ringgits in December 1989. The average price for the whole year 1989 was 247.7 Ringgits as against 301.2 in 1988.

The International Natural Rubber Agreement (INRA) 1987 which was negotiated under the aegis of UNCTAD came into force provisionally on 29th December 1988. The agreeemnt subsequently came into force definitively in April 1989 when the necessary requirements relating to the ratification were fulfilled. During the first session of INRA in April, the reference price under the buffer stocking scheme was revised upwards to 218.1 Malaysian/ Singapore cents. As a result the 'may sell' and 'must sell' levels were increased to 251 and 262 cents respectively, while the 'may buy' and 'must buy' levels to 185 and 174 cents respectively.

Although during the third quarter of 1989 the moving average of the Daily Market Indicator Price went below the 'may buy' lelvel for a short period, there was not market intervention by the INRO. The INRO entered the market in February 1990 and during February and March 1990 it is reported to have purchased about 20,000 tonnes from the various markets.

ABOUT THE ORGANIZERS

(Continued from P - 2)

ALL INDIA RUBBER INDUSTRIES ASSOCIATION

The All India Rubber Industries Association is a non-profit making body, representing large, medium and small scale rubber units in India. It serves the rubber industry and trade with the objective of safeguarding and promoting its interest. The Association was founded on 14th April, 1945 and was registered as a Company in 1951. In 1972 it changed its name to all India Rubber Industries Association-AIRIA. In 1982 the Association was imparted federal structure. At present, besides Head Office and Registered Office at Bombay, it has four regional offices at Delhi, Madras, Calcutta and Bombay. According to rubber consumption, the Association represents more than 85% rubber consuming industry in the country having over 800 members. The Western Regional Office of the Association is situated in Bombay. It has about 368 members in different classes of membership. The aims and objectives of the AIRIA interalia include : to promote and protect the interest, growth and development of the rubber industry, to foster co-operation among individuals and units engaged in the manufacture of rubber goods, to investigate, collect and circulate information and statistics relating to the industry, to represent officially to the Government the views of the industry on all matters, affecting or likely to affect the industry and to help the members in solving the difficulties faced in procuring raw-materials. The Association from time to time brings out publications for dissemination of technical and commercial information, as also publishes a monthly magazine RUBBER INDIA. In the field of education in rubber technology, efforts have been initiated by establishing AIRIA Education Trust and the Association is closely working with ITI Ambernath in the Western Region.

SMALL INDUSTRIES SERVICE INSTITUTE

The Small Industries Development Organisation (SIDO) acts as a policy formulating agency, co-ordinating and monitoring the growth and development of small scale industries at the national level. It provides wide range of extension services through field agency, viz Small Industries Service Institute, with its attached branch institutes and extension centres, located all over the country small industries service institute, Bombay with its branch at Aurangabad and the two extension centers at Pune and Kolhapur, have been rendering extension services in various fields depending on the facilites available with these agencies in Maharashtra. By and large the main services provided to the entrepreneurs both existing and prospective include : technical consultancy services, guidance on selection of machinery, raw-materials and their availability, process of manufacturing, method of testing, guidance of designing, provision of guidelines for modernisation of existing workshop etc. Besides technical assistance. common facility services are provided through workshops attached to SISI, Bombay. For meeting the skills of workers and supervisory staff engaged in the small scale sector, technical training is given in various fields. Economic information services rendered by this institute include survey of a given area to identify the scope for new industries based on localresources, demand etc. Export worthy units of small scale sectors are identified and such units are given intensive guidance in various aspects of exports. Various training courses, covering different management aspects are conducted for the benefit of the entrepreneurs. The SISI is making continuous efforts for development of ancillary industry, it initiates programme of modernisation for selected small scale industries, and promotes project profile and scheme etc. There are several schemes including entrepreneurial development, self-employment, studies on sick small scale units etc..

INDIAN RUBBER INSTITUTE

Indian Rubber Institute, a professional society for rubber materials and engineering, was founded in 1987. The Institute is affiliated to the Plastic and Rubber Institute, London, one of the largest organisations in the world. which is devoted exclusively to the interest of the rubber and plastic industries personnel. Until it changed to a National Institute, the Plastic and Rubber Institute (Indian Section) as it was then called, had served the rubber industry for over 42 years accrediting over 300 rubber technologists with international degrees and diplomas of the plastic and rubber institute, London. Membership of the Indian Rubber Institute is open to all rubber industry personnel. IRI, by maintaining links with the PRI, UK is developing its own modular course to suit the training of the technologists and engineers to various levels. The total membership of the Indian Rubber Institute exceeds 1500. The main objectives of the Indian Rubber Institute are to develop a professional body of those engaged with the science and technology of the rubber and to advance standard and methods of education in this field. The IRI has its Head Quarters at Calcutta, with branches at Bombay, Delhi and Madras. The Bombay Branch of IRI is very active and has over 350 members.

NECTAR AND POLLEN PLANTS FOR EXTENDING THE FLOW PERIOD IN RUBBER-GROWING

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(Reprinted from 'BEE WORLD', a journal of the International Bee Research Association)

Availability of perennial sources of nectar and pollen is the most important limiting factor in the survival, abundance and distribution of honeybees especially during the prolonged dearth period in apiaries based on rubber plantations. It is in this context that an attempt was made to assess the pollen and nectar potential of four bee forage plants in and around the rubber plantations of the Rubber Research Institute of India (RRII) at Kerala that were successfully established at RRII and found to provide the best bee forage during the dearth[4] They were: *Antigonon leptopus*, *Callistemon lanceolatus*, *Manihot glaziovii*, *Pongamia glabra*. With the alternative bee forage, and proper bee management, the colony yield from the Indian honeybee *Apis cerana indica* was 19 kg honey/colony/year. Twenty hives can be well maintained in a rubber plantation having 400 mature trees.

TABLE I. Plants for off-season bee forage in rubber plantations.

	Antigonon leptopus Polygonaccae	*Callistemon lanceolatus* Myrtacae	*Manihot glaziovii* Euphorbiaceae	*Pongamia glabra* Leguminosae
Propagation	vegetative and generative	generative but commonly vegetative (air-layering)	vegetative and generative (stem-cuttings)	generative
No.years to maturity as bee forage	1.5 to 2	3	1	4 to 5
Flowering period*	1 to 12	1 to 12	4 to 11	4 to 6
Peak of flowering*	7 to 9	9 to 10	9 to mid-11	5 to 6
Pollen/nectar ratings**	P_1N_1	P_3N_1	P_1N_2	N_1

* 1 - 12 refer to the months January - December
** 1 = major, 2 = medium and 3 = minor source

The honey flow from rubber (*Hevea brasiliensis*) lasts from January to March and the honey yield accounts for approximately 30% of India's total honey production. Jayarathnam[3] and Suryanarayana6 emphasized the importance of *H. brasiliensis* as a nectar source. Honeybees collect large quantities from the extrafloral nectaries at the tip of the petiole where the leaflets join. The dearth period however lasts from April to December.

Our studies show a synchrony in the activities of bees reared at the RRII Farm and the flowering periods of the newly introduced alternative bee forage plants in various seasons of the year (Table 1). Earlier observations indicated that *A. cerana indica* bees visited more than 60 plant specieis for nectar and pollen in and around the

RRII, of which *Manihot glaziovii*, *Cocos nucifera*, *Manihot esculenta*, *Bauhinia* spp. and *Rosa* spp.,were potential sources of pollen, and *Antigonon leptopus*,

Eucalyptus spp., *Callistemon lanceolatus*, *Pongamia glabra* and

Tamarindus indica were sources of nectar.

Antigonon leptopus, coral vine, is highly attractive to bees as a source of pollen and nectar in India[2-5]. It is a robust vine raised both by vegetative propagation and by seed. Its bright coral-pink racemes arising from the axils of leaves make it highly attractive as an ornamental plant. Some varieties have pure white flowers. Plants grow very fast and flowering begins in the second year after planting; it flowers then almost continously.

Bottle brush, *Callistemon lanceolatus*, has been recorded as an important nectar source in Punjab[1]. It is a small tree with erect or spreading branches, usually propagated by air-layering, and reaches about 2-4 m in height within three years. It grows very well in tropical conditions and flowering beings three years after planting. Its inflorescences have attractive bright red flowers.

Ceara rubber, *Manihot glaziovii*, also grows very fast, and starts flowering a year after propagating by vegetative means. In Kerala State it usually flowers from April to November, but variations are occasionally noted according to variety and agro-ecological regime. This plant is a major producer of pollen and a minor source of nectar.

Pongamia glabra is a tall erect tree with several branches and glabrous leaves. Flowers are borne on simple peduncled axillary racemes nearly as long as the leaves. In India it is a major producer of nectars. The short gaps in flowering that occur after the rubber honey flow (January-March) could be supplemented to a great extent by other *Pongamia* species.

Acknolwdgements

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RUBBER SCALES NEW HEIGHTS

During the 7th Five Year Plan the Rubber Plantation Industry has scaled new heights in accomplishments. Against the area of 40,000 hectares targetted for new and replanting in 5 years of the 7th Plan, the actual area planted is 70,000 hectares registering a 175% increase. The actual production of rubber realised during the plan period is 2,97,000 tonnes against the targetted figure of 2,65,000 tonnes. In respect of the financial target also there has been significant achievement. The initial outlay for the 7th Plan for rubber was only Rs 53 crores. As against this, the actual amount spent is Rs. 74 crores. This was made possible by diverting funds from the unspent reserves of other agencies under the Union Commerce Ministry. These gains are hailed as all time high records.

Performance of the Rubber Industry during the decade 1980-1990 has also touched new heights. Rubber production which was only 1,53,000 tonnes in 1980 shot up to 2,97,000 tonnes in 1990 - a 94% increase. So also the area under rubber rose from 2,78,000 hectares to 4,30,000 hectares in 10 years - a 55 % rise. Consumption of rubber registered a 98% increase from 1,73,000 tonnes in 1980 to 3,42,000 in 1990. Per hectare yield per year which was only 788 kgs in 1980 got up to over 1000 kgs in 1990. Also per capita consumption rose to 0.5 kg per year in 1990 from 0.33 kg in 1980. Natural rubber prices also registered an increase of 72% from Rs 12.42 per kg to Rs. 21.31 during the decade.

These accomplishments are rated as unique and unmatched.

SCIENTIFIC ASPECTS OF PLANTING MATERIAL

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The pedigree of all the rubber trees in the plantations in South-East Asia can be traced to 22 plants which ultimately survived from the Wickham collections. This indicates the extremely narrow genetic base we have. The outstanding success achieved in plant improvement in *Hevea* from a base yield about 250 kg/ha obtained from the seedling population directly derived from wickham collections to about 2500 kg/ha obtainable from the hybrids derived through breeding can be considered as unique. Two factors which resulted in this outstanding success were standardisation of an easy vegetative multiplication system and identification of wide variability in yield potential among the seed population.

Classification of clones

The progeny produced through generative methods always shows wide variations and there is no genetic uniformity among the trees raised from seeds. Seeds obtained from seedling trees are called ordinary seeds. Ordinary seeds collected indiscriminately are termed ordinary unselected seeds and those collected from selected trees are named ordinary selected seeds. Clonal seeds are those collected from budgrafted populations. Such seeds from monoclonal areas are called monoclonal seeds whereas when such collections are made from polyclonal areas the seeds are described as polyclonal seeds. When both the parents are known, the term legitimate seed is used whereas when the parents are not known the seeds are described as illegitimate. A group of plants produced by vegetative propagation from a single tree, directly or indirectly, is termed a clone. All the individual trees of a clone possess identical genetic constitution. Based on the origin, clones are classified into three categories, namely primary, secondary and tertiary. Clones developed from mother trees of unknown parentage are called primary clones. These mother trees are selected from existing seedling populations on the basis of their desirable characteristics. It is multiplied vegetatively, eg. Tjir 1, GT 1, Gl 1, PR 107, PB 86, PB 25/59 and LCB 1320. Secondary clones are developed from hybrid trees which are resultant of controlled pollination between two primary clones. These trees are then multiplied vegetatively. Examples of secondary clones are RRII 105 (Tjir 1 x Gl 1), RRIM 600 (Tjir 1 x PB 86), RRII 208 (Mil 3/2 x AVROS 255). Tertiary clones are produced by controlled pollination between two clones, one of which will be a secondary clone. Sometimes both parents will be secondary clones. For example, RRIM 719 (crossed between two secondary clones RRIM 501 x RRIM 623). Other examples are PB 260, RRIM 703, 707, etc.

Tapping Systems

As Hevea is highly heterozygous even controlled pollinations between two clones may result in different genotypes with successive pollinations. In other words, there is no guarantee that by pollinating between the parents of RRII 105 repeatedly, progenies with high yield potential similar to RRII 105 can be successfully derived. As a matter of fact one of the lowest yielding clones which was available at RRII Experiment Station had the same parentage as that of RRII 105. But plant breeders of Hevea have been lucky because once they spot a high yielding F_1 plant, this can be cloned through vegetative multiplication.

Most of the early selections were made based on yield alone. All these early selections made at RRIM, Indonesia, RRII, etc. were based on data collected under 1/2S d/2 system of tapping. But most of these high yielding selections now appear to be highly susceptible to brown bast syndrome when tapped under d/2 system. It may therefore, be necessary that in future breeding programmes selection of clones should be made with at

* Paper presented at the UPASI-APK Rubber Seminar held on 29th December 1989 at Trivandrum.

least two systems of tapping - d/2 and d/3.

A clone selected on a particular enviornment need not necessarily perform satsifactorily under different agro-environments. Rubber tree is very sensitive to both soil moisture deficinecy and atmospheric drought. In Malaysia, there is no period of drought, while the traditional rubber belt in India is subjected to varying periods of drought. In non-traditional areas where attempts are made to extend rubber cultivation, experience prolonged drought period with high summer temperature. Yield of rubber is influenced by the duration of latex flow, which in turn is determined by latex vessel plugging. This process is signfificantly influenced by soil moisture drought. There is marked clonal variations in regard to susceptibility or tolerance to drought. Therefore plant breeders should try to make their experimental selections in areas with prolonged drought to suit the northern part of the traditional areas and the non-traditional areas in India.

Genetic variations

Another aspect to be considered is the genetic variability of the stock material. Even in a monoclonal population, coefficient of variations in regard to yield and growth is as high as 50%. A large part of this variation can be ascribed to genetic variability of stock. In other words, the full potential of the clone can never be realised because of this stock variability. It is here that the tissue culture plants, having its own root system, may prove to be superior. Investigations are under way to examine any possible relationship between brown bast syndrome and genetic variability of root system. If this can be established, then the potential of tissue culture plants as stock material tro prevent brown bast cannot be ruled out.

The microclimate existing in each estate will have its own characteristics and certain clones may prove to be better than others under such a microclimate. This suitability of a particular clone to a particular microregion can be evaluated only at estate level and collection of yield and growth data by each estate can be highly rewarding in selecting suitable clones for that microregion for future planting.

The future breeding efforts should concentrate on generation of location-specific clones, clones tolerant to different diseases, etc. When clones are selected for secondary characteristics (such as disease resistance) some sacrifice will have to be made in the main character, namely yield. Therefore, the management economics assumes importance in the final selection of the most suitable clones for a particular region.

THE STATEWISE DISTRIBUTION OF LICENSED RUBBER GOODS MANUFACTURERS IN INDIA AS ON 31-3-1990

Sl. No.	Name of the State/ Union Territory	No. of Units	Sl. No.	Name of the State/ Union Territory	No. of Units
01	Kerala	767	13.	Rajasthan	65
02	Maharashtra	571	14	Bihar	45
03	Punjab	529	15	Orissa	18
04	West Bengal	482	16.	Pondicherry	17
05	Uttar Pradesh	482	17.	Goa	16
06	Tamil Nadu	476	18.	HP	15
07	Delhi	393	19.	Daman	5
08	Gujarat	305	20.	Assam	4
09	Haryana	235	21,	Jammu & Kashmir	4
10	Karnataka	216	22.	Tripura	4
11	Andhra Pradesh	148	23.	Manipur	1
12	Madhya Pradesh	81	24.	Mizoram	1
			25.	Sikkim	1
				TOTAL	4881

A BRIEF REVIEW OF COMMERCIAL PRESERVATIVES FOR RUBBERWOOD.

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ASCU INDIA LIMITED

There are some choices in protecting and drying rubberwood. The exact method to be used depends upon the rubberwood available, in size and quality. Originally its utility in India, has been restricted mostly to use as firewood but with the development of processing technology the wood is gaining importance as a joinery and furniture timber. Depending upon the cost and availability, it is a good wood for various uses.

The light-straw to light-brown coloured wood has very acceptable machining properities. Its strength being equal to other light hardwoods (Appendix I). It laminates easily and accepts decorative finishes without any grain or density problems. However, due to its susceptibility to insect and fungal attack soon after it is felled, rubber wood has disrepute and this has prevented its widespread use. The timber is most easily treatable and a variety of methods have been developed to treat it, from diffusion of Boron Compounds, dipping and spraying with organic-solvent based chemicals and vacuum pressure methods with various preservatives. The common commercially used preservative treatments for rubberwood are CCA Salts, Antiblu- Antiborer, Solvent based Preservatives and Boric Acid/Borax/Sodium pentachloro phenate solutions.

CCA SALTS

"Copper Chrome Arsenic" has long been a well established method of treating rubberwood in Malaysia (and India), especially for wood in outdoor use. Most effective is to use the full cell (Bethel) process (Table I):-

TABLE-I

Absorption of some light hardwoods treated by the Bethel Vacuum-Pressure Process (Data from Tan, et al 1979)

Timbers	Absorption[a] kg/m.3 of CCA
Rubberwood	500
Light red meranti (Shore leprosula)	192
White meranti (S.talura)	64

a = Treating solution: 3% Tanalith CT 106

Operating Conditions:-

(i) 700 mm Hg. Vacuum for 45 minutes

(ii) 15 kg/m2 pressure for 22/1 hours

(iii) 700 mm Hg.Vacuum for 20 minutes

(Through the courtesy of Rubber Research Institute, Malaysia)

At Ascu India R & D labs, rubberwood at 53% moisture content, 60 mm thick has been treated to retentions of 12.7 kgs/m3, penetration being through and through. Initial vaccuum of 22 Hg. was held for 40 minutes followed by pressure of 2-psi for 11/2 hours. A final vacuum of 18 Hg. was given for 30 minutes.

The ubberwood from Kerala, so treated, was considered to be preserved through and through.

ORGANIC SOLVENT BASED

These are normally composed of a fungicide (i.e. Penta chloro phenol, metallic napthenates, TBTO etc.) with insecticide and its derivatives (dieldrin, lindane etc.) in an organic solvent medium. Earlier, besides prophylactic spraying and brushing of ends, dip treatments were in common commercial use, but due to the difficulty in being able to control the retention and absorption of the preservative, amended vacuum pressure cycles were used. These treatments have definite advantages over water-brone CCA treatments. They cause no dimensional change in the treated wood, do not require redrying upon treatment and the natural colour is retained. Besides

BORON-FLUORIDE-CHROME-ARSENIC (BFCA)

This type of preservative was developed by the Australian Government's department of Sceintific and Industrial Research. Commercial treatments were begun in 1955 and their effectiveness has been confirmed for interior service. They are applied by dip diffusion to green timbers and has been especially popular for the treatment of sawn timber in Papua New Guinea.

BORON COMPOUNDS

These formulations gained prominence after the Second World War and have been combinarion of boric acid and borax made upto a strength of 5%. After the treatment the cylinder is emptied and refilled after a shortwhile with a dilute solution of Sodium penta chloro phenate (2%), applied as a soak.

Boron compounds have advantage as an effective preservative for internal use, due to its economy in process and price, and low mamillian toxicity. It is leachable - wood treated is restricted to interior use only. The ingredient added that has often been in question is Sodium pentachlorophenol. In fact some South Eastern countries have

TABLE -II

CYCLE	TREATMENT	SOLUTION ABSORPTION ($1/m^3$)	INTERNAL STAIN	SURFACE STAIN
Lowry	Water	100	Severe Internal stain	Severe
Lowry	1.5% ANTIBLU 3738+ 0.25% ANTIBORER 3767	92.6	None	1 sample: slight at sticker
APM	1.5% ANTIBLU 3738+ 0.1% ANTIBORER 3767	150.6 165	1 sample:5% stain at core	None
Rueping	1.5% ANTIBLU 3738+ 0.1% ANTIBORER 3767	91.3	1 sample:10% stain at core	None

being toxic even at low concentration and farily permanent due to its low solubility in water. However, due to apprehensions of the mamillian toxicity of active ingredients, and strong representation from various Environmental Protection lobbies, alternative compounds had to be developed.*

generally in use for its fire retardant properties. These preservatives are usually applied by dip diffusion treatments and more recently in a two stage treatment in combination with the Bethel Process.

