UNIVERSITY OF COCHIN

B. Tech Course

IN RUBBER PROCESSING AND TECHNOLOGY

PROJECT REPORT

ON

A SMALL SCALE UNIT

TO MANUFACTURE RUBBER SHEETINGS

IN KERALA.

DISSERTATION REPORT

Submitted by,

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KOTTAYAM.
28th April 1975.

TOM. K. THOMAS.

C O N T E N T S

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SECTION. A.

INTRODUCTION

A.1. PRODUCT DISCRIPTION AND INNOVATION.

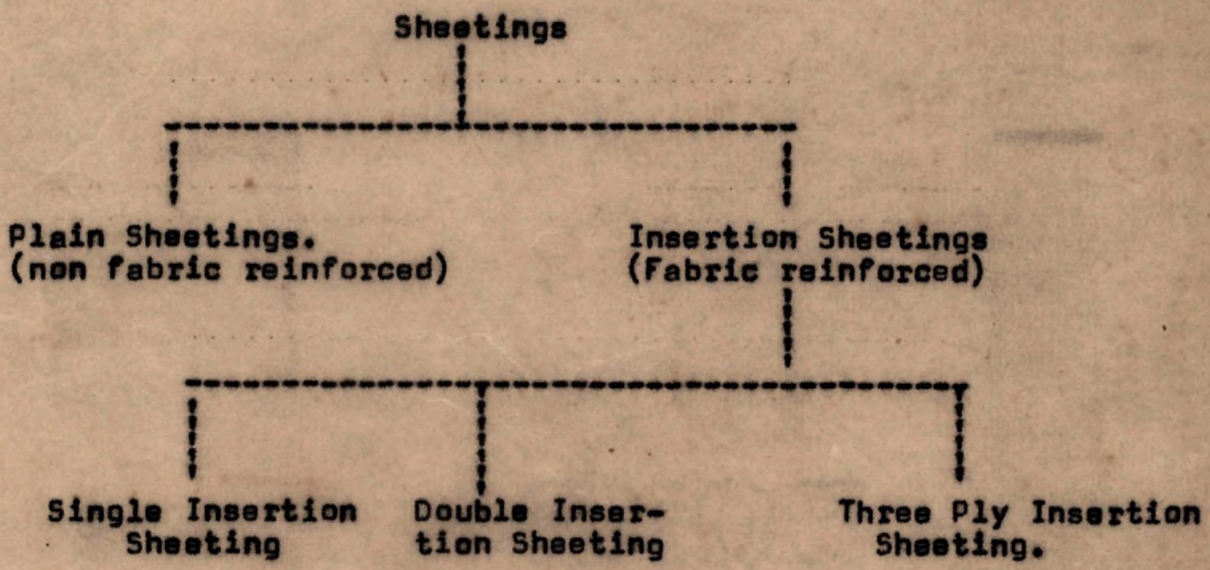
A sheeting is a continuous calendered vulcanised rubber product with or without fabric reinforcement and which can be used either as such or after cutting into required dimensions.

a) Classifications.

Based on the structure, functions and state, rubber sheetings can be classified into various groups.

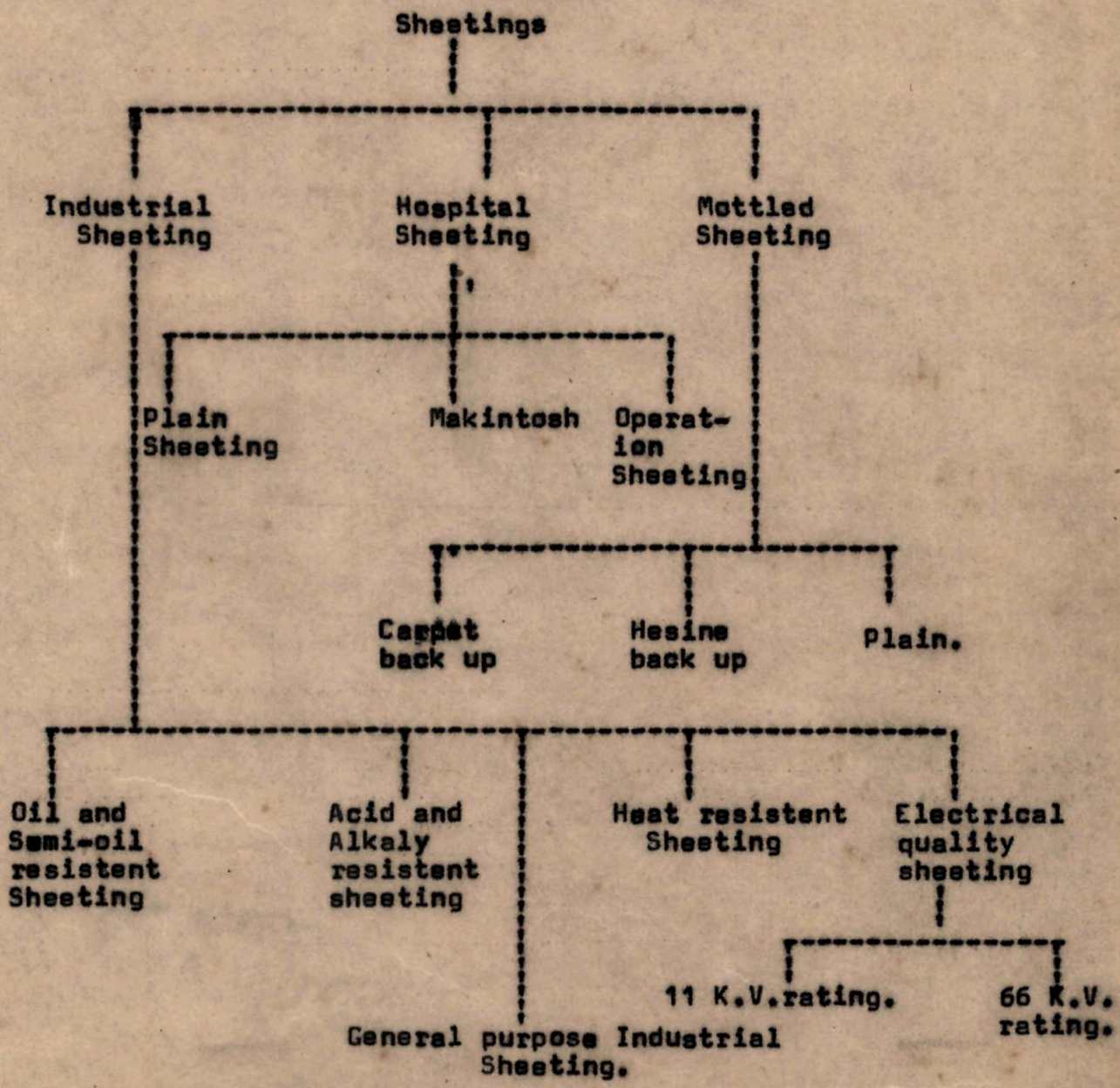
a.1. Structural Classification.

Structurally sheetings may be classified as follows.



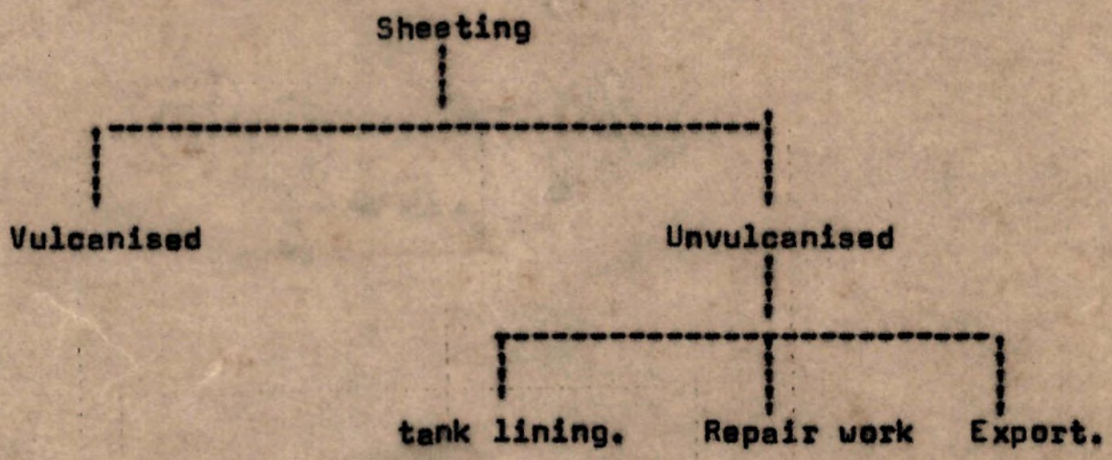
a.2. Functional classification.

Based on the functions envisaged, of the sheetings are classified as follows.



a.3. Classification based on Physical state.

Based on the Physical State of the Sheeting they are classified as follows.



b) Various Sheets and their uses.

b.1. Hospital Sheets.

These are plain sheetings with a uniform thickness of 0.4 mm and width 36 inches. The new design of hospital sheeting, with fabric insertion, called "Makintosh" is getting more and more acceptance. The main uses of hospital sheetings are

1. As bed sheets in hospitals.
2. As baby sheets.

The special variety of hospital sheeting called operation sheetings are used in operation theatres and should be designed for antistatic properties.

b.2. Industrial Sheetings.

In general almost all industrial sheetings are used for those seals and washers which are required in large numbers.

These sheets are available in both plain and fabric reinforced structures. Majority of squeeze type seals are plain and are produced from continuous length sheetings by purcheeing or trepanning. In Insertion sheeting the fabrics are incorporated to increase strength, wear and tear resistence of the seals cut from it.

b.2.1. General purpose industrial sheetings.

Low quality general purpose industrial sheetings, which constitutes the high volume fraction of the sheeting industry are used as seals and washers in the transmission of fluids like water and solutions of salts in water etc. Its major outlet is in textile and chemical factories.

b.2.2. Oil and semi-oil resistent sheetings.

These are used for oil resistent seals and washers and are available in the above two structures. The main uses are in oil refineries, oil pumping stations, all other industries which are using liquid petroleum products or hydrocarbon liquids.

b.2.3. Acid and Alkali resistent sheetings.

These are used for washers, seals and industrial flearings in chemical and textile factories.

b.2.4. Heat resistent sheetings.

They are used as such for heat insulation purposes in factories and in the construction of flates. They can also

be used as heat resistent washers and seals.

5 This firm could manufacture all these types of sheetings according to orders since noneof these involves any additional investment ~~xx~~ on machinery. The scheme envisaged at present aims at manufacturing the following sheetings.

1. Hospital Sheetings - Makintosh.
2. General purpose industrial sheeting.
3. Oil resistant industrial sheeting.

6. Prospects and Targets.

c.1. Hospital Sheeting

The two main outlets for hospital sheetings are

1. As bed sheets in hospitals and
2. As baby sheets.

The prospect of hospital sheeting hence is directly correlated with the following factors.

1. The total number and growth rate of hospital beds and hospitals.
2. Annual birth rate.
3. Total number of births.

The demand for baby sheets hence can be assessed from total number of births per year - table I and annual birth rate - Table II.

POPULATION Vs. YEARS

Fig. I.

