RESEARCH IN RUBBER CHEMISTRY AND TECHNOLOGY: A BIBLIOMETRIC STUDY AND TREND REPORT

1994-1998

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Dissertation
Submitted to the University of Kerala
in partial fulfilment of the requirements for the Degree of
Master of Library and Information Science

DEPARTMENT OF LIBRARY AND INFORMATION SCIENCE
UNIVERSITY OF KERALA
THIRUVANANTHAPURAM
1999

CERTIFICATE

This is to certify that the dissertation entitled **"RESEARCH IN RUBBER CHEMISTRY AND TECHNOLOGY: A BIBLIOMETRIC STUDY AND TREND REPORT 1994-1998"** presented by Ajitha A.S in partial fulfilment of the requirement for the award of the Degree of Master of Library and Information Science is an original work carried out by her under my guidance and supervision. No part of this work has been submitted earlier for the award of any other degree.

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ACKNOWLEDGEMENT

I acknowledge my extreme gratitude to Dr.G.DEVARAJAN, Reader and Head of the Department of Library and Information Science, University of Kerala, who has been the vital force in this study. His valuable guidance and readiness to help at all times have enabled me to complete and submit this dissertation.

I wish to express may deep sense of gratitude to all faculty members of the department for their help and constant encouragement given to me in connection with this work.

I am deeply indebted to Sri. K. J. MATHEW, Chairman, Rubber Board and Dr.N.M.MATHEW, Director, Rubber Research Institute of India, Kottayam for their kindness in sanctioning study leave and giving encouragements to me for this study.

I may also express my thanks to my friends and colleagues at Rubber Research Institute for their help in several ways in completion of this work.

AJITHA A.S.

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CHAPTER - I

INTRODUCTION

Rubber is one of our most interesting and most important raw material. This material has multifarious uses and there is hardly any segment of life which does not make use of rubber based materials. It is also a vital raw material having immense strategic importance. Rubber is the most fascinating material known to mankind both on account of its range of applications in everyday life, defence and civilian purposes and its behaviour under the most diverse conditions of applications.

During the 19th century, several epoch-making discoveries were made in the processing, compounding and use of natural rubber, which resulted in tremendous increase in the demand for this product. Research in rubber is directed mainly toward making a better synthetic rubber to provide improved rubber products for home and industrial use. In addition, many unusual types of rubber are required in the age of nuclear energy and space travel.

Researchers are also trying to develop rubber that can be processed with a minimum of energy.

India now occupies the fourth position in the world in terms of rubber production. More significantly, the present national average productivity of rubber is one of the highest among the rubber producing countries.

A number of studies have been conducted in the field of Rubber Chemistry and Technology. Considering all the above factors, an attempt is made to investigate research in Rubber Chemistry and Technology: A Bibliometric study and Trend Report.

1.1 TITLE OF THE STUDY

The title of the study is Research in Rubber Chemistry and Technology: A Bibliometric study and Trend Report, 1994-98.

1.2 DEFINITION OF THE KEY TERMS

The meaning of the terms used in the title are given by the following definitions.

RESEARCH

Research is repeated search or repeated inquiry. Oxford dictionary defines research as a 'studious inquiry usually critical and exhaustive investigation of experimentation having for its aim, the revision of accepted conclusions in the light of newly discovered facts'.[1]

RUBBER

It was originally named coutchous; literally means tears of weeping wood. English chemist Priestly found that this could erase pencil marks and hence got the name "Rubber".[2]

RUBBER CHEMISTRY AND TECHNOLOGY

It includes primarly processing, chemical modification, rubber technology and product development.

BIBLIOMETRICS

Harrod's Librarians' Glossary defines Bibliometrics as the application of mathematical and statistical methods to the study of the use made of books and other media within and between library systems.[3]

TREND REPORT

It is a type of review literature of a subject intended to study the developments achieved during a particular period of time and the possible achievements in near future.

1.3 OBJECTIVES

The study aims at the following

1. To examine the growth of research studies in Rubber Chemistry and Technology during 1994-98;
2. To identify the thrust areas of research;
3. To identify the year-wise distribution of publications;
4. To identify the most productive journal in the field;
5. To examine the past, the present and the anticipated near future developments in the field of Rubber Chemistry and Technology; and
6. To prepare a trend report on research in Rubber Chemistry and Technology.

1.4 METHODOLOGY

The methodologies applied in this study for data collection are 1. Literature survey; and 2. Bibliometrics. For this, primary journals in the field of Rubber Chemistry and Technology published during 1994-98 were examined and articles selected. Secondary Journals such as RAPRA abstracts, AEDR were also used for data collection. Bibliometric technique was also used for the quantitative analysis of data.

1.5 IMPLICATIONS AND USE

The study is aimed to serve the following.

1. To use this study as a reference tool by the research scholars, students and scientists in the field;
2. As a helpful tool for the compilation of bibliography in the field;
3. To enable the specialist in the area to become familiar with developments in the field so as to cope with it.

1.6 LIMITATIONS

The scope of the study is confined to literature published in the field of study during a period of five years from 1994-1998.

1.7 ORGANIZATION OF THE STUDY

The study is organized under the following chapters.

CHAPTER - I : INTRODUCTION

This chapter forms the introductory chapter where the subject is introduced, key terms are defined, objectives, methodology and limitations are provided.

CHAPTER - II : RUBBER CHEMISTRY AND TECHNOLOGY: GENESIS, DEVELOPMENT AND DIMENSIONS.

In this chapter, an overall view of the subject field, Rubber chemistry and Technology is included. Origin and development of the subject, its divisions and other related aspects are also explained in detail.

CHAPTER - III : LITERATURE ON RUBBER CHEMISTRY AND TECHNOLOGY: A BIBLIOMETRIC ANALYSIS

A quantitative analysis of the collected data are given in this chapter.

CHAPTER - IV : RESEARCH ON RUBBER CHEMISTRY AND TECHNOLOGY: A TREND REPORT.

A Trend Report showing the developments in the subject under study during 1994-1998 is given in this chapter.

CHAPTER - V : FINDINGS AND CONCLUSION

This chapter constitutes the major findings of the study. Conclusions are drawn and recorded.

REFERENCES

The studies used for the preparation of the Trend report are arranged systematically.

REFERENCES:

1. Oxford English Dictionary, 2nd ed.- Oxford: Clarendon press, 1989.
2. Harrod's Librarians Glossary. 8th ed.-England: Gower, 1995
3. Hand book of Natural Rubber production in India-Kottayam: Rubber Research Institute of India.

CHAPTER - II

RUBBER CHEMISTRY AND TECHNOLOGY : GENESIS, DEVELOPMENT AND DIMENSIONS

2.0 INTRODUCTION

Natural rubber is a plantation crop cultivated in large areas as a monocrop, with an economic life cycle of around 32 years. Sustainable farming should essentially be adopted in rubber plantations as well. Natural rubber is nature's most versatile vegetable product. This material has multifarious uses and there is hardly any segment of life which does not make use of rubber based materials. Rubber is the most fascinating material known to mankind both on account of its range of applications in eveyday life, defence and civilian purposes.

2.1 HISTORY

Christopher Columbus is believed to have first found rubber in tropical South America. On return from his second voyage, 1493-1496, he brought a few balls made out of the gum of a tree and used by the inhabitants of Haiti for playing games. There is also documentary evidence that in 1615 the Spanish troops in Mexico wore rubber-coated clothes to guard themselves from rain.

Guayule shrub was probably the first known source of rubber which was discovered in North America. Castilla tree from which rubber or ule was obtained and made into play-balls at Mexico was found to be the next one. Charles de la Condamine, a Frenchman, first described Hevea brasiliensis tree in 1751 as the source of rubber. He found it in the Amazon forests in 1736 during his visit to South America as a member of the party sent by the Academie des Sciences on scientific expedition. Condamine explain the crude methods adopted by the natives for extracting a milky fluid by cutting the bark of the trees and in using the fluid for coating fabric, making shoes and moulding water proof containers.

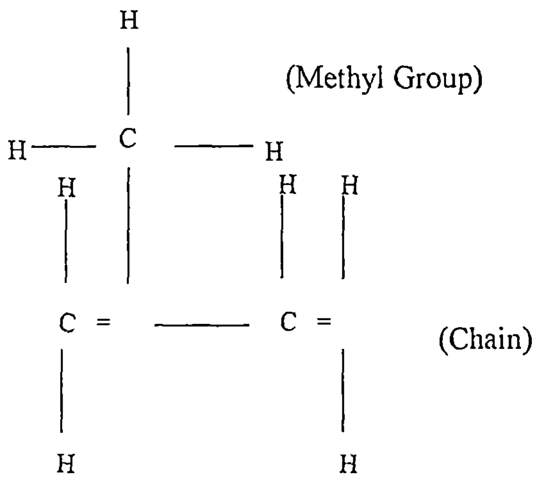
In India, rubber had been in use from time immemorial. In 1810, Roxburgh found that rubber was derived from Ficus elastica grown in Assam and he described that in his 'Flora Indica.' A rubber – yielding vine, Urceola elastica, was discovered in the straits settlements by

Howison in 1798. An inferior quality rubber was obtained from Landolphia vine in the west coast of Africa. Though rubber from various sources was available for centuries, the wild trees of Heve a brasiliensis in the South American forests have been the principal source of the world's supply of natural rubber in the early years. Since this was not sufficient to meet the increasing demand, it became an urgent necessity to increase the production by extending rubber cultivation to the Eastern hemisphere. The first suggestion to introduce rubber to this part was made by Thomas Hancock in 1857.

Hevea brasiliens's is a native of Brazil, which was introduced to tropical Asia in 1876, through kew, with the seeds brought from Brazil by sir Henry Wickham. The tree is now grown in the tropical regions of Asia, Africa and America. The rubber tree is sturdy, quick growing and tall and grows in many types of soils provided the soils are deep and drained. A warm humid, equable climate and a fairly distributed annual rainfall of not less than 200cm are necessary for the optimum growth of this plant. The tree, however, grows successfully under slightly varying conditions also.

2.2 THE CHEMISTRY OF RUBBER

The Chemistry of natural rubber has presented a challenge to scientists. In 1826, Michael Faraday, an English physicist and chemist, discovered that rubber is a hydrocarbon. That is, it belongs to a large family of substances that are composed of hydrogen and carbon. In 1860, another Englishman, Greville Williams, heated some rubber and obtained a colourless liquid that he called isoprene. Each isoprene molecule contains five carbon atoms and eight hydrogen atoms (C_5H_8). The atoms in the isoprene molecule always form a definite pattern. Four of the carbon atoms form a chain. The fifth carbon atom branches off from one of the carbons in the chain. Three hydrogen atoms surrounded the fifth carbon atom to form a methyl group. The following chemical symbols show the arrangement of the five carbon and eight hydrogen atoms in the isoprene molecule.



In natural rubber, thousands of tiny isoprene molecules link together in a giant, chainlike molecule, the rubber molecule. Chemists call such chainlike molecules polymers, meaning “many parts”. They call single molecules, such as isoprene, monomers. The particular chainlike structure of the rubber polymer explains why rubber is elastic. Polymer molecules of unstretched rubber fold back on themselves somewhat like irregular coils. Stretching the rubber straightens the chain of folded molecules. Releasing the rubber lets the chain return to its coiled position.

Sulphur combines with the rubber during vulcanization to set up ‘cross-links’ between the rubber chains. The chains in unvulcanized rubber can slip, causing the rubber to be less elastic. During vulcanization, the cross links bind the chains together so they cannot slip past one another. This gives elasticity and strength to the vulcanized product. However, if the cross-linking is carried too far, the cross-links tend to stop the unfolding of the chains. This reduces the elasticity of rubber. The number of cross-links increases according to the amount of sulphur added to the compound. With large amount of sulphur, rubber becomes stiffer, tougher, and less stretchable, until it turns into hard rubber. Chemists believe that the characteristics of many rubberlike substances depend on the way their atoms are joined together. Natural rubber has many unsaturated carbon atoms. Oxygen atoms from the air gradually attach themselves to these carbon atoms. This breaks down the rubber polymers so that the rubber becomes brittle or soft and loses elasticity. The addition of antioxidants during compounding prevents this action.

2.3 DISCOVERY OF ACCELERATORS

The prime function of an accelerator, as the name implies, is to increase the rate of vulcanization. The first artificial accelerators were inorganic. Goodyear disclosed the use of basic lead carbonate in his original patent. It was largely replaced by litharge, which was the most widely used accelerator for over 50 years. It is considered as a good accelerator and is used in many compounds. Other inorganic materials which are, or have been widely used as accelerators are lime, magnesia, sodium hydroxide, and antimony sulfide. Ammonia was used as early as 1880.

Organic accelerators were first used by Oenslager in 1906. About 1910, German chemists working on synthetic rubber discovered the accelerating activity of various organic bases. Among the first widely used organic accelerators were hexamethylenetetramine, various other aldehyde amines, DPG, and DOTG. Mercaptobenzothiazole, introduced around 1925, and its derivatives, especially MBTs, have continuously increased in popularity until today they are the most widely used of all accelerators. More or less concurrent has been the growth of thiurams and dithiocarbonates. Around 1920, it was discovered that zinc oxide improved the action of many accelerators and that the action of zinc oxide was in turn improved by the presence of fatty acids such as stearic acid. The recognition of this situation was a great stimulus to the use of organic accelerators, particularly of the thiazole and thiocarbomate types.

2.4 COMPOUNDING OF RUBBER

The term compounding in rubber technology is used for selection and incorporation of various additives into rubbers so as to give a homogeneous mix for processing.

Compounding helps to control the elasticity, strength, and other properties of the final product.