The timbers are first treated in the full cell process with a severely restricted the use of Sodium Penta chloro phenol following their European counterparts. The Environmental Protection Agency of America has strict guidelines for the use of these chemicals. Over and above this, many of the chlorinated hydrocarbons e.g. Lindane, Dieldrin are being attacked by

* Note: The only unit in India making PCP at Durgapur, has closed down.

APPENDIX - 1

SPECIES	MOISTURE CONTENT			WEIGHT Kg/m³		STATIC BENDING				IMPACT BENDING			COMPR-ESSION PARALLEL TO GRAIN	HARDNESS (JANKA)		SHEAR		CLEAVAGE	
		Nominal Specific Gravity												INDENTING LOAD [N]		SHEAR STRENGTH [N/mm²]		SPLITTING STRENGTH LB/IN. WIDTH	
TABLE 2 Metric Units	(%)			At 50 % Mois. Cont (Kg.)	At 12 % Mois. Cont. (Kg)	Equivalent Fibre Stress at Maximum Load (N/mm²)	Modulus of Elasticity (N/mm²)	Work to Maximum Load (mm N/mm3)	Total work (mm N/mm³)	Max. DROP (M)	TOUGHNESS (In. LB.)	1200 (ft. lb)	Max. Crushing Strength (M/mm²)	On Side graub	On End grain	Plane of Failure Radial	Plane of Failure Tangential	Plane of Failure Radial	Plane of Failure Tangential
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
RUBBERWOOD **(Hevea brasiliensis)** Average of 10 trees																			
Mean	54	0.573		865		62	8200	0.084	0.190	0.74			30.8	3600			9.8		
Std. dev.		0.0209				8.3	1170	0.026	0.096	0.166			4.38	484			1.31		
No. of Tests						51	51	20	20	54			62	55			112		
		62																	
Mean	12.6				654	92	10500	0.110	0.199	0.71			49.0	4800			13.4		
Std. dev.		0.585				12.2	1780	0.030	0.072	0.142			5.47	617			1.75		
No. of Tests		0.0254				62	62	20	20	57			67	66			130		

environtalists too, all resulting in the quest for new and safer active ingredients.

HICKSON'S ANTIBLU/ANTIBORER

The development of the synthetic pyrethroid products, after many tests, have resulted in a highly effective treatment for rubberwood. (Table II)

The modified pressure impregnation cycle takes approximately 11/2 - 3 hours and complete impregnation of fresh sawn rubberwood can be achieved. The cycle is based on a rapid alternation between a vacuum period and pressure period, intervals being extended as the treatment procedure progresses.

The active ingredient Antiblu is Mythlene-Bis-Thio-Cyanate and in Antiborer, Cypermetherin.

It can be made into a water-borne solution for treatment in an oscillating pressure cycle or used with an organic solvent for log spraying as a prophylactic.

KILNING

a) It is preferable to have planks not thicker than 5 cm and frame shutters max.of about 71/2 cm.

b) Timber should preferably be stacked on trolleys, immediately after it is pressure impregnated or dip treated.

c) Timber is strapped to the trolley frame work.

d) Stacking on the trolley is quite similar to normal kiln stacking as suggested by ISI but the drying has to be done very gently (using a heat pump) to get the least number of rejects/warping or cracking etc.

e) Preconditioning and postconditioning of rubberwood is necessaary only if the timber is thick. After the drying cylce is over the kiln stack should be allowed to cool down for atleast 2 days without removing the binding.

CONCLUSION

It has been found that the prophylactic treatment is best applied at the forest floor. The timber can be pressure impregnated even with a moisture content of about 55 to 60%, using CCA salts. The drying of rubberwood is to be conducted very carefully, for which heat pumps are recommended as heat pumps very gently remove water from rubberwood, which other systems normally cannot.

KEY WORDS

CCA, ANTIBLU - ANTIBORER; HEAT PUMPS.

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Monthly average price of RMA 4 grade rubber during 1989-90

The rubber market was buoyant during 1989/90. The monthly average prices of RMA 4 grade rubber is given below.

		Rs. per quintal
1989	April	1858
	May	2020
	June	2284
	July	2538
	August	2509
	September	2047
	October	1902
	November	1933
	December	2007
1990	January	2163
	February	2135
	March	2175
	Average for 1989/90	2131

REACTION WOOD-A NATURAL DEFECT IN RUBBER WOOD

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Institute of Wood Science & Technology

Hevea brasiliensis Muell. Arg. has been planted in several states of India especially in South for tapping latex. The spent tree has become an important source of industrial wood. According to estimates available with Indian Rubber Board, the rubber wood availability in 1990 is to the order of 45 million cft. and would go upto 61 million cft. by the year 2000. Thus there is scope for continuous availability of such a raw material in large quantities. Due to scarcity of primary species and also to non-availability of timber recommended for packing cases a number of public sector undertakings are getting supplies of rubber wood for packing cases either as substitute of recommended timber species or mixing up with other superior species. Earlier wood obtained from tapped trees did not receive any attention of users as it was found not useful even as fuel wood - on account of its fast burning and smoky characteristics. However, the wood obtained from tapped trees drew the attention of consumers especially those in the South Eastern countries and in India.

In rubber wood there are two types of defects one is due to biological agency - fungi and borer attack and the other a natural defect - occurrence of tension wood. While the former can be controlled by treatments the latter being a natural defect cannot be brought under control.

The presence of tension wood is known to cause problems during processing like fuzzy grain or blunting of tools and also during drying creating excessive longitudinal shrinkage, warping etc (Hughes 1965). In an earlier study made by the senior author (Vijendra Rao et al 1983) irregular distribution in percentage occurrence of tension wood was found responsible for warping of some consignments of match splints made out of rubber wood.

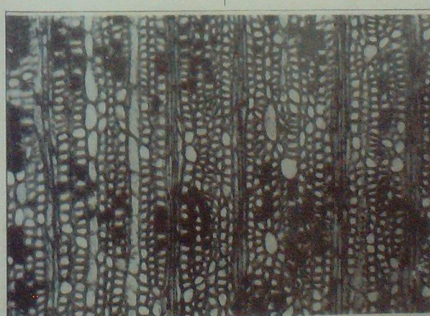

Fig. 1 Diffuse type of tension wood.

MATERIALS AND METHOD

The material was collected from Sullia, Karnataka State during the month of June 1989 from 8 trees about 25-30 years old. The trees had been tapped and their economic period was also completed. Discs were collected from bottom and top portions of trees to find out the variation in percentage distribution of tension wood. These discs were planed with planer and examined as such and after welting for the occurrence of tension wood both with naked eye and also under hand lens. For better visibility, phloroglueinol stain in Hcl was used. Tension wood occuring in bands was seen with the application of this stain. Even with this staining it was not possible to quantify the proportion of tension wood. So the entire study was carried out by examining thin sections under microscope. For this, on each disc marking was made as shown in Fig.1. 3 block from each side at a distance of 2" and block of 1/2 inch thickness were prepared. From each Block a number of sections of 20 " m thickness were cut and stained using different combinations of stains such as phloroglueinol in Hcl, Chlorozel Black E, Chloro-zinc-iodide, Safranine+fast green. Interecept method has been used to quantify tension wood as it has been found to be quicker and accurate in an earlier study (Vijendra Rao, et al, 1983).

RESULTS AND DISCUSSION

An examination of planed surface with the application of phloroglueinol in Hcl revealed to some extent the contrast between the two - the tension wood areas with light fleshy colour in contrast to pink colour of the normal wood.

Under microscope the tension wood was easily identified as narrow and broad bands of gelatinous fibres extending to several milimeters and also as scattered or diffuse. Work on the variation in the percentage occurrence of tension wood from bottom to top is in progress.

Hevea brasiliensis (Euphorbiaceae) posess tension wood as in many genera of this family (Bamber 1974). In *Hevea brasiliensis* only the application of phloroglueinol in Hcl on the cleaned surface has been found to be useful in differentiating it to some extent from the normal wood. It is present both in early and late wood. In *Hevea brasiliensis* S_3 layer gets gelatinized which by staining reaction indicates the lack of lignin and total presence of pure cellulose. The other expression of tension wood is partial or complete reduction of lignification in the cell wall. This is the main cause for wooliness and the longitudinal shrinkage (Dadswell, 1958). Thus the formation of tension wood which has been found to develop right from the seedling stage and found spreading in wide proportion in mature trees is responsible for affecting the properties of this timber species.

The warping of match splints made from some consignment and its absence in others may be attributed to the vide variation in the occurrence of tension wood (Vijendra Rao et al 1983). As such, the wood is likely to behave erratically depending upon the extent of development of tension wood. It is interesting to note here that seasoning behaviour of this species studied by Sharma and Kukreti (1981), revealed that longitudinal shrinkage varies from 0.2 - 0.9% which is quite high when compared with normal wood (0.1%). This may be due to the variation in the incidence of tension wood. Presence of such lognitudinal shrinkage may affect the movement of wood. This may have practical application especially while making furniture etc.

SUGGESTIONS REGARDING UTILITY

As the occurrence of tension wood is a natural defect which cannot be avoided, ways have to be found out to make use of this defect for better utilisation.

As it occurs in the form of more or less circular bands efforts are to be made to make use of these bands to bring out figure for cabinet and furniture making by giving some chemical treatment.

Cellulose content of tension wood is higher than normal. The higher cellulose content, together with

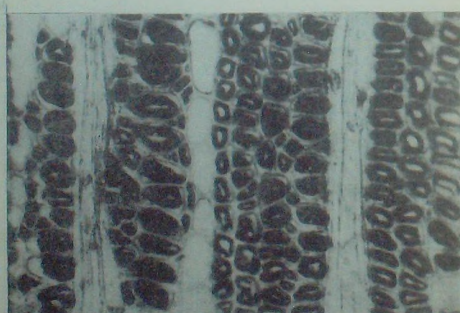

Fig. 2 Banded type of tension wood

5-10% increase in density over normal wood, results in slightly improved chemical pulp yields (Caspersion et al 1968). Tension wood is well suited for dissolving pulp and mechanical pulp. Dissolving pulp is very pure pulp made by removing hemicellulose and lignin from a chemical pulp. Since lignin is low or absent in tension wood - it is very well suited for dissolving pulp which is used in making cellulose products such as cellophane, rayon and nitrocellulose. For this, individual fibre strength is unimportant compared to normal wood. Mechanical pulping of tension wood yield higher strength pulp and is easier to accomplish since the proportion of lignin in tension wood is lower (Scaramuzzi and Vecchi 1968). Experiments may be conducted on tension wood of *Hevea brasiliensis* also to find its suitability for making cellulose products as mentioned above.

ACKNOWLEDGEMENT
Thanks are due to Dr.V. V. Srinivasan, Director, Institute of Wood Science & Technology, Bangalore for encouragement in this work.

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Pre-felling Pressure Injection of rubber trees for preservation of rubber wood - A new concept

Rubber wood can very well be termed timber of the future as it is fast getting important in the context of supply position of conventional timbers becoming discouraging due to dwindling or depletion of natural forests and the consequent curbs on felling of forest trees. Even though Hevea wood is a quality timber with pleasant strawcolour and many other desirable characteristics, high susceptibility of the wood to bio-deteriorating agents like fungi and insects resulting from the high starch content and lack of coloured phenolic compounds in the wood is a limiting factor in its large scale use as a quality timber.

Successful treatment by any timber preserving process requires that the preservative should penetrate evenly into the wood in sufficient depth and concentration to protect it from wood destroyers in the evironment. Even though pressure impregnation method can successfully be employed for fixing the preservatives into the wood, the process is cumbersome and costly. After felling the tree, within the period of transporting the logs to the treatment plant the wood gets affected by fungal attack. Treating the cut ends of logs with protectant chemicals may also not give complete protection as the many wounds produced during felling onthe tree trunk may serve as points of entry for the fungus. Once inside, it will grow from end to end within no time. hence a study was undertaken to evolve an easier and cheaper method of application of preservative chemicals into the wood. Since it is very difficult to impregnate the wood with preservatives once the moisture is lost, the possibility of sending the chemicals into the live wood was thought of.

Attempts were made at Rubber Research Institute of India for evolving a suitable method for preventing the wood destroyers. These have culminated in the development of a method whereby the tree is injected with Copper Sulphate solution using a pressure injection equipment developed at the Institute.

The chemical was found to spread all through out the tree trunk upto the top most twigs, to the centre of the wood and even to the root system downwards. In immature rubber tree, wood injected with Copper Sulphate by this method remained completely free from insect attack and considerably free from fungal attack for a period of 2 years and retained bright white colour of the wood as against the brownish discolouration of the untreated wood due to enzymatic oxidation. The weight per unit volume of wood was also more in the injected wood. Similar result was obtained in mature tree also for more than 6 months and observations are being continued.

This new method of administering the preservative chemical into the tree trunk all throughout has opened up possibilities of sending any water soluble chemical preservative or dye for improving the quality of wood and also for imparting any desirable shades of colour or beautiful patterns to suit the consumer preference. This method of preservation may ensure uniform well distributed usage of preserved logs thoughouts the year as against the presernt constraint whereby the industrial units have to consume the major share of wood dueing the months of February, March and April.

--L. Thankamma, Mycologist, RRII.

RUBBER WOOD - PROBLEMS AND PROSPECTS

G. K. Prakash,
Aspinwood Ltd.

Due to the rapid industrialisation in the country, the demand for timber and timber products has increased considerably. According to available statistics, there has been considerable shrinking and depletion of forest-wealth in the world to the tune of about 45%. Since high quality species like teak and rosewood are no longer available in plenty for building and furniture use, it has become imperative that we should go in for other secondary species of wood and timber products. Among these, rubber wood of late has evoked considerable interest as a substitute for other type of wood. It has been conclusively proved that rubber wood with proper preservation, treatment and seasoning can be upgraded in strength and quality.

Since the economic life of a rubber tree is about 25 to 30 years, there should be a continous replanting cycle. In India, statistics show that there is a replantable area of about 9000 hectares. It is noted that Kerala alone will have about 8,000 hectares of replantable area, which should give approximately 1.6 million cubic metres of wood annually. Thus, rubber tree becomes a renewable source of timber, and availability of raw material will not pose a problem.

Disorganised Source

While wood procurement and upgradation is itself a highly labour oriented and complex industry, rubber wood procurement and upgradation is more cumbersome due to impediments we face right from raw material collection to seasoning. The industry by its very nature will require dispersed locations with regard to log procurement, sawing and prophylactic treatment in view of its high sensitivity for degradation. The treatment facility should also warrant split location. Similarly kiln drying and seasoning may have to be carried out in more than one location. This feature by itself presents a complexity and on top of it the possible governmental controls on restriction for movement of logs and sawn timber will have to be considered. Above all, the biggest problem facing this industry is that the raw material source itself is disorganised, due to a variety of reasons.

Transportation

First of all the bulk of the raw material is with the small grower sector in scattered pockets from where this has to be transported in less than 24 hours after a pre-prophylactic treatment, since rubber wood is highly susceptible to fungus and insects. Most of our estates are steepy in nature with deep terrains and pockets and bad roads with poor communication facilities unlike Malaysia or other Far East countries, and hence quick transportation of raw material is not easy. Secondly the specific periods of felling prevalent in Kerala corresponding to replanting between January and April are not contributing factors for round the year procurement of raw material. Even if it is induced with additional monetary gains, the work becomes hazardous during rainy season. Any industry which has to thrive should work throughout the year without interruption, and hence we should find a viable alternative for the problem mentioned above. Even in Malaysia wood working plants are closed during rainy season and labourers laid off a situation that we can never comprehend under our present labour scenario. Another retarding factor is the problem of purchase of timber and its logistics. The group working in this trade is of a different culture wherein one may have to encounter many economic and social issues on procurement. The problems of "attimari" freely played and as such it would be highly necessary to have a firmed up raw material procurement plan with a reliable and effective monitoring outfit.

Due to the high sensitivity of the raw material against bio-deteriorating organism, initial preservation should start from the log cutting stage itself. Preservation of superficially treatged logs for any length of time is not found feasible although research studies show that sawn and chemically impregentaed rubber wood can be stored without decay for considerable periods. So, transportation of such a sensitive raw material to the site of sawing and then on to the production base in less than 24 hours is posing a serious problem.

Preservation

In India Sodium Pentachlorophenate is used for initial dipping and preservation of rubber wood. This is banned in other countries due to its high toxicity. Arsenic based formulations like CCA are toxic, costly and not freely available and Boron Boric Acid is recommended as a chemical of choice.The cost of chemical is the most critical factor in the whole operation, which in turn escalates the overall cost of processing. So, the priority goes in for adoption of a chemical of minimum cost. The cost of wood along with chemical and labour cost is definitely on the high side in India compared to Malaysia. The fungicides and insecticides manufactured within the country are costly due to the cost of imports of basic chemicals involved in the manufacture of these formulations.

It is understood that trails with low cost chemicals are in progress in FRI and other related institutions to find out a most economical formulation from the point of view of cost and efficiency. Because of high cost of raw material chemical and labour wages, the cost of treated wood reaches very near the cost of other popular species like Anjili, Thambakam, etc. If at all we try to import these chemicals there again we face problems due to the stringent import policies and exorbitant duty which is around 200% or more.

Coupled with all the above factors we have a very low productivity in the country compared to Malaysia, Indonesia or Thailand. While the labour cost per unit of product is much higher than that of Malaysia, the final treated product will be further costlier than Malaysian treated product.

Technology

Now coming to the technology aspects, the question of adoption of proper technology is of great importance. While the indigenous technology - ASCU - for wood preservation in general is prevalent, some other technologies also have been developed in other countries without great change on basic formulations. The CCA formulation is used in Malaysia also for wood preservation but not widely practised for rubber wood because of its colour factor. Various proprietary formulations of companies like Hickson, Celcure, etc. are used for production of rubber wood in Malaysia to retain its natural colour. As Malaysia concentrates only on furniture export market, this treatment is more feasible for them. Malaysia has also imposed a regulation that only pressure treated timber should be exported.

In the rubber wood industry, one may have to look into the effective way of drying the material in the quickest possible time. The conventional drying kilnstake usually 10 to 12 days for drying the material even for reduced dimensions, thus creating an imbalance between impregnated and dried wood. While chemical impregnation is of a limited duration not exceeding 3 to 4 hrs for batches, drying process is time-consuming. The alternative is to have as many dryers as possible to channelise the impregnated wood without storing it for a considerable length of time which is a costly proposition. The new technologies are considered more efficient from the point of view of faster drying but one is not quite sure whether the exorbitant cost of machinery coupled with import duty will be justified from the point of view of timber drying.

Marketing aspects.

Now coming into the marketing aspects of rubber wood, the general fear is that we will have to face some problems on its acceptance. Initially there will be some resistance from the consumers who may be reluctant to adopt rubbeer wood as a part of building material. Though rubber wood has not been used so far for construction works, serious attempt has to be made to get this adopted by the construction industry at least for internal use like doors, windows, etc. The potential use of rubber wood in furniture and allied trade is not found easy since we do not have a large scale organised sector unlike Malaysia, Indonesia or Thailand. While the industry is highly developed in Singapore, Taiwan and Korea, we find difficulty in competing with them in international market due to high cost of our raw material and products. The countries dealing with rubber wood never use rubber wood for internal consumption.

There, the entire rubber wood, treated and seasoned, is exported.

The active market for rubber wood should be in North India, since we have noted that the building and furniture trades have started going in for secondary grade timber, treated, coated or stained. So rubber wood also should pick up in North India, perhaps after a slow start. There are so many other high priority areas like panelling, floor boards, chip boards or hard boards, veneering rubber wood as a core-ply for bonding, etc. But all these will take some time to establish under Indian conditions.

Rubber wood industry no doubt is an upcoming industry and has a very great potential if the cost aspects on raw material, labour and chemical are contained within reasonable limits. If the industry has to thrive, the Government should assist this industry to procure the chemical at international prices.

In the light of conservation of natural forests for providing proper ecological balance and in view of the concept of wood upgradation achieving waste utilisation, the industry should merit substantial subsidies for promotion. Hence my appeal is that the Government at the State and the Centre should formulate a forward-looking plan for promoting the industry in the right lines.

I would like to thank Shri P. C Cyriac, Chairman, Rubber Board, Dr.Sethuraj, Director of Research and Dr. V. Haridasan, Dy. Director (Eco. Res.) for their valuable help.