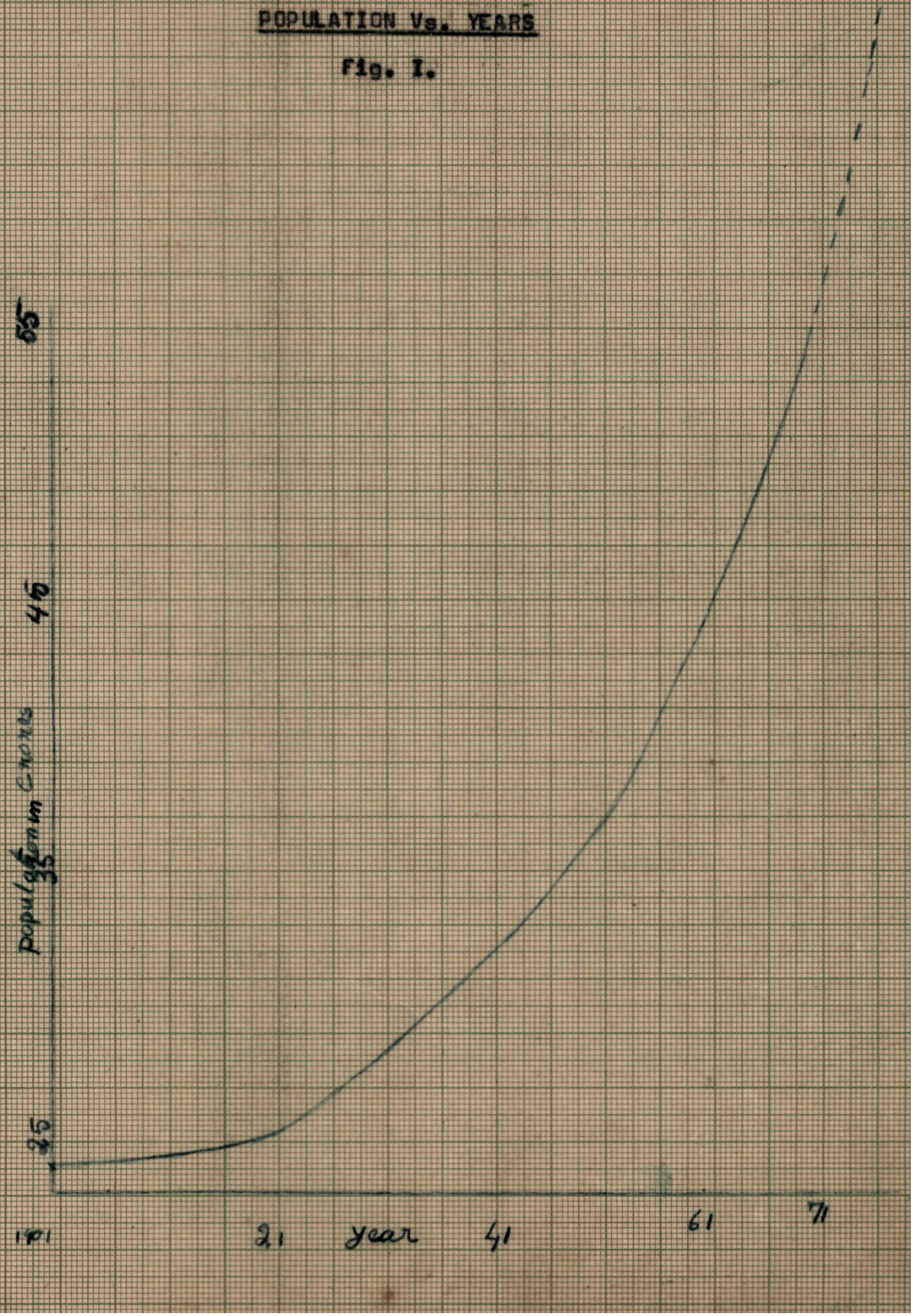


Table. I.

Total births and potential Demand for Baby sheets.

Year	Births (Lakhs)	Potential Demand for Baby Sheet. (Lakhs Meters)
1951	134	134
1961	183	183
1971	220	220

Table. II.

Annual Birth rate.

Year	Birth rate (No. of births/ thousand people)
1921-1930	46.4
1931-1940	45.2
1941-1950	39.9
1951-1960	41.7
1961-1970	39.9

The population growth in turn depends almost fully on these two factors and follows an approximate parabolic curve as in fig. I. In other words the requirement of baby sheets has to increase parabolically. Assuming at least 1 sheet (1 Metre) per baby born the potential demand for baby sheets is increasing as shown in table I.

The requirement of hospital sheets by the hospital depends on total number of hospital beds and its growth rate and can be assessed from table III which gives the total number of hospital beds available in India through the years.

Table III.

Hospital Beds.

Year	Hospital Beds. (in '000's)	Potential Demand for hospital Sheeting per annum (in'000's)
1960-61	186	370
1970-71	266.2	530
1971-72	269.8	540
1972-73	281.6 (targetted)	560

From the table it can be seen that the total number of hospital beds is increasing steadily at a faster rate. Assuming 1 sheet per bed/annum the potential demand for hospital bed sheeting is as shown in table III. The special interest of Central and State Governments and service organisations in increasing health services as evident from table III has increased the scope of this item.

However the total number of factories producing hospital sheeting that has come up and its progress through the years as given in table IV is much lower than what is required.

Table. IV

Number of Hospital Sheeting factories

Years	1935	1940	1950	1960	1965
No. of Factories.	4	6	8	12	13

This was due to the following impending factors.

1. The calender machine that is required for production had to be imported.
2. The sheeting thickness is very small and hence the calendering problems will be high.
3. These difficulties are further increased by the growing demand for lower compound cost.

The present scheme won't suffer from any of these troubles.

In addition to the great scope for manufacturing this product in the country an entreprenuer in Kerala is favoured by the following conditions also.

1. The density of population and medical facilities available in Kerala is much higher and hence represents a major part of the total market.
2. Power is cheap and is available in abundance.
3. All raw materials are locally available.
4. The entire market in Kerala at present is satisfied by firms in Calcutta and Bombay and hence can be captured easily.

A survey conducted showed that the total sales of hospital sheeting (whole sale and retail) in Kottayam during the year 1974 was approximately 1.97 lakh meters. An approximate estimation of the total consumption in Kerala from this figure may be taken as 20 lakh meters.

Competitive Products.

Competitive products in this field are plastic sheeting and rexin. These does not affect in any way the sole monarch, Rubber in this field since

1. Rubber sheeting is the only recommended sheeting for hospitals and baby's by physicians.
2. Price-wise they cannot compete with rubber sheeting.
3. Plastic and rexin sheeting does not have the soft feel of rubber sheeting.
4. Unlike rubber sheets they slip over the surface.

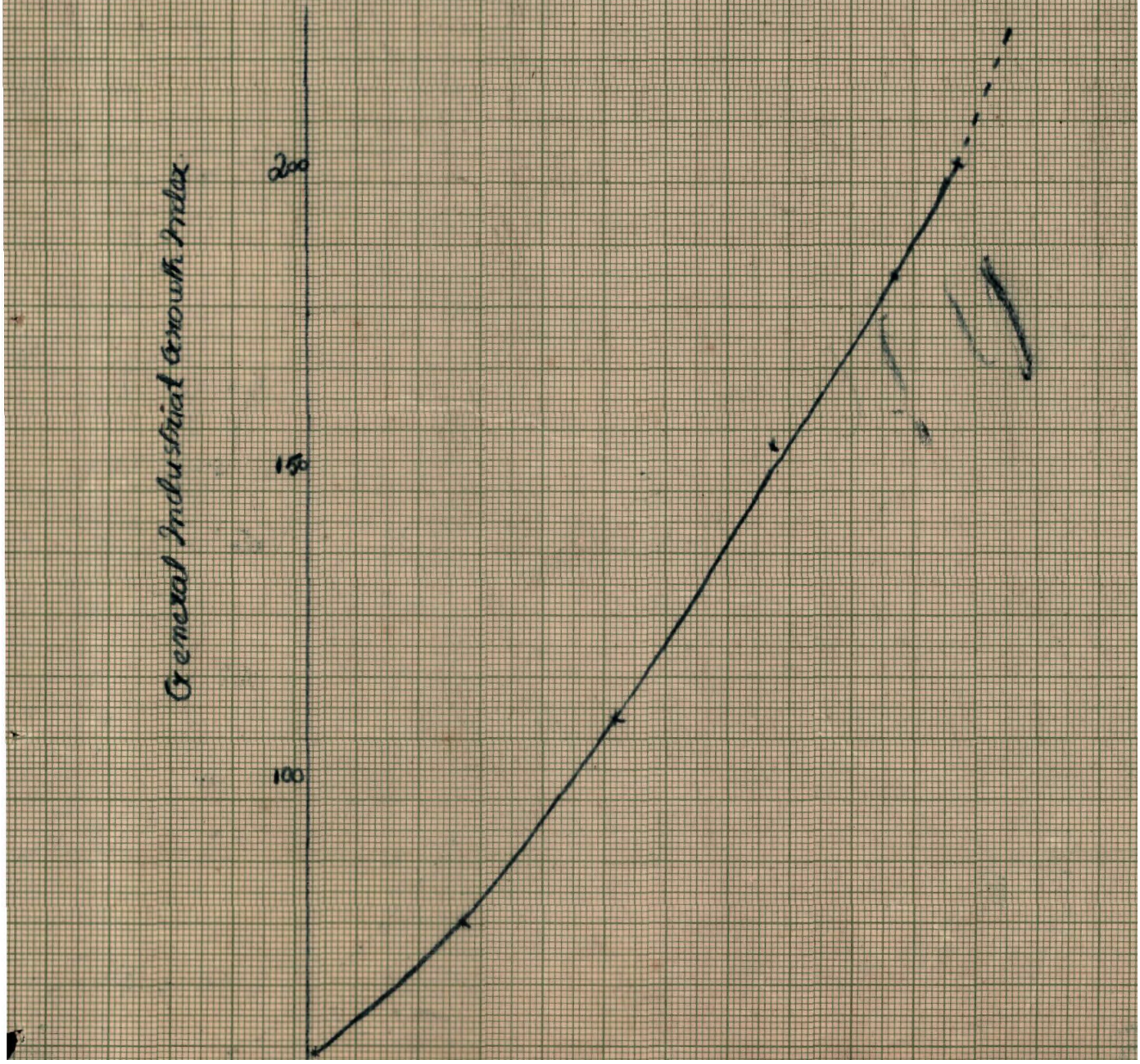
Therefore looking at the projected demand and favourable conditions,a unit producing 8 lakh meters of Hospital sheeting is quite feasible.

c.2. Industrial Sheetings.

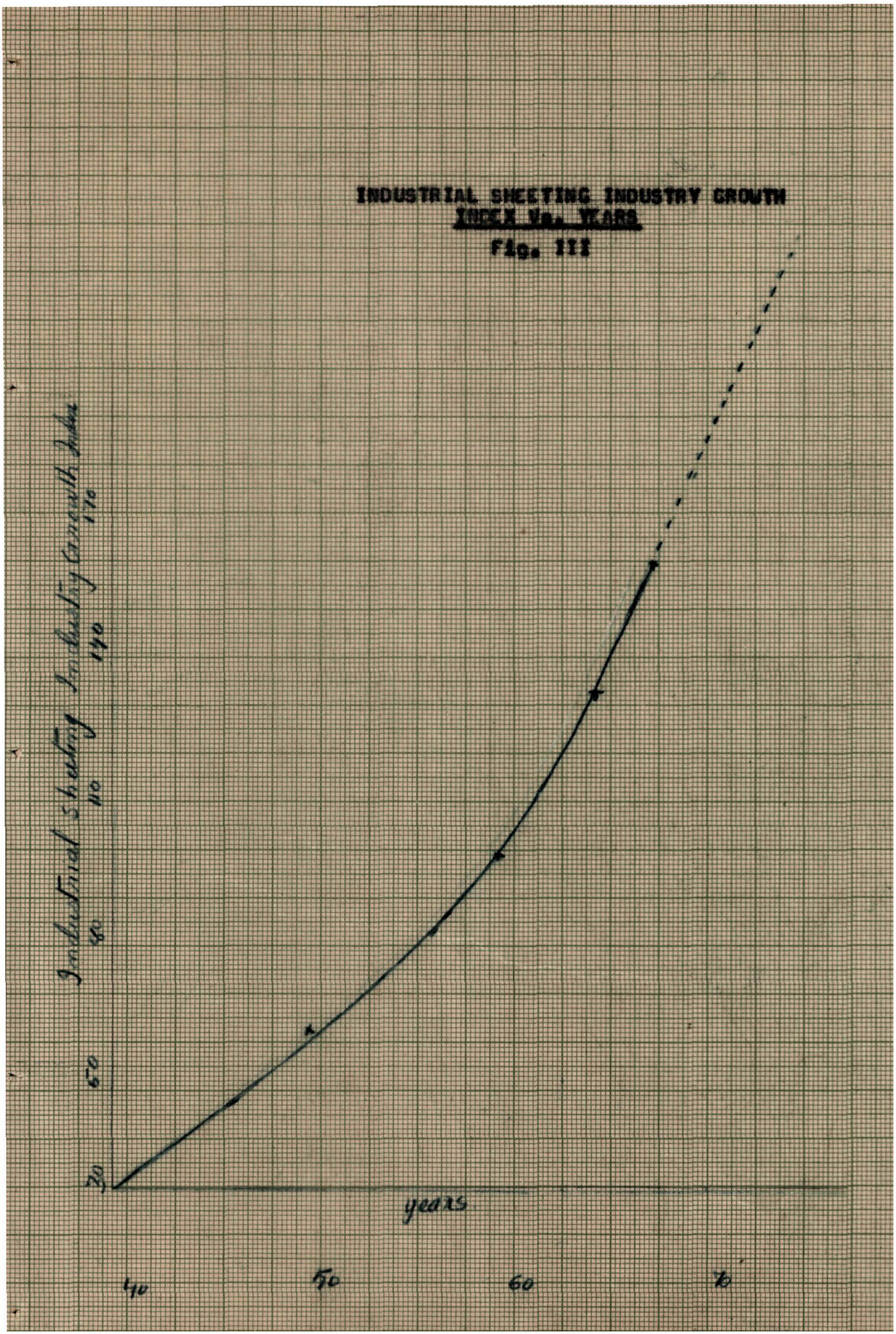
Industries are the major outlet for sheeting. Irrespective of the type of industry all requires one or other type of sheeting in very small or very large volumes. The most important uses to which sheetings are put are seals and washers. So the maximum use for these sheets are in industries where fluid handlin g is very high. Thus the major Industries according to consumption is as follows.