The materials used in compounding can be categorised as Elastomers, Fillers, Processing Acids, Vulcanizing agents, Accelerators, Activators, Antioxidants, Antiozonants and miscellaneous additives. Elastomers form the backbone and are the basic components. They can be natural or any synthetic rubber or thermoplastic elastomer and are selected to give specific physical properties to the final product. Fillers are used to reinforce or reduce the cost of the product. Carbon blacks are the most important fillers used for rubbers. Their incorporation brings about marked improvement in properties such as hardness, tensile strength, tear and abrasion resistance. The processing acids help during processing. Vulcanising agents bring about cross-linking resulting in a marked improvement in the physical properties of the rubber products. Accelerators reduce the time of vulcanization by accelerating the rate of vulcanization. Activators activate the accelerators to work more effectively and increase the cure rate. Antioxidants are added to slow down and improve the aging behaviour Antiozonants slow down the deterioration due to attack by ozone. The miscellaneous additives are not normally incorporated in the rubber compounds but may be used for specific purposes.

2.5 SHAPING

Manufacturers use several methods to shape rubber into final products. These include Calendering, Extrusion, Moulding and Dipping.

Calendering means rolling rubber into sheets. It is done on a machine that has two to five rolls mounted one above the other. Rubber is passed between pairs of highly polished heated rolls under pressure. Proper calendering requires precise control of roll temperature, pressure and speed of rotation. High rubber mixes are difficult to calender and require higher temperature. Incorporation of fillers ease calendering. Calendering can be done single bank or double bank. Double bank calendering gives more uniform thickness as air blistering is reduced. The products include rubber flooring, toys, bedsheets, washers, rings etc.

In the extrusion process, rubber is propelled continuously along a screw through regions of high temperature and pressure where it is melted and compacted and finally forced through a hole to give the final product. Extruded products include hoses, inner tubes and rubber strips. Extruded products are vulcanized after they have been formed.

Moulding produces shoe soles and heels, rubber tyres, hot-water bottles, industrial products etc. compression moulding is the most common method used in the industry. Many products are formed in moulds and vulcanized at the same time. During vulcanization, the rubber takes the exact shape of the mould in which it has been placed.

Dipping is used only to make products from liquid latex. Products made by dipping include rubber gloves and toy balloons.

2.6 SYNTHETIC RUBBER

Research in rubber is directed mainly toward making better synthetic rubbers to provide improved rubber products for home and industrial use. Rubber like materials made from chemicals are called synthetic rubbers because they were intended as substitutes for natural rubber. Manufacturers group synthetic rubbers into two classes: general-purpose synthetic rubbers and special-purpose synthetic rubbers.

General-purpose synthetic rubbers have many uses. The most important general-purpose rubber is styrene-butadiene rubber (SBR). It usually consists of about three parts of butadiene and one part styrene. Butadiene, a gas, is made from petroleum. It must be compressed or condensed into liquid form for use in making rubber. Styrene is a liquid made from coal tar or petroleum.

Special-purpose rubbers have special properties such as resistance to oils and fuels, air and extream temperatures, that make them better than natural rubber for certain uses. Special purpose rubbers include Butyl rubber, Cis-polyisoprene rubber, Neoprene rubbers, Nitrile rubber, Polysulphide rubbers, Polyurethane rubbers, Silicone rubbers, Ethylene-propylene rubbers, Fluorocarbon rubbers and Thermoplastic rubbers.

2.7 RUBBER INDUSTRY

Thomas Hancock made many remarkable observations and inventions from 1819 which established a real base for the rubber industry. It was he who performed for the first time the operation known as 'rubber compounding'. The 'masticator' fabricated by Hancock and the mixing mill and calender developed by Chaffee in 1836 are landmarks in the history of rubber industry. Charles Goodyear spent his whole life and money on improving the properties of rubber. His work and repeated failures from 1831 finally made him succeed in discovering 'vulcanization' in 1839 and this laid the foundation upon which the rubber industry is built.

The first pneumatic tyre was invented in 1845 by a Scotsman called Thomson but this was not taken seriously for about half a century. It was J.B. Dunlop, a veterinary surgeon of Belfast, who reinvented pneumatic tyre and he patended it in 1888. The invention of pneumatic tyre was a milestone in the history of rubber industry as the tyre sector today is the biggest consumer of rubber. Goodrich started his programme of manufacturing rubber goods in 1870 at Akron, and this place turned out to be the leading rubber manufacturing centre in the world. The continuous developments in the technology have developed a great deal in the commercial production of a large variety of rubber goods.

2.8 CONCLUSION

Over the past 100 years, the importance of rubber to civilized living has increased at a constantly accelerated pace. According to present estimate, the consumption of rubber in the world stands at about 16.66 million tonnes. For these reasons, tremendous interest is shown in research on rubber products. The future of natural rubber will also be bright in view of its special qualities and its competitiveness with synthetic rubber, the production of which is dependent on the high- priced and non-renewable petroleum resources.

REFERENCES:

1. BLOW, Steven
   Hand book of rubber technology/ by Steven Blow.-
   New Delhi :Galgotia Publications, 1998.

2. KHANNA, B.B.
   Chemistry and Technology of rubbers/by
   B.B.Khanna.–New Delhi:Galgotia Publications, 1998.

3. MORTON, Maurice
   Introduction to rubber technology/ edited by Maurice
   Morton.–New York : Van Nostrand Reinhold company,
   1959.

4. SETHURAJ, M.R. and MATHEW, N.M.
   Natural Rubber : Biology, Cultivation and
   technology/edited by M.R.Sethuraj and N.M.Mathew.-
   Amsterdam : Elsevier, 1992.

5. WHITE, James L.
   Rubber processing : technology, materials and
   principles/by James L.White.-New York : Hanser
   Publications, 1995.

6. The world book encyclopedia.Vd 16 World book
   international, London, 1996.P.429

7. Annual report 1995/RRII.

CHAPTER - III

LITERATURE ON RUBBER CHEMISTRY AND TECHNOLOGY : A BIBLIOMETRIC ANALYSIS

3.0 INTRODUCTION

Bibliometric distributions are used to study the frequency of occurrence of words in a text, productivity of authors in terms of scientific papers and scattering of articles over different journals.

A bibliometric analysis of literature published during 1994 – 1998 in the field of Rubber Chemistry and Technology is provided in this chapter. The variables used for analysis include year, subject, core journals and authorship pattern. The articles were collected from various primary periodicals in the field of Rubber Chemistry and Technology. Secondary journals such as RAPRA abstracts, AEDR were also examined. 500 articles published in the field of study during 1994 – 1998 were selected. The analysis of collected data are carried out under the following heads.

3.1 YEAR-WISE DISTRIBUTION OF MATERIALS

An attempt has been made to find out the year-wise distribution of the papers. The data given in Table I shows the year-wise distribution of publications from 1994 – 1998.

TABLE - I

YEAR-WISE DISTRIBUTION OF PUBLICATIONS

Year	Number of Articles	Percentage
1994	69	13.8%
1995	128	25.6%
1996	154	30.8%
1997	74	14.8%
1998	75	15.0%
Total	**500**	**100.0%**

From the data given in the table it is clear that maximum contribution, 154 (30.8%) published in the year 1996. It was followed by 1995 with 128 contributions (25.6%). The year 1998 gets the third position in the case of publications with 75 contributions (15%). Since much of the papers of 1998 will appear in the issues of 1999, it is difficult to give the overall contribution of 1998.

3.2 DISTRIBUTION OF ARTICLES IN PERIODICALS

Journal productivity refers to the number of articles published by a journal over a particular period of time. It implies that the journals that publish more number of articles on a subject are more productive than others. Journals constitute the bulk of the literature in any discipline and serve as the forum where different intellectual contributions are made by different authors and carry current information.

Attempts have been made to identify the core journals that produce maximum number of articles in the field of Rubber Chemistry and Technology. 46 journals were identified and listed. They were ranked on the basis of the largest number of the articles in the field of Rubber Chemistry and Technology.

The data given in Table 2 shows the core journals in the field of Rubber Chemistry and Technology arranged in decreasing frequency of productivity.

TABLE - II

DISTRIBUTION OF PERIODICAL ARTICLES

SL. No.	NAME OF JOURNAL	NUMBER OF ARTICLES	PERCE-NTAGE	RANK No.
1	Journal of Applied Polymer Science	109	21.8	I
2	Rubber Chemistry and Technology	88	17.6	II
3	Kautschuk Gummi Kunststoffe	75	15.0	III
4	Journal of Rubber Research (Formerly Journal of Natural Rubber Research)	54	10.8	IV
5	Rubber World	24	4.8	V
6	Journal of Elastomers and Plastics	23	4.6	VI
7	Plastics Rubber and Composites: Processing and Applications	15	3.0	VII
8	Rubber Chem Review	11	2.2	VIII
9	Indonesian Journal of Natural Rubber Research	9	1.8	IX
10	International Polymer Science and Technology	9	1.8	IX
11	Rubber India	9	1.8	IX

12	Progress in Rubber and Plastics Technology	6	1.2	X
13	Rubber Developments	6	1.2	X
14	Polymer	5	1.0	XI
15	Polymer International	5	1.0	XI
16	Journal of Adhesion Science and Technology	4	0.8	XII
17	Journal of the Rubber Research Institute of SriLanka	4	0.8	XII
18	Rubber Asia	4	0.8	XII
19	Bulletin of the Rubber Research Institute of SriLanka	3	0.6	XIII
20	Polymer Degradation and stability	3	0.6	XIII
21	European Polymer Journal	2	0.4	XIV
22	Indian Journal of Natural Rubber Research	2	0.4	XIV
23	Journal of Biological Chemistry	2	0.4	XIV
24	Journal of Polymer Materials	2	0.4	XIV
25	Journal of polymeric Materials	2	0.4	XIV
26	Polymer Engineering and Science	2	0.4	XIV
27	Rubber and Plastics News	2	0.4	XIV
28	Rubber News	2	0.4	XIV
29	ANRPC News	1	0.2	XV

30	Biomaterials	1	0.2	XV
31	European Journal of Biochemistry	1	0.2	XV
32	European Rubber Journal	1	0.2	XV
33	FEBS Letters	1	0.2	XV
34	Indian Rubber Journal	1	0.2	XV
35	International Journal of Polymeric Materials	1	0.2	XV
36	Journal of Adhesion	1	0.2	XV
37	Journal of Polymer Science: Polymer Chemistry	1	0.2	XV
38	Journal of Polymer Science: Polymer Physics	1	0.2	XV
39	Macromolecular Reports	1	0.2	XV
40	Materials World	1	0.2	XV
41	Phytochemistry	1	0.2	XV
42	Plantations, Recherche, Development	1	0.2	XV
43	The Planters' Chronicle	1	0.2	XV
44	Plastics and Rubber Weekly	1	0.2	XV
45	Polymer Plastics Technology Engineering	1	0.2	XV
46	Trends in Polymer Science	1	0.2	XV
TOTAL		**500**	**100**	

The data given in Table 2 shows that Journal of Applied polymer Science published 109 article (21.8%) in the field of Rubber Chemistry and Technology. So this is the most productive journal in this field. The second position goes to Rubber chemistry and Technology. This journal published 88 articles (17.6%). The third position goes to Kautschuk Gummi Kunststoffe, published 75 articles (15%). The fourth position goes to Journal of Rubber Research which published 54 articles (10.8%) out of the total articles published during the period of study.

3.3 SUBJECT-WISE DISTRIBUTION

Subject-wise distribution of publications in the field of study is subjected to detailed analysis. The publications are grouped under the following subjects.

TABLE - III

SUBJECT-WISE DISTRIBUTION OF ARTICLES

Sl. No.	SUBJECT	NUMBER OF ARTICLES	PERCENTAGE
1	Latex	70	14.00%
2	Rubber Blends and Composites	61	12.20%
3	Synthesis of Elastomers	46	9.20%
4	Chemical Analysis	41	8.20%
5	Rheology of Rubber	38	7.60%
6	Techniques of Vulcanization	35	7.00%
7	Rubber compounding	34	6.80%
8	Chemical reactions and modifications	28	5.60%
9	Instrumental analysis	25	5.00%
10	Properties of Rubber	25	5.00%
11	Physical Testing of Rubber	16	3.20%
12	Dynamic mechanical properties of Rubber	16	3.20%
13	Rubber products	15	3.00%
14	Application and uses of compounding ingredients	15	3.00%
15	Latex Allergy	12	2.40%
16	Rubber In Engineering Applications	9	1.80%
17	Preparation and reactions of compounding ingredients	7	1.40%
18	Reclaimed Rubber	4	0.80%
19	Testing equipment	3	0.60%

The analysis of the data shows that the major subjects under study which had contributed the maximum number of studies in the field of latex. It had 70 papers to its credit (14%) out of the total 500 papers. It is followed by Rubber blends and composites with 61 papers (12.2%). The third position goes to Synthesis of Elastomers with 46 papers (9.2%).

3.4 AUTHORSHIP PATTERN

Authorship is a desirable phenomenon reflecting the contemporary practices by clearly showing patterns of communication, productivity and influences among researchers. Scientific productivity is frequently measured in terms of the published output, mostly because the data on the number of publications by authors can be easily collected and are quite reliable. The contributions of authors in terms of number of papers published on the subject is an indicator of the productivity of the author. The higher the contribution, more the productivity of authors.