THE CLONES APPROVED FOR 1990 - CATEGORY I

RRIM 600

A high yielding clone evolved by the RRIM Parents are Tjir 1 and PB 86. Tall straight stem moderate to fairly heavy branches, branch unions weak. Young plants show spindly grow and late branching with occasional leader. Narrow broom shaped crown, foilage sparse, small yellowish greenleaves. Virgin bark thickness below average, renewed bark above average, bulges above tapping cut. Vigour at opening below average, after tapping above average.

This clone shows rising yield trend. Initial and subsequent yields is good. Commercial yield over 15 years in Malaysia is 2199 kg/ha/yr. Commercial yield in India over 10 years is 1317 kg/ha/yr.. Latex is unsuitable for concentration. Highly suscesptible to Phytophthora and pink diseases and hence requires efficient protective measures when planted in area where these diseases are prevelent. Tolerant to *Oidium,* brown bast and wind damage..

GT 1

An outstanding primary clone developed in Indonesia; upright and slightly kinked stem. Variable branching habit. Main branches long and secondary branches light. narrow globular crown, dense dark green glossy foliage. Virgin bark thickness average, renewed bark below average, vigour at opening above average to average, girth increment on tapping average. This clone shows rising yield trend. Summer yield also high. Commercial yield in Malaysia during 15 years was 1615 kg/ha/yr. In India it was 1359 kg/ha/yr during 10 years of tapping.

Good tolerance to pink disease and brown bast, average to above average tolerance to wind damage average to below tolerance to Phytophthora and Oidium. Withstands higher intensities of tapping. Considered to be well suited for small grower.

RRII 105

A promising clone evolved by the Rubber Research Institute of India. Parents are Tjir 1 and Gl 1. Stem tall and straight. Branching good, strong union. Canopy dense, mostly restricted to the top.

Foilage dark green, leaves glossy. Vigour before and after tapping average. Virgin bark and renewed bark thickness above average. Number of latex vessel rings in bark high.

Shady yield trend. Very high initial and subsequent yield. Estimated yield in large scale trial during ten years of tapping is 2480 Kg/ha/year. The average yield in commercial estates is 1652 kg/yr during 6 years. This clone has fair degree of tolerance to abnormal leaf fall disease under normal prophylactic measures. Susceptible to pink. Fairly tolerant to yield depression during drought. S/2 d3 system of tapping is preferable as brown bast tendency is reported from many holdings.

A STUDY OF THE WORKING AND LIVING CONDITIONS OF LABOUR IN RUBBER PROCESSING FACTORIES

Dr. V. Haridasan
Rubber Research Institute of India.

Rubber is a crop which involves a degree of processing. In the case of large estates the processing factories are located within themselves, while processing the rubber of small growers is undertaken by crepe mills spread all over Kerala and Tamil Nadu. Around 15-20 per cent of the crop is scrap rubber. These are converted into estate brown crepe or crumb rubber. There are separate factories for manufacturing crumb rubber as well as estate brown crepe rubber. The present study covers only the crepe mills.

The study was carried out in 1988-89 and the data related to the period 1987-88. At the end of 1988, there were 124 crepe mills in Kerala and Tamil Nadu. For the purpose of collecting data, an investigator visited 102 crepe mills. Although he could visit 102 mills he could collect data only from 67 mills. The others were not working at the time of visit. The operation of the crepe mill is often seasonal, depending upon the availability of scrap rubber. The investigator contacted two workers from every crepe mill, totalling 134 workers from 67 mills. The data were collected in a pre-tested questionaire. The information collected included the family background of workers, their education, age, dependants, size of family, length of service, nature of work, working days in the previous year, income from the crepe mill, supplementary income, savings and expenditure.

Table I:
Age distribution of workers.

Age	*No.*
18 to 25 years	21
26 to 35 years	47
36 to 45 years	46
46 to 55 years	16
Above 55 years	4
Total	134

The family size of workers is shown in Table 2.

Table 2: No. of families with children.

		No.of families		*Dependants (other than own children)*	*No.of families*
1	child	26	1	dependant	22
2	children	43	2	dependants	23
3	children	25	3	dependants	17
4	children	9	4	depdnedants	9
5	children	3	5 & above		5
	Total	106			76

Family background: Of the 134 workers, 132 were male and the rest female. Of the total, 78 workers belonged to christian, 47 to Hindu and 9 to Muslim community. Out of 134 workers, 5 were illiterates. Of these 3 were Malayalam speaking workers, while 2 spoke Tamil. 15 workers studied upto SSLC and 2 beyond SSLC. The percentage of literates therefore formed 96. Of the 134 workers 112 were married but only 106 had children. The age distribution of the workers is given in Table 1.

From the table it can be seen that families with more than 3 children formed only 11 per cent and families with more than 3 dependants formed 18 per cent.

Income and expenditure: On an average, the workers earned Rs.508/- per month from their main occupation and Rs.160/- from subsidiary occupation. In addition to these sources, other family members contributed on an average Rs.119/- per month. The total monthly income of the worker's family was Rs.787.

The workers were found to spend more than what they were earning. The total monthly expenditure per family was Rs.811/- showing a deficit of Rs.24/- per month. The average expenditure per head (per capita) was Rs.197.80. The deficit was met from their bonus payments and by borrowing. Although this was the general picture there were some workers who had savings also. Thus 21 workers had some sort of insurance with the LIC, 17 workers had joined chitty and 10 workers had small bank deposits. Gold ornaments were found with 104 families. The pattern of expenditure showed that 65% of expenditure was on food followed by 12% on the item "entertainment and others". This item included expenditure on beedy, cigarettes, alcaholic beverages and film. The details are shown in Table 3.

Table 3:
Average expenditure per head of the worker and his family (monthly).

Items	Rs.	Percentage
Food	127.83	65
Clothing	13.80	7
House rent	0.90	1
Education 6.00	3	
Fuel & lighting	9.38	5
Medicine	6.76	3
Travel	7.95	4
Entertainment & others	25.18	12
Total	197.80	100

Social security benefits from crepe mills: The study showed that the minimum wages notified by the Government were being paid in 57 mills, while 2 mills engaged workers on piece rate and 1 mill engaged the workers on a productivity linked wage system. Seven crepe mills followed different wages. Of these 1 factory engaged women workers only. The average working days were 6 per week and working hours were 8 per day. Fifty eight mills gave washing and uniform allowances to the workers and 62 mills gave annual bonus. Sixty one mills gave leave with wages to the workers. However, Provident Fund facility was available only in 20 mills. There was no uniformity in the annual bonus paid to the workers. It varied from 8 to 19 per cent. Out of the 134 workers 14 workers had undergone prolonged medical treatment during the last 5 years. However, there is no evidence to attribute that the disease was caused by the working conditions in the crepe mills.

Acknowledgement

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Rubber Honey

Rubber tree is a prolific producer of honey. In the rubber tree, honey is found at the extra-floral nectory glands at the end of the petiole where the leaflets join. It is estimated that honey from rubber plantations form around 40 per cent of the total Indian production of honey. Studies show that about 15 hives can be placed in a hectare of rubber plantation. In a normal year about 10 Kg. of honey can be obtained from one hive.

Honey is a saturated solution of sugars. Rubber honey contains three major sugars viz., fruit sugar, grape sugar and cane sugar. Cane sugar forms only a way small percentage and hence rubber honey is devoid of the harmful effects associated with cane sugar.

AN ECONOMIC STUDY OF COVER CROPS IN RUBBER SMALL HOLDINGS

P. Rajasekharan,
Rubber Research Institute of India.

Leguminous cover crops enhance the growth as well as yield of the rubber tree. Besides acting as a protective cover against soil erosion, legumes reduce the immaturity period of the rubber tree and save nitrogenous fertilizer. Cover crops trail on the weeds and suppress their growth, thereby reducing the expenditure on weeding. But till date the economic aspects of raising cover crops have not been studied and hence the present study.

Methodology

The study was conducted in Kottayam District. Two sampling frames were constituted using the list of cultivators growing cover crops and those growing no cover crops, from the records of the concerned regional offices of the Rubber Board. Seventy two samples from the first and fifty samples from the second category were selected by simple random sampling technique making the total sample size at 122. The study was restricted to the small holdings. Data collection was done during the period December 1988 to August 1989 using a pretested questionnaire, keeping the reference period of the study as 1988-1989.

The cost of cover crop establishment and maintenance in the holdings was computed. The difference in weeding cost between the two categories was analysed separately and compared.

Salient features of the samples.

The taluk-wise distribution of samples in the study area and some features of the sampled units are shown in Table I. The average size of holdings with cover crops was found to be slightly large, compared to holdings without cover crops. The stand per hectare was also slightly less in the holdings with cover crops. From these findings it can be concluded that the relatively better off growers showed a tendency to adopt scientific crop management practices.

Results and discussion

The cost of weeding and cover crop establishment and management was worked out and is shown in Table II. In the holdings with cover crops the costs decreased from the first year to the seventh year. There was a sudden decrease in the total costs from the third year onwards as compared to the first two years. This is mainly due to the decrease in weeding cost from the third year onwards as the cover crops got established firmly by the second or third year.

Table I:
Features of the samples

1. Distribution of the samples

Name of taluk	*No.of samples with cover crops*	*No.of samples without cover crops*
Meenachil	28	10
Changanacherry	44	40
Total	72	50

2. Hodlings size and stand per hectare.

Description	*Holdings with cover crops*	*Holdings without cover crops*
Size of holdings(ha)	0.64	0.45
Average stand per ha.	471	486

Table II: Cost of weeding, cover crop establishment and mangement cost (Rs/ha)

I. Cost of the growers with cover crop.

	Item of cost	Ist year	2nd year	3rd year	4th year	5th year	6th year	7th year	Total
A.	**Cost of Labour**								
	Sowing	117.25	77.00	4.55	--	--	--	--	198.80
	Weeding	423.85	347.90	135.80	95.90	54.25	56.35	64.75	1178.80
	Cover cropmanagement	1.05	64.75	140.00	135.45	101.50	84.70	67.55	595.00
	Cover crop manuring	8.75	30.10	--	--	--	--	--	38.85
	Sub-total cost	550.90	519.75	280.35	231.35	155.75	141.05	132.30	2011.45
B.	**Material cost**								
	Fertiliser	0.72	27.67	--	--	--	--	--	28.39
	Farmyard manure	1.03	24.75	--	--	--	--	--	25.78
	Wood ash	1.73	--	--	--	--	--	--	1.73
	Planting materials	27.00	--	--	--	--	--	--	27.00
	Sub-total cost	30.48	52.42	--	--	--	--	--	82.90
	Total cost	581.38	572.17	280.35	231.35	155.75	141.05	132.3	2094.35
II.	**Cost of growers without cover crop (Rs/ha)**								
	Cost of weeding	961.80	1064.70	813.40	618.10	429.10	369.60	326.20	4582.90

In these holdings weeding cost was slightly high in the sixth and seventh year of planting compared to fifth year of planting, possibly due to regeneration of weeds, once the cover crops die off.

The maximum cover crop management cost was incurred during the third and fourth year of planting synchronising with the luxurient growth of the covers. This cost is less in the sixth and seventh year of planting, since the cover crop was almost destroyed when the canopy closed the entire area.

Most of the growers were reluctant to apply manures and fertilisers for the cover crop. Only 13 farmers out of 72 (18 per cent) applied manures and fertilisers for the cpver crops. Regarding fertiliser application for cover crop no scientific principles were followed. Most of them applied a portion of the fertiliser nutrients intended for the rubber tree along with the manuring of rubber. So also none of the growers interviewed followed the recommended cover crop seed treatment like hot water treatment, scarification etc.

Labour requirement

The total labour requirement for weeding, cover crop establishment and management for the entire period of immaturity was 57.47 man days in the holdings with cover crops and 130.94 man days for weeding in the holdings without cover crops.

Costs of the growers without cover crops

As mentioned earlier the average size of holding was relatively less for growers without cover crops.

The maximum weeding cost was incurred during the second year of planting and since then there was a progressive decrease in the total weeding cost. One possible reason for the non-establishment of cover crops may be due to the low level of managerial input.

Net effect of cover cropping

The net saving in costs is presented in Table III. The saving in weeding cost in the plantations raising cover crop was wroked out at Rs.3404/- per hectare over the entire immaturity period of seven years. The total cost required for the establishment and maintenance of cover crop came to Rs.916/- . Taking into account the cost of weeding and cover crop management, the net saving in total cost, compared to the holdings without cover crop came to Rs.2489/- per hectare for the entire immaturity period of seven years.

Fertiliser application for rubber

The fertiliser application for rubber in the area studied deserves mention. Irrespective of the fact whether cover crop was established or not there was a tendency for applying the same kind and quantity of fertilisers in both categories of holdings.

Studies conducted by the Rubber Research Institute of India and Malaysia reveal that the fertiliser requirements of rubber grown with legume ground cover and natural ground cover vary considerably during the latter half of immaturity and during the early years of maturity period.

The higher growth rate of rubber noticed in legume cover areas could be achieved in natural cover areas only with the application of extra doses of nitrogenous fertilisers adding to higher costs.

In order to achieve uniform plant growth in both categories of holdings, separate recommendations viz., 250kg of 12.12.12. NPK mixture per hectare (or its equivalents) for areas where leguminous ground covers are established and 400 kg of 15.10.6.NPK mixture per hectare (or its equivalents) for areas with no legume ground covers are recommended from the fifth year of planting till tapping stage. Unfortunately this recommendation was not followed by the sample growers. The majority of the growers applied 17.17.17 complex, Ammonium phosphate sulphate (Factramphos)

Table III:
Net saving in costs (Rs/ha)

Weeding cost in holdings with cover crops	1178.80
Cover crop establishment manuring and management	915.55
Total	2094.35
Weeding cost in holdings without cover crops	4582.90
Net saving in weeding cost	3404.10
*Net saving in total cost	2488.55

*Total cost include cost of weeding and cover crop establishment only.

with potash or strait fertilisers with no discrimination between the above two categories. One possible reason for following this practice may be lack of scientific knowledge.

In an experiment counducted by the Rubber Research Institute of India with leguminous ground cover (Pueraria phaseoloides) and natural cover showed that the annual yeild per hectare was higher in the legume cover area and a cumulative yeild increase of 466 kg was obtained in three years time. The additional yield obtained in legume cover area for the first three years of tapping more than justified the cost of establishing and maintenance of legume cover (Mathew et al., 1989).

Suggestions

The present study reveals the wide gap in the lab to land technology. Considerable cost can be saved by proper establishment and maintenance of ground covers with scientific fertiliser application. As a partial remedy extension activities may be strengthened.

Popularisation of shade tolerant cover crops are essential since most of the small growers resorted to intercropping during the initial years. After the removal of intercrops, usually by the third year, the chances of establishing Pueraria was relatively less compared to shade tolerant cover crops like Mucuna sp.

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Mathew, M. Punnoose, K. I. Potty, S. N. and George, Elsie, S. (1989). A study of the response in yield and growth of rubber grown in association with legume and natural ground cover during the immature phase. Proceedings of the Seventh Symposium on Plantation Crops. Editors - M. K. Nair et al., Vol. 16 (supplement), 433-441.

Lightning Injury

Rubber tr..s of different ages are susceptible to lightning injury. The damage may be for a group of trees in lines or even in a scattered pattern. The extent of damage varies. The manifestation of visible symptoms of distress is rather sudden. Seriously effected trees are killed and they wilt in two to three days. Partial damage to some branches or portions of the main stem may also occur. In the affected portions, exudation of latex is observed and the bark seperates from the wood and the damaged bark is colonised by borer beetles in large numbers. A characteristic feature is that cambium is the tissue that gets damaged first and as a result, the cambium and the inner bark are coloured dared to dark violet. Dying of tissues starts from the cambium extending through the bark in an outward direction. Soon after lightning strike incidence of patch canker also increases.

An assessment of the damage may be made as early as possible after the lightning strike. Completely affected and dried up plants may be removed. In the case of partially affected plants, the damaged bark is scraped out, the exposed area washed clean with Aretan or Emisan or Ceresan or Agallol solution and after drying a wound dressing compound applied. It exposed to hot sun the treated portions may be white washed.

Sun-scorch

Young nursery seedlings often suffer from sun-scorch. The bark at the collar region dries up resulting in a girding effect and the affected seedlings dry subsequently. This is mainly due to heating up to the soil around the collar and could be prevented by mulching the nursery beds with dry organic matter by the advent of hot dry weather. Fresh green mulch should be avoided.

In young clearings the bark at or above the collar region on the side facing South of South-West often gets damaged due to sun-scorch. In buddings sometimes, the dead snags of stocks fall off leaving a cavity at the bud union. When this faces South or South West, sun--scorch effect becomes prominent and the bark on the scion dies. In these cases often the damaged bark is in the shape of a spearhead. The affected bark is colonised by wood parasite fungi like Diplodia causing further damage.

RUBBER PRODUCERS SOCIETIES: AGENTS OF CHANGE

P. K. Narayanan
Jt. Director (Rubber Promotion)

Transfer of appropriate technology on a seasonal basis to the vulnerable section of the rubber planting community in an intelligible manner, coupled with timely delivery of quality inputs and equipments at cheaper rates is perhaps the largest single factor that would help maximise production and productivity of rubber from small holdings. Proliferation of small holdings year after year on the one hand and inadequacy of extension personnel with Rubber Board to cater to the information needs of the rubber grower community on the other have been imposing severe constraints to fulfil these tasks. As a result productivity of small holdings has been remaining far lower than that of the professionally managed large estates.

In view of this the Rubber Board felt it necessary to promote "group approach" among rural small holders at the village level for timely transfer of technology and delivery of inputs during 1986, by organising voluntary associations of rubber growers in each village with an average membership of 150 to 200 growers limiting the service area of such associations to 2-3 Km. Past experiences show that membership exceeding 200 would make internal communication and intraction among the members ineffective.

RPS

These associations were called Rubber Producers Societies (RPS) registered with the District Registrar under the Charitable Societies Act based on a draft bye-law issued by the Rubber Board. Only 7 small holder promoters need be there to register an RPS. The Board insisted that to qualify for the Board's approval there should be 50 rubber small grower members each contributing Rs. 50/- as entrance fee and Rs. 10/- as annual subscription in the beginning. Once this condition is satisfied the Board would accord its approval to the RPS after an on the spot inspection by the Board's Field Officerof the area to verify the eligibility of the members enrolled, viability to function as a voluntary association of small growers, permises where the RPS intends to operate from, calibre of the organisation etc. The Field Officer of the area is then nominated to the Governing Body of the RPS to guide its functioning for achieving the laid out objectives of improving the production, productivity, processing and marketing of the rubber of the members of the society.

The general body of the society is suggested to be held at least once in three months, preferably in a holding of one of the members of the society and discuss the calendar of cultural operations to be followed in their holdings for trees of differing age groups during the succeeding quarter. Demonstrations by the extension officer of the Board on relevant techniques are also to be done if necessary at such meetings, such as correct methods of planting, manuring, tapping plant protection, processing, nursery raising etc. During such meetings, it is suggested that the Managing Committee should apprise the members of the progress achieved since the previous meeting and present the accounts. Frequent meetings of this type would enable to foster an intimacy between the members and ensure smooth functioning of the RPS with a sense of belonging.

Organising new RPSs

Similarly the Governing Committee of the RPS is suggested to meet once in a month in the presence of the Field Officer who is a member of the Committee and discuss the verious activities to be undertaken by the society to help the members.

The number of RPS so far approved by the Board is over 1000. Region-wise break up of the RPS is as follows:-

Region	No. of RPS	Region	No. of RPS
Nagercoil	6	Kothamangalam	37
Trivandrum	36	Ernakulam	58
Punalur	34	Trichur	41
Pathanamthitta	58	Palghat	49
Adoor	29	Nilambur	36
Changanacherry	38	Calicut	34
Kanjirappally	68	Tellicherry	29
Kottayam	51	Taliparamba	90
Palai	93	Kanhangad	48
Erattupetta	32	Mangalore	7
Thodupuzha	45	Goa	1
Moovattupuzha	48	Port Blair	1

The membership in each of these ocieties is around 100 on an average.