GENERAL INDUSTRIAL GROWTH INDEX Vs. YEARS

Fig. II



INDUSTRIAL SHEETING INDUSTRY GROWTH
INDEX Vs. YEARS
Fig. III



1. Textile and Jute Industries.

2. Chemical Industries.

3. Petroleum based industries and refineries.

Because of its universality of application in Industries there is direct correlation between Industrial growth-table V and 'Industrial Sheeting Industry' growth - Table V. Industrial growth in India has shown a sudden upward trend during the last few years and is continuing at a much higher vigour now than was ever before. This is clearly evident from the graph II where the Industrial growth index is ploted for the last few years. A plot of the growth index of Industrial sheeting factory's for the last few years is given in graph III. Evidently it shows a very identical trend as that of the industrial growth curve, thereby establishing the close relationship between the two.

Table. V.

Industrial growth indux
Vs 'Industrial Sheeting Industry growth Index
(Computed)

Year	Total No. of Units	Growth Index of Industrial Sheeting Industry based on 1960 as 100	General Industrial growth Index based on 1960 as 100
1940	8	30.0	N.A.
1950	17	63.0	51
1960	27	100.0	100
1965	36	133.3	140
1968	43	160.0	165
1975 (Projected)	59	220.0	225

Extrapolation of the curve III shows that the growth indux of industrial sheeting industry during the year 1975 would be 220% . In other words during the period 1971-75 there should come atleast 10 factories producing Industrial Sheeting. Based on the capacities obtained from a few well established factories, total production of Industrial Sheeting in the year 1970 was approximately 36000 tonnes. Therefore the capacity in the year 1975 would be 45000 tonnes registering an increase of 1800 tonnes per year. So there exists a very safe market for industrial sheeting. Thus analysing the projected demand, a unit producing 512 tonnes per year of Industrial Sheeting could be planned very safely.

c.2.a. General purpose Industrial Sheeting.

Major part of the general purpose sheeting is going into textile and chemical factories. The growth of these factories, especially that of chemical factories (16.5%)-table VII is tremendous and contributes the major part of Industrial growth Index. This in turn establishes the unquestionable prospect for the general purpose industrial sheeting. So out of the targeted 512 tonnes of Industrial Sheet a major part viz 462 tonnes should be general purpose industrial sheeting.

c.2.b. Oil resistent sheetings.

The major sones for special purpose sheetings on the other hand are petroleum industries and chemical industries. These two industries are running at such a speed (See table VI and

table VII) that the ancilliary industries could not keep pace with their growing demand. In the words of the ministry

Table VI

Index Numbers of Industrial Production.

Base 1960 as 100

Material	1951	1961	1966	1970	1971	1972	% change in 1972 over 1971
Textiles	79.7	102.8	108.9	109.7	106.7	114.3	+ 7.8
Cotton Textiles	N.A.	104.8	106.5	111.8	105.2	112.5	+ 6.9
Woollen Textiles.	N.A.	99.3	129.6	161.6	181.6	211.6	+16.5
Jute Textiles.	N.A.	89.1	100.4	85.1	94.7	96.8	+ 2.2
Chemical & Chemical Products.	42.4	113.4	168.4	236.5	252.7	294.7	+16.3
Petroleum & refinery products.	11.0	106.0	195.9	297.3	316.9	317.7	+0.3
General Industrial Growth Index.	54.8	109.2	153.2	180.8	186.1	199.4	+7.1

Table VII

Pattern of Production of Petroleum Products In India

Year	1960	1965	1970	1971	1972	1973	1974
Petroleum Products. '0000 tonns.	574.7	911.3	1718	1823	1820	1913	All time record

of commerce and trade the oil industry has made an"all time record" in production and consumption during the year 1974. We can be sure that by the recent discovery of large oil fields in India this "all time record" will be broken again and again in the coming year. In other words the prospect of oil resistent sheeting is unquestionably high. Realising this situation the Government has given license to M/S. Synthetic and Chemicals for protection of Nitrile Rubber - the main component of oil resistent sheeting. This step elimanated the heavy import of Nitrile Rubber which is practically impossible for a small entreprenuer. Thus examining the potential grouth it appears quite reasonable that a unit producing 50 tonnes of oil resistent sheet a year could be planned safely.

Thus the scope of all Industrial sheetings in this period of rapid Industrialisation is unquestionable.

Competitive Products.

Industrial sheetings are a sole field of rubbers since the unique elastic properties of rubbers are being made use of in these applications viz. seals and washers.

Export Market of Sheetings.

Both hospital sheeting and other sheetings are exported mainly in their unvulcanised state. The export statistics show wide fluctuations. Proper export promotion programme will result in goode stable market.

SECTION. B.

MARKET SURVEY

B.1. USERS AND CUSTOMERS ANALYSIS.

B.1.a. Hospital Sheetings.

The new design viz. Insertion hospital sheeting is getting more and more acceptance especially from hospitals because of the following.

1. It offers more tearing resistance.
2. The sheets develop minimum holes during service compared to plain hospital sheetings.
3. The "hot feel" of insertion rubber sheeting is less than that of whole rubber sheets.
4. Insertion sheeting gives more life.
5. Double coloured sheets are easily possible and hence more variety.
6. Unlike whole rubber sheeting, Insertion hospital sheeting has got only 4% Sales Tax, same as that of textiles. This results in more acceptance from dealers.

The following informations were also obtained from the market Survey.

1. The accepted standard width of the hospital sheeting is 36".
2. The thickness of the sheet should be 0.4 mm.
3. The colour most in demand is blue, then comes red and in small amounts green.

4. The colour preferred in Anthra Pradesh is black and this colour selection is based on some religious faith.

5. The usual complaints from users of hospital sheeting were

   i. The sheeting is getting tacky during use.

   ii. The sheets after a few washings develop microholes.

6. The entire hospital sheeting is marketed by textile dealers.

7. The three accepted grades available in the market are known by the following popular names.

   1. Insertion hospital sheeting - Makintosh.
   2. Plain Sheeting. - Duck buck.
   3. Sponge rubber. - Sponge sheet.

   All makintosh sheets possess different colours on both sides.

8. The prices and demand for these rates are in the following range.

Sheet.	Price range Rs/Meter.	Demand.
Makintosh	7.35 - 7.95	Very high
Duck buck	5.30 -	Little.
Sponge Sheet.	12.00	In significant.

9. Maximum demand for hospital sheeting in Kerala is in the period April/May and accounts for 30% of total demand.

10. Almost all textile dealers in Kerala are getting these sheets from firms in Culcatta and Bombay through company's Agent.

11. The sheets are marketed in rolls of 30 to 50 meter length.

12. The Company price for makintosh is Rs. 6.75/Meter.

13. The retail sizes does not exceed 1 or 2 sheets of 0.75 to 1 meter length.
14. Dealers usually place orders of sizes equal to their consumption for 2½ to 4 months.

Compound design, production scheduling, stock keeping, marketing policy's and pricing are based on these data.

B.1.b. Industrial Sheeting.

The market data obtained by the Survey on Industrial sheetings are the following.

1. The accepted width of all sheetings in 36"
2. The thickness most in demand is 1/8" and next in demand is 1/16".
3. The structure most in demand is single insertion.
4. The low priced sheets having the above characteristics are the most in demand.
5. The market for all types of Industrial Sheetings is concentrated in big Industrialised cities, Bombay, Calcutta, Ahamadabad, Delhi, Madras etc.
6. The marketing system is mainly through established agents in these cities on contract basis.
7. The usual grades, their prices, and their accepted commission rates are given Appendix 5.
8. These third parties are cutting these sheets according to the requirements of the final consumer.

9. Since they are used as seals and washers they form one of the periodically replacing items in many industries.

10. These sheets are marketed in the form of rolls of usually 50 Kg. weight.

11. The colour most in demand is drab colour and then black.

Decision of quality, marketing policy, pricing policy, stocks etc are based on these informations.

B.2. SALES CHANNELS AND METHODS.

Channels of distribution of a product depends on

i. The product.

ii. The concentration of the market.

iii. The accepted practice in the market.

B.2.a. Hospital Sheeting.

As far as hospital sheetings are concerned the market is wide spread. The only distributors of hospital sheeting are textile dealers. Hospitals and medium and small textile dealers are getting these sheets from established big textile dealers in a near by city or town on a whole sale basis. So if one can get the complete orders of big textile dealers, it is equivalent to getting the entire wholesale and retail market. In other words the market of hospital sheeting in the eyes of sheeting manufacturer is very concentrated. Considering all these factors the best sales channel which produce the least work, lower distribution cost and better understanding between the producer and consumer is to appoint company's own agent who will get orders from these big textile dealers. Since the

duration between orders is pretty long from any dealer (2½ to 4 months) One agent per State is enough to meet the entire market. Bulk orders such as from the State health department via quotations will be handled by the company directly.

B.2.b. Industrial Sheetings.

The market for industrial sheetings is concentrated in big industrialised cities. The accepted marketing practice in the Industry viz through third parties will be followed on the following grounds.

1. These sheets are not used as such by the altimate consumer.
2. There is no standard dimensions to which these sheets are cut.
3. It is a low volume consumption item.
4. The market is far away from the location.
5. Opening of company's own depots at the initial stages of its establishment is expensive and difficult.

However proper thinking will be given to the fifth point in due course because experienced hands in this field has shown that self selling cost is only 10% of the product price as against 17% through agents. Above all it gives direct contact with the consumer thereby the risk of loosing market is eliminated.

According to the accepted procedures sales contract for periods ranging from 1 to 2 years at reasonable discount will be made with these third parties.

B.3. GEOGRAPHICAL EXTENT OF MARKET.

Since the main market for industrial sheetings is the Industrialised cities in India marketing of the Industrial sheetings is proposed to be restricted to the following centres only.

i. Bombay
ii. Ahamedabad.
iii. Madras.
iv. Alwaye.

Though Calcutta is the most industrialised city since the major part of the sheeting factories are located in and around Calcutta marketing will be difficult there.

For hospital sheeting the firm proposes to limit the market in Kerala at present. Gradually the market can be extended to the neighbouring states viz. Tamilnadu, Andhra, and Karnadaka.

B.4. COMPETITIVE SITUATION.

Since the demand for all sheetings are very high, the competition in this field is practically negligible. Major part of the sheeting factories are located in north and Central part of India so that competition in South is small.