TABLE - IV

AUTHORSHIP PATTERN

AUTHORSHIP PATTERN	YEAR					TOTAL	PERCENTAGE
	1994	1995	1996	1997	1998		
Single Author	12	28	21	9	6	76	15.2
Two Authors	19	47	37	23	21	147	29.4
Multiple Authors	38	53	96	42	48	277	55.4
TOTAL	69	128	154	74	75	500	100

From the table it is clear that majority of the publications are brought out by multiple authors, 277 (55.4%). Publications contributed by two authors are 147 (29.4%). The data reveals that single author contributions are relatively less. This indicates that collaborative research is more in the field of study.

3.5 CONCLUSION

The bibliometric analysis helped in identifying the various characteristics of the contributions in Rubber Chemistry and Technology using various parameters.

CHAPTER - IV

RESEARCH ON RUBBER CHEMISTRY AND TECHNOLOGY: A TREND REPORT

This chapter provides a trend report on Rubber Chemistry and Technology. The trends have been traced through the analysis of abstracts of the publications published in the field . The period covered is from 1994 to 1998.

The analysis is carried out mainly under 3 broad classes and each of them is again divided on the basis of narrower concepts dealt within. The subject groupings followed in the study are listed below.

4.1 RUBBER PHYSICS AND RUBBER ENGINEERING

4.11 Rubber Rheology

4.12 Properties of rubber

4.13 Rubber in engineering applications

4.2 RUBBER CHEMISTRY

4.21 Elastomers

4.22 Polymerization

4.23 Reactions of compounding ingredients.

4.24 Chemical reactions and modifications

4.25 Chemical analysis

4.26 Latex

4.3 RUBBER TECHNOLOGY

4.31 Compounding

4.32 Rubber products

4.33 Vulcanization

4.34 Rubber machinery

4.35 Application of compounding ingredients

4.36 Reclaimed rubber

4.37 Rubber blends and composites

4.38 Physical testing

4.39 Dynamic mechanical properties

4.1 RUBBER PHYSICS AND RUBBER ENGINEERING

4.11 RUBBER RHEOLOGY

Aranguren and others studied the rheological properties of filled elastomers. They described about the rheology of silica-silicone rubber (1/1994). Ashalatha and others described about the rheological and mechanical properties of PP/EPDM/NR ternary blends (2/1994). Ashalatha et al conducted another study on the rheological and mechanical properties of compatible PP/CPE blends (3/1996).

Bhattacharya and Chakraborty conducted a study on rubber processing. They used peptiser for product performance (4/1997).

Claramma and Mathew described about the rheological behaviour of prevulcanized latex. They have studied about the viscosity modifiers (5/1998).

The evolution of rubber processing and its challenges have been studied by Freakley (6/1996).

Ganesan and others described about the carbon black dispersion in rubber by an image processing technique. They have studied about the quantitative measurement of dispersion (7/1995).

Ganesan and others conducted another study about the quantitative fractography of rubber by image processing technique (8/1995). Gopalakrishnan and others outlines about the effect of blend rheology (9/1995).

Guriya and others described about the rheological properties of EDDM compounds. They have studied about the effect of blowing agent, curing agent and silica filler (10/1998).

Han and white explain about the rheological studies of dynamically vulcanized blends of polypropylene and ethylene-propylene rubber (11/1995).

Isayev and Wan conducted a study about the material characterization. They have studied about the injection molding of rubber compound with rheology affected by vulcanization (12/1996).

Ishikawa et al studied about the processing agents for silica-filled rubber (13/1998). Joseph and others described about the melt rheological behaviour (14/1994).

Karnika de Silva and others studied about the vulcanizable processing aid for natural rubber. They described about the depolymerized natural rubber as a processing aid (15/1996).

Leblanc outlines about the rubber compound testing. He described about the discrepancies in testing rubber compounds with different type of commercial capillary rheometers (16/1994).

Leblanc and others described about the mixing behaviour and rheological properties of SBR compounds. They explained about the composite design experiments to study the relationship between the mixing behaviour and rheological properties (17/1994). Lee and others studied about the effect of network formation on the rheological properties of SBR modified asphalt binders (18/1997). Li and white described about the rheological behaviour of highly filled EPDM compounds with calcium carbonate, carbon black, silica and zinc oxide (19/1996).

Long explains about the current status and future prospects of rubber processing and products (20/1995).

In a study conducted by Marinelli and Magg described about the rheological properties of rubber compounds. They described about a new acrylonitrile-butadiene rubber for moulded articles (21/1995).

Mousa and others have studied about the mixing rheology (22/1997).

Mukhopadhyay described about the developments in rubber processing technology (23/1995).

Nair and others have studied about the viscosity modifier in nitrile rubber. They described about liquid natural rubber as a viscosity modifier (24/1997). Osanaiye et al outlines about the rheological properties of rubber-carbon black and carbon oil compounds (25/1995).

Ray and others have studied about the effect of zinc salt of unsaturated fatty acids as processing aid (26/1994). Reena Susan George and others described about the reheological and extrude behaviour of natural rubber (27/1995).

In a study by Schmidt and Kreipe described about the thermal utilization of waste rubber (28/1995).

Sambatsompop and others described about the rheological behaviour and flow vulcanization. They have studied about the flow analysis of natural rubber in a capillary rheometer (29/1997). Sombatsompop and wood have studied about the flow analysis of natural rubber in a capillary rheometer. In this study the flow patterns and entrance velocity profiles are described (30/1997).

Soos and white described about the rheological characterization of NBR elastomers. The use of BF goodrich dynamic stress relaxometer is described in this study (31/1996).

Thomas and others studied about the processing properties of raw rubber. A comparative evaluation of ISNR 20 with conventional forms of natural rubber are used (32/1995).

Varkey and others studied about the effect of prevulcanizatgion on the rheological behaviour of natural rubber (33/1996). Wada outlines about the rubber friction test methods (34/1998). Wan and Isayev described about the injection molding of rubber compound with rheology affected by vulcanization (35/1996).

4.12 PROPERTIES OF RUBBER

Ahlbland et al outlines about the physical properties of rubber/cellulose fibre composites. They have studied about the effect of electron irradiation on physical properties (36/1996).

Anantharaman and others conducted an investigation on cure characteristics and the magnetic properties of rubber ferric composites (37/1998).

Azemi Bin Samsuri described about the properties of rubberised bitumen (38/1996). Bhattacharya and Gangopadhyay studied about the properties and processing techniques of butadiene rubber (39/1998). Gajewski and Prot described about the crosslink density and properties of rubber (40/1994). Galan and others outlines about the effect of adhesive composition on the properties (41/1996). Gibala and Hamed described about the cure behaviour (42/1994). Guyriya and Tripathy outlines about the dynamic viscoelastic properties of carbon black loaded closed-cell microcellular ethylene-propylene-diene rubber vulcanizates (43/1996).

Hagen and others studied the effects of the type of crosslink on viscoelastic properties of natural rubber (44/1996).

Heinrich and Dumler outlines about the wet skid properties of filled rubbers (45/1998).

Kakubo and others described about the origin of characteristic properties of natural rubber. They described the effect of fatty acids on crystallization of cis-1, 4-polyisoprene (46/1998).

Karnika de Silva conducted study on some of the properties of blends of polyisoprene (47/1994). Li and others conducted study on variation of structure and properties of natural rubber (48/1998). Low et al described about the properties of rubber-modified cellulose-fibre-epoxy laminates (49/1994). Manas and others studied about the physical properties of NR/polystyrene blends. They studied the effects of dicumyl peroxide and liquid natural rubber (50/1998). Nishiyama and others described about the origin of characteristic properties of natural rubber (51/1996).

Okel and Waddell studied about the silica properties/rubber performance correlation (52/1994).

Patkar studied the viscoelastic properties. The effect of silica is described in this (53/1998). Pu and Ding described the properties of EVA preirradiation grafted NIPPAm. The preparation and characterization are also described (54/1996). Srilathkutty and others studied about the effect of fillers on the properties of NBR/PVC microcellular shoe soles (55/1998). Suwardin and others described about optimizing the quality control of SIR 20 crumb rubber (56/1995). To et al suggests sulfanimide accelerators for improving the properties of rubber (57/1996).

Uchiyama described the non-slip properties of rubber (58/1998). Vink suggests the influence of filler surface treatment on properties of reinforced rubber products (59/1996). Wang and Wang suggest a new technique to quantitatively characterize crosslink density (60/1998).

Wang and others described the dynamic properties of filled rubber. They suggests the dynamic stress-softening of filled vulcanizates (61/1998).

Yang and Hsiue describes the physical and dielectric properties of acrylic acid grafted silicone rubber (62/1996).

4.13 RUBBER IN ENGINEERING APPLICATION

Bauman described high – value engineering materials from scrap rubber (63/1995).

Bhuana and others described about the earthquake rubber damper. They suggest the homogenization of temperature and reduction of vulcanization time by applying additional heat source (64/1996).

Chatterjee described about the rubber spring in earthquake protection (65/1995).

Davies and others outlines the stress relaxation under repeated stressing (66/1996). De Varies described about the heat-resistant conveyor belts (67/1995). Dierkes explain about the rubber recycling. The re-use of rubber waste is described in this (68/1995). Dutta gives an account of the engineering application of rubberised fabrics (69/1994). Gopalakrishnan described about the rubberised roads (70/1995; 71/1994).

4.2 RUBBER CHEMISTRY

4.21 ELASOMERS

Besdo and Ihlemann describes the material behaviour of elastomers (72/1996).

Blume and others describes the kinetic aspects of nitrosamine formation during the production and storage of elastomers (73/1996).

Bowers outlines the new developments in improving the processibility of fluoelastomers (74/1997). Chaudhury and Bhowmic described the thermostable insulating thermoplastic elastomers (75/1996).

Class described the peroxide crosslinking of elastomers (76/1995).

Drake and others suggested the use of polybutadiene coagents in peroxide cured elastomers (77/1995).

Eisenbach described about thermoplastic elastomers and polyurethane elastomers. He described the structutre and morphology of filled rubber and thermoplastic elastomers (78/1996). Elleithy and others described about the fracture and fatigure failure behaviour of fluoroelastomers (79/1996). Ellul suggests low temperature resistant thermoplastic elastomers for speciality applications (80/1997).

Fukushima et al describes the synthesis of graff copolymers from highly deproteinised natural rubber (81/1998).

Furukawa and others described the preparation of functionally graded polyurethane elastomers. The method used is electrophoresis of monomer (82/1997).

Gerspacher and others proposed a mechanism for the reinforcement of elastomers (83/1994).

Hamed gives the characteristics and properties of crosslinked elastomers (84/1994). Hamed and Wu descibes the relationship between the cohesive strength and tack of elastomers (85/1995). Herd and Bobo give an account of the analysis and properties of carbon black filled elastomer blends (86/1995). Kelm and others described about the crosslink density of elastomers (87/1998). Kohler and O'Neill describe a new technology for the devulcanization of sulfur-cured scrap elastomers (88/1997). Kotz and Stevens described the improved proce3ssing variants of viton GFLT fluoroelastomers (89/1995). Lake and Mente described the antiozonant protection of elastomers (90/1995). Liu and Li studied about the curing reaction kinetics and properties of elastomers (91/1996).

Martin et al described about the morphology and properties of polyurethane elastomers. They described the average soft segment length (92/1996). Meissner gives an account of bound rubber and elastomer – filler interaction (93/1995). Mousa and others describes the oil-resistance study (94/1998). Nakauchi and others describes the crosslinking structure and properties of elastomers (95/1996). Nuyken and others studied about the reinforcing polymeric fillers. They suggests core-shell polymers as reinforcing polymeric fillers (96/1995). Parker et al suggests the applications of 'Dimide-Hydrogenated' styrene butadiene and polybutadiene thermoplastic elastomers (97/1994).

Pader and Agarwal studied about the thermoplastic elastomers for automotive applications (98/1998).

Roychoudhury and De describes about the elastomer-carbon black interaction (99/1995).

Song and others conducted studies on the relationships between network structure and mechanical properties of interpenetrating polymer networks (100/1995).

Steinbuchel describes about the synthesis and production of biodegradable elastomers (101/1996).

Suhara and others give an account of the stress relaxation of polyester fiber-polyurethane elastomer composite (102/1998).

Sykes describes about the structure and property relationships in polyurethane elastomers. (103/1996).

Thomas gives and account of the thermoplastic elastomers and their influence in future world elastomer consumption (104/1995). Tonelli et al describes about the new flurorinated thermoplastic elastomers (105/1996).

Van der pol describes about the fiber reinforcement of elastomers (106/1995). Vladkov and Amaudova describes the influence of oligoamidophosphates (107/1994). Xie and others describes about the synthesis and properties (108/1996).

4.22 POLYMERIZATION

Change Nemeth studied about the rubber particle agglomeration phenomena (109/1996). Datta and others describes about the electron beam initiated grafting and crosslinking (110/1996). Decker et al gives an account of the polymerization of multifunctional monomers. Photocrosslinking is used (111/1996; 112/1996;113/1996). El – Ghaffar describes about the emulsion polymerization of vinyl acetate. A semicontinuous polymerization technique is used (114/1995).

Fang and others described about the radiation-induced graft copolymerization (115/1996). He and others described about the formation mechanism of silicone rubber particles with core-shell structure by seeded emulsion polymerization (116/1996). Wood and Iroh describes the effect of electrolytes and process parameters on the electropolymerization (117/1996). Yang and Hsiue describes about the graft polymerization of acrylic acid. Preirradiation method is used (118/1995).

4.23 REACTIONS OF COMPOUNDING INGREDIENTS.

Ahagon describes about the evaluation of polymer chain during mixing of filled compounds (119/1996).

Arnaudova and others describes about the influence of oligoamidephosphates (120/1996).

Ghosh and others suggest a plant product modified carbon black as a reinforcing filler (121/1995).