Obviously impressed by the demonstrated advantages derived by being members of RPS, brisk activities are afoot among rubber growers to organise new RPSs in village where such societies do not exist now. The extension personnel of the Board also have been organising group meetings of selected rubber growers in each region and persuading them to form RPSs. Rubber growers who have been keeping away from RPSs existing in their villages also have started enrolling as members. Ultimately it is likely that every eligible rubber small holder within the jurisdiction of each RPS would be attracted and enrolled as members in the respective RPSs. Generally, rubber growers owning rubber area of less than 0.20 ha (50 cents) are not suggested to be enrolled as members of RPSs as they will find it hard to pay Rs. 60/- and take up membership. But the RPSs have been advised to extend all the benefits to such small growers also, as in the case of other regular members. This arrangment will enable even the smallest rubber grower to avail all benefits without actually enrolling as members of RPSs.

Improving the Processing and marketing of small holders' rubber

Another area of emphasis is the improvement in the processing and marketing operations of small holders rubber through the RPSs. Study classes and demonstrations are arranged under the RPSs regarding correct processing techniques, so that they are able to make rubber sheets of better grade which will fetch higher price. Alongside arrangements for marketing small holders rubber based on the grade of the sheets they produce are also made. The fact that they can realise higher price for better grades has made the small growers 'grade-conscious' leading to improvement in the quality of the sheets they produce.

The machinery set up by the Board in this direction is to engage leading tyre companies like Dunlop, Modi, Vikrant and MRF to procure rubber sheets direct from RPSs by paying grade-wise price for the sheets. This facility had warranted adoption of fair trade practices among all those who deal in rubber even in villages. But this system also had met with certain impediments like the tax authorities harassing the RPSs interpreting that what they do is real trade and that they are liable to be taxed.

To tide over this the Rubber Board has set up Private Ltd. Companies in all regions under the joint share participation of RPSs and the Board. Six of them will handle both Processing and marketing while remaining six companies will be mainly under taking only trading of rubber to begin with. In addition, these Companies would also be taking up distribution of Formic acid, plantation inputs and raising polybag nurseries.

Each Company will have 49 RPSs and the Rubber Board as share holders, making the total share holders 50, to be well within the stipulaltion of Company Law.

In the case of Companies undertaking Processing and marketing of rubber, the share contribution per RPS is Rs. 25,000/- while in the case of trading companies it is Rs. 10,000/- per RPS. In both type of companies the Rubber Board will have controlling shares.

In the case of Processing factories the crop from members of share holders RPSs will be procured as latex, sheet and scrap as the case may be, as far as possible.

The Trading Companies will handle all activities of the Processing Companies, except processing. Once they are commissioned and become stable in the trading activities, processing activities will also be taken up as second stage of expansion.

Distribution of inputs

Distribution of inputs to the small holder members of the RPSs is being done now directly from the Board through its Regional Offices. During 1988, it was done from one centre at Kottayam, when the number of RPSs were only a few. During 1989 the

Details about the Companies are given below:

Processing and Marketing Companies.

Sl. No.	Name and product of the Company	Operational region	Present stage
1.	Pazhassi Rubbers (Crumb Rubber)	Taliparamba Tellicherry	Shares fully paid up. Factory ready to commission near Tellicherry.
2.	Sreekantapuram Latex (Centrifuged latex)	Taliparamba	Share collection on at initial stage.
3.	Periyar Latex (Centrifuged latex)	Moovattupuzha, Thodupuzha, Kothamangalam, Ernakulam.	Shares fully paid up. Factory under erection at Kalloorkad.
4.	Kavanar Latex (Latex Crumb)	Palai, Erattupetta	Shares almost paid up. Site for factory being searched for.
5.	Pamba Rubbers (Crumb Rubber)	Pathanamthitta, Adoor.	Shares fully paid up. Factory under erection at Konni.
6.	Ponmudi Rubbers (Crumb Rubber)	Trivandrum, Punalur	Share collection on. Site for factory purchased.

Trading Companies

1.	Kanhangad Rubbers	Kanhangad	Share collection in progress. Company being registered.
2.	Kunhali Marikkar Rubbers	Kozhikode	Share collection on. Company registered.
3.	Thunchath Ezhuthachan Rubbers	Nilambur	-do-
4.	Bharathapuzha Rubbers	Palghat	-do-
5.	Vallathol Rubbers	Thrissur	-do-
6.	Manimalayar Rubbers	Kanjirappally, Changanacherry, Kottayam	-do-

centres were increased to 5. Again during 1990 the number of centres was increased to 17 to cater to the RPSs in a decentralised manner.(See Table 1).

The inputs distributed include straigh fertilisers of NPK, Polythene and Adhesive for rainguarding, Plastic cups, Head lights, hand sprayers, panel protectants, fungicides, spray oil, Power sprayers etc. Those RPSs which are interested to set up Community smoke houses are given subsidy at the rate of about a lakh of Rupees to bear the cost of construction and equipments limited to about 75 %.

To those RPSs which come forward to collect latex from their members and sell it at remunerative prices to processors the Rubber Board supplies necessary equipments such as platform balance to weigh latex, Electric oven to dry sample coagulum for estimating dry rubber content, chemical balance to weigh the dried sample coagulum to find out the exact weight of dry rubber in the sample and other accessories required.

Platform balances are supplied to those RPSs which undertake the procurement of smoked sheets and scrap rubber.

To ensure effective functioning of the RPSs as a credible rural change agency, the Board has been insisting that they should adopt a work culture of total openness, enabling every member of the society to have acess to the records and documents of the society. Registers for recording the accounts, minutes of meetings list of members with details of their holdings, inventory etc are

Table- 1 ITEMS OF ESTATE INPUTS ISSUED TO RPSs

Sl. No.	Item	1987-88 Quantity Issued	1988-89 Quantity Issued	1989-90 Purchased for Issue*
1.	Urea	420 MT	1733 MT	3660 MT
2.	Potash	327 MT	1365 MT	2818 MT
3.	Mussorie	977 MT	4085 MT	8500 MT
4.	Rubber Mixture	834 MT	--	--
5.	Copper Sulphate	55MT	168 MT	375MT
6.	Copper Oxy Chloride	7MT	24 MT	70MT
7.	Spray Oil	40 KL	60 KL	350 KL
8.	Polythene sheet	28 MT	83 MT	300 MT
9.	Adhesive	121MT	115 MT	1000 MT
10.	Plastic cups-White	6 lakhs	5 lakhs	10 lakhs
11.	do Black	1.5 lakhs	6 lakhs	9 lakhs
12.	Tapping shade	1.3 lakhs	--	--
13.	Sopkot	4.8 MT	3.2 MT	2 MT
14.	Emissan	135 kg	400 kg	2000 kg
15.	Paranitrophynol	230 kg	625 kg	450 kg
16.	Sieves-wooden	2411 nos	2675 nos	430 nos
	do -10" Aln	--	1200 nos	2400 nos
	do -12"Aln	--	800 nos	3900 nos
17.	Tapping Knives	--	2600 "	4200 "
18.	Sub soil water injector	--	59 "	--
19.	P.Girdle	--	40,000 "	50000 "
20.	Sprayer	--	--	500 nos
21.	Head light	--	3000 nos	400 nos
22.	Template	--	--	5000 nos

* Part of the meterial has already been issued.

supplied to the societies by the Board. The Board has selected professional chartered accountants to train the office bearers of the RPSs regarding the keeping of accounts and to audit their accounts. 4 Superintendents/ Asst.Superintendents also have been posted by the Board in 4 different zones to visit the RPSs periodically and assess how they perform to achive the laid out objectives. Based on their inspection reports, the RPSs are given instructions to rectify defects, if any, in their working.

To enchance credibility of the RPSs, the Board has already initiated steps to promote group new planting and replanting of rubber by their members by organising steps like collective filling and submission of applications, engaging common surveyor for preparing survey plans,jointly procuring or preparing poly bagged seedlings for planting, organising joint field inspections with the help of RPS, distribution of subsidy cheques to growers at special meetings convened by RPSs etc. Selected RPSs are encouraged to raise polybag nurseries for which polybags are given free to the RPSs, while budded stumps are supplied at half cost for planting in the polybags. This programme has helped rural growers to learn correct techniques of polybagging. Easy availability of high quality polybagged planting materials with RPSs has also helped to check the price rise of polybagged plants in the open market.

Another demonstrated advantage of the RPS was convnicingly proved at the Rain guarding campaign held in 1989 and the One lakh tappers training Campaign held in 1990. The message of rain guarding has been well driven home to the small growers, which is testified by the huge response for this programme in 1990. This year over 40,000 hectares of rubber plantations under the small holding sector have been rain guarded. The Tappers trainning campaign of 1990 also has been a very sucessful excercise in disseminating the correct techniques of tapping among rubber tappers of small holdings. Such grass root level excercises met with real sucess, because the Board had the added advantage of the existence of the strong base net work of RPSs at the village level, which played a key-role in joining hands with the Board for organsing these campaigns. These exercises were clear instances of peoples participation in development and resultant change.

Obviously impressed by the potential of the RPSs in managing rural change, the Institute of Rural Management (IRMA) under the National Diary Development Board at Anand volunteered to depute scholars to study about the unique features of RPSs as they consider the example of RPSs as "Something bigger than the Amul experiment with milk producers". Three IRMA scholars are right now in Kerala and are conducting a three-month long study on the strength and weakness of the RPS model. The Board is extending all assistance to these scholars, including financial, to hold this study. The outcome of the study would be utilised to strengthen the movement.

Constant communication with the office bearers and members of the RPSs in the form of personalised letters from the Chairman himself has been yet another strategy followed by the Board to ensure that the beneficiaries are taken into confidence on every programme of small holder development.

The movement has proved beyound doubt that for ensuring agricultural change in rural economies group approach is the best for transfer of technology and motivation of farmers. This is easliy accomplished because the Board has time and again reminded the organisers and office bearers of RPSs that it is " a non profit, non-political, secular, democratic, socialist fraternity of the growers, for the growers and by the growers". Most of the RPSs have lived up to expectation.

The movement is not fool-proof. Bottlenecks have to be identified and corrective step taken to see that the movement comes to stay and survives the impediments in its course. This could be ensured as rightly observed by the Chairman, Rubber Board, if only those who are at the helm "never distance themselves from the beneficiaries of the programme, maintain intimate communication with them and steer clear with a heigh degree of dedication and sense of direction". ■

FORM IV
STATEMENT OF OWNERSHIP AND OTHER PARTICULARS ABOUT NEWSPAPER
RUBBER BOARD BULLETIN

1.	Place of Publication	Kottayam
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5.	Editors Name Whether Citizen of India Address	P. K. Narayanan Yes Joint Director Rubber Promotion Rubber Board, Kottayam 686 001
6.	Name and address of individuals who own the Newspaper and partners and share holders holding more than one per cent of the total capital.	The newspaper is owned by the Rubber Board, a statutory body constituted under the Rubber Act 1947.

7. I, P. K. Narayanan hereby declare that the particulars given above are true to the best of my knowledge and belief.

Kottayam,
Date 9th March 1990 (Sd.-) Publisher

NEWS & Notes

CESS ON RUBBER 1989 - '90

The key to success is diligent forecasting, planning and implementation and so it has been with the Licensing, Excise Duty and Market Intelligence Sections. Nothing else can explain the phenomenal increase in cess collection of the Board. From an earlier record of Rs, 12,66 crores during 1988-89, the cess collection during 1989-90 has soared upto Rs.14.15 crores as against the target of Rs 13.75 crores.

The implementation part involves the synergetic efforts of a centralised team of officers for assessment and collection of cess backed by a group of enthusiastic Market Intelligence Inspectors, Excise Duty Officers and staff with jurisdictions running across the length and breadth of the country. The whole set up is guided and supervised by the Deputy Secretary (L & ED). The setting up to of two new checkposts on important routes for surveillance and monitoring of inter state movements of rubber has made its own impact in preventing evasion of cess on rubber. A Management information system involving fortnightly review of achivement against targets, setting targets in the light of new information and a good communication network worked as catalysts in bringing about this increase of Rs. 1.49 crores in cess collection which by any yardstick is no mean feat.

Nevertheless, there is no room for complacency. The department has, in right earnest, decided to improve upon the performance of 1989-90 by setting still higher targets for 1990-91.

INDONESIA TAPS INTO TYRE MAKER'S NEEDS

If you cannot beat them,join them. This is how they feel. Indonesia's rubber producers are joining hands with the big foreign tyre companies who dominate world rubber trade.

Cheaper supplies will be matched by calls for greater quality. Yet for all that, Mr. Sutrisno Budiman, Head of Gapkindo, the Rubber Association, believes the changes represent a real opportunity for indonesia to boost earnings from rubber, the country's most important export crop.

"It is the only way to go" says one US buyer, and the message is now trickling down to the smallholders who grow most of Indonesia's crop. Rubber cultivation is still a fairly primitive, labour activity. With increasing market concentration among the larger tyre makers, the introduction of automated production runs and the drive to reduce rubber scrap, the industry needs a clean and consistent raw naterial supply. Traders say the trend has been further intensified by the new technical standards required to make the steelbraced radials that have overtaken crossply tyres to become the biggest sellers. Indonesia is the second largest rubber producer after Malaysia. Already more than half of its rubber is channelled direct to the tyre manufactures-65 per cent to the US and around 20 percent to Japan.

In many respects tyre rubber is no longer a plantation commodity. One simple illustration is that Goodyear, the US tyre company which buys around 75 per cent of its rubber needs from indonesia, has now turned over its own Indonesian estates to the heigher valued latex production. In Indonesia today smallholders now account for more than 70 per cent of production, working in conditions more akin to a cottage industry. In total, there are around 3 million hectares of rubber trees more than in any other country. With relatively little additional investment current output of 1.25 million tonnes could be doubled.

Indonesia's other main advantage is its low costs. Labour costs, which account for about 50 per cent of the total on plantations, are largely absorbed in the smallholder sector.

Indonesia's priority is to improve its tree stock. According to officals, average annual yields are less than 500 kg a hectare, well below Malaysia's 1,000 or the 800 kg achived in Thailand.

Plantations typically are replanted every three to five years. In smallholdings Mr. Budiman says many of the trees are damaged by overtapping and need replacing.

"A rubber tree will produce for a week or 25 years, it just depends on how you tap it", he says.

The World Bank is supplying smallholders with new budgrafted planting meterials-some 100,000 hectares of smallholdings have been assisted at cost of Rs 1.5 million ($ 500) a hectare. And a new loan is currently under negotiation.

A more immediate concern is disease. Researchers are currently grappling with a defoliant which is causing extensive damage to the GTI, the most widespread rubber clone. Officials say it could be costly to contain. In an unusual move, the World Bank which funded the original project, is being asked to extend the payback period on its loan.

INTERNATIONAL CONFERENCE

The British Plastics and Rubber Institute is organising "Rubbercon 92" an international conference at the Metrople Hotel in Brighton, England in June 1992. The last meeting was held in 1987. The Conference will focus on advancements in elastomer science and technology, materials and applications, management, health and safety and enviromental and quality issues. The organisers are expecting participation of about 1000 delegates. Simultaneously an International rubber exhibition also will be held. The organisers are Crain Communications Inc and Promotions international of Holland. Further details on the "Rubbercon 92" can be had from the Plastics and Rubber Institute, 11 Hobart Place, London, England SW 1 WOHL.

NR PRODUCTION LOW

The Malaysian Rubber Exchange and Licensing Board revealed that the Natural Rubber production in Malaysia dropped to 1.42 million tonnes in 1989 from 1.66 million tonnes in 1988. The difference was to the tune of 240,000 tonnes. The shortfall was in rersponse to the call made by the Minister for Primary Industries to avert an excess supply situation. The result was the prompt response of the growers to cut back in production. However the fall in output forced the rubber processing factories in Malaysia to import more rubber for processing. Rubber crepe, cup lumps and scrap rubber grades totalling 121,706 tonnes was imported by Malaysia in 1989 against 46,718 tonnes in 1988. These were processed into value added technically specified rubbers (TSR) for export. Rubber exports from Malaysia totalled 1.49 million tonnes in 1989 compared to 1.61 million tonnes in 1988.

WOOD PROCESSING

The plantation Corporation of Kerala will undertake wood processing also. PCK has started a Wood Processing Unit in their Kodumon estate. A good number of their old Plantations is to be replanted and thus the trees to be felled could be chemically treated and utilized for manufacturing furniture and construction materials. Doors and windows made out of rubber are becoming more and more popular now-a-days. Hard wood appears to be very scarce in Kerala and therefore there is a great demand for cheaper woods suitable for making furniture and building materials. Now atleast a part of the requirement in Kerala for logs is met by import from countries like Malaysia. The State Housing Board which undertakes house constructions requires too much of wood and treated rubber wood will, no doubt, serve the purpose.

NEW ASSOCIATION

An Association to promote the use of rubber wood as an alternative to the fast depleting hard wood forest resources was inaugurated in Cochin on 23rd March 1990. Mr Justice K Sukumaran of the Kerala High Court delivered the inaugural address while the mayor of Cochin Mr KJ Sohan presided. An exhibition of rubber wood furniture was arranged to conncide with the inaugural function. Shri PC Cyriac IAS, Chairman, Rubber Boardinaugurated the exhibition at Rama Varma Club.

The Rubber Wood Devepment Association of India is a non-profit society of scientists, technologists and industrialists, aimed at creating an awareness among the people about the efficacy of rubber wood as timber suitable for quality furniture and other uses if properly treated with chemicals.

SHORT TERM COURSE

Rubber Technology Centre, Indian Institute of Technology, Kharagpur, is organising a Short Term Course on "COMPOSITES BASED ON RUBBER AND RUBBER LIKE MATERIALS" during 7-12th January 1991 at Kharagpur. The course will cover:

1. Developments of different composites;
2. Processing and Engineering Application ; and
3. Characterisation.

For further information please contact:

(Dr. (Mrs) Prajna P.DE)
(Dr. D. K. Khastgir)
Co- ordinators, Short Term Course on "Composities based on Rubber and Rubber like Materials".

IMPORT DUTY HIKE HITS TN PLASTICS UNITS

Nearly 2,000 small-scale plastics units in Tamil Nadu, employing over 50,000 people directly, face the threat of turning sick in the wake of the steep hike in basic customs duty on import of polymers effected recently.

According to spokesman of the Tamil Nadu Plastics manufacturers Association (TPMA) the increase in import duty would push up the prices of plastic items used by common men by as much 25 per cent. This, in turn, will result in substitutes taking over the market, affecting the viability of the plastics units.

Nutritional disorders of rubber commonly observed in India

Rubber plants are found to exhibit typical symptoms of nutritional disorders caused by deficient and or excessive supply of individual plant nutrients. Deficiency symptoms due to lack of Magnesium, Potassium and in some isolated cases Zinc and Manganese have been observed in our rubber nurseries and field plantings.

Of these Magnesium deficiency is the most commonly observed nutritional disorder. The characteristic symptom of Magnesium deficiency is the development of chlorosis (yellowing) in the interveinal areas on exposed mature leaves giving a herring bone pattern. The deficiency incidences are seldom seen in Kanyakumari district and in the northern part of the rubber tract consisting of Palghat, Malapuram, Kozhikode and Cannanore districts and in the northern parts of the rubber tract consisting of Palghat, Malapuram, Kozhikode and Cannanore in the plantations located in Central Kerala areas and or in cases where the rubber has been manured with excessive quantities of Muriate of potash.

Potassium deficiency is commonly found on rubber grown in highly impoverished soils.

The characteristic symptom of Potassium deficiency is the development of marginal and tip chlorosis which is followed by marginal necrosis. Only older leaves exhibit the deficiency symptoms. Size reduction of the lealves and the absence of herring bone pattern of yellowing allow Potassium deficiency symptoms to be distinguished from those of Magnesium deficiency.

Zinc deficiency causes intervenal chlorosis of leaves. The outstanding failures of the deficinecy are that the laminae become much reduced in breadth in proportion to their length and the young leaflet becomes incurved towards one another and present a hooked or claw appearance. Zinc deficiency incidences have been noted so far only in the case of young rubber plants either in the nursery or in the field. In most cases these deficiences were noticed to be only transient. The cause of the deficiency appears to be heavy applications of Rock phosphate in most cases resulting in poor availability of Zinc.

The typical Manganese deficiency symptom is an overall paling and yellowing of the leaf with bands or green tissue outlining the midrib and main veins. Though the deficiency is widespread in India, it has been found to be only very mild in intensity.

Apart from these disorders connected with nutrition problems such as precoagulation of latex on the tapping panel and excessive drainage of latex causing dryness of trees, have also been reported from rubber plantations. Of those, the precoagulation of latex on the tapping panel, has been found to be due to excessive supply of Magnesium to rubber. Also, there are indications to believe that unbalanced nutrition can cause excessive drainage of latex resulting in the dryness of trees.