B. P

SECTION C

PRODUCTION REQUIREMENTS

C.1. Location

The basic considerations in the selection of location of any type of factory are the following.

i. A factory is relatively immobile.

ii. The impact of location on operating costs may very up to 25% or even 50% between locations.

iii. Building costs maintenance costs and taxes on land and building are large and fixed.

However the specific factors relating to the rubbere sheeting factory according to order of importance are as given below.

i. Power availability and cheapness.

ii. Availability of skilled and unskilled labour.

iii. Availability of water.

iv. Facilities for transportation by rail and road.

v. Proximity to high volume raw materials.

vi. Proximity to market.

Considering all these important factors the best compramise offering almost all the above advantageous is a suitable place in Kottayam District.

C.2. LAND AND BUILDING REQUIREMENTS.

C.2.a. Land.

Total land required is estimated as 15,000 Sq.ft. considering

future expansion as well.

C.2.b. Building.

For finalising the requirement of build up area for the factory the following considerations are taken into account.

i. The minimum build up area required for each machinery.
ii. The layout plan to be adopted.
iii. Expansion programme in the coming years.
iv. Space to be provided for keeping the maximum amount of inprocess inventories characteristic of process layout.

Based on these considerations the following areas are adopted for the specified machinery.

i.	Raw material storage	450 Sq.ft.
ii.	Compounding and laboratory.	400 Sq.ft.
iii.	Mill room and stock storage.	750 Sq.ft.
iv.	Calendering and building.	1000 Sq.ft.
v.	Autoclave and accessories.	400 Sq.ft.
vi.	Boiler.	500 Sq.ft.
vii.	Packing, Stores and Inspection.	2000 Sq.ft.
viii.	Office, Toilet and other facibities.	500 Sq.ft.
	Total.	6,000 Sq.ft.

C.3. REQUIREMENTS OF MAIN RAW MATERIALS.

The total estimated production for two shift working per annum including process losses is 960 tonnes. The break of this production under the various products is as follows.

Detailed break up is given in Appendix I.

C.3.a. Hospital Sheeting.

Total production of Hospital sheeting.	8,00,000 M.
Total compound requirement.	3,50,000 Kg.
Total fabric requirement.	8,00,000 M.

C.3.b. Industrial Sheeting.

Total Production of Industrial Sheeting of 1/8" thickness.	3,14,500 Kg.
Total production of Industrial Sheeting of 1/16" thickness.	1,64,500 Kg.
Total fabric requirement.	1,38,000 M.
Total compound requirement.	4,65,000 Kg.

C.3.c. Oil resistant Sheeting.

Total production of oil resistant Sheeting	50,000 Kg.
Total compound requirement.	50,000 Kg.

For the above estimated production, total requirements of all types of raw materials based on selected formulations are given in Annexure II.A. The important class of raw materials used are listed below.

Polymers.

For the estimated production the firm requires 286 tonnes of Natural rubber and 24.5 tons of Nitrile rubber. Natural Rubber is available from local market at a consolidated price of Rs. 9/Kg. with an unintrupted supply. Nitrile rubber can be had from Synthetics and Chemical Bombay at Rs. 17/Kg.

Fillers.

The following fillers are used for different types of Sheetings.

Fillers	Annual Consumption	Price/Kg. Rs
China Clay	4,18,200	0.25
Barium Sulphate.	40,350	1.50
Whiting	4,500	0.30
GPF Black	18,380	4.58

Details of suppliers are given in appendix.

Process Aids.

Aromatic and aliphatic oils and Pinetar are used in natural rubber and Dioctyl Phthalate is used in Nitrile rubber as the process aids. Their requirements are as follows.

Process aids.	Amounts Kg.
Aromatic and aliphatic oil.	20,860 Kg.
Pine tar.	360 Kg.
DOP	4,900 Kg.
Wax.	5,500 Kg.

Curing Systems.

The accelerators required are i. HBS ii. MBTS, iii. T.M.T. iv. ZDC. Zinc Oxide - Stearic acid activation system is used. The annual consumption and price of these chemicals are given in Annexure II. A.

The other materials used are colours, Peptisers, anti degradents, dusting powders etc. and are listed in Annexure II.A.

Terms of Purchase of Raw Materials.

All negotiations related to purchase of raw materials are done through banks. On a margin money of 30%, the bank will advance 70% for the purchase of materials. The amount has to be paid back from sales with in 70 days with interest. The purchased materials will be kept in the banks Godown in the factory and materials are withdraw on payment of cash when ever required.

C.4. Machinery selection and Utilisation.

The selection of machinery is the most important since maximum utilisation of machinery gives better return for the money spent. However maximum utilisation is not always possible when the machine size is fixed by the nature of the product. The selection of each machinery is based on the following considerations.

i. The targeted capacity.

ii. The accepted standard dimensions of the product.

iii. The type of production.

iv. Its effect on the utilisation of all other Machinery.

Based on these considerations the following machinery are selected for the targetted production of 960 tonnes per annum.

C.5.a. Calender and its utilisation.

Calendering is the method most suited for continuous

production of Sheetings. Since the accepted standard width of all types of sheeting is 36" the calender size is fixed by the product dimension as 104 cm. This also enables the production of 1 meter width sheeting also. Calender Specificatio

Size. roll dia. x length mm.x mm.	H.P. required	Production capacity Ms/min.	Maximum width of sheat cm.
350 x 1050	30	26.25	100

Utilisation.

Total calender capacity per annum working in Single shift (Machine hour 7)	30 Lakh M.
Total calendered length of hospital sheeting (double side)	16,20,000 M.
Total calendered length of oil resistant sheeting	52,000 M.
Total calendered length of General purpose Industrial Sheetings.	4,50,000 M.
Total doubled length	1,00,000 M.
Total friction length (double side)	2,76,000 M.
Total calendered length.	24,98,000 M.
Rounded off	25 Lakh M.
Assuming 20% re-working etc	
Total calender utilisation	30 lakh M

Since Calender capacity is very high only single shift work is enough.

C.4.b. Mixing Mill and Utilisation.

For mixing and warming of 850 tonnes of compound this unit require two 42" mill and one 30" mill working 2 shifts each.

The utilisation of each of these is as follows.

Process	Mill Size cm x cm	Compound	Batch Size	No.of Batches/ Shift	Total utilisation in Shift.
Mixing.	40x105	Hospital & Oil resistant sheeting 400 tonnes.	40 Kg	22	455
Mixing	40x105	Industrial Sheeting 450 tonnes.	40 Kg	25	450
Warming	30 x 75 40x105	Hospital Sheeting.	6Kg/min.		170 170
Warming	30x75 40x105 40x105	Oil resistant heating.	25 Kg/min.		6 6 6
Warming	30x75 40x105 40x105	Industrial	29Kg/min.		55 55 55
Warming	30x75	Friction Compound.	1.5Kg/min.		21

Assuming 300 working days the 1200 shifts available/annum for the two 42" mill is fully utilised as shown above. Out of the 600 shift available/amnym of the 30"mill approximately 300 shift is utilised for warming and feeding in to the calender. From the remaining 300 shift, 250 shift is utilised for mastication of natural rubber and the rest 50 shift is utilised for friction compound preparation and by products manufacture. A conveyor is connected wh between the 30" mill

and calender to effect uniform feeding to the calender.

C.4.c. Auto-clave selection and Utilisation.

For economic production the autoclave internal diameter should be 4 ft and trolly drum diameter should be 3.5 ft. The length of the autoclave can be 4 ft with one trolley or 8 ft with 2 trolley inside at a time. Assuming one full cycle of cure per hour with a thickness of 2" sheet over the drum the Autoclave can cure 5.75 cft of sheet per batch. Assuming two shift work with 6 batches per shift autoclave can cure 20700 cft. The total production of sheet per annum in two shifts is 19740 cft. Thus 4 ft x 4 ft size is quite satisfactory. Same autoclave is enough in the expansion stage also.

C.4.d. Boiler selection and utilisation.

Total steam consumption per cure is as follows.

Amount of steam required to heat the autoclave and trolley upto 140°C with steam at 140°C	6 Kg.
Amount of steam required to heat 2" thick sheet on the 3.5 ft dia trolley (Sp.heat of sheet 0.5)	27 Kg.
Amount of steam required to fill the autoclave at 5 Kgf/Cm^2	1.5 Kg.
Total Steam consumption.	34.5 Kg.
Assuming 20 min. cure time steam production / hour should be	103.5 Kg/hr.
Assuming 30% losses due to conduction and radiation the capacity should be	135 Kg/hr.
Next higher size boiler available	150 Kg/hr.

So this boiler with a capacity of 150 Kg/hr at a pressure of 5 Kgf/cm^2 should be selected.

C.4.e. Transformer Selection.

Total installed H.P. is as follows.

Machine.	No.	H.P.	Total H.P.
42" Mill.	2	60	120
30" Mill	1	30	30
42" Calender.	1	30	30
Boiler 150Kg/hr	1	2	2
Conveyor	1	2	2
Water Pump.	1	4	4
Fans, Light and Others.	--	3	3
	Total.		191

Maximum Kilowatt consumption	142.4 KW
Assuming a power factor of 0.8	
Total installed power	178 KW.
Assuming 20% safty total installed power should be	215 KW.
∴ Suitable standard size of the transformer is	250 KVA

Other than these Machineries minor equipments like water pump, winding and rewinding machines, testing apparatus, consolidation rollers etc. are to be purchased.

Terms of Purchase of Machinery.

i. Quotations are called for and satisfactory quotations are confirmed.

ii. Price quoted are exclusive of packing, transportation costs, sales tax, octroi, excise duty etc.

iii. 30% of the price should be paid in advance and the remaining at the time of purchase.

iv. Purchaser has the right for inspecting machinery.

v. Supplier posses the right for cancellation, changing delivery time and price due to unforeseen reasons.

vi. Warranty against manufacturing defects is assured.

viii. Liabilities passes on to customer immediately after despatch and shortages should be notified with in one week.

C.5. MAN POWER REQUIREMENTS.

The total manpower requirements are classified under the followinge heads.

i. Administrative Staff.

ii. Technical Staff.

iii. Labourers.

Administrative Staff.

The head of the administrative staff is the Manager who handles the overall management of the factory. He should be a technologist as well so that the additional salary incurred on a separate technologist can be eliminated. The other staff involved in the Administration are given in Appendix.

Technical Personnel.

The head of this department is the works engineer who looks after the production. An experienced and able Engineer should

be selected for this purpose. The production Supervisor are answerable to the works Engineer.

Labour Requirement.

The labourers are the people involved in the actual production operation . According to the skill and experience requirements they are classified into three classes Skilled, Semiskilled and unskilled. Details of the distribution of labour for various jobs is given in Appendix IV.

C.6. UTILITIES.

a. Water requirements per day.

	Liters.
Water consumption in mixing	30,000
Water consumption of Calender.	3,750
Boiler.	1,000
Water required for autoclave and others.	500
Water consumption for employees amenities.	10,000
Total water requirements.	45,250

So a water tank with a capacity of 50,000 liters will serve the purpose.

b. Power Requirements.

Assuming 80% consumption of the installed capacity the total power per day can be calculated as follows. Hore power of double shift machinery 156 H.P. Power consumption of double shift machinery 1862 KWH.

Horse power of single shift machinery	35 H.P.
Power consumption of single shift machinery.	209 KWH
Total.	2071 KWH/day

c. Steam Requirements.

Total steam generation per annum	2,10,000 Kg.
Steam production per litre of furnace oil	10 Kg.
Total oil consumption per annum.	21,000 Liters
Total oil consumption per day.	70 liters.

SECTION. D.

DESCRIPTION OF PROCESS OF MANUFACTURE

The production sequence can be clearly defined into four stages I. Compounding II. Mixing. III. Sheeting and IV. Vulcanising. A flow diagram of the process is given in appendix II. The layout of the plant is given in appendix III.

D.1. COMPOUNDING.

Concerned with securing an acceptable balance between

a. Vulcanisate properties required.

b. Price.

c. Processability.

The service performance demanded on the product by the consumer determines the vulcanisate properties and is obtained from a detailed market survey. An outline of the principles adopted in arriving at suitable formulations to produce sheetings of specified service performance in both the unvulcanised and the final vulcanisate states are given below.