Compounds of natural rubber containing different fillers were evaulated for their air permeability. The results indicated that incorporation of filler generally reduce the permeability. Certain fillers such as mica, graphite and clay produced substantial reduction which was attributed to the particular morphology of these fillers as evidenced from photomicrographs (122/1997).

Pramanik describes about LLDPE composites (123/1995). Pushpa and Billingham describes about the solubility of antioxidants in rubber (124/1996).

Yusof and others describes about the purification and characterisation of an inhibitor of rubber biosyntesis (125/1998).

4.24 CHEMICAL REACTIONS AND MODIFICATIONS

Abbate and others give an account of a new reactive liquid rubber with maleimide end groups (126/1996).

Abdel-Aziz describes about the influence of polyfuctional monomers (127/1995).

Avirah and Joseph conducted studies on natural rubber bound para-phenylenediamine antioxidants (128/1995).

Bielinski and others describes about the influence of chemical modification on tribological properties of elastomers (129/1995).

Cho et al have found the effect of interfacial adhesion on toughening behaviour of rubber modified poly(methyl methacrylate) (130/1997). Debnath and Basu conducted studies on the effect of thiuram disulphide on naturtal rubber vulcanization (131/1996). Derouet and others described about the phosphorus modification of expoxidized natural rubber. This can improve flame resistance (132/1994).

De Sarkar and others describes about the optimization of reaction conditions (133/1997). Ellul et al outlines the crosslink densities and phase morphologies (134/1995). Evans and Waddell describes about the ultra-high reinforcing precipitated silica (135/1995). Ghosh et al outlines the effect of modified carbon black (136/1997). Huang and Tsiang describes the effect of tetrahydrofuran as a structure modifier (137/1996). Isayev and others describes the elastic recovery of rubber vulcanizates (138/1996). Ishiaku et al describes the effect of di-2-ethylhexyl phosphate (139/1996). Kali Ray explains the chemical modification of EPDM rubber (140/1997). Lee and others explains the method for estimating the chemical crosslink densities of cured natural rubber (141/1994).

Myhre and Mackillop outlines the modification of crumb rubber (142/1996).

Nasar and Goman describes about the influence of physical ageing (143/1995).

O' conner and ohters describes about the role of rubber particles (144/1997). Okieimen and Urhoghide conducted studies on miscibility of poly(vinyl chloride) (145/1996). Ou and others describes the effects of alkylation of silica filler on rubber reinforcement (146/1994).

Puskas and Wilds describes about the kinetics of the epoxidation of butyl rubber. They describes the development of high precision analytical method (147/1997).

Roychoudhury and others shows the chemical interaction between carbon black and elastomers (148/1994).

Tanka and others gives the structural characterisation of natural rubber (149/1997). Tangpakdee and Tanka describes about the branching of natural rubber (150/1998). Thammathadanukul and others shows a comparison of rubber reinforcement using various surface-modified precipitated silica (151/1996).

4.25 CHEMICAL ANALYSIS

Anachkov and others described about the DSC study of thermal decomposition (152/1996). Ansarifar and Lake explains the mechanics of rubber-to-metal bon failure (153/1995). Bandyopadhyay and others described about the surface-oxidized carbon black. 3-Aminopropyltriethoxysilane is used as a promoter in the crosslinking of carboxylated nitrile rubber (154/1996; 155/1996). Bayers described about the silane-coupling agents for enhanced silica performance (156/1998). Bhaumic and Datta describes about the thermal analysis (157/1995). Blume and others explains the analysis of N-Nitrosamines (158/1996).

Bohin and others describes the using of a dispersion model for single agglomerates. They describes the analysis of power requirements and dispersion quality in batch compounding (159/1996).

Bonfils and others explains the chromatography study of natural rubber films (160/1995).

FT-NMR is used in the analysis of rubber blends crosslink distribution in carbon black filled blends of NR and cis-BR have studied. Sulphenamide accelerators are used in this study. (161/1995)

Buding and others described about the influence of peptizer on rubber-to-steel cord adhesion (162/1998). Burbank and others outlines about the continuous processing of high quality compounds (163/1995). Campbell et al describes about the characterisation of the chemical structure of sulfur vulcanizates of natural rubber. They used the 1H NMR spectroscopy method for the analysis (164/1994). Campbell and Farley describes about the gel formation during latex epoxidation. Acid-catalysed hydrolysis is used (165/195).

In a study chandra and others describes about the scanning electron microscopy, energy dispersive X-ray studies of the influence of a cobalt adhesion promoter on the interface between rubber skim compounds and tyre steel cord (166/1996).

^{13}C NMR spectroscopy has been used to study vulcanised blends of natural rubber. Effect of trans-polyoctenylene on crosslink structure of NR and SBR are explained (167/1997).

Chetri and others outlines about the homogeneous acetalization and esterification of poly (vinyl) alcohol) in non-aqueous medium Ethyl nitrate dimethyl sulfoxide is used (168/1998). Sulfur vulcanization of NR, BR, SBN and their blends have been studied. This study is conducted by using rheometer and DSC (169/1996). Effective processability measurements of acrylonitrile butadiene rubber have been described by Cousins and Dick (170/1998).

The experimental results of the crack growth in twisted rubber disks have been studied by De and Gent (171/1998). Dehnicke studied about the acqueous adhesives as an alternative to conventional rubber-to-metal adhesives (172/1998).

An investigation on the distribution of fillers in natural rubber by element spectroscopic transmission electron microscopy is described (173/1994). Ellul and Hazelton studied about the chemical surface treatments. The effects on friction and adhesion are explained (174/1994).

The reaction of moist ozone with natural rubber have been studied using attenuated total reflectance spectroscopy (175/1998). ^{13}C NMR study of oxidative degraded rubbers is conducted by Eng and others (176/1998). A study is conducted by Fong and others about the mathematical model of diffusion of solvents in rubber (177/1998).

Hydrogenation of natural rubber using nickel 2-ethylhexanate catalyst in combination with trisobutylaluminium is described by Gan and others (178/1996). Ganghoffer and Schultz described about the cavitation in rubber (179/1995).

Geethamma and others described about the short coir fiber-reinforced rubber composites. They investigated the effects of fibre length, orientation and alkali treatment (180/1995).

In a study conducted by Gonzalez and others a new interpretation of the crosslinking mechanisms of natural rubber with dicumyl peroxide have described (181/1998). Diffusion of organic solvents in rubber membranes is measured (182/1995; 183/1995).

Thermal degradation of polythiophene-natural rubber is described by Hacaloglu (184/1997).

Hamed and Zhao described about the longitudinal cracking. During chemical stress relaxation of carbon black filled natural rubber vulcanizate the longitudinal cracking takes place (185/1998).

An attempt is made to analyse the network structure of BR and SBR vulcanizates. Model vulcanization and sulfur vulcanization is described. NMR spectroscopy is used (186/1998).

Hardiman and Kartika conducted study on stabilizing mooney viscosity of narural rubber. This is conducted by using sodium phenolate, sodium metabisulphite and acetaldehyde (187/1995).

Proton NMR studies of molecular mobility in vulcanized and eposidised natural rubber is conducted (188/1996). Analytical electron microscopy study is conducted by Hofer and others. The characterisation of rubber-brass bonding layers have been studied (189/1996).

Swollenstate ^{13}C spectroscopy has been used to study vulcanised blends of natural rubber/nitrile butadiene rubber and natural rubber/epoxidised natural rubber both qualitatively and quantitatively. The results obtained show that although the polymers present can be identified and the individual polymers characterised in terms of their co-polymer composition, the use of this technique to determine the actual blend composition is unsatisfactory. The reasons for the deviations of the results obtained from the true values are discussed (190/1994).

Hummel and others described about the rubber-brass bonding. Morphology of cross sections through the bonding layers as a possible basis for classification is described (191/1996).

A comparative study of the effect of thermo-oxidative aging on the physical properties of rice husk ash and commercial fillers in epoxidized natural rubber compounds have been explained (192/1997).

Job and Joseph described about the studies of the adhesives for rubber to rubber bonding (193/1995). FTIR analysis of silica-filled natural rubber is described by Kralevich and others (194/1998).

Linos and Stein Buchel describes about the microbial degradation of natural and synthetic rubber. They used a novel bacteria for this. This bacteria is belonging to the genus 'Gordona' (195/1998).

The density of chemical crosslinks and chains entanglements in unfilled EPDM vulcanizates studied with low resolution solid state IH NMR (196/1998).

The microstructure of carbon black is investigated by atomic force microscopy (206/1994). IHNMR analysis of thermal groups in the rubber chain is described by Ohye and Tanaka. The structural characterisation of rubber from tactarium mushrooms are identified (207/1998). The evaluation of the performance of polymeric roofing materials have studied by Paroli and Delgado. They used thermal analysis for this (208/1996). Quigley and others described about the viscoelastic constitutive models for rubber. They have determined the material constants (209/1995). Richards and Roberts described about the friction of various rubber articles lubricated with acid and alkaline water (210/1995).

Selden outlines the fracture mechanics analysis of fatigue of rubber (211/1995). The nonlinear elastic analysis of the adhesive strength between rubber like materials and regid surfaces are analysed by Sun and Chang (212/1995).

The gel content of rubber from high-ammona latex (HA-latex) decreased significantly after deproteinization with proteolytic enzyme. The addition of 1-2% ethanol in toluene solution reduced the gel content of rubber from HA-latex, deproteinized HA-latex and pale crepe. Transesterification of the rubber in toluene solution with sodium methoxide dissolve the gel fraction. The gel fractions solubilized after transesterification showed molecular weight distribution rich in low molecular-weight fraction. The findings suggest that the branching and crosslinks are composed of two types of branch-points, one by association or aggregation of proteins or oligopeptides at the initiating end and the other by ester linkages including phospheric ester at the terminal end (213/1997).

Urabe and others conducted studies on rubber mixing. The action of zinc oxide during the mixing process is explained in this (214/1995). The rubber to metal bonding study is conducted by Van Ooji (215/1996). Veeralakshmanan and others described about the chlorination of liquid natural rubber (216/1995).

Nitrosamine formation in rubber is explained by Willoughby and others (217/1998).

Yeoh described about the rubber analysis. HE used hyperelastic material models for finite element analysis (218/1997).

4.26 LATEX

Aftab Alam conducted a study on the estimation of protein contamination in latex (219/1996). Akasawa and others outlines a new acidic allergen, Hev b 5, in latex. (220/1996). Amir-Hashim described about the effect of leaching and humidity as prevulcanized natural latex film. The most effective method is the use of a recentrifuged prevulcanized latex with a combination of wet gel leaching and dry-film leaching or direct water spraying (221/1997).

Azizah and others conducted study on latex protein allergy among factory workers. The finding of the study are described in this (222/1996). Beezhold and others described about the surface-bound latex protein antigens on surgical gloves (223/1995).

There is an urgent need to produce latex gloves with minimum extractable proteins. Stability of antigenic proteins in latex extracts is described by Bradley and others (224/1996).

The quality control of latex products used in the medial setting has to take into account the presence of allergens which induce a Type I hypersensitivity response. Assays to measure the total protein eluted from these products does not address the problem of allergenicity of the proteins extracted. The study by cardosa and others introduces to rubber manufacturers the concept of enzyme immunoassay and describes various immunoassay formats by which antigens can be detected (225/1994).

The gloves produced by different manufacturers contain different amounts of antigens and antibodies. Monoclonal antibodies are used to show that different antigens are found in different latex gloves (226/1994).

Sulfur prevulcanization of natural rubber latex was conducted at 60,70,80 and 90 o C for different periods. At lower temperatures the rate of reaction was slow (227/1997; 228/1997).

Cook and other describes about the microstructure of natural rubber latex films (229/1997; 230/1997).

The properties of natural rubber latex concentrated by creaming method for gamma ray irradiation is described by Dafader and others (231/1996). The permeability and material characteristics of vulcanized latex film is described by Dillon and Schroedar (232/1997). The mechanisms of latex film formation is explained by Dobler and Holl (233/1996).

Elizabeth and others described about the treatment of examination of gloves for reducing extractable protein content (234/1996). Geurts and others described about the molecular mass control in methacrylic copolymer latexes (235/1997).

Low protein latex-has been found to be suitable for factory scale production of examination gloves. A post vulcanized formulation was used in the factory run. Unaged tensite strength of these gloves was in the region of 25 MPa-27MPa and a retention of more than 908 was obtained when they were aged at 70°C for 7 days and 100°C for 1 day (236/1994).

Gidrol and others described about the lectin-like protein called havein from the rubber trees. The use of havein in the coagulation of latex is explained (237/1994).

Hamsa and Amir-Hashim described about the latex processing. The changes of latex proteins during processing is explained (238/1997; 239/1998). They described about the elastomeric films from structured latexes (240/1997). They also conducted another study about the grafting behaviour of n-Butyl acrylate (241/1997). In another study they described about the hydrogenation of styrene-butadiene rubber latexes (242/1997).

Jacob and others described about the concentrated natural rubber latex. They points out the glove manufacture (243/1995). Karnika de Silva outlines about the natural rubber latex based adhesives (244/1996). Karnika de Silva and Hamielec conducted a Kinetic study of the graft polymexization of unsaturated monomers with natural rubber latex (245/1994). Khalid and others described about the dielectric properties of have a latex at various moisutre contents (246/1994).

The isomerization of isopentenyl diphosphate to dimethyl diphospate and the formation of oligoprenyl diphosphate as well as polyprenyl diphosphates, catalysed by IDP-Isomerase and polyprenyl transferases, respectively, were observed following bottom fraction which had been preincubated at 4°C overnight (247/1996).