The incidence of nutritional disorders mentioned above are known to affect the growth and productivity of rubber to a great extent. Therefore, the planters are advised to consult the Rubber Research Institute of India if any of these disorders is noticed in their plantations and to take necessary preventive measures without delay.

RUBBER BOARD BULLETIN

Vol. 25 Number 4 April - June, 1990

Chairman
(Smt.) J. Lalithambika I.A.S.

Rubber Production Commissioner
P. Mukundan Menon

Director of Research
Dr. M. R. Sethuraj

Project Officer
C. M. George

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THE QUARTER

The events that helped the systematic growth and development of rubber plantations in India deserve a careful study. A review of the different phases of development would reveal the fact that there has been consistent progress in rubber production in the country. Rubber cultivation which started on a commercial scale during the early part of this centuary showed remarkable progress in terms of area, production and productivity, often surpassing the targets fixed for. A close look at the performance of rubber during the VII Plan period shows that the targets have been exceeded in hewplanting, replanting etc. The following figures present a very optimistic note and provide us opportunities to visualise the future trends:

VII PLAN : PERFORMANCE OF RUBBER AT A GLANCE

Item	Unit	Target	Achievement	Excess over target
Production	tonnes	265,000	297,300	12%
New Plantation (North-East Region and Non-traditional area)	Hectares	21,000	22,000	5%
Total New Plantation/Replantation (including item 2)	Hectares	40,000	72,000	80%
Outlay	Rs/Crores	53.43	74.04	39%

PRODUCTION YIELD AND CONSUMPTION

		1984-85	1989-90	Growth
Production	Tonnes	186,450	297,300	59.5%
Consumption	Tonnes	217,510	341,840	57.2%
Yield Per hectare	(kg)	886	1,029	16.1%

The yield which stood at 886 Kg in 1984-85 had gone upto 1029 in 1989-90 registering a 16.1% growth rate while the production during the corresponding period rose from 186,450 to 297,300 showing a growth rate of 59.5%. The achievement of the VII Plan period augurs well especially when new beginning is made for adopting new strategy for the next plan period.

COMMENT

THE RUBBER (AMENDMENT) BILL 1990

The Rubber (Amendment) Bill introduced in the Lok Sabha (No. 124 of 1990) on 8th August 1990 seeks to enhance the rate of cess on natural rubber form the present 50 paise to Rs. 2 per kg. Generally a bill to enlarge the existing tariff will face opposition from one section or the other. The Rubber (Amendment) Bill is currently going through the same process. Both the rubber consuming sector and the rubber producing sector apprehend that the bill, if passed into law, would adversely affect their interests. The All India Rubber Industries Association has commented in a press statement that the bill apart from being one sided, imposes a heavy burden on the industry. The rubber growers have raised their voice of dissent fearing that the buyers may hand out a reduction in price corresponding to the hike in the cess.

The bill calls for a four fold rise from the existing rate, but the hike may not be imposed at one stroke. A piecemeal amplification commensurate to the fund requirements from time to time may be the obvious option. Precedents speak for themselves. The Rubber Act, 1947 envisaged collection of cess to the extent of 50 paise per kg of natural rubber produced in India. But initially the impost was at 50 paise per 100 lb (equal to 1.1 paise per kg). It was then raised to the level of 13.80 paise per kg in August 1955. In 1961 the rate was brought up to 30 paise and in July 1975 to 40 paise per kg. It was revised to the present level of 50 paise in August 1984. This increase of 10 Paise per kg. was for organising a fund to provide financial assistance to the rubber goods exporters under the NR subsidy scheme.

Generate own funds

The current outgo on rubber development programmes does not necessitate immediate revision of the rate beyond Re.1/ per kg. These programmes are undertaken by the Rubber Board to whom the Government make annual allocations in the Union budget. The expenditure of the Board during 1989/90 was Rs. 24.48 crores against collection of Rs. 14.15 crores into the cess fund. The budget allocation for 1990/91 is of the order of Rs. 29.75 crore while the expected cess collection is Rs. 15 crores. The revenue comes to about 50% of the expenditure. The Planning Commission has always been taking the stand that each sector should generate its own resources for development expenditure. This means that the NR has to generate enough resources from its own sector. Otherwise the programmes would come to be restricted to the resourcees avilable. It would not be feasible to meet the deficit from the revenue collections in the Consolidated Fund of India in the wake of a substantial growth in public expenditure. The Government was meeting the shortfall between the expenditure and the cess collection only as a short term measure, not as a tangible solution. Continuance of the development schemes already commenced during the VII Plan and those under implementation during the VIII Plan would necessitate increased expenditure per year. The Bill has been introduced to pave the way for collecting enough money to meet such growing expenses.

Cess well utilised

As is obvious, the cess on rubber is a development cess levied for promoting NR production in the country. The Government of India have been making allocations from the cess fund to expand the area under rubber and to improve the productive efficiency of the rubber holdings. Utilisation of cess has tremendously increased rubber output. The natural rubber production in India was around 15,000 tonnes in 1947. This successively rose to 297,300 tonnes during 1989/90. In about 42 years the production went up by 20 times. The development programmes undertaken assisted by the cess collection was largely responsible for this.

The rubber industry has also been making tremendous progress in India. Natural rubber is an important raw material for the industry. In 1947/48 India consumed 17,300 tonnes of NR. After 42 years in 1989/90, the consumption went up to 342,000 tonnes. This also comes to nearly twenty times the growth in just over a four decade period. It is necessary to produce enough NR to meet such impressive growth.

The gap between production and consumption of NR during 1989/90 was 45,000 tonnes. For about a decade the gap has been almost static aroud 15 per cent of the annual output. We have to bring it down and ultimately clear it. For that new measures in expansion of rubber area and improvement in yield per hectare are needed. These need more funds.

Position abroad

It has been the practice in many developing countries to levy development cess on commodities of great utility value for furthering the

Continued on Page 6.

J LALITHAMBIKA
CHAIRMAN, RUBBER BOARD.

Smt. J Lalithambika IAS took over as Chairman of the Rubber Board on 19 July 1990.

She brings to the Board rich administrative experience in various positions under the Government of Kerala such as District Collector of Kottayam and Trivandrum, Secretary to the Departments of Education, Health and SC/ST Development. She was in addition, Chairman of the Kerala State Womens' Development Corporation, Commissioner and Secretary, Rural Development and Secretary, Social Welfare Department. Rubber Board is not the first agriculture development institution she presides over; earlier she was Managing Director of the Agro Machinery Corporation.

She had a brilliant academic career consistently scoring top marks in school and college examinations. A postgraduate in English language and literature, she did her MBA at the University of Leeds, UK. She was selected to the Indian Administrative Service in 1966.

A well known writer in Malayalam with flourish, she has developed a unique style of her own. She wields a facile and fluent pen. The published works to her credit are 'Narmasallapam' and 'Mullum Malarum'. She is a regular columnist in leading Malayalam journals.

Smt Lalithambika is an able administrator and an eloquent orator.

Married to Sri Mohanachandran, IAS who is former Chairman of the Rubber Board and currently Secretary for Industries in the Government of Kerala, she is the first lady to preside over the Rubber Board.

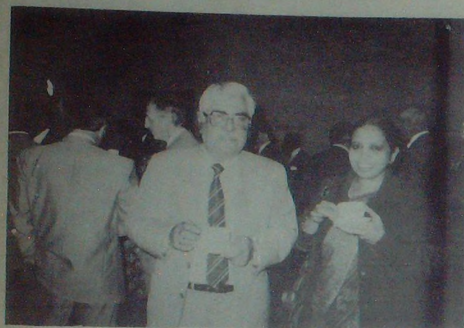
M. O. JOSEPH
SECRETARY, RUBBER BOARD

Shri. M.O. Joseph, formerly Joint Rubber Production Commissioner in the Rubber Board, has been appointed as the Secretary of the Board by the Government of India. He assumed charge of the post on 27th September 1990.

Having entered the service of the Board as early as 1956, Shri. Joseph has a long record of distinguished and dedicated service. He had made significant contributions in the field of implementation of various plantation development schemes and has substantially contributed to strengthening the organisational set up of the Rubber Production Department. He has also served in A & N Islands and in North Eastern States and played a key role in expansion of rubber cultivation to non-traditional regions. Shri. Joseph passed B. Sc and M.A. Degree Examinations from the University of Kerala and had undergone senior level management training courses.

Shri. Joseph who hails from Punalur belongs to Maramon Mannekkattil family. His wife Smt. Chinnamma is from Kallada family, Mavelikkara. His daughter Smt. Anitha and her husband, Reebu are lecturers in the T.K.M. Engineering College, Quilon. His son Jijo is an Engineer under the Kerala State Film Development Corporation.

THE INTERNATIONAL RUBBER STUDY



Smt. J. Lalithambika, Chairman, Rubber Board with Dr. B. C. Sekhar, Secretary General, International Rubber Study Group at the 32nd assembly

The Thirty second Assembly of the International Rubber Study Group (IRSG) was held from 10 to 14 September 1990 in the capital city of Canada-ottawa. Smt. J. Lalithambika IAS Chairman, Rubber Board attended the assembly as the Head of the Official Delegation from India. Delegates and advisers from 23 member countries of the IRSG as well as observers from Peoples Republic of China, Bulgaria, Gabon, Gautemala, Mexico, Papua New Guinea, Philippines and Tanzania attended the assembly.

There were 11 other international organisations concerned with natural and synthetic rubber production, manufacture, research and development as well as the rubber trade represented. In number, over 200 representatives from all sections of the world elastomer industry gathered in Ottawa to attend the Plenary sessions of the Assembly and the International Rubber Forum. The Forum takes place each year at the time of the IRSG Assembly and is world renowned for the quality and coverage of topical items relating to developments on the world elastomer scene.

RUBBER FORUM

The International Rubber Forum, held in conjunction with the annual meetings of the IRSG, always has a distinguished number of experts amongst its participants. This unique occasion in the world rubber calendar leads to extensive interactions during the question and answer period following each of the enlightening but provocative presentations.

A major success for the IRSG this year was to have four keynote lectures at its Forum. These keynote lectures covered between them a wide spectrum of the world rubber scene, as can be seen by the eminence of the speakers and their topics given below:-

The NR Industry - the Sri Lankan Contribution by the Hon R Wijeratne, Minister of Plantations, Sri. Lanka.

The Impact of Solution SBR on the Emulsion Process by Mr. R. J. Renninger, President, Synthetic Rubber Division, Firestone, USA

The Natural Rubber Industry Towards the Year 2000 and the Expanding African Contribution by the Hon J. N. Ngu, Minister of Agriculture, Cameroon

Synthetic Rubbers in the 1990s by Mr. G. Robert, Vice President, NOVA Petrochemicals Inc., Canada.

The Forum itself had five separate, but linked sessions and covered not only natural and synthetic rubber and their blends but also many aspects of the manufacturing and marketing of rubber.

MARKETING NEEDS ATTENTION

The question of emulsion SBR was addressed indicating future trends. The future is for solution elastomers with the time frame dictated by the economic life of existing emulsion SBR plants. Specialised synthetics, particularly engineering elastomers and thermoplastic elastomers, were declared as the growth areas in the coming decade. Apart from the quality of NR which is receiving close scrutiny and attention by producers of NR, the presentations made clear that the NR industry has a place in the speciality area, albeit with the necessary constraints. Marketing and market promotion were identified as areas requiring attention. There was considerable emphasis on globalisation, triangular or multifaceted cooperation across the board, the quality age, energy and the quality of the environment.

Technology trends in manufacturing clearly indicated that there will be no surprises in the elastomer mix that will be needed in the years ahead. Rolling resistance, precision in quality, cosmetics, energy use and safety standards will be the areas of concern.

The marketing of NR remained a vexing issue to be continuously addressed in the context of the changing environment with price determination and producer-consumer dialogues as critical issues.

longer term the evolving situation in the countries Eastern Europe with its movement towards "market oriented" economies should lead to an increased off-take of elastomers.

The result in supply/demand balances for natural and synthetic rubbers are given below:-

Canada as the host Government was elected Chairman of the Assembly in the person of Mr. W. Turner.

The next Assembly of the IRSG will be held in November 1991 at Yaounde, capital of Cameroon by the gracious invitation of the Hon J N Ngu, Minister of agriculture on behalf of the Govt of Cameroon. The Minister for Plantations of Sri Lanka, the Honourable R Wijeratne in accepting the Vice Chairmanship of the Group extended the invitation of his Government for holding the 1993 Assembly in Sri Lanka.

SUPPLY/DEMAND BALANCE
(000 tonnes)

NR Position	1989	1990	1991
Production	5110	5170	5425
Consumption	5225	5320	5510
Change in Stocks	-115	-150	-85
SR Position			
Production	10280	10315	10580
Consumption	10270	10345	10630
Change in Stocks	+10	-30	-50

GROUP AT OTTAWA 10 - 14 SEPT 1990

PLENARY SESSIONS

These sessions are in fact the "business" part of the Group's annual meetings. During the meeting of the Economic Committee the papers produced by the Secretariate under its Work Programme were reviewed.

The meeting of the Statistical Committee examined the production and consumption of natural and synthetic rubber for the years 1989 to 1991 in view of the Member Governments' statements on the "Outlook for Elastomers". There was general consensus that the next two years were going to range from "cautious uncertainty" to "business as usual". The continuing problems in the Gulf may have a short-term impact on the elastomer scene, whereas in the

Mr. Kuttaiha of Harrisons Malayalam, Mrs J. Lalithambika, Chairman, Rubber Board., Mr. D. S. Kulkarni, Editor "Rubber News", Dr. Hidde P. Smit, Free University Amsterdam at the International Rubber Forum.

Contd from Page 2.

output. Major rubber producing countries like Malaysia, Indonesia and Thailand impose export cess on the quantity of rubber sold out of the country. In addition, a separate cess is levied for meeting the expenses on research and development activities. Malaysia currently levies 13.77 cents per kg as cess for R & D activities. This comes to about 7 per cent of the price per kg. The export cess levied ad valorem, varies with the movement of rubber price in the international market. Thailand levies an export tax of 1.7 baht per kg of rubber sold abroad. In addition they make a levy on the NR produced for the Rubbber Replanting Aid Fund, to subsidise replantation of rubber and an R & D tax to pursue research activities, totalling 0.82 baht. Indonesia also makes similar levies. In all these rubber producing countries the cess element ranges from 10 to 15 per cent of the price of rubber per kilogram. At the same time, even at the maximum ceiling of Rs. 2 per kg, the cess element comes to only about 10% of the price in India. If the levy is raised immediately on passing the Bill to Re. 1/ per kg it would attract only 5% of the price realisation.

Past lessons

The Sub Group on Rubber of the Working Group on Plantation Crops constituted by the Government to draft the VII Plan proposals had recommended enhancing the cess on rubber to Re. 1/ per kg in 1984. While the Group's proposals came up for examinaton at a meeting of the Government official and the rubber industry's representatives, the latter opposed the recommendations. The Government did not introduce a bill in Parliament at tha' time to amend the Rubber Act and provide for revision of the rate of cess. The overall expenditure proposed by the Working Group was Rs. 150 crores for natural rubber development during the VII Plan period. But when it came up for consideration before the Planning Commission, resource constraint appeared as a major irritant to accept the proposal in toto. They wanted every crop to find resources from its own sector for development. The Commission curtailed the allocation to Rs. 53.43 crores. They were sizing down the plan to avilable resource. This had a depressing impact on the rubber developments during the VII Plan.

The Working Group had also proposed rubber development programmes in 135,000 hectares during the VII Plan period, composed of one lakh hectares of newplanting and 35,000 hectares of replanting under the Rubber Plantation Development Scheme. But owing to lack of funds the target was brought down to 40,000 hectares. The achievement was however about 72,000 hectares. That was possille largely owing to a liberal approach of the Ministry of Commerce. The Ministry improved upon the allocation of the funds for rubber under the annual plans locating savings from other heads, which ultimately resulted in an expendutire of Rs 74 crores during the VII Plan. If funds as proposed by the Sub Group were to be allotted, 63,000 hectares more would have come under rubber plantation during the VII Plan period. The NR availability as a result of this might have gone up at least by 90,000 tonnes from 1995.

Hard realities

Already a demand has been raised in certain quarters that the marketing system through auctioning as is prevalent in tea, should be introduced in rubber. Tea is a surplus commodity in India and a large chunk of the production is sold abroad. The auction system will not unduly push up its price in the internal market. On the contrary rubber is in short supply. If auctioning system is introduced, there will be competing bids by the big units for the available quantity. The price will rise very high and the quantity will flow to those who can afford to pay high. Small rubber manufacturing units will be the greatest sufferers; they will find it hard to acquire raw rubber. The improvement in the supply position could very well act as a restraining factor in escalation of price. If we do not attain self-sufficiency in NR in the near future, prices are sure to go up pegged up even by marginal shortages. Therefore the prudent course for the manufacturing sector woud be to encourage a step that will improve production of NR.

In the wake of the oil crisis and outgo of enormous amounts of foreign exchange on oil import, it would be very difficult to get foreign exchange allocations for import of commodites like NR, the shortage of which is marginal. The Government have of late suspended even import of 8 lakh tonnes of phosphoric acid, an essential feedstock of fertilisers. Import of ammonia, another fertiliser feedstock, also hangs in the balance. Chemical fertilisers are very essential to sustain the growth of agricultural production that we have achieved in recent times. If we fail to import rubber to meet the gap between demand and supply, the NR prices will go up further and show a tendency to approximate to the SR price in the country, which is nearly tendency to approximate to tne SR price in the country, which is nearly double the NR price at present. Since the petroleum products go up in price occasionally, the prospects for synthetic rubber production in India at a price affordable to the rubber industry is also bleak.

The grower's fear about reduction in price to the extent of the increased cess element is also not well founded. At present the cess of 50 paise per kg is not deducted from the price. The cess is collected from the manufactures. The manufacturers can charge the cess to the finished products as cess is accepted as a cost element in determination of the price of finished goods. In fact it is the general public who consume rubber goods that would come to bear the burden.

Taking all these factors into consideration, will it not be prudent for both the manufacturing and the rubber producing sectors to cooperate with the proposed legislation and ensure self-sufficiency in NR at the earliest opportunity?

—Thomas Ouseph.

NATURAL RUBBER PRODUCTION : PROSPECTS ON A LONG TERM BASIS*

P. Mukundan Menon
Rubber Production Commissioner
&
RG. Unni
Dy. Director (Statistics & Planning)
Rubber Board, Kottayam - 686 001.

Rubber plantation industry in India has recorded all round progress during the last 10 year period as can be seen from the following:

* Area under rubber increased from 2.62 lakh ha in 1979-80 to 4.40 lakh ha in 1989-90.
* Production of rubber more than doubled from 148,470 tonnes to 297,300 tonnes during the same period.
* Productivity measured in terms of yield per ha per year improved from 771 kg to 1,030 kg.
* Growth rate in production surpassed all major crops in the country recording 9.8 per cent growth during 7th Plan period.

The annual growth in the area, production and yield per hectare in the past decade were as shown in Annexure - 1.

As rubber planted on ground takes 6 to 7 years to start yielding, the impact of extensive new plantings and replantings carried out during the 7th Plan period will be visible only during the coming years. Thus the plantation industry is poised for giving further spectacular results.

Rubber goods manufacturing industry has also recorded remarkable progress during the decade. The consumption of rubber which is considered as the index of growth of rubber industry showed an average compound growth rate of 7.6 % per year during the period. During the last 5 year period alone, the average rate of growth had gone up 8.9 % per year. It is particularly noteworthy that the value of exports of rubber products had surged up from Rs. 22.83 crores to Rs. 214.87 crores during the ten year period.

The relevant parameters of rubber production are :

* Area under existing plantations.
* Future scales of newplanting & replanting.
* Choice of cultivars.
* Age structure of the trees on the ground.
* Technological advances in agronomic and production practices.
* Price of rubber.

1. Newplantation.

Rubber tree flourishes and yields best in warm, equable tropical climate. Such conditions are normally obntained at low elevations in certain regions of the world lying within 10° latitude on either side of the Equator. In India, Kanyakumari District of Tamilnadu, southern districts of Kerala and Nicobar group of islands are the only regions falling within this geographical limits. Areas lying outside this belt experience pronounced seasonal variations such as excessive rainfall, prolonged drought, low winter temperature etc which are all factors adversely affecting the growth and yield of rubber depending on the severity of the incidence of each or all of these climatic variations. Of the total existing area of 4.40 lakh ha, as much as 89 % is in Kerala and Kanyakumari District of Tamilnadu which together form the traditional rubber growing region of the country. The remaining 11 % is in non-traditional regions composed of North East States/Union Territories, Orissa, Andhra Pradesh, Karnataka, Goa and Konkan Region of Maharashtra, Andaman & Nicobar Islands etc.