D.1.a. Hospital Sheeting.

The service requirements of the hospital sheeting are

i. It should be very pure and nontoxic.

ii. It should have sufficient tearing resistence.

iii. The "hot feel" of the rubber sheeting should be low.

iv. Continuous washing with surfectants should not make it tacky or produce holes.

v. Should give reasonable life at economic cost.

Processing requirements ate

i. It should have low viscosity to effect calendering in to thin sheets.

ii. Should have better scorch safety.

iii. Better colour stability during cure.

The best compramise polymer is natural rubber . Use of fillers like barium sulphate, clay in suitable proportions gives lower "hot feel". The protecting system should not be leached out by water and should be non-discolouring. Higher amounts of polymerised phenolic type antioxidents are preffered. Paraffin wax improves the finish and reduce water leaching of antidegradents. Above all the materials used should be pure and non toxic. Sulphanamides because of their toxicity are not prefered. The prefered accelerators include thicarbamates and thiurams. Naphthanic types of plasticisers produce lower discolouring effect on rubber.

D.1.b. Industrial Sheetings.

Industrial sheetings are used mainly for static and dynamic seals. The development and selection of rubber mixes for seals

is dictated by three factors. a) the fluid with which the seal is in contact (b) the temperature range of its enviornment (c) the mechanical enviornment. a and b restrict the choice of base polymer to one or two, compounding will be directed to achieve the correct hardness, abrasion resistance, and to adjusting the swelling behaviour.

The most important property in seal application is the elastic property of rubber. The distorted seal excerts a pressure on the contacting surface to maintain the seal. Because of the stress relaxation of rubber the excerted stress relaxes with time and ceases to function as a seal. This process is accelerated by swelling. So compression set measurement is of very important value.

Based on these fundamentals principles and the specific requirements of each type of sheeting the ingredients are selected.

3. The General purpose Industrial sheeting.

The polymer selected for General purpose Industrial sheeting is natural rubber since its solubility parameter is far away from that of water with which it is offen in contact and it does not have much water soluble ingredients in it. All fillers and other materials selected should be insoluble in water as they facilitate swelling. Materials which possess poor solubility in rubber should not be used as they will be extracted speedily. The volume content of the polymer should be low so that its effect on swelling or contraction will be low.

In case where acid resistence is required precipitated barium sulphate should be selected as the filler. Since it is a periodically replacing item its price should be as low as possible. The calendering thickness is high so that the compound should not be too soft. Medium quality cotton is generally used as the reinforcing fabric.

2. Oil resistent sheeting.

Nitrile rubber mixes are the work horses of the seal industry since it is the only polymer whose solubility parameter is far away from that of mineral and ester based lubricants and to hydraulic liquids. A knowledge of the "seal compatibility index" of various fluids the correct grade of nitrile rubber can be selected for a specific oil. In addition to the polymer selection final adjustments in swelling resistence can be obtained by reducing the volume content of the polymer in the compound to as low a value as possible. Oil extractable plasticisers and antidegradents should not be used. Polymerised ester plasticisers are preferred. Semi-reinforcing fillers are used in higher amounts. Due to poor solubility of Sulphur in nitrile rubber low sulphur - TMT acceleration system is preferred.

D.II. MASTICATION AND MIXING.

Mastication

Natural rubber for both hospital sheeting and general purpose industrial sheeting should be masticated before mixing.

In the case of rubber used for hospital sheeting a good mastication is needed since the thickness of sheeting is very small. Rubber for the industrial sheeting should however be sufficiently soft so as to effect loading easily. Very high degree of mastication is required for friction compound and hence a peptiser active at low temperature is used.

Mixing.

The masticated rubber and other ingredients are weighted and mixed according to the formulations and batch sizes for different compounds. (Appendix V) Several batches of the same compound are mixed together in order to get uniformity by blending different batches. The batch size for a 42" mill is between 34 to 40 Kg. Mixing time ranges from 15 to 30 minutes. The mixed compounds are sheeted out and matured for 24 hours.

D.III. SHEETING.

It involves the following steps.

a. Warming.

The mixed batch is prewarmed on a 42" mill and then on a 36" mill until it regainst its plasticity. Proper uniform warming is highly essential for hospital sheeting. In the case of Industrial sheeting, since the output of the calender is very high both the 42" mills and the 36" mill have to be used for warming. The warming time usually given is 5 min.

The temperature of the feed must be sufficient to reduce grain effect.

b. Calendering.

The calender rolls are prewarmed to get the following temperatures.

Top roll	50°C
Middle roll	80°C
Bottom roll	45°C

The calender nip is set to get the specified thickness. In the case of hospital sheeting the fabric is first topped at the second nip with the sheet coming from the first nip, on one side and then on the other side. In the case of Industrial sheeting, sheets of 1/32" thickness are taken and plied up to get the correct thickness.

The warmed mix is now fed on to the first calender nip at a constant rate, with the help of the conveyor. The sheets are rolled in cloth with as little delay as possible with the help of the winding unit. The tension and speed of the inner lining cloth must be well controlled, and the temperature both of the rubber and the calender bowls, must be carefully supervised. Use of 3 bowl calender gives more smooth and uniform sheet since the top bowl acts as metering nip and second bowl acts as refining nip. This will reduce uneveness in thickness, if any and remove "cold spots"and blisters. The thickness of the sheet being produced must be controlled continuously by the operator by cutting pieces, at intervals,

from different parts. The temperature of the rolls must be maintained in close tolerances. If the bouls are two hot, air bubbles and blisters are formed. The rolling of the sheet in liners reduce the shrinkage or grain effect of the sheet and consequent increase in thickness.

The rolled sheet with the inner liner should be kept for some time to effect dying out of the strains by creep. It is then transferred to another inner liner and rolled before it is getting completely cooled down. This allows the remaining natural shrinkage.

c. Frictioning.

The insertion fabric for the Industrial sheeting should be friction coated in order to get good bonding during plying up. For the frictioning operation the roll gears are changed so that the middle roll runs faster than other two. The temperatures of the rolls are adjusted on a trial and error basis to give the required viscosity adhesive characteristic of the compound. The compound should be warmed perfectly before feeding into the calender nip. The friction coated fabric is rolled with inner liners which are pre-treated and dried with soap solution.

d. Building.

The sheets are usually calendered to a thickness of upto 1.2 mm. Higher thickness will cause blisters and air bubbles. In the case of thicker sheets such as Industrial Sheets, it is customery to make them by doubling thin sheets one on the other until sufficient thickness is obtained. Doubling is effected

on the building table or on heated plates or even - speed calender rolls. Great care must be taken so that no air is included in between any two sheets and that there should not be any traces of dust, chalk, solvent, moisture etc. Air entrapment results in porosity, blow holes, defective adhesion etc. causing separation even after vulcanisation of the sheet. In order to promote the through adhesion of the two given sheets a heavy heated iron roller is run over the sheets. Any air bubble present will be pressed to the surface, become easily recognisable, and can readily be removed by pricking with a needle. The sticking of rubber onwarm roller or table is avoided by surface powdering with chalk.

e. Dusting prior to vulcanisation.

Before the actual vulcanisation it is necessary to reduce the adhesiveness of the surface of the sheets by dusting. Uniform coating of fine powders of rice, maize, potato starch, talc etc can be used. Absolutely dry starch must be used to avoid defects. Talc gives a greasy touch for the product while pototo starch gives a velvet like shimmer. The dusting is usually effected by hand brush on the table. If the dusting is not perfect sheets will adhere together and produce faulty sheets. The dust laiden air should be removed since its retension will make sheets and frictioned fabric non tacky.

D.IV. VULCANISATION.

The dusted sheet is wound up tightly on a hollow, iron roller of 3.5 ft diameter and is well covered with fabric to prevent the access of moisture and vulcanised in open steam. This method demands exceptional care as it is essential that not a trace of moisture be allowed to reach the sheet being vulcanised. In the wrapping as the edges of the roller are approached, the bandages should be made narrower than in the centre of the roll and should be carried round until the original sheet is completely enclosed. If by any chance the live steam does penetrate through the wrapings there is every probability that both the colour and the lusture of the sheet will be very seriously changed. The roll is now pushed into the autoclave and cured in steam at 140°C. After vulcanisation the steam is exhausted and the sheets are cooled and inspected.

Inspection, packing and despatch.

The vulcanised sheets are inspected for the following defects.

(i) Blisters (ii) Rough surface (iii) Air bubbles (iv). Discolouration.

The defective portions are cut and removed. The passed sheets are packed into rolls of following sizes.

Sheeting.	Roll size.
Hospital Sheeting.	30 to 50 M length.
Industrial Sheeting.	50 Kgs.
Oil resistent.	50 or less Kgs.

The rolls are properly packed and sent to stores.

Process loss.

Perfect elimination of the process losses costs more than the what is lost by it. So the aim is to reduce the losses to economic level. The extent of losses depend on the product and the process. The losses in the case of sheatings are classified as follows.

i. Handling losses - This include fly losses during transportation, handling, weighing and compounding.

ii. Calendering losses. These are due to the following trouble sheetings in the calendering process.

a. Bare coatings b. Scorched compounds. d. Loose topping

d. Crows feet etc.

These are more pronounced in hospital sheets due to its smaller calendering thickness (0.2 mm) and the percentage losses runs upto 5%.

iii. Losses during vulcanisation.

These involve losses due to cutting off the deffective portions.

The effective losses due to all these for the different sheets may be taken as follows.

Sheeting.	Losses.
Hospital Sheeting.	6%
General purpose Industrial sheetings.	3.2%
Oil resistent sheeting	0.5%

Quality Control.

Quality is the surest foundation of success in an industrial venture. So proper care has to be taken to ensure better qualities at economic costs. The control measures adopted can be classified into the following heads.

a. Acceptance tests.

Acceptance tests on all raw materials are done in order to ensure quality. An outline of the tests proposed to be carried out on each material is given below.

i. Fabrics

All fabric rolls are examined for clenliness, weave defects, moisture, presence of size etc.

ii. Polymers

Random samples are selected and tested for moisture content accetone extracts and dirt content . In the case of nitrile rubber acrylo nitrile content also is measured.

iii. Fillers.

Fillers are tested for grit content and purity.

iv. Accelerators, antidegradents and stearic acid.

Random samples are selected from each lot and tested for Melting point, solubility in suitable solvents and in some cases complete chemical analysis.

b. Inprocess quality testings.

The following tests are proposed.

i. Specific gravity - Specific gravity of each batch is

tested after press-curing small strip samples. If it conforms to the compound specific gravity,the compound can be passed.

ii. Hardness- The hardness of the above strip is measured to ensure proper addition of fillers. If the results are with in specified tolerances it is passed.

iii. Elongation at constant load - Elongation at constant load of the strip, used for determining specific gravity is determined to ensure proper addition of vulcanising agent.

c. Product testing.

i.Hospital Sheeting.

1. Thickness is measured to ensure that it is 0.4 mm.
2. Ageing resistence - Aged at 70°C in an oven for 24 hrs. and the relative resistence to degradation is determined. The resistence to discolouration is also noted.

ii. Industrial Sheeting.

The following tests are proposed to be done to see whether the product meets the specification demanded on the product by the consumer.

1. Thickness is measured.
2. Ageing resistence is measured as above.
3. Oil resistence of the oil resistant sheeting is measured by determining the percentage increase in volume in a selected solvent for immersion period of 24 hrs.
4. Compression set under constant compression load is measured.

WASTE DISPOSAL.

The main losses are occuring during calendering and vulcanising. These waste materials could not be reworked since they contain fabric. So they are sold for reclaiming.

SUBSIDIARY PRODUCTS.

The extra time available with the calender and warming mill could be utilised for friction coating of fabrics. This involves preperation of water proof fabrics, cycle tyre fabric coating etc. Because of the heavy price rise of solvent oils the spreading process has become too costly for the cycle tyre units. The calender being a costly machinery is available very rarely so that there is definite scops in this field. As far as this unit is concerned no additional investment is required for the preparation of these products.

SECTION. E.