Laliamma Jose and Rani Joseph suggest an accelerator system for transparent latex products (248/1996). Legge describes about the TPE condoms and described about the ozone level in it (249/1994). Llosent and others described about the particle size distribution of SBR and NBR latexes by UV-VIS turbidimentry (250/1996).

The allergenic responses in latex sensitive persons are evaluated by means of the skin-prick test.

Studies are in progress to identify the allergens. Allergenic repossess to radiation cured natural rubber latex is explained (251/1996).

Martin and Urban described about the spectroscopic studies of latexes (252/1996). Matthan explained about the underexploited export potential for the Indian latex gloves industry (253/1994). Mehta described about the cause of cessation of viral passage through artificially-induced holes in latex condoms (254/1998). Miller described about the latex sales (255/1996).

Considerable criticism has been made against the use of natural rubber latex for the maxifacture of elastic medical goods due to allergic reactions that can be used. A survey reveals that the proportion of the population affected by latex proteins is small and the effects are not usually serious. The inferior performance of PVC, Polyurethane, nitrile and neoprene, and styrene copolymers can lead to increased health and safety risks, and that they have also been known to cause toxi and allergic effects (256/1994).

Nagarajan and others described about the latex intepreneterating polymer networks. Their synthetic variations have explained (257/1996; 258/1996; 259/1996; 260/1996).

Prick test studies of raw materials and products of commercial natural rubber latex showed different threshold levels of residual extractable proteins. The threshold level of MRL products is currently 50-100 g/g, a level impossible to attain by leaching out the protein content. The threshold recommended is 30-40 g/g. (261/1998; 262/1997).

Naon and others describes about the drying of granules from natural rubber latex (263/1995).

With the reported incidence of Type 1 hypersensitivity associated with the presence of residual water-soluble proteins in latex products, there is an urgent need to produce latex gloves with minimum extractable proteins. The study shows that an additional leaching operation after drying is necessary the most effective means is the use of a recentrifuged prevulcanized latex with a combination of wet gel leaching and dry-film leaching or direct water spraying. Under the most favourable conditions, an extractable protein content of approximately 0.03 mg/g can be achieved (264/1994).

Niu and Urban outlines about the surface and interfacial FTIR spectroscopic studies of latexes (265/1995; 266/1996). Nordin Abdul Kadir Bakti and Isa described about the efficient treatment system for rubber glove manufacturing plant (267/1997). Odeberg and others described about the influence of spacer groups on grafting ability, curing ability and film properties of water-based radiation curable latexes (268/1998; 269/1996).

Fluorescence method of studying void closure kinetics during film formation from high T latex particles are described by Pekcan and Canpolat (270/1997).

The problems currently facing by latex products manufacturers are protein allergy, and presence of nitrosamines and nitrosatable amines. Pendle in his paper discusses about the significance and scale of these problems in relation to the formulation of compounds and of production technique (271/1997).

Schloman and others described about the performance testing of guayule latex (272/1996). Shamsui Bahri describes about the immunocytochemical localisation of rubber membrance proteins in have a latex (273/1996).

Singha and others proposed a new method to hydrogenate nitrile rubber in the latex form (274/1995). Soedjanatmadia and others described about the processed products of the hevein precursor in the latex of the rubber tree (275/1995). Solichin described the preparation of constant viscosity stabilized rubber from thin slab derived from latex in the presence of hydroxylamine neutral sulphate (276/1995).

Natural Hev b 7, a 43-k Da patatin-like allergen was purified from the latex of Hevea brasiliensis and several internal peptide sequences were determined (277/1998).

Subramaniam and others described about the use of mechanistic principles to make modified natural rubber latex products using emulsion polymerization (278/1997).

A spectrum of proteins derived from Havea brasiliensis reacted with IgE in the plasma from persons allergic to natural rubber latex. Latex B-serum, C-serum and rubber particle membrane proteins were all found to contain allergenic proteins. Variations were observed in the reactivity of the latex IgE positive plasma to the different proteins. Monoclonal antibodies have been developed against some of these allergens (279/1994; 280/1995).

Suwardin describes about the simultaneous latex coagulation in the bamboo tube· (281/1996). Tangboiboonrat and others explains the characterization of non-crosslinked natural rubber latex by phase transfer technique (282/1994; 283/1996). Tanrattanakul describes about the toughening of polycarbonate with core-shell structured latex particles (284/1996). Tebelius and Urban conducted surface and interfacial FTIR spectroscopic studies of latexes (285/1995; 286/1996).

Thiandchanya and others described about the degradability testing of radiation – vulcanized natural rubber latex films (287/1994). Triwiyoso and Handoko described about the preservation of field latex. The study is aimed to increase the production of latex shares in NES project (288/1995). Tucci and others described about the structural features of latex gloves in dental practice (289/1996).

Varghese and others described about the use of sulphuric acid as a coagulant for natural rubber latex (290/1996).

Allergenic activity must take into account of the nature of allergenic proteins. White describes about managing the latex protein allergy (291/1996; 292/1995).

Yapa describes about the manufacture of low protein natural rubber pineapple juice or bromelain treatment of hevea latex (293/1995; 294/1995). Yeang describes about the new techniques in the quantitation of total proteins from latex gloves (295/1994). Yeng and others conducted a latex allergy study by extraction of natural rubber latex proteins (296/1995).

With the awareness of Type 1 allergy, improvements of latex-dipped products, particularly the medical gloves, invariably involve the reduction or removal of their residual extractable protein fraction containing the allergens. Studies have been carried out with 16 dry natural rubbers of various commercial grades and five rubber products including cut threads manufactured via processes quite different from those of latex-dipped articles. Findings reveal that they not only have extremely low extractable protein contents, but also show negligible or no allergic responses when skin-prick tested on a total of 28 latex hypersensitive persons. So dry natural rubber products are free from the protein allergy problem reported for some latex products (297/1997; 298/1997).

Yuen describes about the dithiocarbamyl compounds in natural latex concentrate (299/1995). Zehr and others described about the extraction of antigenic protein from latex films and gloves (300/1994).

4.3 RUBBER TECHNOLOGY

4.31 COMPOUNDING

Abo-Hashem and Elshokrofy explains about the thermal effects of carbon black-rubber composites (301/1994). Busfield and others described about the crack growth and strain induced anisotropy in carbon black filled natural rubber (302/1997; 303/1996). Dyrda and Meshchaniov describes about the dielectric permiability of rubber (304/1995).

The reinforcement mechanisms in carbon black and silica loaded rubber have been studied by Eggers and Schummer (305/1996). Ertong and others outlines about the flow properties of carbon black filled natural rubber. They described about the steady state shear flow properties (306/1994).

By using the thermal filed-flow fractionation and multi-angle laser light scattering Fulton and Groves determined the molecular architecture of synthetic and natural rubber (307/1997). Gent and Lai conducted a study on the adhesion and autohesion of rubber compounds (308/1995). Gerlach proposed some additives for the modification of silicone rubber (309/1995).

Gerspacher and others described about the high frequency viscoelasticity of carbon black filled compounds (310/1996).

A study conducted by Ghosh and others suggests modified carbon black as reinforcing filler for SBR (311/1996).

Gibala and others outlines about the cure and mechanical behaviour of rubber compounds containing ground vulcanizates. They explains about the mooney viscosity (312/1996). Gori and Nordsiek described about the rubber/filler batches in powder form. These batches will help to simplify the production of rubber compounds (313/1998).

Guerbe and Freakley gives a comparison of some indirect methods for measuring the carbon black disperson in rubber compounds (314/1998). Ismail and others describes about the different modes of action of a multifunctional additive in a carbon black filled natural rubber compound (315/1996; 316/1996).

Jurkowski and others conducted study on the methods of sulfur disperson and sulfur blooming in rubber compounds. They have used radioisotopic determination methods for their study (317/1996). Klasek and others described about the rubber coupling agents (318/1996). Kluppel and Heinrich described about the fractual structures in carbon black reinforced rubbers (319/1995).

Koczorowska and Jurkowska conducted studies on sulfur behaviour in rubber compounds (320/1998). Li and others have studied about the carbon black aggregate structure. They proposed some simple methodologies for the modeling of carbon black aggregate structure (321/1996).

The evaluation of the external surface area of carbon black by nitrogen adsorption is described by Magee (322/1995).

Mantia and others conducted studies on the chemical interaction between surface oxidized carbon black and epoxidised natural rubber (323/1997).

Marwede and Sumner points out the new developments in the field of general purpose synthetic rubber (324/1998). Mass and Gronski conducted a study by atomic force microscopy. They have studied about the deformation of filler morphology in strained carbon black loaded rubbers (325/1995).

In a study conducted by Matheson and others the effect of carbon black filling on the pyrolysis of natural rubber and synthetic rubber have been identified (326/1996).

Medalia explains about the effects of carbon black on abrasion and treadwear (327/1994). Pond explains about the cavitation in bonded rubber cylinders (328/1995). Sangtani gives an introduction of practical rubber compounding (329/1997).

The effect of adhesion on the equilibrium swelling of short sisal fiber reinforced natural rubber composites have been described by Varghese and others (330/1995). Srilathakutty and others described about the use of amine terminated liquid natural rubber as a plasticizer in filled natural rubber and NBR compounds (331/1996). Tokita et al studied about the carbon black elastomer interaction modelling (332/1994).

Waddell and others studied about the mechanism of precipitated silica. This silica improves the brass-coated wire-to-natural rubber adhesion (333/1996).

4.32 RUBBER PRODUCTS

Anon described about the natural rubber mountings for Pakistan (334/1995). Holownika describes about the rubber cylinders (335/1995). Huyberechts described about the truck tyre retreading (336/1995).

The analysis of extractable proteins in rubber products have been described by Karnika de Silva (337/1996).

Kuhn-Stoffers and others described the determination of carbonyl compounds in emissions from manufacture and storage of rubber products (338/1997). Lambillotte and Eiber described about the truck tyre technology (339/1994).

Leca and Runcan studied about the reclaiming of rubber from waste tyres by physical methods (340/1996). Mitra described about tyres and the properties of tyres (341/1995).

Mohn. Nor. Zairossani and others conducted studies on biosorption of zinc from the effluent of rubber product (342/1998). Mukhopadhyay and others points out the future developments of tyre technology (343/1998).

Nakauchi describes about the service life of rubber products (344/1996).

Reader gives an account of medical and anatomical models (345/1996). Veith described about the pneumatic tyres (346/1998). In a study conducted by Will and Giese points out the influence of plasticizer aerosols on sampling and analysis of air pollutants in the rubber industry (347/1996).

Yip and others conducted study on the non-allergenicity of NR dry rubber products. The dry natural rubber products are free from the protein allergy problem (348/1995).

4.33 VULCANIZATION

Abdul-Aziz and others described about the radiation vulcanization of styrene-butadiene rubber. They studied about the effect of polyfunctional monomers on radiation vulcanization (349/1996).

The efficiency of modified phthalocyanine compounds as antioxidants and UV stablilizers for SBR vulcanizates have been studied by Botros and Abd El-Ghaffar (350/1997).

Chandran and Kuriakose described about the utilization of coconut pith and coir waste as filler in natural rubber vulcanizates (351/1995).

Sulfur prevulcanization of natural rubber latex was conducted at 60, 70, 80, and 90°C for different periods. The extend of crosslinking was assessed. At lower temperatures, the rate of reaction was slow. At each temperature, tensile strength and elongation at break decreased when the prevulcanization time increased, whereas the modulus increased up to a maximum cross linking and thereafter decreased. The rate of stress relaxation slightly increased as the extent of prevulcanization increased (352/1997).

Colvin and Bull described about sulfur or olefin copolymers as vulcanizing agents (353/1995).

Conveney and others suggests a triboelastic model for the cyclic mechanical behaviour of filled vulcanizates (354/1995).

Deiber and Bortolozzi give a comparison of two oscillating bicone cells for vulcanization (355/1995)

Ding and Leonov suggests a kinetic model for sulfur accelerated vulcanization of natural rubber compound (356/1996; 357/1996).

Gibbesch and others outlines the product constancy in the vulcanization of rubber lining for corrosion protection (358/1995). Guriya and Tripathy described about the dynamic viscoelastic properties of silica-filled closed-cell microcellualr ethylene propylene diene rubber vulcanizates. The effect of blowing agent, the effect of temperature and strain are described in this study (359/1995; 360/1995).

Hill and others described about the mechanism of radiation vulcanization of natural rubber latex sensitized by monocylates (361/1995). In a study conducted by Isayev and others suggests a new ultrasonic technology for devulcanization of rubber waste (362/1995; 363/1996). Flammability of cis-1, 4-polyisoprene vulcanizates are described by Janowska (364/1997). Jurkowsaka and Jurkowski outlines about the computer simulation of changing the rubber network structure during vulcanization (365/1998).

Kawabata and others described about the mechanism of carbon-black reinforcement of rubber vulcanizate (366/1995).

The effect of crosslink structures as the fatigue crack growth behaviour of natural rubber vulcanizates with various aging conditions were described by Kim and Lee (367/1994).

Kresja and others conduct an analysis of the mechanism of N-t-butyl-2-Benzothiazole sulfenamide accelerated sulfur vulcanization of cis-polyisoprene (368/1994).

Kretzschmar and Weigel described about the isothiocyantes which is formed during accelerated vulcanization (369/1997). Levin and others described about the effect of crosslink type on the ultrasound devulcanization of SBR vulcanizates (370/1998; 371/1997). Mathur and others described about the quarternary ammonium salts, the new curatives which are used for the vulcanization of natural rubber (372/1996).