Expansion of rubber cultivation in the traditional region can be only limited in view of the high pressure on land. Non-traditional areas, on the other hand, offer very good scope for extension planting. According to the tentative estimates of the Rubber Board, this can be of the order of 1.2 million ha as shown below :

Assam	:	200,000 ha
Tripura	:	100,000 "

* Paper presented at the Seminar on availability and growth of rubbers in India by 2000 AD organized by the All India Rubber Industries Association, Southern Region at Cochin on 7th July, 1990.

Meghalaya	:	50,000 ha
Mizoram	:	50,000 "
Other NE States	:	50,000 "
A & N Islands	:	50,000 "
Orissa	:	200,000 "
MP (Bastar Dt.)	:	100,000 "
Goa & Konkan Region	:	100,000 "
Karnataka	:	150,000 "
Andhra-Pradesh	:	100,000 "
West Bengal	:	50,000 "
TOTAL	:	**1,200,000 ha**

The availability of these areas would, however, depend on release of waste lands and degraded forest lands for cultivation. Taking into account the potential vis a vis various constraints, the target proposed for expansion during the 8th Five Year Plan period is 80,000 ha comprising 65,000 ha in non-traditional areas and 15,000 ha in traditional areas. The pattern of growth of rubber area in traditional and non-traditional regions during the last two Plan periods was as shown in Table I :

The ground work done during the 7th Plan period in non-traditional areas would facilitate large scale development in the coming years. For achieving the overall target, it would be necessary to offer on continued basis all the existing forms of assistance with upward revision of financial assistance commensurate with increased cost of cultivation. When the entire targeted area of 80,000 ha would reach full yielding stage,the production therefrom would be of the order of 120,000 tonnes.

TABLE I

		6th Plan period	7th Plan period
Traditional	:	82,000 ha	63,000 ha
Non-traditional	:	9,000 ha	25,000 ha
Total	:	91,000 ha	88,000 ha

2. Structure of existing area and replantation.

The old plantations require immediate replantation. The target proposed for replantation during the 8th Plan period is 40,000 ha. The achievement in this regard during 7th Plan period was 23,000 ha. Almost the entire area requiring replantation is in tradiltional region and to a small extent in Karnataka State. Increased financial and technical assistance is necessary to achieve the target as in the case of newplantation. When the entire area of 40,000 ha reaches full yielding stage, the net increase in production therefrom would be 72,000 tonnes.

Age structure of the existing rubber area is estimated as under :

		('000 ha)
5 years and less old	:	110
6 to 16 years	:	157
16 to 25 years	:	72
26 to 30 years	:	63
Above 30 Years (old area)	:	38
Total	:	440

3. Choice of cultivars.

Genetic improvement through breeding and selection has brought about significant improvement in productivity. With unselected seedlings used as planting materials in the initial years of rubber cultivation, productivity was only around 300 kg per ha. Systematic breeding and selection, which followed subsequently, have brought about development of a good number of high yielding varieties some of which have a production potential of around 3,000 kg ha. The clone RRII 105 evolved and released by the Rubber Research Institute of India during the close of 1970's and now in extensive use yields between 2,000 to 3,000 kg per ha. The high yielding cultivars now under use would provide the mainstay for continued productivity improvement.

4. Reduction of pre-bearing period.

The pre-bearing period of rubber has been around 7 years. Technology has now been developed for obtaining early maturity. Introduction of various agro-management techniques like planting of polybagged plants of advanced growth, balanced nutrition, early branch induction, irrigation, scientific cover crop management, proper soil and moisture conservation, timely and effective protection of plants from diseases and pests etc are helpful in this regard and hese are being popularised amongst all categories of growers. It should therefore be possible to ensure that the immaturity period of rubber is by and large reduced to 5 or 6 years. However, for purposes of projecting the production, the average pre-bearing period is assumed as 6 years.

5. Short term measures for enhancing production.

Production from existing plantations can be enhanced significantly through adoption of discriminatory fertiliser application based on soil and leaf analyses, systematic plant protection, efficient crop exploitation through improved methods of tapping, rainguarding rubber trees for enabling tapping during rainy season and chemical stimulation of yield in older plantations. Productivity enhancement so achieved can range from 10 per cent to 50 per cent depending upon various factors. In order to tap this potential in small holdings, the Board has evolved schemes and the action programmes which include :

* Organising small holders under the Rubber Producers' Societies (RPSs) which *inter alia* would enable identification of small holdings requiring adoption of each of the above technologies and act as vehicle for effective transfer of technology.
* Educating, motivating and training the identified small holders for adoption of the improved practices.
* Supplying the required inputs to small holders through the RPSs and making them use the inputs in the prescribed manner.

The Rubber Producers' Societies are organised at the village level and registered under Charitable Societies Act. Each society covers a service area of 2 to 3 km radius and membership of 50 to 250 small holders. About 1000 such societies have been already established and the target is to increase the number to 3,000 by the end of 8th Plan. Material inputs such as fertilisers, fungicides, sprayers, yield stimulants, rainguarding materials, tapping and processing equipments are procured in bulk and distributed with marginal price concessions. The target is to bring 50,000 ha of small holder rubber under this productivity improvement programme during the first year and to progressively increase it thereafter to 250,000 ha by the end of 8th Plan.

6. Price.

Maintenance of a steady and remunerative price is essential for the sustained development of the rubber plantation industry. Small holders react very quickly to price changes. During 1970-75 period when the market price was below the remunerative level, there was steep fall in planting tempo and price support operations including export of small quantity of rubber had to be carried out. During this period, a considerable number of small growers even replanted their holdlings with other crops. Newplanting during 1971-77 fell to around 3,000 ha per year as against 6,000 ha during 1963-70 and 13,000 ha during 1956-62. The recovery of price in the 1980s and introduction of new plantation development schemes brought about a spurt in planting in the 1980s to the average level of 18,000 ha per year.

Projection of production of NR.

Projection of production can be based more or less on reasonably predictable criteria under the prevailing market conditions, with the exception of climatic factor which however can bring in only transient variations in the general trend. The position in regard to demand projection is however far different as it involves many imponderables which are being touched upon briefly later in this paper. A glance through the various earlier projections and forecasts both on supply and demand, vide Annexure-2, would reveal how unknown and hidden factors had resulted in the actual developments getting far removed from those anticipated. However, the exercise of looking towards the future and preparing ourselves for whatever that can be reasonably anticipated will have to continue as an essential and inescapable part of long term planning for development.

Taking into consideration the various parameters that could touch upon NR production and the position obtaining against each as discussed above, production of NR upto the year 2,000 can be in fairness projected as shown below.

Projected production of natural rubber.

Year	Total area ('000 ha)	Tapped area ('000 ha)	Yield (kg/ha)	Production ('000 tonnes)
1990-91	454	312	1075	335
1991-92	469	329	1125	370
1992-93	485	343	1180	405
1993-94	502	358	1240	444
1994-95	520	370	1300	481
2000-01	640	460	1500	690

Synthetic rubber.

Synthetic rubber is produced mainly in two factories owned by M/s. Synthetics & Chemicals Ltd., and M/s. Indian Petro Chemicals Corporation Ltd. The first unit which is producing Styrene Butadiene Rubber (SBR) and Nitrile Rubber (NBR) is now expanding its SBR capacity to 80,000 tonnes and NBR capacity to 7,500 tonnes with Government approval. M/s. IPCL are producing Polybutadiene Rubber (BR) and the licensed capacity of the unit is 20,000 tonnes. They have proposed enhancement of the capacity to 50,000 tonnes by 1992. According to the norms laid down by the Government of India, the minimum economic size of SBR and BR units in Indian canditions are 100,000 tonnes and 50,000 tonnes respectively. The SBR capacity of M/s.Synthetics & Chemicals Ltd could ultimately go up to 100,000 tonnes. Two small units viz., M/s. APAR(P) Ltd., and M/s. Asian Paints Ltd are also producing synthetic rubber in limited quantities. The former unit is manufacturing SBR with a capacity of 3,000 tonnes. The company is now also implementing a project for producing NBR with a capacity of 6,000 tonnes per year, M/s. Asian Paints Ltd are manufacturing SBR latex, VP latex and NBR latex with a total capacity of round 2,000 tonnes. M/s. Herdilia Chemicals Ltd are creating capacity for manufacturing Ethylene Propylene rubber (EPDM)to an extent of 10,000 tonnes per year.

Thus the total production capacity of various types of BR by the mid 1990s will be around 178,000 tonnes made up of 153,000 tonnes of general purpose varieties (SBR & BR) and around 25,000 tonnes of special purpose varieties. Rubber goods manufacturing lindustry requires a variety of other special purpose rubbers also of which Butyl rubber (IIR) is the most important one. About 16,000 tonnes of IIR is now imported annually. Its demand could more than double towards the turn of this century. The minimum economic size of an IIR plant being 25,000 tonnes, there is scope for its indigeneous production. Already three firms have made proposals for establishing Butyl units. If at least one of them succeeds in the venture, the country would be in a position to dispense with continued imports of IIR. Requirement of each of the

other special puprpose rubbers is rather limited and hence it may not be economical to produce those indigenously. The total import of these varieties may be only 10,000 to 20,000 tonnes per year during 1990s.

Projection of rubber consumption

Rubber is the basic raw material required for manufacture of a large variety of products. The pattern of use shows that automobile tyre and tube sector is by far the single largest user of rubber accounting for 48.4% of the total consumption of NR and SR. The other important sectors are of cycle tyres and tubes (12.1%), footwears (11.6%), belts and hoses (7.0%), tyre retreads (6.5%), latex foam (3.8%) and dipped goods (3.1%), vide Annexure 3. About 95% of the output of various rubber products is used for domestic consumption and only about 5% is exported. 1980s witnessed an upsurge of the general manufacturing activities as a result of easing of import restrictions, relaxation of Government controls and general improvement of investment climate. The recent announcment of de-licensing of tyre industry is another beneficial move in this direction. As a result of all these, the annual compound growth of rubber consumption during 1979-80 to 1989-90 went up to 7.6% as against 6.0% in the previous decade, vide Annexure 4.

With the advances in the areas of transportation, industrial production and agricultural activities and excellent potential for increased exports, the demand for rubber products in India is bound to increase. The fast growing motor vehicle population would result in increased demand for tyres and tubes and tyre products. There are reports that 4 large automobile tyre units are being newly set up. However, some of the recent developments in rubber technology help to increase the service period of many products which may in turn also adversely affect the growth and demand for rubber. Switch over from conventional cross ply tyres to radial ply tyres for automobiles, wide-spread use of pre-cured retreading and down sizing of motor vehicles and resulting shift to small size tyres are some of the examples. Implementation of recent amendments to Motor Vehicles Act is also reported to bring in a negative effect in the demand for rubber. Production trend of different types of tyres during the last one decade reveals that the growth is highly biased towards small size tyres, vide Annexure 5.

Forecasts available also indicate that the future demand will be more for two and three wheeler tyres and passenger car tyres compared to truck and bus tyres. Whereas bus and truck tyres now account for 70% of the total production of auto tyres and tubes in tonnage, ATMA has reported that the domestic demand growth for truck and bus tyres can be "optimistically estimated at 3% per annum during the 8th Plan period". It is however possible that this estimate could not have absorbed the likely impact of the recent Government ordered curbs on the use of petroleum fuels. It might not be out of tune with the existing outlook to conclude that there would be a slow down in growth rate in demand for rubber in the auto tyre & tube sector. However, the demand in the non-tyre sector, especially in regard to cycle tyres & tubes, conveyor & transmission belting, foot-wear, examination & surgical gloves, condoms, etc could keep burgeoning.

Exports of tyres and tubes and other rubber products are expected to pick up substantially over the coming years. At present only about 5% of the turn-over of rubber products is exported. Various incentives are given for exports like subsidy to compensate the difference between Indian and international price of NR, cash compensatory support, duty draw back and favourable export credit. Many NR producing countries with developing economy are earning substantial amount of foreign exchange through the export of rubber products, as shown below:

Export of rubber products in million US$

India	(1988)	:	79
Malaysia	(1988)	:	397
Indonesia	(1987)	:	43
Thailand	(1987)	:	110

It may be seen from the above that factors that are to decide the future demand of rubber are not only numerous but also complex and difficult to yield any firm conclusions. It would, therefore, be only prudent to aim at a projection within a range comprising of a low, medium or acceptable and high estimates. The medium or acceptable levels of estimates might themselves follow a growth rate ranging from 8% in 1990-91 gradually declining to 6.5% by 2000-01 in view of the fact that during the 10 years from 1980-81 the average annual growth rate has been 7.6% and that during the 5 year period from 1985-86 to 1989-90 alone it was 8.9%. On this basis, the consumption during 1994-95 would reach a level between 5.93 lakh tonnes and 6.51 lakh tonnes and by 2000-01 it would be between 8.12 lakh tonnes and 10.03 lakh tonnes, vide table given below:

Projection of Consumption of NR and SR

('000 tonnes)

	Low	Medium (Reasonable)	High
1979(Actual)	433	433	433
1994-95	593	621	651
2000-01	812	906	1003

Some of the recent forecasts of production and consumption of NR and SR for 2000 AD are excerpted in Annexure 6 for comparison.

The average pattern of use of NR and SR in the country during 1989-90 was in the ratio 79:21 as against a global ratio of 34:66. There can be change in the use pattern in future mainly depending upon the availability and ralative price of NR and SR. Domestic prices of SBR and BR are right now 70% and 25% higher than that of NR for comparable grades. With the implementation of expansion programmes and utilisation of full capacities, economies of scale could be derived with the result that prices of SR could come down. It would, however, be too much to expect SR to become lower priced than NR in any foreseeable future.

In the circumstances, the ratio of NR & SR usage which averaged around 78:22 during the 7th Plan

period may remain more or less unchanged in the coming years. On this basis, the break up of use of NR & SR during 1994-95 and 2000-01 would be as follows:

Share of NR in total projected consumption

('000 tonnes)

	Low	Medium (Reasonable)	High
1994-95	462	484	508
2000-01	633	707	782

In conclusion, it may be stated that domestic production capacity of general purpose SR does not require to be augmented by establishing additional units till at least the turn of this century. Establishment of a Butyl rubber plant with capacity of 25,000 to 30,000 tonnes capacity would be a highly welcome addition to the rubber industry in India. As regards NR, the country is poised for achieving short term self sufficiency in supply by 1994-95 or even earlier. There could be marginal deficits by 2000-01 which could also be matched by production by suitably gearing up production efforts. Temporary or short-term surpluses in production during certain years cannot altogether be ruled out. In that event, the country would have to undertake exports as well.

Annexure - 1

AREA, PRODUCTION & YIELD PER HECTARE OF RUBBER

Year	Total area ('000 ha)	Tapped area ('000 ha)	Yield per ha (kg)	Production (tonnes)	Growth in production (%)
1979-80	262	193	771	148,470	
1980-81	278	194	788	153,100	3.1
1981-82	296	196	779	152,870	-
1982-83	313	200	830	165,850	8.5
1983-84	332	205	857	175,280	5.7
1984-85	352	211	886	186,450	6.4
1985-86	369	223	890	200,465	7.5
1986-87	389	237	926	219,520	9.5
1987-88	405	249	944	235,197	7.1
1988-89	423*	266	974	259,172	10.2
1989-90	440*	289	1030	297,300	14.7

* Provisional.

Annexure - 2

Forecasts of consumption and production made in the past for 1989-90 vis-a-vis actuals obtained.

		Consumption		Production ('000 tonnes)
1. NCAER (1980) (Sponsered by AIRIA)				
	NR	386	Low	216
			High	235
	SR	97	Low	42
			High	57
		483		**258/292**
2 Sub Group on Rubber (1980)				
	NR	342		268
	SR	63*		
		405		
(*SBR, BR, Butyl only)				
3. R.G. UNNY (1980) (Rubber Board)				
	NR	370		290
4. HIDDE P. SMITH (1983)	NR	-		200
5. K M. PHILIP (1980)	NR			
	SR	425		225
				61
Actuals	NR	342		297
	SR	91		53
		433		**350**

The above figures indicate that the consumption forecasts are generally on the high side while production forecasts are on the lower side.

Sources: 1. 'Ten Year Pespective Plan for Rubber'
2. 'VI Five Year Plan for Rubber'
3. 'Study on production potential of NR upto 2000 AD'
4. 'Demand & Supply of Rubber, Un ESCAP"
5. 'Review of the pattern of demand & supply in the 1980's and measures t aken to bridge the gap' AIRIA Seminar in New Delhi on Sept. 1980.

Annexure - 3

Usage pattern of rubber during 1988-89

tonnes

		Natural	Synthetic	Total	Percen-tage share
1.	Auto tyres & tubes*	148,088	44,407	192,495	48.4
2.	Cycle tyres & tubes	38,210	10,012	48,012	12.1
3.	Tyre retreades	21,611	4,153	25,764	6.5
4.	Footwears	33,891	12,263	46,154	11.6
5.	Belts & hoses	21,724	6,212	27,936	7.0
6.	Latex Foam	15,230	-	15,230	3.8
7.	Dipped goods	12,236	-	12,236	3.1
8.	Others	22,840	7,103	29,943	7.5
	Total	313,830	84,150	397,980	100.00

(*Including tractor, ADV, off the Road & Aero).

Annexure - 4

CONSUMPTION OF RUBBER

	Natural	Sunthetic (tonnes)	Total	Incease %
1979-80	165,245	43,238	208,483	
1980-81	173,630	47,050	220,680	5.9
1981-82	188,420	52,650	241,070	9.2
1982-83	195,545	55,250	250,795	4.0
1983-84	209,450	62,300	271,780	8.4
1984-85	217,530	85,000	282,910	4.1
1985-86	237,440	70,035	307,475	8.7
1986-87	257,305	71,765	329,090	7.0
1987-88	287,480	76,410	363,890	10.6
1988-89	313,830	84,150	897,980	9.4
1989-90	341,840	91,055	432,895	8.8

Annexure - 5

GROWTH OF PRODUCTION OF AUTO-TYRES

('000 Nos.)

		1979	1988 (Provisional)	Growth %
1.	Truck & bus	2,858	4,872	70.5
2.	Light truck & Jeep	609	1,296	112.8
3.	Motor Car	1,057	1,969	86.3
4.	Motor Cycle & Scooter	1,820	5,704	213.4
5.	All (including others)	7,275	17,800	144.7

ANNEXURE - 6

Some of the recent forecasts of consumption and production of rubber for 2000 AD (1000 tonnes)

		Consumption			Production	Consumption Ratio
		NR	SR	Total	NR	(NR : Sr)
1.	Dr BC Sekhar (1987) (Study sponsored by AIRIA)					
	Conservative	483	136	619	436	78 : 22
	Pragmatic	559	158	716	480	78 : 22
	Optimistic	646	180	828	574	78 : 22
2.	IRSG/ESI (1988)	490	148	638	500	77 : 22
3.	AIRIA (1989) (Forecast for 1999-01	745	200	945	-	78 : 22
4.	KK. Philip (1988)			835	444	

1. 'Natural Rubber Supply in India, Scenario upto 200 AD.'
2. 'World Rubber Economy, changes and challenges' IRSG and Economics and Social Institute, Amsterdam.
3. 'Address of President of AIRIA - Sept 1989.
4. 'Estimate on Elastomer Requirments of Rubber Industry upto 200 AD'.

Do insects talk ?

Depending on the season, many places resound with insect music. Crickets, locusts, katydids and others call incessantly in aid of love and war — or courtship and defence, to use the biologist's less emotive terms. But what of insect talk?

Entomologist Philip J. DeVries of the University of Texas at Austin (US) has found that caterpillars of a number of butterfly species communicate with ants by tapping on leaves and twigs. The sound travels through the leafy twiggy substrate rather than through the air. Its purpose seems to be to recruit an ant bodyguard for the caterpillar.

In a research paper in Science,. he says that it is one of those mutually beneficial arrangements that econogists call symbiosis. The caterpillars produce amino acids, sugar secretions and other goodies that the ants collect. The ants, in turn, protect the caterpillars. In fact, Dr. DeVries says, if insect predators find one of these caterpillars without the anti bodyguard, the caterpillar has "no chance of survival".

If that was all there were to it, the caterpillars would get the worst of the bargain, for the ants would tend simply to collect the food and run off to their nests. Thus, as Dr De Vries notes. "There is a premium for any caterpillar species involved in symbiosis with ants to maintain a constant cadre of ant guards." Ants communicate by vibration. The caterpillars have "learned" the ants' vibration language. They tap out calls that "persuade" ants to linger and defend them.