DISTRIBUTION ARRANGEMENTS

Distribution of sheets outside the state will be done through train on F.O.R. basis. However inter-state distribution will be through parcel agencies. With this distribution arrangement the firm could fulfil any order within 15 days from the date of receiving the order.

SECTION. F.

CAPITAL REQUIREMENTS

The financial aspect of the firm can be given in the following five heads.

I. Fixed Capital Requirement.

II. Working Capital Requirement.

III. Gross Capital Requirement.

IV. Total Manufacturing cost.

V. Sales and Administration Expenses.

I. Fixed Capital Requirement.

It is the sum of the expenses incurred for plant, Machinery, Land, building and pre-operative expenses that can be capitalised. Pre-operative expenses are accounted for the costs incurred during the idle time of plant and Machinery before regular production starts. The estimated Fixed Capital requirement in the above heads are as follows.

		Rs
1.	Land and Building.	2,56,000
2.	Plant and Machinery.	10,06,000
3.	Pre-operative Expenses.	80,500
4.	Miscellaneous fixed assets.	28,500
	Total.	13,71,000

Details of fixed capital is shown in Annexure I.

II. Working Capital Requirement.

The working capital requirement depends on

i. The duration for which raw material inventory has

to be kept so as to ensure unintrupted production.

ii. The duration involved in manufacturing, marketing and selling.

iii. The duration for which finished goods should be stocked to ensure uninterrupted supply to the market.

iv. The duration between the selling of the goods and the payment to be received.

It also depends to a greate extent on credit facilities available from the bank, from raw material suppliers and the credit terms between the firm and the customer.

The costs involved during this interval is called Working Capital. In the present case since all materials are available indeginiously one months raw material inventory is enough. The duration involved in the manufacturing, marketing, stocking, selling and cash payment is usually 2 months for sheetings,if a bill discount scheme through the bank is followed in sales. So the working capital may be taken as the total variable expenditure involved during the period of three months and are classified in the following heads.

		Rs
1.	Raw materials,cost of purchase, transportation, Inventory carrying costs etc.	14,64,250
2.	Manufacturing costs	
	a. Cost of utilities.	28,750
	b. Salaries and wages.	61,250
3.	Other Overheads.	26,000
	Working Capital.	15,80,250

Details of working capital components are given in Annexure II.

III. Gross Capital Required.

It is the sum of the fixed capital requirement and Working Capital requirement and is the total investment on the Scheme. Details are given in Annexure III.

IV. Total Manufacturing Cost.

It comprised of all the direct and indirect costs involved in the manufacturing operation. Annual manufacturing cost may be classified in the following heads.

1. Raw Material Cost.
2. Personnel Cost - Salaries and Wages.
3. Utilities - It involves total cost incurred on power, water and steam.
4. Overhead expenses - Overhead expenses incurred on maintaince of building and machinery, administrative expenses etc.
5. Other Fixed costs and Interest on Working Capital - Consists of a) Factory depreciation b) Insurance c) Interests on Block loan d) Interest on Working Capital.

The annual costs involved in these heads are as follows.

1.	Raw materials cost.	58,57,000
2.	Personnel Cost.	2,46,000
3.	Utilities.	1,15,000
4.	Overhead Expenses.	1,03,000
5.	Other Fixed Costs and Interest on Working Capital.	4,39,000
	Total Cost of Production.	67,60,000

Details of total manufacturing costs are given in Annexure IV.

V. Sales and Sales Administration Expenses.

These expenses can be broken down into

i. Sales Commission.

ii. Marketing,distribution and freight expenses.

iii. Sales Administration Expenses.

The annual costs under these heads are as follows.

Sales Commission.	12,84,600
Annual freight, distribution and handling charges(@ 1.25% on sales)	1,00,000
Sales administration.	10,000
Total.	13,94,600
Rounded off	13,95,000

SECTION. G.

FINANCING PLAN.

Proper thought should be given to the financing aspects of the firm before hand. Since the finance requirements of any industry are very high and as such an entrepreneur could not meet by himself all these expenses. There are a good number of financial institutions to assist the financial requirements of entrepreneurs. A brief discription of the aids offered by the financial institutions are as follows.

1. State Financial Corporations.

Loans of up to 10 lakhs for a period of 12 years can be obtained for a single concern from this institution. They

provide 100% of machinery cost, 75% of building cost and 40% of working capital at 7.5% interest. Repayment starts only after two years.

2. Kerala Employment Promotion Corporation.

They provide 95% of the cost involved in the purchasing, servicing, taxes, Insurance and transportation of all machinery and equipments as a loan on an Interest of 7%.

3. Kerala State Small Industries Corporation.

Machinery worth up to Rs. 10 Lakhs can be obtained on a Hire purchase scheme on a marginal money deposit of 20% (10% for technically qualified personnel). Repayment starts after two years and should be complete within 7 years. Interest is 7.5%.

4. Commercial Banks.

Nationalised banks provide entire working capital at 16% interest and loans for machinery on 25% margin money and 12% interest.

5. National Small Industries Corporation.

Indegenious and imported Machinery can be obtained on hire purchase scheme from this institution. Other Institutions are Industrial Development Bank of India, The Unit trust of India etc.

In the present scheme the entire machinery costs including taxes, insurance, transportation charges are proposed

to be taken from Kerala Employment Promotion Corporation, 75% of the land and building cost from Kerala Financial Corporation. The total loan on fixed capital is thus Rs. 10,97,000. The entire working capital is proposed to be taken from Nationalised banks at an interest of 16% and is Rs. 15,80,000.

SECTION. H.
PRICING POLICY.

The market survey on hospital sheeting clearly reveals the fact that the consumers are concerned more about the quality than price. The trend of the market towards insertion sheeting and the common complaints that are arising clearly explains this conclusion. So it is proposed to give a better quality at the existing price allowing a higher discount of 15% to the dealers. Special discounts will be given to orders sizes over 100 rolls.

With regard to general purpose Industrial Sheeting, being a periodically replacing item price is the most concerned. This is evident from the existing market prices. As a further reduction of this prices is practically impossible, it is proposed to market it at the same price and allowing the same discount (10%). Special discounts of 15% will be given to order sizes over 100 rolls.

But for special purpose Industrial Sheeting where the quality is more important there is no standard price except for

oil resistant sheets. Therefore the pricing policy will be based on total cost of production + 15% profit unless otherwise agreed between the parties.

SECTION. I.

PROFITABILITY

I. Rate of Return on own Capital.

	Rs.
Own Capital.	2,74,000
Net Profit.	5,47,000
∴ Rate of return on own Capital.	199.6%

II. Rate of Return on Capital Employed.

Fixed Capital.	13,71,000
Working Capital.	15,80,000
Total Capital employed.	29,51,000
Annual Net Profit.	5,47,000
∴ Rate of Return on Capital employed.	18.54%

III. Percentage Profit on Sales Turnover.

Annual Sales Income.	89,27,000
Annual Net Profit.	5,47,000
Percentage Profit on Sales turnover.	6.128%

IV. Break-even Analysis.

Total Fixed cost per annum	5,08,800

	Rs
Variable cost per ton	6,893
Total sales income per ton of Product.	8,318
Break-Even	357.2 Tonnes.
is.	40%

SECTION. J.

ECONOMIC VIABILITY.

I. Interest commitments.

	Rs.
7.5% interest on Block loan	82,000
16% Interest on Working Capital loan.	2,53,000
Total Interest commitments.	3,35,000

II. Ability to pay back borrowed funds.

The block loan should be paid back in the prescribed period. However an early pay back of the loan will result in greater savings on interest. So the firm is intented to use 75% of its surplus to pay back block loan and the rest is retained. Since part of the block loan is paid back the ability to pay back loans will be high in the subsequent years.

III. Pay back Periods.

	Rs.
a. Annual Profit.	5,47,000
b. Depreciation.	1,04,000
Available surplus (a + b)	6,51,000
Less Drawings.	1,62,750
Amount used for repayment.	4,88,250

	Rs.
Block loan to be paid back.	10,97,000
Pay back period.	2.25 years.

SECTION. K.

SOCIAL BENEFITS

This Small Scale Industry based on sheetings provide the following benefits to the nation and to the entrepreneur

I. To the entrepreneur.

It gives a) Profit.

b) Opportunity to use his ideas.

II. To the Nation

It gives a) Larger employment with less investment.

b) Facilitates an effective mobilisation of local resources and skills.

c) Increases the revenue earnings of the nation.

d) Ensure a more equitable distribution of the National Income.

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ANNEXURE I

FIXED ASSETS

ANNEXURE I A

Land and Building.

	Rs.
Cost of 15,000 Sq. ft of land @ Rs. 0.75/Sq.ft.	11,000.00
Cost of 6000 Sq.ft. of built up area @Rs.35/Sq.ft.	2,10,000.00
Site levelling, fencing, approach road etc.	5,000.00
Overhead tank (50,000 Litres)	30,000.00
Total.	2,56,000.00

ANNEXURE I B

Plant and Machinery.

	Item.	No.	Price. Rs
1.	Mixing mill 40 cmx105cm with accessories.	2	3,12,000.00
2.	Mixing Mill 30cmx75cm with accessories.	1	75,000.00
3.	3 roll calender 35cmx105cm with accessories.	1	2,50,000.00
4.	Autoclave 4'x4'	1	12,000.00
5.	Winding and unwinding machine, 2 trolleys, rails and other accessories.		10,000.00
6.	Boiler, 150 Kg/hr with ion exchanger	1	35,000.00
7.	Building table 50 ft length.	1	5,000.00
8.	Conveyor and accessories.	1	7,000.00
9.	250 KVA Transformer.	1	50,000.00
10.	100 Kg. Dial Balance.	3	15,000.00

11.	5 Kg. Weighing balance.	1	500.00
12.	Materials handling equipments, consolidation rollers, Miscellaneous tools and equipments.		10,000.00
13.	Laboratory equipments:		
	Ageing oven.	1	5,000.00
	Hardness meter.	1	1,000.00
	Thickness gauge.	1	700.00
	Other laboratory equipments.		1,000.00
	Total.		7,89,200.00
	5% provision for price escalation.		39,500.00
	Total.		8,28,700.00
	Installation, transportation etc at 10%		79,000.00
	Sales tax etc at 7.5%		59,250.00
	Distribution of power, lighting, cabling etc. at 5%		39,000.00
	Total.		10,05,950.00
	Rounded off		10,06,000.00

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ANNEXURE I.C.

PRE-OPERATIVE EXPENSES(to be capitalised)

Interest on block loan-for Rs. 10.97 lakhs at 7.5% for 6 months.	Rs.	41,000.00
Establishment.	Rs.	7,000.00
Taxes.	Rs.	1,000.00
Travelling Expenses.	Rs.	5,000.00
Postage, telegram, telephone.	Rs.	750.00
Legal charges.	Rs.	750.00
Advertisement, interview, printing, typing.	Rs.	2,000.00
Building insurance.	Rs.	2,000.00
Provision for meeting unexpected increase in building cost 10%	Rs.	21,000.00
Total.	Rs.	80,500.00

ANNEXURE. I.D.

MISCELLANEOUS FIXED ASSETS

Equipments for supply and distribution of water and steam.	Rs.	5,000.00
Work shop equipments.	Rs.	15,000.00
Miscellaneous tools, spares and equipments.	Rs.	2,000.00
Fire fighting equipments.	Rs.	2,000.00
Office machinery and equipments.	Rs.	3,500.00
Furniture.	Rs.	1,000.00
Total.	Rs.	28,500.00

ANNEXURE I.E.
TOTAL FIXED ASSETS

Land and Building.	Rs.	2,56,000.00
Plant and Machinery.	Rs.	10,06,000.00
Pre-operative expenses.	Rs.	80,500.00
Miscellaneous.	Rs.	28,500.00
Total.	Rs.	13[illegible],71,000.00

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ANNEXURE II

WORKING CAPITAL REQUIREMENTS.

		Rs
Annual Working Expenses.		
1.	Total raw materials cost.	58,57,000
2.	Manufacturing cost	
	a. Cost of Utilities.	1,15,000
	b. Salaries and wages.	2,46,000
3.	Administrative and other overheads.	1,03,000
	Total.	63,21,000
	Working Capital(taken as 3 months working expenses)	15,80,000

Components of Working Capital.