Menon outlines about the stress-relaxation characteristics of natural rubber modified with phosphorylated cashew nut shell liquid polymer (373/1997). Nieuwenhuizen and others described about the homogeneous catalysis by zinc complexes during accelerated vulcanization (374/1998).

In a study conducted by Poh and others described about the cure characteristics of unaccelerated sulfur vulcanization of epoxidised natural rubber (375/1996). The accelerator activity of TBAB is described by Purohit and Mukhopadhyay (376/1997).

Shaker and others outlines about the UHMW-PE fibre as reinforcing materials in EPDS rubber vulcanized E-Beam radiation (377/1995).

Ramsingwani describes about sulfur as a vulcanising agent (378/1995).

Temple and Esyev have studied about the continuous ultrasonic devulcanization of unfilled natural rubber vulcanizates (379/1998). Tukachinsky and others described about the devulcanization of waste tire rubber by powerful ultrasound (380/1996).

Van Duin and Soupahanthong conducted study on resin vulcanization. They described the chemistry of phenol-formaldehyde resin vulcanization of EPDM (381/1995).

Versloot and others outlines about the sulfur vulcanization of simple model olefins (382/1997; 383/1994; 384/1995).

Yushanov and others described about the ultrasonic devulcanization of SBR rubber (385/1998).

4.34 RUBBER MECHINERY

Othman and others described about the stress relaxation behavior of natural rubber vulcanisates (386/1996). Pingyue described the effect of stearic acid level on tear and heat build-up of natural rubber-based tread compounds (387/1994). Popovic and others outlines the stress-strain modelling (388/1996).

4.35 APPLICATION OF COMPOUNDING INGREDIENTS

Dias and Galuska described about the curative migration in rubber compounds (389/1996). Gorl and others investigate about the influence of white fillers on the formation of N-Nitrosamines (390/1994). Grtaft and others described about the application of promoters in rubber compounds (391/1996). Graf and Knorr give an account of the accelerator systems for the injection moulding compounds (392/1996). The effect of Bis 3-Triethoxysilypropyl) tetrasulfide on silica reinforcement of styrene-butadiene rubber have been studied by Hashim and others (393/1998).

The influence of clearance variation between the rotors of an internal mixture on the mixing process have been studied by Michaeli and Meiertoberens (394/1994).

Nandavanam and others suggests linseed oil as a multipurpose ingredient in their study (395/1996). Terakawa and others described the application of epoxidized NR/diamine vulcanizates for tyre tread (396/1998). Rouse explains the application of crumb rubber modifier in asphaltic materials (397/1995).

The sorption and diffusion of aromatic hydrocarbons. Through filled natural rubber are described by Unnikrishnan and others (398/1996). Vande walle and others described about the carbon black reinforcement in rubber compounds (399/1996).

Wolf described about special carbon blacks for applications in mechanical rubber blacks for applications in mechanical rubber goods (400/1996).

Wolf and others described the effect of fillers on rubber reinforcement (401/1994; 402/1994).

4.36 RECLAIMED RUBBER

The processing, control and growth of rubber reclaiming is described by Biswas (403/1994; 404/1994).

Osborn explains about the reclaimed tire rubber in TPE compounds (405/1995).

4.37 RUBBER BLENDS AND COMPOSITES

Abbate and others described about the curing kinetics and mechanical behaviour of rubber blends. They described about the thermosetting bismaleimide rubber blends (406/1997). Abdullah and others described about the blending of natural rubber with linear low-density polyethylene (407/1995).

The partition coefficients of ester plasticisers between natural rubber and epxidised natural rubber were explained by Ahmad and others in their study (408/1995). A qualitative and quantitative analysis of SBR/BR blends by the thermogravimetric method is described in this study (409/1996). Asaletha and others outlines about the technological compatibilization of natural rubber blends. This is done by the addition of natural rubber-graft-polystyrene (410/1995). The viscoelastic behaviour of NBR/EVA polymer blends were studied by Bandyopadhyay and others by the application of models (411/1998). Bensason and others described about the damage zone in PVC and PVC/MBS blends (412/1992; 413/1997).

Bhwomick outlines the influence of interaction on the properties of rubber-rubber and rubber–plastics blends (414/1996).

Biswas and others suggests new coupling agents for rubber blends in their study (415/1995). Blom and others described about the iPP/HDPE blends (416/1995).

Brown and Tinker explains the effect of modifying EPDM on the crosslink distribution in NR/EPDM blends (417/1996). In another study they described about the high damping epoxidised natural rubber blends (418/1997).

Bussi and Ishida explains the structural characterisation of the epoxidised rubber and the mechanical properties of the partially miscible blends (419/1994).

The effects of short-chain branching and comonomer type on the interfacial tension of polypropylene-polyolefin elastomer blends were described in a study conducted by Carriere and Silvis (420/1997). Chakraborty and Seth conducted studies on the blends of high styrene resin master batch and natural rubber (421/1998).

Cook and others described about the thermal behaviour of natural rubber and chlorinated rubber blends (422/1997).

Cook and others conducted another study about the morphology and property relationships in ABS/PET blends (423/1996; 424/1996).

The phase morphology of rubber and plastic blends were described by Coran and other (425/1998).

Elastomers are considered by many to be one of the most difficult groups of materials to prepare for electron microscopy. The study by Cudby and others describes the techniques used in scanning transmission imaging of elastomer blends using an unmodified conventional scanning electron microscope (426/1995).

Das and Banerjee explains the role of methods of blending on polymer-polymer compatibility (427/1996).

Dutta and others outlines the ionic elastomer blends of zinc salts of maleated EPDM rubber and carboxylated nitrile rubber (428/1998). Fujita and others describes the phase diagrams of the blends of natural rubber and petroleum resins (429/1998).

Natural rubber has a shorter scorch time than butadiene rubber, but results indicate that in blend materials the BR phase begins curing before and at a much faster initial rate than natural rubber. The cure rates are reversed as the cure progresses and the NR phase eventually attains the crosslinking levels expected from single polymer data (430/1996).

Huang and others conducted studies on the blends of carbondioxide copolymer using NBR/PPC system (431/1996). Ibar explains about the control of performance of polymers and their blends through melt vibration technology (432/1997). Thermo-oxidative ageing of poly (vinyl chloride) based thermoplastic elastomers were studied by Ishiaku and others (433/1997). Jansen and others studied about the effect of curing system on mechanical and thermal properties of the blends (434/1996; 435/1996). Kannan and others conducted studies on the oil distribution in polymer blends (436/1996). Kazno and others conducted studies on the distribution in Polymer blends (437/1996).

Kida and others conducted studies on the structure and formation mechanism of carbon gel in the carbon black filled polyisoprene rubber composites (438/1996).

Kim describes the effect of blending thermoplastic elastomer with natural rubber compound (439/1996). Kim and Do outlines the effect of viscosity ratio, rubber composition, and peroxide/coagent treatment in PP/EPR blends (440/1996). Kole describes the influence of the nature of diene in EPDM rubbers on the properties of silicone-EPDM blends (441/1994).

Compounding the ground rubber tire (GRT) with commercial polyolefins is a possible and effective way of used tirte recycling which can provide new rubber/plastic blends at a much tower cost. In the study GRT and ultra sonically deveulcanized GRT are incorporated into a polypropylene. GRT is compounded and dynamically relvulcanized in polypropylene. Mechanical properties, rheology and morphology as well as the thermostability and melting behaviour of the resulting rubber/plastic blends are studied (442/1998).

Mallick and others explains the effect of HAF carbon black filler on chemorheological behaviour of expoxidised natural rubber blend (443/1997; 444/1997).

Oshinski and others describes the effect of polyamide end-group configuration on morphology and toughness of blends with maleated elastomers (445/1996).

Petrovic and others describes the effect of addition of polyethylene on properties of polypropylene/ethylene – propylene rubber blends (446/1996).

The effect of blend ratio on mooney scorch time of rubber blends were described by Poh and Wong (447/1998). The mechanical properties, crosslink density and surface morphology of SBR/silicone rubber blends were described by Popovic and others (448/1997).

Radusch and Merseburg outlines the morphology formation in dynamic vulcanized PP/EDM blends (449/1996). Rahman and others outlines the influence of phase morphology on the properties of natural rubber and epoxidised natural rubber blends (450/1994). Roy and Das describes the speciality polyblend stem (451/1995).

Rozman and others describes the rubber wood-polymer composites. The study is based on glycidyl methacrylate and diallyl phthalate blends (452/1998).

Sankarapandian and Kishore gives a comparison of the miscibility stratetgies in poly (benzyl methacrylate) – polystyrene blends (453/1996).

Sorption and diffusion of n-allcanes into different blends of natural rubber such as NR/BIIR, NR/CIIR, NR/ neoprene, NR/EPDM, NR/polybutadiene and NR/SBR have been studied from 25 to 60°C. Arrhenius parameters for the diffusion process and the thermodynamic quantities for the process of equilibrium sorption have been estimated (454/1998; 455/1998).

Thomas and Gopinathan Nair describes the viscosity behaviour of PVC-modified liquid natural rubber blends (456/1996).

Tripathy and Das describes the effect of blending on the dispersion and flow behaviour of carbon black filled NBR and chlorosulphonated polyethylene rubber (457/1995; 458/1994).

Tsai and Chang outlines the polymer blends of PBT and PP compatibilized by ethylene-co-glycidyl methacrylate copolymers (459/1996).

Vainio et al describes about the functionalised polypropylene (460/1996). Varkey and Rao explains the flow behaviour of natural rubber and expoxidised natural rubber latex blends (461/1996). Vilgis and Heinrich explains about the crosslinked polymer blends (462/1995).

Vinod and others conducted study on the effect of adhesion on the equilibrium swelling of natural rubber-aluminium powder composites (463/1998).

Wang and others conducted study on the effect on the mechanical properties of blends (464/1997). Wefringhaus and Gruber described about the water based rubber to metal bonding agents (465/1995). Yoon and others describes about the blends of brominated EPDM and natural rubber (466/1996).

The mechanical properties and fracture behaviour of natural rubber/poly (methyl methacrylate) blends were investigated as a function of composition, graft copolymer concentration, and mixing conditions. The mechanical properties and failure behaviour vary with the blend ratio, graft copolymer concentration, and mixing conditions (467/1997).

4.38 PHYSICAL TESTING

Aboutorabi et al explains the fracture energy calculations (468/1998). Azemi Bin Samsuri describes the tearing of unvulcanized black-filled natural rubber (469/1995). Charlton and Teh describes the athermo-mechanical FEA for rubber components (470/1995).

A double-networked natural rubber (DNNR) was prepared by a "two-step cross linking method, in which the cross linking was achieved while the natural rubber was in stretched condition. The swelling behaviour, tensile properties, crepe, recovery and permanent set were investigated (471/1997).

Kasner and Meinecke describes the effect of porosity on mechanical properties of rubber (472/1995). Kim and others conducted study on the preparation and physical properties of rubber-modified epoxy resin (473/1997). Konar conducted a kinetic and rheometric investigation of hexamethylol melamine derivative on the cure of natural rubber compounds (474/1997).

Lee explains the effect of heating and pressuring on PBA/PS linear composite polymer (475/1998).

Mariani et al conducted study about the thermal properties of elastomeric compounds (476/1997).

The flow properties of thermally depolymerized liquid natural rubber were explained by Nair and others (477/1995; 478/1994).

Okel explains the effect of precipitated silica and physical properties on silicone rubber performance (479/1995). Okieimen and Aligbodion describes the estimation of dilute solution viscosity parameters of rubber seed oil alkyds (480/1998). Santangelo and Roland explains the mechanical behaviour of double network elastomers (481/1994). Wang and others describes about the carbon-silica dual phase filler (482/1998). Yoon and others explains the effect of bromination on the properties of ethylene-propylene-diene rubber (483/1990).

4.39 DYNAMIC MECHANICAL PROPERTIES

Abd-El-Messieh and Younan explains the dielectric relation and mechanical properties of natural and chloroprene rubber with some nitroaniline additives. A systematic dielectric study over a frequency range from 400 to 10MHz was carried out on natural rubber and chloroprene rubber with a small amount of nitroaniline additives (484/1996).

The non-linear stress-strain characteristics of fille rubber, and attempts at producting a non-linear model have been reviewed. Alternative methods of calculating the equivalent linear parameters: secant, harmonic, or skeleton methods, give different answers, as demonstrated for a particular rubber (485/1997).

Bandyopadhyay describes the low strain dynamic properties of carboxylated nitrite rubber-carbon black system (486/1996).

Bhowmic and Jha explains the dynamic mechanical properties of thermoplastic elastomers (487/1997).

The dynamic properties of batch polyomerized SSBR based compounds were described by Bortolotti and others (488/1998).

Dick and Pawlowski explains the application of new dynamic mechanical rheological tester in measuring carbon black (489/1995).

Good child and Pond explains the dynamic mechanical properties of certain natural rubber vulcanisates (490/1997). Hanhi and Stenberg explains the friction and dynamic mechanical and thermal properties of polyurethane elastomers (491/1994). Leblanc explains the dynamic strain methods to probe the morphology of uncured rubber compounds (492/1996).

Luo conducted study on the dynamic properties of polymeric isolators (493/1996). Mallic and Tripathey explains the effect of carbon black filler on strain dependent dynamic mechanical properties (494/1994). Mandal explains the dynamic mechanical properties of an ionic elastomer based on carboxylated nitrile rubber. The effect of calcuim carbonated and clay were explained (495/1997; 496/1996).

Metteo and others studied about the dynamic mechanical properties of NR/BR blends at different cure levels (497/1995). Schaefer explains the dynamic properties of rubber (498/1995).