Here is a finding that points to a previously unknown aspect of insect evolution, Dr. De Vries explains that "our current understanding of insect communication suggests that accoustical signal evolved in response to courtship and rivalry, mate recognition, short-distant communication between colony members of social insects, or as defence. Now, this study points to the possibility that, under selection for symbiotic associations, the calls of one insect species have evolved to attract other, distantly related insect species."

The caterpillars involved belong to the Riodinidae and Lycaenidae butterfly families — the only butterfly families in which some members are known to form symbiosis with ants. Dr. DeVries notes that, until now, entomologists did not know butterfly caterpillars made sounds or that sound was involved in symbotic relationships with ants.

But, as he researched the subject, Dr. DeVries found that the ability of butterfily caterpillars to tap out calls has evolved independently at least three times — twice among riodinid species and once among the lycaenids. Moreover, it has always evolved as part of a relationship with ants. His survey covers butterfly species from Australia, South Central and North America, Europe and Thailand. He also carried out experiments, in the field in Panama and in the laboratory.

Speculation as to whether insects can be said to think or be conscious is controversial and is dismissed by many biologists. But there are many subtle modes of insect communication. Eveny chirp, buzz or tap has a meaning.

AN INTEGRATED MODERN APPROACH FOR BETTER UTILISATION OF RUBBER

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INTRODUCTION

The first attempt to plant rubber tree (Hevea brasiliensis) was made in India in the teak plantations of Nilambur in 1879 and commercial plantation was started around 1900. Today India is one of the leading rubber growing countries of the world.

Latex is the main source of income from rubber tree. The economic life of this tree is about 30 years of which the initial 5 years is not suitable for tapping. After about 25-30 years of planting, the yield of latex becomes gradually reduced and the tree is available for slaughter tapping and is felled for replanting.

On a reasonable estimate around 1.2 million cubic metres of woood is available per annum from felled trees of rubber plantations in India. Since replanting is a regular feature, availability of rubber wood is likely to be uninterrupted.

With ever increasing demand along with the fast depletion of forest, the prices of naturally durable conventional timbers have sky-rocketed recently and are beyond the economic means of an average man. With the increasing demand for housing especially for the weaker sections of the society it is imperative that supply of low cost chemically treated rubber wood is augmented and will be a boon for them. In accordance with the National Forest Policy 1988 the department of Environment and Forest proposed to stop the extraction of major forest produces like timber by the end of the Eighth Plan. As a result rubber wood becomes the only available source of timber and would be a viable substitute for traditional commercial timber.

The main cause of bio-degradation of converted rubber wood is the attack by insect borers of which the attack of "Synoxylon Anale" is the most serious. These beetles bore into planks and riddle them with holes. Rubber wood develops sapstain within a few days after conversion and various types of fungus attack the wood of which the attack of Botryodiplodia theobromae is very serious. In addition to attack by these blue stain fungus, serious attacks by surface moulds such as Asperingillus sp. and Pencillium sp. on the surface of the fresh rubber wood are a frequent occurrence. Sapstain discolours the wood and mould and fungus degrade the wood thus rendering it inferior or useless. But after proper preservative treatment and kiln seasoning rubber wood can be used for the manufacture of numerous useful articles viz. door and window components, furniture, parquet flooring, wall panelling, interior decoration, tool handles etc.

General characteristic properties

Rubber wood is a homogenous pale straw coloured wood with a density of about 620 kg per cubic meter. The wood has straight grains and a moderately coarse texture without any characteristic odour.

Strength properties

The strength properties of Rubber wood are comparable to sal indicating that it is sufficiently strong for furniture, door and window components. A comparison of the strength properties of rubber wood with teak wood is given in Table I.

Machining properties

Rubber wood is fairly easy to resaw, cross out, plane, bore and turn. In a nutshell it has good machining properties for making furniture, door and window components.

Seasoning properties

Rubber wood can be dried rapidly. A 28 mm plank takes 4 days and 63 x 105 mm frames take 13 days to kiln dry from green conditions. Spring bow and twist are common but not too severe and can be minimised by proper kiln drying.

Durability

One of the major draw backs of rubber wood for construction purposes is its non-durability as it is easily attacked by wood destroying insects and fungus and thereby leads to biodegradation. The key to the successful utilisation of rubber wood for the manufacture of useful articles like furniture, building components etc lies in effective preservative treatment.

A modern approach for a better utilisation of rubber wood

Rubber wood should have the following characteristics for its viable utilisation.

(a) Adequate strength properties

(b) Durability

(c) Easy workability - easy to machine and not too dense.

(d) Good nail and screw holding capacity

(e) Amenability to pressure treatment with preservative chemicals - easily permeable

(f) Can be seasoned easily

(g) Negligible distrotion while drying

(h) Good finish after painting and polishing

In order to achieve these parameters, series of steps have to be taken.

I. Felling

Normally only about 35% - 40% output is obtained during rubber wood processing. For high wood recovery the rubber wood logs should be fairly cylindrical and reasonably large, preferably greater than 25 cm diameter. The Rubber Research Institute of Malaysia suggests that rubber wood logs are to be treated soon after it is felled and not to be stored for more than one month. So immediately after felling the ends of rubber wood logs should be given a chemical treatment by brush coating with sodium pentachlorophenate (NaPCP) in terpentine or with ASCU teak oil.

II. Sawing

The freshly felled rubber wood logs should be converted into sawn sizes, and given a prophylactic treatment with Na PCP solution and boron compounds. During sawing the pith and heart should be excluded.

Freshly sawn rubber wood develops sapstain within a few days after conversion and various types of fungus attack the wood during subsequent storage and transportation. Sapstain discolours the wood and mould and decay fungus degrade the wood. In order to avoid sapstain the surface treatment should be given within 72 hours after sawing. This prophylactic treatment comprises of dipping the sawn sizes in 1% sodium pentachlorophenate solution and 10% boric acid equivalent solution for about 30 minutes. A 10% ply save (manufactured by M/s. Borax Morarji Ltd., Bombay) solution can also be used for initial surface treatment.

III. Air drying

Freshly sawn rubber wood has a moisture content of about 65%-70%. The prophylactically treated sawn rubber wood sizes are

Table I
Physical and Mechanical properties of Rubber Wood

Species & Trade Name	Seasoning condition	Moisture content %	Sp gravity	Wt.at given m.c.	Static MOR Kg/cm2	bending MOE Kg/cm2	Compression parallel to grain	Compression Perpendicular to grain	Hardness Side (Kg)	Hardness End (Kg)	Shear parallel to grain	Tension perpendicular to grain
TECTONA GRANDIS	Green	76	0.0596	1053	841	109.7	415	86	554	486	94.9	73.9
" TEAK	Dry	12	0.604	676	959	119.6	532	101	512	488	102.3	62.0
HEVEA BRASILIENSIS	Green	81-2	0.521	944	437	55.6	200	47	310	309	77.1	47.4
"RUBBER WOOD	Dry	12-0	0.557	624	756	82.0	374	101	538	627	113.6	59.8

stacked in shade with 2" reeper for air seasoning to reduce the moisture content to 20%. Air seasoning will take 15 days time for 1" thick planks depending on the prevailing weather conditions.

IV. Pressure impregnation

The pressure impregnation is easy with rubber wood and it is easily permeable. After air seasoning the charge is introduced into a pressure treatment cylinder. The door is tightly closed and a vacuum is applied. The object of this operation is to remove as much air as possible from the cells of timber. At the end of the vacuum treatment, copper-chrome-arsenic solution is introduced into the cylinder, and hydrolic pressure is increased. This injects the preservative into the cells of the timber. The penetration should be such that the treated wood has a net chemical retention of 0.5 – 0.7 lbs for cubic ft. The chemical inpregnated rubber wood is then taken out and stacked for air seasoning to attain an equilibrium moisture content ranging from 14% to 19% and then send to kiln drying and machining.

V. Kiln drying

In India kiln seasoning is being done in three different ways.

1. By using conventional steam kiln.
2. By using a heat pump working on refrigerent principle (ASCU-India Heat Pump).
3. By using dehumidifier working on desicant adsorption principle (Dry-Air)

In Europe and East Asian countries better energy efficient seasoning systems are available viz. kiln working on super heated steam (Danish Wood Treating Co.)

Dehumidifier (Muhlbock, Austria), Dehumidifier (Arrowsmith U. K.), Seasoning Kiln (Malroop).

Warping and end splitting are the common defects occurring during kiln seasoning but can be minimised by proper kiln drying schedule.

VI. Machining and sanding

Rubber wood can be machined very easily. It is easy to re-saw, cross cut, plane, bore and turn.

VII. Nail and screw holding capacity

Rubber wood has good nail and screws holding capacity. This has been tested as per Indian Standard Specification using nail and screw pulling test and the values are given in Table II.

TABLE II

Nail and Screw holding capacity of Rubber Wood

Test as per IS 1708 - 1969

		Nail pulling test	Screw pulling test
1.	Average of the Radial Tangential values (in kg.)	91	267
2.	Average of the end values (in Kg.)	53	164

VIII. Painting and varnishing

Many samples of rubber wood have been tested using accelerated weathering tests. These have been finished with different types of paints such as acryline, enamel, urethene, and standard varnishes. In all tests painted surfaces or rubber wood has performed as well as the control teak samples. Rubber wood takes a good gloss. It gives mirror finish with malemene lacquor.

Suggestions for the promotion of treated rubber wood

1. In India, during replanting budgrafted planting materials have become popular. Budded trees have lower girth. The out turn from budded trees will be rather small and cannot be used for manufacture of building materials as it requires large scetion. So the Rubber Board and other Government agencies should promote and popularise replanting with clonal materials which give high wood content.
2. There is a general apprehension, especially in Kerala, for the acceptance of rubber wood as an alternative for conventional wood. Rubber wood can be used as a viable substitute for conventional timber only if it is properly treated with preservatives and kiln dried. So a governing body or agency should monitor the working or rubber wood processing units in order to assure that only properly

TABLE III

A comparative study of strength properties and cost of Treated Rubber Wood with Teak and Mango Wood

Species of wood	Sp. gravity	Wt.at given MC	Static MOR Kg/cm^2	Bending MOE Kg/cm^2	Compress-ion perpen-dicular to grain Kg/cm2	Impact bending CM	Cost of sawn timber per cft
Teak wood	0.604	676	811	109.7	101	91	Rs.600
Treated Ruber wood	0.557	624	756	82.0	101	75	Rs100
Mango Wood	0.495	620	612	91.0	94	66	Rs. 250

Durability : Chemical Inpregnated rubber wood is as durable as teak wood at 1/6th prices.

Appearance : Grain pattern, like teak wood and appearance like white cedar.

processed rubber wood is coming to the market.

3. Since utilisation of processed rubber wood is in its infant stage in India getting a public acceptance is not an easy task. So the Rubber Board and other Government agencies should take steps to promote this new product in India.
4. Rubber Board should take initiative to include processed rubber wood in ISI as a semi hard wood suitable for making furiture and building materials.
5. Since treated Rubber wood products are popular abroad, Rubber Board should help SSI units to explore the export market for treated rubber wood articles.

CONCLUSION

Rubber wood with its inherant properties such as attractive apperance, grain pattern, lower density, and easy workability makes it a versatile timber suitable for the manufacture of numerous products such as furniture, door and window components, parquet flooring, wall panelling, interior finishing, cabinet making, tool handles moulded products etc. Rubber wood should be used in larger quantities and has a promise of a low cost and dependable timber in India. Utilisation of rubber wood will spare other costlier timbers like teak and rose wood for sophisticated uses. Wider utilisation of rubber wood will also indirectly help to conserve our national forest wealth and thereby maintain the ecological balance.

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DIFFERENTIAL NATURAL DECAY RESISTANCE OF *HEVEA BRASILIENSIS* (RUBBER WOOD)

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INTRODUCTION

Hevea Brasiliensis Muell arg. (Rubber Wood) is primarily grown in Kerala, Tamil Nadu and Karnataka States. Recently this wood has assumed importance as a suitable raw material in industrial and low cost furniture.

However, its wider utilisation is hampered by the high susceptibility to sap stain fungi and insects. Our knowledge of the resistance of rubber wood against decay fungi is meagre. This study is an attempt to understand the durability, and behaviour of rubber wood against seven virulent and non virulent decay fungi.

MATERIALS AND METHOD

Sawn logs (lumber) of about 100 cm girth from five trees obtained from Karnataka Plantation Corporation were selected. Strips of samples (2 x 1 x 10 cm) were taken radially from logs leaving 1cm margin towards pith and periphery. These were cut into two halves so as to obtain sample block size 2 x 1 x 5 cm. The first half of wood block obtained from periphery to the middle portion of wood was taken as *outer wood* zone and the second half wood block taken towards the pith was taken as *inner wood* zone. Sample of wood blocks free from sap stain were dried for 2 hours at 110° C, taken out, cooled in dessicator and weighed

These blocks were conditioned at 70% relative himidity for a week and aseptically introduced into Kolles' flask, which had one week old actively growing test fungi on 2% malt agar.

The fungi used in this accelerated laboratory tests were *Lanzitis trabea (pers)* Fr. FRI No. 535, *Fomes annosus* Fr. FRI No. 1061, *Choetomium globosum* FRI No. 393, *Ceratocystis ulmi*, FRI No. 804, *Polyporus meliae* under FRI No. 836, *P Versicolor* L. ex. Fr. FRI No. 165, and *P. Hirsutus Fr.* FRI No. 175, were obtained from Forest Research Institute, Dehra Dun. Two test blocks were placed in each flask and 4 flasks were kept for each test fungus. Flask were incubated for 16 weeks at 27° C, Eight blocks were used as adjustment blocks. At the end of 16 weeks test blocks were removed from Kolle's flask, cleaned from fungal mats, drid at 105° C for 24 hours and wiighed. Percentage of weight loss in the inner and outer wood zone were calculated and results were analysed.

RESULTS AND DISCUSSION

Weight loss data of test blocks are shown in table 1 and figure 1. Average weight loss in wood due to decay by different fungi varied from 17 to 75 and 13 to 67 per cent in inner wood and outer wood zone respectively. Inner wood appears to be more susceptible to fungal attack compared to that of the outer wood zone, and decay pattern in the radial wood showed a gradual increase from periphery to pith zone.

TABLE I

Weight loss (%) of test blocks of Hevea braziliensis exposed to different fungi. The Figures are the average of 8 replications.

	Name of the fungus	*weight loss in percentage	
		Inner Wood Zone	Outer wood Zone
1.	Fomes annosus	17.22	16.62
2.	Lenzites trabea	23.39	14.78
3.	Ceratocystis ulmi	23.87	21.18
4.	Chaetomium globosum	28.96	13.27
5.	Polyporus meliae	48.38	25.81
6.	Polyporus versicolor	54.3	41.52
7.	Polyporus hirsutus	75.03	67.97

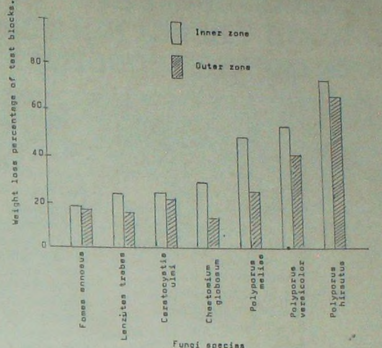

Fig. 1. weight loss (%) test blocks of *Hevea braziliensis* (Both inner and outer zone) exposed to different fungi

It appears that F. Annous, L. trabea, C. ulmi and C. globosus are not able to decompose the wood completely and the attack is mainly on the surface of the wood. These blocks of wood remained harder even after 16 weeks of exposure.

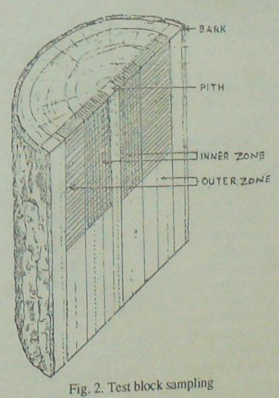

Fig. 2. Test block sampling

P. meliae, P. versicolor, P. hirsutus have caused maximum deterioration to wood. Their attack on the inner zone was comparatively greater than outer zone of the wood. The infected wood were soft with skeleton fibers intact more or less.

From the above observation, it may be concluded that Rubber wood has the least natural resistance to attack by some of the common tropical decay fungi.

Their resistance to different fungi appears to be relatively different. These results will help in the understanding of the behaviour of fungi against decay of heighly susceptible timber.

NATURAL DURABILITY OF RUBBER-WOOD (*HEVEA BRASILIENSIS*) UNDER MARINE CONDITIONS.

L. N. Santhakumar and V. V. Srinivasan
Institute of Wood Science & Technology,

Wood from Hevea brasiliensis (Wild ex Adr. dejuss) Muell. Arg., the para rubber tree, is widely used at present in packing cases, match industry and also as fire-wood. This plantation raw material is now available in large quantities. However, for the effective utilisation of this timber, steps should be taken to diversify its uses as a construction material including marine structures.

The present paper deals with the natural durability of rubber wood against marine borers in Goa waters. Test panels of rubber wood were completely destroyed within a short period of seven months due to severe attack by marine borers indicating their very low natural resistance. Woodborers encountered were *Martesia striata* Linnaeus, *Nausitora hedleyi* Schepman, *Bankia rochi* Moll, *Lyorodus pedicellaturs Quatrefages* and *Bankia comapanellata* Moll and Roach. The need for improving the durability of rubber-wood by suitable preservation techniques for its potential use in various marine constructions is presented and high-lighted.

INTRODUCTION

Rubber-wood (Hevea brasiliensis (H.B.K.) Meull, Arg) is now available in India in large quantities from plantations, as the trees are cut after about thirty years of tapping. At present, its use is generally restricted to packing-cases and match-box making and fire-wood. However, because of its availability in considerable quantities now, it has become a low-cost timber. The scarcity of conventional timbers and their soaring prices vis-a-vis the ready supply of rubber-wood have now forced the industry to probe for potential uses for the latter in other areas as well. One such new area to be explored is the possibility of its utilisation in the construction of marine structures.

Large quantities of different species of timber are at present used for a variety of marine structures like fishing craft, jetty piles, fishing stakes etc. However, there is an acute scarcity for timber for these purposes, particularly for the fabrication of catamarans and other indigeous craft. Therefore, it is worthwhile to examine the suitability or otherwise of rubber-wood for various marine applications, where one important requirement is the ability to with-stand biodeterioration. The present paper gives an account of the antural resistance of *H. brasiliensis* to marine borer attack.

MATERIALS AND METHOD

Small panels of rubber-wood were obtained from the Institute of Wood Science and Technology, Bangalore, and they were immersed at about 2 metres below low-tide level from a jetty at Betim in the Mondovi estuary. In the first experiment, which was of a preliminary nature, two panels (of 20 cm x 5 cm x 5 cm size) were exposed from 20-5-1983 to 3-1-1984 and in the subsequent confirmatory trials, four panels (of 30 cm x 3.8 cm x 3.8 cm size) were tested from 13-3-1989 to 4-8-1989. Periodical observations were made at every 2 months to record the intensity of attack by marine borers on the panels. When the panels became too brittle to withstand wave action due to heavy destruction, they were removed to the laboratory and data on the intensity of borers, their growth-rate and the extent of internal damage were collected.

RESULTS AND DISCUSSION

The important wood-borers encountered onthe panels were the pholad, *Martesia striata (Linnaeus), and the teredeinids, Nausitora hedleyi Schepman, Lyrodus peidcellatus (Quatrefages), Bankia rochi Moll and Bankia campanellata Moll* and Roch. The intensity of attack by these borers was so severe that all the test panels were completely riddled and destroyed within a short period of 5 to 7 months (Figs. 1 and 2). Some of the teredinid burrows were very large measuring as much as 183.5 mm. The pholadid borer had attained a length of 18.5 mm. The rate of growth of the borers and the extent of destruction of the panels clearly demonstrate the lack of any natural bioresistant substances in rubber-wood.

The rapid destruction of the rubber-wood in Goa waters is but natural since no timber-even *Tectona grandis* Linnaeus (teak) and *Xylia xylocarpa* Taub (iruli) is bioresistant at this locality on account of the intense borer activity, particularly of M. stiata (Santhakumaran, 1986.). Further, rubber-wood is known for its susceptibility to fungal and insect attack on land also within a few days of felling.