ANNEXURE II.A.

DETAILS OF WORKING EXPENSES ON RAW MATERIAL CONSUMPTION.

(Annual)

Sl.No.	Material	Annual consumption Kg.	Price/ Kg. Rs.	Total Annual Cost. Rs.
1	Natural Rubber.	2,85,500	9.00	25,69,500
2	Nitrile Rubber.	24,480	17.00	4,16,200
3	Zinc Oxide.	10,290	18.00	1,85,200
4	Stearic Acid.	3,200	12.00	38,400
5	G.P.F. Black.	18,380	4.58	84,160
6	China Clay	4,18,200	0.25	1,04,540
7	Barium Sulphate	40,330	1.50	60,500
8	Whiting.	4,500	0.30	1,350
9	Aromatic and Aliphatic oil.	20,860	9.00	1,87,770
10.	Pinetar.	360	5.50	1,980

			Rs.	Rs.
11	D O P	4,900	12.00	58,800
12	H B S	1,105	45.75	50,550
13	M B T S	1,400	32.50	45,500
14	T M T	580	30.72	17,850
15	Z D C	135	33.15	4,470
16	Paraffin Wax.	5,500	2.50	13,750
17	Renacit VII	9	26.80	240
18	Nonox B.	2,000	36.40	72,800
19	Nonox SP	2,020	23.25	46,990
20	Colour (Red & Blue)	525	140.00	73,500
21	Sulphur	7,260	2.00	14,520
22	Titanium Dioxide.	13,460	12.50	1,68,200
23	Dusting Powders.	9,000	----	7,100
24	DBP Spirit and others.	----	----	1,000
	Total (Rounded off)			42,25,000

Annual cost of Raw Materials.	42,25,000
Total cost of 9,46,000 Mts of fabric at the rate of Rs. 1.50/M.	14,19,000
Total cost of 20,000 Mts. of inner liner fabric required @ Rs. 2.5/M.	50,000
Packing Materials cost.	40,000
Cost of purchasing, Inspection, transportation ware housing, etc. Rs. 125/ton.	1,23,000
Total cost of Raw Materials.	58,57,000

ANNEXURE II.B.

MANUFACTURING COST (Annual)

		Rs
1.	Cost of Utilities.	1,15,200
2.	Salaries and Wages.	2,46,000
	Total.	3,61,200

ANNEXURE II.B.1.

COST OF UTILITIES.
(Annual)

a.	Cost of 21,000 liters of furnance oil at the rate of Rs. 1.05/litre.	22,000
b.	Cost of 6,21,300 KW power @ Rs. 0.15 per KW	93,200
	Total.	1,15,200

ANNEXURE II.B.2.

SALARIES AND WAGES(Annual)

a. Administrative and Technical Staff.

No.	Position	Total Staff/ day	Monthly Salary/ Staff. Rs.	Total Annual Salary. Rs.
1	Manager cum Technologist.	1	1,300	15,600
2	Accounts Officer.	1	600	7,200
3	Sales Officer.	1	600	7,200
4	Clerk cum Typist	1	400	4,800
5	Works Engineer.	1	700	8,400
6	Production Supervisors.	2	600	14,400
7	Mechanicl	1	400	4,800
		Total.		62,400

ANNEXURE II.B.2.

b. Wages of Labours (Annual)	Rs.
Wages to be paid to 18 unskilled personnel @ Rs. 350/month.	75,600
Wages to be paid to 10 Semi-skilled personnel @ Rs. 400/month.	48,000
Wages to be paid to 2 Skilled personnel @ Rs. 450/month.	10,800
Total.	1,34,400
Total Salaries and Wages (a + b)	1,96,800
Allowing 25% annual fringe benefits	49,200
Total salaries and wages. (including benefits)	2,46,000

ANNEXURE II.C.

ADMINISTRATIVE AND OTHER OVERHEADS
(Annual)

1.	Repairs and maintenance of building @ 1%.	2,000
2.	Repairs and maintenance of Machinery @ 5%	41,000
3.	Travelling and advertisement expenses.	8,000
4.	Insurance @ 2% of fixed capital.	27,000
5.	Taxes etc.	1,000
6.	Audit fee.	5,000
7.	Legal charges.	3,000
8.	Stationary, supplies, and Printing.	10,000
9.	Postage, telephone etc.	3,000
10.	Miscellaneous.	3,000
	Total overheads.	1,03,000

ANNEXURE. III

GROSS CAPITAL REQUIREMENT

		Rs.
a.	Total Fixed Capital requirement.	13,71,000
b.	Total Working Capital requirement.	15,80,000
	Gross Capital requirement.	29,51,000

ANNEXURE. IV.

TOTAL COST OF PRODUCTION (Annual)

1.	Raw materials cost (Annexure II.A)	58,57,000
2.	Utilities (Annexure II.B.1)	1,15,000
3.	Salaries and Wages (Annexure II.B.2)	2,46,000
4.	Administrative and other overheads (Annexure II.C.)	1,03,000
5.	Fixed costs and Interest on Working Capitals. (Annexure IV.A.)	4,39,000
	Total cost of Production)	67,60,000

ANNEXURE. IV.A.

OTHER FIXED COSTS AND INTEREST ON WORKING CAPITAL

1.	Factory Depreciation.	
	a) Depreciation on buildings (Rs.2,10,000 @ 5%)	10,000
	b) Depreciation on Machinery (Rs. 8,29,000 @ 10%)	83,000
	c) Depreciation on other fixed assets and preoperative expenses (Rs. 1,09,000 @ 10%)	11,000
2.	Interests on loans.	
	a) Interest on estimated block loan (Rs. 10.97 lakhs @ 7.5%)	82,000
	b) Interest on Working Capital loan (Rs. 15.80 Lakhs @ 16%)	2,53,000
	Total Fixed costs.	4,39,000

ANNEXURE. V.

SALES ANDSALES ADMINISTRATION EXPENSES

		Rs.
1.	Commission	
a.	Sales Commission of hospital Sheeting @ 15% of Sales.	8,46,000
b.	Sales Commission of 1/8" General purpose Industrial Sheeting @ 12% of Sales.	1,83,600
c.	Sales Commission of 1/16" general purpose Industrial Sheeting @ 12% Sales.	1,03,000
d.	Sales Commission of oil resistant Industrial Sheeting @ 17% of Sales.	1,52,000
	Total Commission.	12,84,600
2.	Annual freight, distribution and handling charges of products.	1,00,000
3.	Sales Administration expenses.	10,000
	Total Sales and Sales Administration Expenses.	13,95,000

ANNEXURE VI.

ANNUAL SALES TURNOVER.

1.	Total sales Income from hospital sheeting at the rate of Rs. 7.50/Kg.	56,40,000
2.	Total sales turnover from 1/8" General purpose Industrial Sheeting @ Rs. 5/Kg.	15,30,000
3.	Total sales income from 1/16" general purpose Industrial Sheeting @ Rs.5.50/Kg.	8,61,500
4.	Total sales turnover from Oil resistent sheeting @ Rs. 18/Kg.	8,95,500
5.	Total sales income from 20,000 Kg.process loss @ Rs. 0.50/Kg.	10,000
	Total sales turnover.	89,37,000

ANNEXURE VII.
ANNUAL SALES INCOME AND PROFIT.

	Rs.
Total Sales turnover.	89,37,000
Less Sales and Sales Administration	13,95,000
Annual Sales Income.	75,42,000
Annual Sales Income.	75,42,000
Less Cost of Production.	67,60,000
Profit before taxation.	7,82,000
Less Tax incidents @ 30%	2,34,600
Net Profit after taxation.	5,47,400
Rounded off	5,47,000

ANNEXURE VIII

PROFITABILITY ANALYSIS

I. Rate of Return on own Capital.

Own Capital.	2,74,000
Net Profit.	5,47,000
∴ Rate of return on own capital.	199.6%

II. Rate of Return on Capital Employed.

Fixed Capital.	13,71,000
Working Capital.	15,80,000
Total Capital employed.	29,51,000
Annual Net Profit.	5,47,000
∴ Rate of Return on capital employed.	18.54%

III. Percentage Profit on Sales Turnover. Rs.

Annual Sales Income.	89,37,000
Annual Net Profit.	5,47,000
Percentage profit on sales turnover.	6.128%

IV. Break-even Analysis.

Break-even is calculated from the following formula.

GP (GL) = n(SP-VC) - FC

GP - Gross Profit.

GL - Gross Loss.

SP - Average selling price per ton.

VC - Variable cost per ton.

FC - Total Fixed Cost.

N - Break-even Production.

At break-even production GP(GL)=0. Hence $n = \frac{FC}{SP-VC}$

Variable cost per tonn. VC

		Rs.
1.	Annual Raw material Cost.	57,34,000
2.	Purchasing Inspection, warehousing and transporetation.	1,23,000
3.	Total expenses on utilities.	1,15,200
4.	Interest on Working Capital.	2,53,000
5.	Miscellaneous variable cost.	27,000
	Total.	62,52,200

Total product sold per annum	907 Tonnes.
Variable cost per ton VC	6,893
Total cost of production	67,60,000
Total fixed cost = Total cost of production - variable costs ie FC =	5,08,800
Sales income per ton of product. SP	9,318
Break-even.	357.2 Tonnes.
ie.	40%

APPENDICES

APPENDIX. I.

BREAK UP OF ANNUAL PRODUCTION

1.	Estimated production of hospital Sheeting	8,00,000 M
	Total compound requirement for Hospital Sheeting.	3,50,000 Kg.
	Assuming 6% process losses the actual production.	7,52,000 M
2.	Estimated production of single insertion 1/8" General purpose Industrial Sheeting.	3,14,500 Kg.
	Total compound requirement.	3,07,500 Kg.
	Assuming 2.7% process losses, the actual production is.	3,06,000 Kg.
3.	Estimated production of single insertion 1/16" general purpose Industrial Sheeting.	1,64,500 Kg.
	Total compound requirement.	1,57,500 Kg.
	Assuming 4.5% process losses the actual estimated production.	1,56,700 Kg.
4.	Estimated production of oil resistent Industrial Sheeting.	50,000 Kg.
	Assuming 0.5% process losses the actual estimated production.	49,750 Kg.
	Total estimated production. (including process losses)	960 tonnes.