The dynamic mechanical properties and morphology of silica-reinforced butadiene rubber by the sol-gel process were described by Sugia and others (499/1997). The electrical and mechanical properties of ethylene propylene diene monomer-chloroprene rubber blend loaded with white and black fillers were explained by Younan and others (500/1998).

CHAPTER V

FINDINGS AND CONCLUSION

5.0 INTRODUCTION

This chapter is a summing up of the major findings and inferences drawn from 'Bibliometric Analysis' and 'Trend Report'. The findings are fruitful in substantiating the objectives formulated in chapter one. The findings are grouped under two major headings:

(1) Findings based on bibliometric analysis

(2) Research trends in Rubber Chemistry and Technology.

5.1 FINDINGS BASED ON BIBLIOMETRIC ANALYSIS

The findings of this major heads are grouped under the following subheadings

5.11 YEAR-WISE DISTRIBUTION

From year-wise analysis of publications during the period under study, the following conclusions were drawn.

1. The year 1996 is the highest productive year, produced 154 articles (30.8%) out of the total 500 publications.
2. Year-wise distribution of publication on rubber chemistry and technology is relatively low in 1994, 69(13.8%).
3. The number of publications has decreased during 1997 and 1998.

5.12 CORE PERIODICALS

The periodical, "Journal of Applied Polymer Science" is the most productive journal in the field of study that published 109 articles (21.8%) during the period of study, followed by "Rubber Chemistry and Technology" which published 88 articles (17.6%) and "Kautschuk Gummi Kunststoffe" that published 75 articles (15%). These periodicals are the core journals in the field of Rubber chemistry and Technology.

5.13 SUBJECT-WISE DISTRIBUTION

In the case of subject-wise distribution, the literature on latex comes first with a percentage of 14 and the second position goes to Rubber Blends and composites with 12.2%.

5.14 AUTHORSHIP PATTERN

Authorship pattern shows that majority of publications are brought out by multiple authors (55.4%). The contribution by single author constitutes 15.2%.

5.2 RESEARCH TRENDS IN RUBBER CHEMISTRY AND TECHNOLOGY.

The findings based on research trends in Rubber Chemistry and Technology are grouped under the following sub-heads.

RUBBER RHEOLOGY.

Recent trends in the field of study show that the rheological behaviour of selfvulcanizable blends on chlorosulphonated polyethylene and carboxylated nitrile rubber has been investigated in terms of effect of blend ratio, carboxyl content of carboxylated nitrile rubber, carbon black filler loading, rate of shear and temperature on viscosity, die swell and power law constants. The blend system follows the power law model in the experimental range of rate of shear and shows pseudoplastic flow behaviour.

PROPERTIES OF RUBBER

The degree of compatibility of two rubbers is important in determining the morphology and mechanical properties of blends made from them. The mechanical properties of the blends are largely determined by phase morphology and this is particularly marked with regard to air permeability and tear strength.

RUBBER IN ENGINEERING APPLICATION

The engineering applications of rubber is in the field of engine mounts, bridge bearings, piers and fenders, as flexible composites, noise control and structural dampling and in vibration isolation.

A study of the behaviour of laminated rubber bearings is described with particular emphasis on important aspects concerned with seismic isolation. The effect of compressive load on damping and the height reduction behaviour of a bearing under combined compression and shear were studied. Shear stiffness and the tilting of individual rubber layers in a bearing indicates that a departure from the normal linear shear stiffness behaviour occurs at large deformation.

ELASTOMERS

Thermoplastic elastomers have been prepared by blending poly (vinyl chloride) and epoxidised natural rubber in the presence of a plasticiser. Low temperature resistant thermoplastic elastomers were identified.

A novel preparation method of functionally graded interpenerating network polymer (IPN)- type elastomers were prepared by electrophoresis of ionic manomers. Abrasion resistance of the surface of IPN-type PUEs evaluated by DIN abrasion test was better than that of nontread polyurethane elastomers.

POLYMERIZATION

The non-rubber substances present in natural rubber latex seem to have influence on the rate of polymerization reaction, degree of grafting and grafting efficiency of graft copolymerization reaction of methyl methcrylate on to natural rubber. The semicountinuous emulsion polymerization of vinyl acelate in the presence of potassium persulfate and octyl aldehyde sodium bisulfite as a newly developed redox initiation system was studied using polyvinyl alcohol as a unique surface active agent. It shows that very small amounts of polyvinyl alcohol in the presence of the newly developed octyl aldehyde sodium bisulfite led to the formation of highly stable emulsions, with 40% solid content.

COMPOUNDING INGREDIENTS

The incorporation of filler generally reduce the permeability. But certain fillers such as mica, graphite and clay produced substantial reduction which was attributed to the particular morphology of these fillers.

CHEMICAL MODIFICATION

Aerobic ageing is found to increase the dynamic modulus of the vulcanizates. Results at longer ageing times indicate the modulus may, depending up on the vulcanisates, ingredients, pass through a maximum, however the modulus remains greater than for unaged material.

The number of branch-points in natural rubber was analysed for the rubber from deproteinised fresh field and high-ammonia latices, using ^{13}C-NMR and osmometric measurement before and after transesterification of the rubber.

CHEMICAL ANALYSIS

Epoxide groups in natural rubber, which are derived from oxidative degradation of polymer are found to be mainly in cis configuration. Solid state C^{13}-NMR has been used to compare the chemistry of accelerated vulcanization of natural rubber using N-t-butyl-2-benzothiazole-sulfenamide in the presence and absence of carbon black. Swollen state ^{13}C spectroscopy has been used to study vulcanised blends of natural rubber/nitrile butadiene rubber and natural rubber/epoxidised natural rubber both qualitatively and quantitatively.

The application of gamma-ray attenuation techniques to characterize natural rubber, rubber compounds and latex has yet to be fully exploited. DRC of latex at various concentrations has been measured using the multi-component system and the results show a good correlation between the attenuation method and the standard laboratory method.

LATEX ALLERGY

By identifying the proteins of various latex compounds that are responsible for the allergenicity, it might be possible to eliminate, or at least greatly reduce these proteins. The strongest antigenic responses to the antibodies were from the B-serum proteins which arise from the lutoids. Two allergenic proteins have been isolated from the B-serum of natural rubber latex by dialysis- induced protein precipitation followed by gel filtration.

The Finnish Natural Public Health Institute and a team from the universities of Helsinki and Tampere reported a step forward in establishing which proteins in latex cause allergenic reactions.

A study revealed that dry natural rubber products are free from protein allergy problem reported for some latex products.

COMPOUNDING

Rubber compounding is a term covering a wide scope including the art and procedures that are necessary to produce useful products from natural or synthetic elastomers. A component rubber compounder must be able to use the proper elastomers and additives available to meet the conditions required for the finished product.

Different carbon black master batch blending procedure were used to achieve a wide range of black distribution. The black distribution and blending procedures influenced the physical properties significantly. Modified carbon black can be used as reinforcing filler for SBR.

RUBBER PRODUCTS

India is one of the leading countries which manufacture recycled rubber in the form of reclaim rubber and crumb rubber. Whole tire reclaim is the main product.

About 33% of reclaim rubber is used in bicycle tires, the result in battery, containers, footwear etc.

VULCANIZATION

Sulfur prevulcanization of natural rubber latex was conducted at 60, 70,80 and 90°C for different periods. At each temperature, tensile strength and elongation at break decreased when the prevulcanization time increased. The rate of stress relaxation slightly increased as the extent of prevulcanization increased.

Sulfur/olefin copolymers are known as vulcanizing agents for rubber, but synthetic procedures for these materials are poor. The relationship between the sulfur/olefin copolymer and vulcanizate properties are discussed in terms of the structure of the copolymer and other reaction products.

The radiation vulcanization of natural rubber latex has been investigated for many years. Recent trends shows that certain antioxidants are capable of improving the ageing properties of radiation vulcanization of natural rubber latex films.

MACHINERY

Stress-strain modeling is used to find out the resolution of natural rubber /poly dimethylsiloxane binary blend properties.

APPLICATION OF INGREDIENTS

Surface energy of fillers and its effect on rubber reinforcement have been determined.

The applications, performance and mode of action of promoters in rubber compounds have identified.

RECLAIMED RUBBER

A trend in the reclaimed rubber reveals the processing, control and growth of rubber reclaiming.

RUBBER BLENDS

A swollen-state NMR method of rubber blend analysis has been used to study cross linking in gum vulcanisates for cure times compatibility of natural rubber/polystyrene blend is poor and can be enhanced by the addition of a graft copolymer of natural rubber and polystyrene. Light and optical microscopy and nuclear magnetic resonance have been used to study the phase contrast and crosslink distribution of the elastomer blends.

The mechanical properties and fracture behaviour of natural/poly (methyl/methacrylate) blends were investigated as a function of composition, graft copolymer concentration and mixing conditions.

DYNAMIC MECHANICAL PROPERTIES

Dynamic mechanical analysis of silica-filled closed-cell microcellular EPDM vulcanizates has been studied as a function of temperature and double strain amplitude. The viscoelastic behaviour of silica-filled microcellular EPDM is similar to that of solid rubber vulcanizates.

5.3 CONCLUSION

The above findings and discussions are fruitful in substantiating the objectives of the study. This study will help to examine the growth of research studies in Rubber chemistry and Technology during 1994-98.

REFERENCES

1. ARANGUREN, M.I et al.
   Rheological and mechanical properties of filled rubber: Silica-Silicone.
   Rubber Chemistry and Technology, 67(5), 1994, p.820-833.

2. ASHALATHA, P.V et al.
   Studies on the rheological and mechanical properties of PP/EPDM/NR ternary blends.
   Kautschuk Gummi Kunststoffe, 47(12), 1994, p.868-872.

3. ASHALATHA, P.V et al.
   Studies on the rheological and mechanical properties of compatible PP/CPE blends.
   Journal of Elastomers and Plastics, 28(3), 1996, p.223-235.

4. BHATTACHARYA, J.K and CHAKRABORTY, S
   Peptiser for product performance and processing
   Rubber Chem Review, 26(8), 1997, p.19-22.

5. CLARAMMA, N.M and MATHEW, N.M
   Rheological behaviour of prevulcanized natural rubber latex
   Kautschuk Gummi Kunststoffe, 51(2), 1998, p.126-128.

6. FREAKLEY, P
   Rubber processing: evolution and challenges
   Materials World, 4(4), 1996, p.194-196.

7. GANESAN, L et al.
   Quantitative measurement of dispersion of carbon black in rubber by an image processing technique
   Jouranal of Applied Polymer Science, 56(13), 1995, p.1739-48.

8. GANESAN, L et al.
Quantitative fractography of rubber by image processing technique
Rubber Chemistry and Technology, 68(1), 1995, p.132-145.

9. GOPALAKRISHNAN, R et al.
Effect of blend rheology on the transport property oriented poly (ethylene terephthalate) blends.
Journal of Applied Polymer Science, 56(13), 1995, p.1749-60.

10. GURIYA K.C et al.
Rheological properties of EPDM-compounds: effect of blowing agent, curing agent and silica filler
Kautschuk Gummi Kunststoffe, 51(2), 1998, p.134-138.

11. HAN, P.K and WHITE, J.L
Rheological studies of dynamically vulcanized and mechanical blends of polypropylene and ethylene-propylene rubber
Rubber Chemistry and Technology, 68(5), 1995, p.728-738.

12. ISAYEV, A.I and WAN, M
Injection molding of rubber compound with reheology affected by vulcanization, Pt.I Material characterization
Rubber Chemistry and Technology, 69(2), 1996, p.277-293.

13. ISHIKAWA, K et al
Novel processing agents for silica-filled rubber.
Rubber World, 218(5), 1998, p.26-29.

14. JOSEPH, K et al
Melt rheological behaviour of short sisal fibre reinforced polyethylene composites.
Plastics, Rubber and Composites: Processing and Applications, 21(4), 1994, p.237-245.

15. KARNIKA DE SILVA, K.G
Depolymerized natural rubber as a processing aid
Journal of the Rubber Research Institute of Sri Lanka, 77, 1996, p.38-53.

16. LEBLANC, J.L
Discrepancies in testing rubber compounds with different commercial capillary rheometers
Plastics, Rubber and Composites: Processing and Applications, 21(2), 1994, p.81-88.

17. LEBLANC, J.L et al.
Composite design experiments to study the relationships between the mixing behaviour and rheological properties of SBR compounds.
kautschuk Gummi Kunststoffe, 47(6), 1994, p.401-408.

18. LEE, Y.J et al.
The effect of network formation on the rheological properties of SBR modified asphalt binders
Rubber India, 49(12), 1997, p.17-23.

19. LI, L.L and WHITE, J.L
Rheological behaviour of highly filled EPDM compounds with calcium carbonate, carbon black, silica and zinc oxide
Rubber Chemistry and Technology, 69(4), 1996, p.628-636.

20. LONG, Ong Eng
Downstream rubber processing and products: current status and future prospects.
ANRPC News, 10(2), 1995, p.11-16.

21. MARINELLI, L and MAGG, H
A new acrylonitrile-butadiene rubber for moulded articles
Kautschuk Gummi Kunststoffe, 48(10), 1995, p.724-728.

22. MOUSA, A et al.
Dynamic vulcanization of poly(vinyl chloride) epoxidised natural rubber thermoplastic elastomers Pt.1. Mixing rheology.
Plastics, Rubber and Composites: Processing and Appliocations, 26(8), 1997, p.331-335.