Sonti et al. (1982) have remarked that rubber-wood is amenable to kiln seasoning and when suitably processed can be used for manufacturing furniture, doors and windows. When treated with Copper-Chrome-Arsenic (CCA) at 8 kg per m3 and above, it will resist fungal and insect attack on land. Rubber-wood has not so far been tested under, marine conditions and therefore, it is difficult to predict its application in marine constructions. It has been, however, reported that several equally non-resistant timbers, like *pinus roxburghii* Sargent, *pines insignis*, *Abies pindrow* Royle, *Acrocarpus fraxinifolius* Wight and Arn., *Polyalthia fragrans* (Dalz.) Bedd., *Bombaxceiba Linnaeus*, *Mangifera indica* Linnaeus etc., which were also destroyed within 4 to 6 months in the untreated condition, have resisted borer damage for preiods several times its natural life, sometimes for 15 years or even more, when pressure-treated with either Copper-Chrome-Arsenic (CCA) or Copper-Chrome-Boric (CCB) (Cheriyan et al, 1988; Santhakumaran et al., 1984, 1987). In view of this possibility of enhancing the durability of inferior varieties of timber and also in view of the availability of rubber-wood in large quantities, experiments should be initiated to determine the performance of treated rubber-wood against marine biodeterioration. Scientific preservation methods might possibly pave the way for the effective utilisation of this low-cost timber by further extending its use in marine constructions.

Fig. 1. A panel of *Hevea brasiliensis*, exposed at Betim from 20-5-1983 to 3-1-1984, split open to show heavy internal damage.

ACKNOWLEDGEMENTS

The authors are greateful to Dr. R.V. Singh, Director General, Indian Council of Forestry Research and Education, Dehra Dun, and to Dr. B.N. Desai, Director, National Institute of Oceanography, Goa, for their interest and encouragement during the course of this study. They are also thankful to the River Navigation Department, Panaji, for giving facilities for exposing the panels from their jetty at Betim.

Fig. 2 : Panels of *Hevea brasiliensis*, exposed at Betim from 13-3-1989 to 4-8-1989, split open to show heavy internal damage.

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'Electronic rodent killer'

Some 200 inventions ranging from papad press to an 'electronic rodent killer' specially made for villages are to be marketed shortly. Coordinated by the Council of Scientific and Industrial Research (CSIR) 35 centres in the country will market these items.

Some of the items that have aroused interest in villages include filter candle (a cylindrical cenramic bowl which filters water instantaneously), paper slate making and a machine that makes leaf cups.

The new technologies give results straight-away. The papad press can make 600 papads an hour compared to 120 an hour by hand. Technologies like the paper slate can play a crucial role in rural development, in a mostly illiterate country where slates are required in millions to spread education. Conventional slates, made from slate-stones found only in a few places in the country, are brittle. But paper slates are light, cheap and retain their abrasiveness for long.

The electronic rodent killer is said to be popular. It is an automatic machine which attracts rats, kills them instantly and then disposes them of immediately, says the Pilani-based Central Electronics Engineering Research Institute which has pioneered the device.

Hevea brasiliensis (Rubber wood) – Its Strength Properties And Utilization

By N.K.Shukla
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Dehra Dun.

Introduction

Rubber wood *(Hevea brasiliensis)* from spent rubber trees cultivated primarily for latex, is reported to be available to the tune of about 1.2 million cubic meters annually from South Indian States mainly Kerala. Its availability is likely to increase further as a result of extensive plantations not only in southern states but also in some regions of Maharastra, Goa,Assam,Tripura, and Andaman & Nicobar islands, where it is now being cultivated (13). Rubber wood is yellowish-white when freshly cut,turning to light brown on exposure, has distinct growth rings, straight grained and medium to fine textured. Although studies in Malaysia have established its suitability for furniture, joinery, door components, panelling, interior finishing, bentwood items, picture frames, packing cases, pallets, plywood, blockboard cores and pulp & paper (89), in India it is presently utilised in limited quantities for packing cases, match veneers and splints, compressed-wood shuttle blocks, cheap furniture items etc. and bulk of its supplies are used as fuel wood. This hug wood resource continues to be under-utilized in India and very little progress has so far been made in extending its utilization for other wood products. The susceptability of rubber wood to fungal stain within a few days after conversion, borer and insect attack on one hand and lack of sufficient information about its utilization characteristics and processing techniques on the other, appear to be the main hindrences in its acceptability for wider utilization.

Due to the scarcity of well known popular timbers for many industrial uses, interest is now developing in the rubber wood as an alternative resource. In the recent years some studies have been undertaken at the Forest Research Institute, Dehra Dun for the evaluation of its physical and mecnanical properties and other utilization characteristics with a view to exploring its possible industrial uses and the same are briefly discussed in the following paragraphs.

Strength properties

Testing of rubber wood has been carried out for the evaluation of its physical and mechanical properties (13;19) as per normal procedures (7) and the results are given in Tables 1 & 2. The safe working stresses for structural purposes and suitability indices for different industrial and engineering uses, with respect to teak taken as 100, have also been given in Tables 3 and 4 respectively. In Table 1,the available data on physical and mechanical properties of Rubber wood of Malaysian origin is also given from the published literature (6), for comparison.

The results indicate that some of the strength propertis of green condition of rubber wood from Quilon(Kerala) locality (Table 1) are lower to those of Malaysian locality. The strength properties of dry condition are not precisely comparable due to their being at different moisture contents. While the nail withdrawal resistance values of rubber wood from Quilon(Kerala) locality are higher than those of teak, the screw withdrawal resistance of teak is some-what higher (Table 2). The safe working stresses for structural purposes (Table 3) of Indian rubber wood are lower than those of Malaysian locality and teak. The suitability indices for different properties and uses of rubber wood from Quilon (Kerala) locality (Table 4) are on the average 25 percent lower to those of teak. As per the normal practice followed for grouping and classification of timbers (14) rubber wood from Quilon(Kerala) locality has been classified as heavy, weak,not tough, moderately hard and moderately steady timber.

From strength point of view, Indian rubber wood is suitable for packing cases and crates as Group II species (comparative packing

Table 1

Sl. No.	Properties	*Hevea brasiliensis* Quilon(Kerala)		Kottayam (Kerala)	Selangor (Malaysia)	
		Green	Dry	Dry	Green	Dry
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	Specific gravity (Weight oven dry/ volume at test)	0.521	0.557	0.562	0.53	0.55
2.	Moisture content %	81.2	12.0	11.7	0.52	17.2
3.	Weight, (kg/m^2)	994	624	629	800	640
4.	Shrinkage%(Green to oven dry)					
	(i) Radial	2.9*	-	-	0.9+	-
	(ii) Tangential	6.1*	-	-	2.7+	-
	(iii) Volumetric	11.1*	-	-	-	-
5.	Static bending					
	(i) Fibre stress at elastic limit (kg/cm 2)	229	368	328	-	-
	(ii) Modules of rupture (kg/cm 2)	437	756	587	594	668
	(iii) Modules of elasticity (10^3 kg/cm 2)	55.6	82.0	60.7	90.0	94.2
6.	Impact bending					
	(i) Fibre stress at elastic limit (kg/cm 2)	886	820	664	-	-
	(ii) Modules of elasticity (10^3 kg/cm 2)	137.2	118.3	39.3	-	-
	(iii) Max.height of drop(cm)	75	43	79	-	61
7.	Compression parallel to grain					
	(i) Compressive stress at elastic limit (kg/cm 2	110	187	168	-	-
	(ii) Max. crushing stress (kg/cm 2)	200	374	331	264	329
	(iii) Modules of elasticity (10^3 /cm 2)	51.7	99.3	72.2	-	-
8.	Compressive stress perpendicular to grain at elastic limit kg/cm 2)	47	101	98	37.2	47.8
9.	Hardness					
	(i) Side (kg)	310	538	654	308	440
	(ii) End (kg)	309	526	732	-	-
10.	Shear parallel to grain(kg/cm 2)					
	(i) Radial	72.6	107.7	92.1		
	(ii) Tangential	81.6	119.5	113.4	92.1@	111.8@
11.	Tension perpendicular to grain (kg/cm 2)					
	(i) Radial	46.7	56.7	55.6	-	-
	(ii) Tangential	48.1	62.8	70.5	-	-

*Report from another publication (15)
@Average of radial and tangential values
+Percent shrinkage from green to 12% m.c.

case strength coefficient 85) (3), dunnage pallets (comparative stength coefficient 73) (18) and door and window shutters as group II species (comparative strength coefficient 77) (11), besides match veneers and splints and compressed-wood shuttle blocks for which it is already being utilised. Although for structural purposes Indian rubber wood meets the requirement of flexure stress in bending or tension along grain (87kg/cm2) (minimum limit 85 kg./cm2), its modules of elasticity in bending (55.6 x 10^3 kg/cm2) falls marginally short of the minimum required (56 x 10^3 kg/cm2) for inclusion as ordinary group species in IS : 3629(1). Being moderately steady timber, it appears to be suitable for the manufacture of ordinary furniture and bentwood items, and also as a general utility timber. As rubber wood is a non-durable timber and shows some tendency to surface cracking, warping, bowing and end-splitting, it should be properly seasoned (2) and given appropriate preservative treatment (5) before utilization to prevent degradation and enhance its service life.

Other utilization characteristics

Working qualities

Sawing and working qualities under major wood working operation i.e. turning, boring, mortising and planing operations have been reported (17). Rubber wood has been found easy to work in sawing and machining. For achieving good results in sawing, narrow gauge saw blade with teeth having front rake of 20° and top clearance angle of 15° has been suggested. For planing, cutters set at 30° angle gave very smooth surface. While rubber wood was found good in turning, in mortising and boring operations, clear surface could not be obtained due to defects like fuzziness, tearing off of grains and crushing. Studies on finish adaptability have indicated that rubber wood can be spirit polished satisfactorily using Turkey amber coloured chalk power base (17) to obtain good appearance.

Seasoning and preservation

Studies carried out on seasoning of rubber wood have indicated (15) that short length narrow-width timber stock intended for furniture, packing cases, bobbins, shuttle, foot-wear bottoms tec. can be kiln dried rapidly with very little drying degrade and schedule V of IS : 1141(2) has been recommended. In another study on steam bending property of rubber wood (16), it has been found as a good timber for bent-wood work in sections suitable for furniture components.

While the results of studies on treatability of rubber wood have not been reported so far, the preliminary data indicate that its heart wood is fairly well treatable with preservatives (16). A simple and cheap method has been developed at K.F.R.I. (4) for protection of rubber wood planks (intended for packing cases) from fungal and insect attack. The method involves applying preservatives to green timber by momentary immersion of green planks in the water-soluble boron

TABLE 2

Nail/Screw withdrawal resistance

Sl. No.	Condition	Species	Nail withdrawal resistance(kg)		Screw withdrawal resistance(kg)	
			Side	End	Side	End
1.	Driven in green condition and pulled immediately	(1) Hevea brasiliensis	155	96	252	154
		(ii) Tectona grandis	126	81	274	155
2.	Driven in dry condition and pulled immediately	(i) *Hevea brasiliensis*	121	113	296	176
		(ii) Tectona grandis	93	85	399	283

Table 1

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5.	Static bending					
	(i) Fibre stress at elastic limit (kg/cm 2)	229	368	328	-	-
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		(ii) Tectona grandis	93	85	399	283

TABLE 3

Safe working stresses for structural uses

(For standard grade)

Sl. No.	Property	*Hevea brasiliensis* (Quilon, Kerala)	*Hevea brasiliensis* (Malaysia)	*Tectona grandis* (Malabar, Nilambur & Coimbatore)
1.	Modules of elasticity (10^3 kg/cm 2) (All grades and locations)	55.6	90.0	109.7
2.	Bending & Tension along grain Extreme fibre stress (kg/cm 2)			
	(i) Inside location	87	119	163
	(ii) Outside location	73	99	140
	(iii) Wet location	58	79	112
3.	Shear along grain (kg/cm 2) (All locations)	12.1	14.5	14.9
4.	Horizontal shear (kg/cm 2) (All locations)	8.5	10.1	10.4
5.	Max. crushing stress along grain (kg/cm 2)			
	(i) Inside location	50	66	104
	(ii) Outside location	44	59	92
	(iii) Wet location	36	48	75
6.	Compressive stress across grain (kg/cm 2)			
	(i) Inside location	27	21	49
	(ii) Outside location	21	17	38
	(iii) Wet location	17	14	31

compounds solution (borax and boric acid) which works as a prophylatic treatment and does not affect the natural colour of wood.

Utilization for hardboard

Rubber wood bas been succesfully tried for the manufacture of hardboards (12). Studies have demonstrated that by initially subjecting the material to mild alkali treatment (2% and above) and tempering the boards with cashew nut shell liquid, satisfactory strength properties could be obtained.

Pulp and Paper

Rubber wood has also been successfully pulped by sulphate process and wrapping paper of suitable quality and strength properties has been manufactured on laboratory scale (10). The optimum conditions of pulping and the strength properties are presented in Table 5.

From the above studies it is evident that Rubber wood from spent Hevea brasiliensis trees which is by and large under-untilized so far could be efficiently used for a variety of wood products. However, more exhaustive studies are required not only on different utilization characteristics for the asessment of effect of locality but also for the development of cheap and simple processing techniques to popularise its acceptability for different industrial uses and for the prevention of fungal damage, borer and insect attack leading to its fast degradation within a short span after felling of trees.

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TABLE 4

Suitability indices of *Hevea brasiliensis* from Quilon (Kerala)

Sl. No.	Property/Use	Suitability index as compared to Teak as 100
1.	Weight at 12% m. c.	93
2.	Strength as a beam	62
3.	Stiffness as a beam	77
4.	Suitability as a post	52
5.	Shock resisting ability	75
6.	Retention of shape	77
7.	Shear	92
8.	Hardness	74
9.	Splitting coefficient	75

TABLE 5

Pulping conditions, yield and strength properties of *Hevea brasiliensis* pulp

Pulping conditions		
1.	Total chemicals*	20%
2.	sulphidity*	25%
3.	Temperature	170°C
4.	Time	4 hrs.
5.	Yield*	41.5%
Strength properties		
6.	Breaking length	7819m
7.	Burst factor	46.6
8.	Tear factor	66.6

* % expressed on oven dry raw material

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NEWS & Notes

NATIONAL SYMPOSIUM INAUGURATED

NEED FOR BETTER SPECIES STRESSED

There is need to develop more high-yielding varieties of rubber plants in the country, Mrs. J. Lalithambika IAS Chairman Rubber Board, said at Kottayam.

Inaugurating a national symposium on new trends in crop improvement of perennial species at the Rubber Research Institute of India, Mrs. Lalithambika said that the RRII had made remarkable achievements in developing wonder species of rubber plants, which were now being planted by most of the rubber growers. She expressed the hope that more such species would be developed by RRII, the Upasi Research Institute and other such bodies.

The symposium discussed at length the strategies for improving the genetic quality of the tree and highlighted the major advancements made in the field of crop improvement of perennial species such as rubber, tea, coffee, cardamom etc. Ten papers were presented by eminent scientists attached to the Rubber Research Institute and other institutions. There was also a panel discussion on future thrust areas and priorities in breeding with respect to perennial plantation crops.

Dr. S. Narayanan Potti welcomed the scientists and delegates attending the suymposium. Mr. V. K. Bhaskaran Nair, former Director of Research, RRII, Prof R. Gopimani and P. Mukundan Menon delivered the felicitation speeches. Dr. A O N Panicker proposed a vote of thanks.

Smt. J. Lalithambika IAS., inaugurating the national symposium on new trends in crop improvement of perennial species.

FOUNDATION STONE LAID

Smt. J. Lalithambika, Chairman, Rubber Board formally laid the foundation stone of the Pilot Plant for producing 'Radiation Vulcanised Latex' at the campus of the Rubber Research Institute of India. This Pilot Plant is the only one of its kind in India which could profitably produce the raw material for medical rubber products like catheters, blood transfusion tubes, surgical gloves, condoms etc. In this factory vulcanisation is done by 'gamma radiation' and use of chemical like sulphur, accelerators etc is totally avoided. The total investment of the factory is around Rs. 30 lakhs of which Rs.17 lakhs is provided by 'The Board of Research in Nuclear Science'. Shri. P. Mukundan Menon and Shri. C M George delivered the felicitation speeches. Dr. E V Thomas welcomed the gathering and Sri K C Chacko proposed a vote of thanks.

FINANCIAL ASSISTANCE FOR BEE-KEEPING

Rubber Board is continuing implementation of the scheme for promotion of bee-keeping among small and marginal rubber growers owning rubber area not exceeding 5 hectares. Each participating small grower has to set up a minimum of four bee hives together with all specified accessories. The Board would render financial assistance to the extent of 70 per cent of the approved cost in the case of growers of general categories and 90 per cent in the case of growers of SC/ST. These would work out to a maximum of Rs. 1,225/- and Rs.1,575/- respectively.

The scheme will be implemented through sponsoring agencies found fully equipped and fit for supply of bee keeping equipments and bee colonies, rendering training and other assistance and marketing of honey produced.

Agencies/institutions interested in promoting bee keeping under the scheme should apply in plain paper to the Development Officer in charge of the concerned Regional Offices of the Board having jurisdiction over the area of operation of the sponsoring agency on or before 20th October, 1990 stating full particulars of the facilities available with them for assisting growers in bee-keeping and work done by them in this regard during the last three years. Full details of the scheme will be made available to interested agencies/institutions from all the offices of the Board.

The last date of receipt of applications from individual growers through sponsoring agencies is fixed as 31/12/1990.

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EXPORT SUBSIDY EXTENDED

The Government of India has extended the Natural Rubber Subsidy Scheme by which exporters of rubber products are compensated for the losses on account of higher indigenous raw rubber prices.

The earlier scheme had expired on March 31, 1990.

The Government has, on a representation from the Chemical & Allied Products Export Promotion Council (CAPEXIL), now extended the operation of the subsidy scheme up to March 31, 1995.

The order, No. 10 (1)/90-EP (CAP) dated April 2, 1990, however, lays down that (a) the ceiling limit of subsidy would continue to be Rs. 6,000 per metric tonne, (b) in the case of automobile tyres and tubes, only those exporters whose annual exports are less than Rs. 1.00 crore would be eligible for subsidy under the scheme.

TISSUE CULTURE PLANTS RELEASED

The Rubber Board has formally released the tissue culture derived rubber plants to the public for experimental planting on 27th June 1990. Mr. P. C.Cyriac formerChairman, Rubber Board, gave away the first polybagged plant to Mr. M.K Vidyadharan, member of the Board.

Dr. M.P Asokan, the progenitor of the plantlets, said that facilities for mass production have now been established and it would be possible to distribute thousands of plants next year.

REGISTRATION IN RUBBER DISCONTINUED

The Rubber Board at its 115th meeting on 27th June 1990 has recommended to do away with the registration of rubber plantations in the small holding sector. Estates of large planters would, however, continue to be registered, in view of the provisions in the Rubber Act relating to election to the large growers' constituency in the Board every three years.

Registration of plantations was mainly undertaken for statistical purposes. But a sample census of the rubber areas taken a few years ago in the Vaikom Taluk brought to light the shortcomings of the registration process. More than 30% of the rubber planted remained unaccounted. A follow up census extending to about one-third of the plantations in Kerala confirmed the finding. In that contingency, the Board decided to discontinue the registration exercise. It now proposes to extend the census operation to the whole rubber planted areas in five years' time.

S T C TOLD TO HALT IMPORT

The Commerce Ministry has directed the State Trading Corporation. (STC) not to import any natural rubber during the rest of the current financial year. (STC is the canalising agency for rubber imports.)

The directive has been issued by the Commerce Minister, Mr. Arun Nehru, who presided over an emergency meeting at New Delhi on the rubber situation . Mr. Nehru had assured a delegation of Kerala MPs on Wednesday that a decision on halting rubber imports would be announced soon.

On the demand of the MPs for a floor price of Rs.24 a kg for rubber, Mr. Nehru said an urgent cost analysis of production would be undertaken and on that basis a minimum selling price would be determined. He also announced that the Ministry would shortly initiate a total review of all plantation items, including rubber and coffee, to evolve a future production perspective for these crops.

Imports of natural rubber during the current year so far have been of the order of 31,700 tonnes. The STC also had some opening stock to act as a buffer, but the growers had pointed out that the heavy imports had resulted in price decline.

DROUGHT HITS LATEX

The 2.5 million rubber smallholders in Malaysia have been hard hit by drought since March which has seen the daily output plunge from 100 kg to just 30 kg. According to reports, the drought has also resulted in the closure of several Mardec-(Malaysian Rubber Development Corporation) factories as they were unable to obtain their usual supply of latex. This has caused the corporation to lose about US $ 740,000 in the Ist half of this year.