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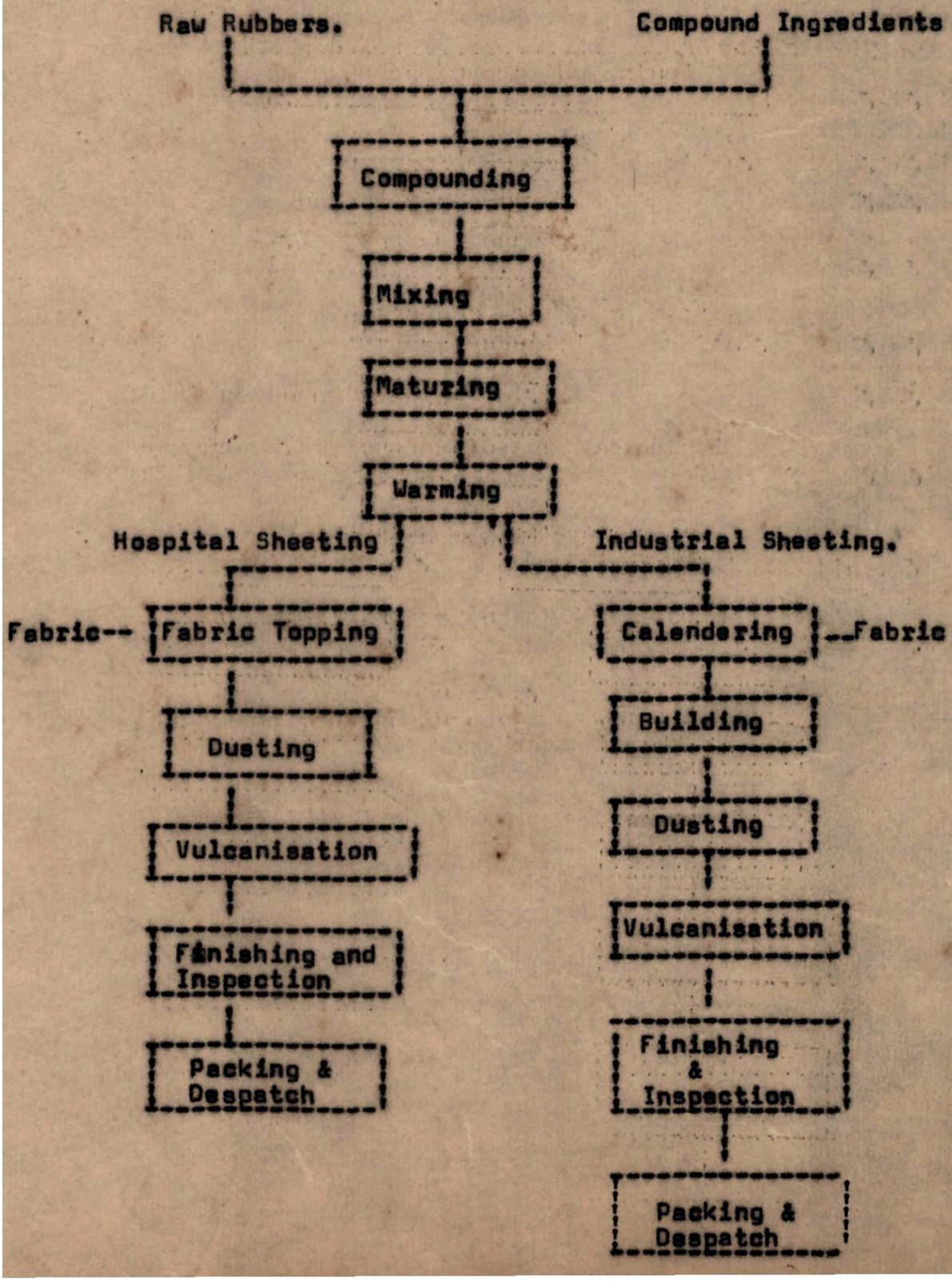
APPENDIX. II

MANUFACTURE OF SHEETINGS

PROCESS FLOW CHART



APPENDIX. II.A.

COMPOUND FORMULATIONS FOR VARIOUS SHEETINGS.

I. Hospital Sheeting.

Material.	Parts/Wt.	Batch weight based on 40 Kg.
		Kg
NR	100.0	15.380
ZnO	3.5	.540
China Clay	100.0	15.380
TiO_2	10.0	1.540
$BaSO_4$	30.0	4.610
Paraffin Wax.	2.0	0.308
MBTS	1.0	0.154
Stearic acid.	1.0	0.154
ZDC	0.1	0.015
S	2.5	0.385
Nonox SP	1.5	0.231
Naphthenic Oil.	8.0	1.230
Colour Blue	0.4	0.060
	260.0	40.000

APPENDIX. II.A.

II. Industrial Sheeting - General Purpose.

Material.	Parts/ Weight.	Batch Size 40 Kg. Kg.
Natural Rubber.	100.0	12.610
Zinc Oxide.	3.0	0.378
Stearic acid.	1.0	0.126
China Clay.	200.0	25.220
HBS	0.6	0.076
TMT	0.2	0.025
Nonox B.	1.0	0.126
Wax.	2.0	0.252
Flexon 840	7.0	0.882
Sulphur.	2.5	0.315

III. Oil Resistent Sheetings.

Material.	Parts/ Weight.	Batch Size 40 Kg. Kg.
Nitrile	100.0	19.590
ZnO	3.5	0.690
Stearic acid.	1.0	0.200
GPF black.	75.0	14.700
Nonox B.	2.0	0.390
DOP	20.0	3.920
HBS	1.0	0.200
TMT	1.2	0.240
S	0.5	0.100

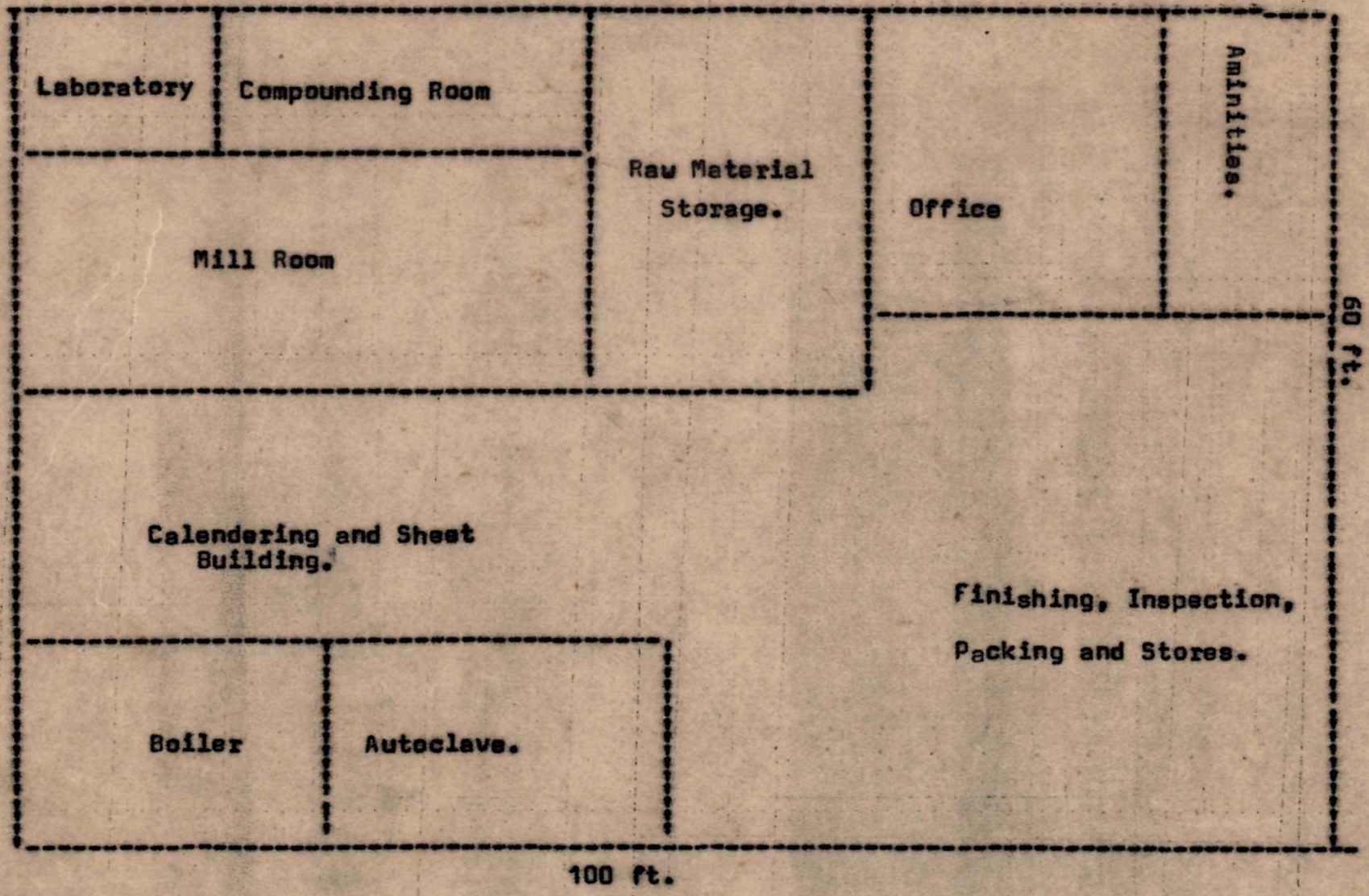
APPENDIX. II.A.

IV. Friction Compound.

Material.	Parts by Weight.	Batch size 25 Kg.
Natural Rubber.	100.0	15.00
Renacit VII	0.1	0.015
Whiting.	50.0	0.450
Pinetar.	4.0	0.600
Aromatic Oil.	2.0	0.300
Zinc Oxide.	5.0	0.750
Stearic Acid.	2.0	0.300
Nonox B.	1.0	0.150
MBTS.	0.6	0.090
S	2.5	0.375

APPENDIX. III

PLANT LAY-OUT



APPENDIX-IV.

Total Staff and Labour Requirement.

A. Staff Requirement.

Job discription.	Total Staff per shift	Number of shifts	Total Staff per day
a) Administrative			
1. Manager cum Technologist	1		1
2. Account Officer	1	1	1
3. Sales Officer	1	1	1
4. Clerk cum-Typist	1	1	1
5) Technical Staff			
1. Works Engineer	1	1	1
2. Production Supervisors	1	2	2
3. Mechanic	1	1	1

B. Labour Requirement

Job description.	Total labour per shift/ job. — U.S.	S.S.S	No.of shift	Total labours per day
Compounding & laboratory	1	1	2	4
Mixing	2	2	2	8
Warming & Mastication		1	2	2
Calendering	2	1	1	3
Sheet building	3	1	1	4
Curing	1		2	2
Inspection		1	1	1
Packing & despatch		1	1	1
Watchers	1		3	3
Boiler attendant	1		2	2

APPENDIX -V.

Price List of Industrial Sheetings.

Type of Sheetings	Commission Rate.	Price/Kg. Rs.
General purpose Industrial Sheetings 1/8" thickness	10%	5.00
General purpose Industrial Sheetings, for order sizes of 100 rolls or more of 50 Kg each	15%	5.00
General purpose Industrial Sheeting 1/16" thickness	10%	5.50
General purpose Industrial Sheetings, for order sizes of 100 rolls or more of 50 Kg each	15%	5.50
Good quality general purpose Industrial Sheeting 1/8" thickness	10%	6.50
Oil resistant Sheeting	10%	19.80

APPENDIX-VI.

Suppliers of Machinery and Raw Materials.

Suppliers	Item
A. Suppliers of Machinery	
1. Richardson & Crudas Ltd., Byculla Iron Works, Bombay - 400 008.	Mixing mills.
2. Sohal Engineering Works, Tulsi Pipe Road, Off Haines Road, Mahalaxmi, Bombay-400 013	Mixing mills, Calenders. Autoclaves.
3. Indian Expeller Works, 17 A, Saitafalwadi, Mazgaon, Bombay-400 010	Mixing mills.
4. SCA Pvt. Ltd., Machinery Manufacturers, Mahalaxmi Chambers, Bombay- 400026.	Mixing mills, Calenders, Autoclaves,etc.

	Suppliers	Item
5.	Varsha Boilers Private Ltd., Green House, Bombay-400 001	Boilers.
B.	**Fabric Suppliers.**	
1.	Madura Mills Co. Ltd., Mfg. Agents: A.F. Harvey Ltd., P.O. B. No. 35, Madurai, Madras.	Industrial Fabric.
2.	Balammal Mills, Trivandrum - 695 001.	Fabric.
3.	Gokak Mills Limited, Home Street, Bombay - 400 001	Fabric.
C.	**Raw Materials Suppliers.**	
1.	Synthetics & Chemicals Limited, New Great Insurance Bldg. 7 J.N. Road, Bombay - 400 020.	SBR Rubbers.
2.	Indian Rubber Regenerating Co. Ltd. Wagle Industrial Estate, Thana - 400 604.	Reclaimed Rubber.
3.	United Carbon India Limited, Backbay Reclamation, Bombay.400 020	Carbon Black.
4.	Kamani Metallic Oxides Pvt. Ltd. Kamani Chambers, Nicol Road, Bombay - 400 001.	Zinc Oxide.
5.	Esso Standard Eastern Inc., 17 J. Tata Road, Bombay - 400 001.	Solvent and Rubber Process oils.
6.	Bayer (India) Limited, Express Towers, Nariman Point, Bombay - 400 001.	Rubber Chemicals.
7.	The I.C.I. India Ltd., Rishra, Dist. Hooghly, W.Bengal.	Rubber Chemicals.
8.	I.A. & I.C. Private Limited, Bombay - 400 001.	Sulphur.