23. MUKHOPADHYAY, R
Innovative developments in rubber processing technology
Rubber Asia, 9(3), 1995, p.11-119.

24. NAIR, N.R et al.
Liquid natural rubber as a viscosity modifier in nitrile rubber processing
Polymer International, 42(3), 1997, p.289-300.

25. OSANAIYE, Gabriel J et al.
Rheological properties of rubber-carbon black and carbon black oil compounds including measurements at very low shear stresses
Rubber Chemistry and Technology, 68(1), 1995, p.50-58.

26. RAY, G Singha et al.
Effect of zinc salt of unsaturated fatty acids (ZFA) as processing aid in tyre tread compound
Rubber Chem Review, 24(3), 1994, p.51-58.

27. GEORGE, R.S et al.
Rheological and extrudate behaviour of natural rubber/latex reclaim blends.
Journal of Elastomers and Plastics, 27(2), 1995, p.138-147.

28. SCHMIDT, U and KREIPE, E
Changes for the thermal utilization of waste rubber
Kautschuk Gummi Kunststoffe, 48(4), 1995, p.244-253.

29. SOMBATSOMPOP, N et al.
Flow analysis of natural rubber in a capillary rheometer.1: rheological behaviour and flow vulcanization in the barrel
Polymer Engineering and Science, 37(2), 1997, p.270-280.

30. SOMBATSOMPOP, N and WOOD, A.K et al.
Flow analysis of natural rubber in a capillary rheometer.2: Flow patterns and entrance viscosity profiles in the die.
Polymer Engineering and Science, 37(2), 1997, p.281-290.

31. SOOS, I and WHITE, J,L
Rheological characterization of NBR elastomers by the BF goodrich dynamic stress relaxometer.
Kautschuk Gummi Kunststoffe, 49(12), 1996, p.821-825.

32. THOMAS, K.T et al.
A comparative evaluation of ISNR 20 with conventional forms of natural rubber
Indian Journal of Natural Rubber Research, 8(2), 1995, p.123-129.

33. VARKEY, K.T et al.
Effect of prevulcanization on the rheological behaviour of natural rubber/styrene butadiene rubber latex blends.
Journal of Applied Polymer Science, 62(12), 1996, p.2169-80.

34. WADA, N
Rubber friction test methods
International Polymer Science and Technology, 25(2), 1998, p.52-759.

35. WAN, M and ISAYEV, A.I
Injection molding of rubber compound with rheology affected by vulcanization. Pt.3 Modeling and Experiment.
Rubber Chemistry and Technology, 69(2), 1996, p.294-312.

36. AHLBLAND, B et al.
Effect of electron irradiation an physical properties of rubber/cellulose fibre camposites.
Polymer International, 39(3), 1996, p.261-269.

37. ANANTHARAMAN, M.R et al.
Investigation on cure characteristics and magnetic properties of rubber ferric composites.
Plastics, Rubber and Composites: Processing and Applications, 27(2), 1998, p.77-81.

38. AZEMI BIN SAMSURI
Properties of rubberised bitumen from reclaimed rubber
Journal of Natural Rubber Research, 11(3), 1996, p.166-182.

39. BHATTACHARYA, B and GANGOPADHYAY, N.K
Butadiene rubber: properties and processing techniques
Indian rubber Journal, 34, 1998, p.108-112.

40. GAJEWSKI, M and PROT, T
Correlation between crosslink density and properties of rubber containing chemically and modified carbon black
Kautschuk Gummi Kunststoffe, 47(8), 1994, p.574-577.

41. GALAN, C et al.
A jot-melt pressure-sensitive adhesive based on styrene-butadiene-styrene rubber: the effect of adhesive composition on the properties
Journal of Applied Polymer Science, 62(8), 1996, p.1263-75.

42. GIBALA, David and HAMED, Gary R
Cure and mechanical behaviour of rubber compounds containing ground vulcanizates. Pt.1. cure behaviour
Rubber Chemistry and Technology, 67(4), 1994, p.636-648.

43. GURIYA, K.C and TRIPATHY, D.K
Dynamic viscoelastic properties of carbonblade loaded closed-cell microcellular ethylene-propylene-diene rubber vulcanizates: effect of blowing aget, temperature frequency, and strain
Journal of Applied Polymer Science, 61(5), 1996, p.805-813.

44. HAGEN, R et al.
Effects of the type of crosslink in viscoelastic properties of natural rubber
Journal of Polymer Science: Polymerphysics, 34(2) 1996, p.1997-2006.

45. HEINRICH, Gert and DUMLER, Herbert, B
Wet skid properties of filled rubbers and the rubber-glass transition
Rubber Chemistry and Technology, 71(1), 1998, p.53-61.

46. KAKUBO, T et al.
Origin of characteristic properties of natural rubber: effect of fatty acids on crystallization of Cis-1, 4-Polyisoprene
rubber chemistry and Technology, 71(1), 1998, p.70-75.

47. KARNIKA DE SILVA, K.G et al.
A study of same of the properties of blends of polypropylene and chemical incorporated granular
Journal of the Rubber Research Institute of Sri Lanka, 74, 1994, p.10-23.

48. LI, S.D et al.
Study on variation of structure and properties of natural rubber during accelerated storage
Journal of Applied Polymer Science, 70(9), 1998, p.1779-83.

49. LOW, I.M et al.
Properties of rubber-modified cellulose-fiber-epoxy laminates.
Journal of Applied Polymer Science, 54(13), 1994, p.2191-94.

50. MANAS, Z et al.
Effects of dicumyl peroxide and liquid NR on the physical properties of NR/Polystyrene blends
Kautschuk Gummi Kunststoffe, 51(1), 1998, p.14-18.

51. NISHIYAMA, N et al.
Origin of characteristic properties of natural rubber: synergistic effect of fatty acids on crystallization of cis-1, 4-polyisoprene
Rubber Chemistry and Technology, 69(4), 1996, p.608-614.

52. OKEL, Timothy, A and WADDELL, H
Silica properties/rubber performance correlation, carbon black filled rubber compounds
Rubber Chemistry and Technology, 67(2), 1994, p.217-236.

53. PATKAR, S.D. et al.
Effect of silica on the viscoelastic properties of a model tread compound
Rubber World, 218(3), 1998, p.21-28.

54. PU, H et al.
Preparation, Characterization, and properties of EVA preirradiation grafted NIPAAM
Journal of Applied Polymer Science, 62(10, 1996, p.1529-35.

55. SRILATHAKUTTY, R et al.
Effect of fillers on the properties of NBR/PVC microcellular shoe soles.
Kautschuk Gummi Kunststoffe, 51(1), 1998, p.44-50.

56. SUWARDIN, D et al.
Optimizing the quality castrol of SIR 20 crumb rubber using the goal programming technique.
Indonesian Journal of Natural Rubber Research, 13(2), 1995, p.188-194.

57. TO, Byron H et al.
Improved rubber properties created with sulfenimide accelerators
Rubber World, 214(2), 1996, p.34-40.

58. UCHIYAMA, Y
Fundamentals of rubber friction-slip and non-slip properties
International Polymer Science and Technology, 25(2), 1998, p.48-51.

59. VINK, D
Influence of filler surface treatment on properties reinforced rubber products
Kautschuk Gummi Kunststoffe, 49(2), 1996, p.131-135.

60. WANG, Yu F and WANG, H.C
New technique to quantitatively characterize crosslink density in IR and brominated poly (Isobutylene-co-paramethyl styrene) blends.
Rubber Chemistry and Technology, 70(4), 1998, p.663-670.

61. WANG, M.J et al.
Dynamic stress-softening of filled vulcanizates
Kautschuk Gummi Kunststoffe, 51(2), 1998, p.106-117.

62. YANG, J.S and HSIVE, G.H
Synthesis of acrylic acid grafted silicone rubber via preirradiation graft copolymerization and its physical and dielectric properties
Journal of Applied Polymer Science, 61(2), 1996, p.221-229.

63. BAUMAN, Bernard D
High-value engineering materials from scrap rubber
Rubber World, 212(1), 1995, p.30-33.

64. BHUANA, K.S et al.
Homogenization of temperature and reduction of vulcanization time of earthquake rubber damper by applying additional heat source
Indonesian Journal of Natural Rubber Research, 14(1), 1996, p.95-99.

65. CHATTERJEE, S
Rubber spring in earthquake protection
Rubber India, 47(10), 1995, p.11-33.

66. DAVIES, C.K.L et al.
Characterisation of the behaviour of rubber for engineering design purposes: stress relaxation under repeated stresssing
Progress in Rubber and Plastics Technology, 12(3), 1996, p.208-220.

67. DE VARIES, L.F
Developing heat-resistant conveyor belts
Rubber World, 213(3), 1995, p.39-42.

68. DIERKES, W
Re-use of rubber waste: a recycling concept
International Polymer Science and Technology, 22(8), 1995, p.17-24.

69. DUTTA, B
Engineering application of rubberised fabrics design of inflactable crafts.
Rubber Chem Review, 24(3), 1994, p.23-31.

70. GOPALAKRISHNAN, K.S
Why runways should be rubberised
Rubber Asia, 9(5), 1995, p.69-71.

71. GOPALAKRISHNAN, K.S
Rubberised roads for superior performance
Rubber Asia, 8(4), 1994, p.57-58.

72. BESDO, D and IHLEMANN, J
Modelling the material behaviour of elastomers
Kautschuk Gummi Kunststoffe, 49(7/8), 1996, p.495-503.

73. BLUME, A et al.
Investigation to the formation of nitrosamines during production and storage of elastomers. Pt.3. Kinetic aspects of nitosamine formation in the gas phase
Kautschuk Gummi Kunststoffe, 49(10), 1996, p.683-691

74. BOWERS, S
New Developments in improving the processability of fluroelastomers
Kautschuk Gummi Kunststoffe, 50(9), 1997, p.618-629.

75. CHOUDHURY, N.R and BHOWMICK, A.K
Thermostable insulating thermoplastic elastomers from rubber polycarbonate blends.
Journal of Elastomers and Plastics, 28(2), 1996, p.161-181.

76. CLASS, J.B
Fundamentals of crosslinking with peroxides
Rubber and Plastics News, 25(3), 1995, p.91-92.

77. DRAKE, Ronald E et al.
Use of polybutadiene coagents in peroxide cured elastomers for wire and cable.
Rubber world, 213(3), 1995, p.22-30.

78. EISENBACH, C.D et al.
Structure and morphology of filled rubber and thermoplastic elastomers
Kautschuk Gummi Kunststoffe, 49(6), 1996, p.406-410.

79. ELLEITHY, R et al.
Fracture and fatigue failure behaviour of fluoroelastomers
Journal of Elastomers and Plastics, 28(3), 1996, p.199-222.

80. ELLUL, M.D
Novel Low temperature resistant thermoplastic elastomers for speciality applications.
Plastics, Rubber and Composites: Processing and Applications, 26(3), 1997, p.137-142.

81. FUKUSHIMA, Y et al.
Synthesis of graft copolymers from highly deproteinised natural rubber
Journal of Rubber Research, 1(3), 1998, p.154-166.

82. FURUKAWA, M et al.
Functionally graded polyurethane elastomers prepared by electrophoresis of monomer
Journal of Natural Rubber Research, 12(4), 1997, p.237-246.

83. GERSPACHER, M et al.
A proposed mechanism for the reinforcement of elastomers in the rubbery plateau by carbon black
Kautschuk Gummi Kunststoffe, 47(5), 1994, p.349-353.

84. HAMED, Gary R
Fundamental characteristics and properties of crosslinked elastomers
Rubber World, 211(1), 1994, p.25-29.

85. HAMED, G.R and WU, P.S
Relationship between the cohesive strength and tack of elastomers. Pt.4. Carbon black filled styrene-butadiene rubber
Rubber Chemistry and Technology, 68(2), 1995, p.248-258.

86. HERD, R and BOMO, F
Phase distribution analysis and properties of carbon black filled elastomer blends
Kautschuk Gummi Kunststoffe, 48(9), 1995, p.588-599.

87. KELM, J et al.
Comparative investigations of the crosslink density of elastomers
Kautschuk Gummi Kunststoffe, 51(5), 1998, p.364-369.

88. KOHLER, R and O'NEILL, John
New technology for the devulcanization of sulfur-cured scrap elastomers
Rubber World, 216(2), 1997, 32-36.

89. KOTZ, D.A and STEVENS, R.D
Development of improved processing variants of viton GFLT fluoroelastomers
Kautschuk Gummi Kunststoffe, 48(3), 1995, p.159-165.

90. LAKE, G.J and MENTE, P.G
Mechanisms of antiozonant protection of elastomers
Polymer Degradation and Stability, 49, 1995, p.193-203.

91. LIU, J and LI, Zhen
Studies on curing reaction kinetics and properties of the CPE as a modifier of polyester-urethane elastomer
Journal of Applied Polymer Science, 62(8), 1996, p.1231-36.

92. MARTIN, D.J et al.
The effect of average soft segment length on morphology and properties of a series of polyurethane elastomers: characterization of the series
Journal of Applied Polymer Science, 62(9), 1996, p.1377-86.

93. MEISSNER, B
Bound rubber and elastomer-filler interaction
Rubber Chemistry and Technology, 68(2), 1995, p.297-310.

94. MOUSA, A et al.
Oil-resistance study of dynamically vulcanized poly (vinyl chloride)/epoxidized natural rubber thermoplastic elastomer
Journal of Applied Polymer Science, 69(7), 1998, p.1357-66.

95. NAKAUCHI, Hideo et al.
Crosslinking structure and properties of poly (urethane-urea) elastomers
Rubber World, 214(1), 1996, p.35-40.

96. NUYKEN, O et al.
Core-shell polymers as reinforcing polymeric fillers for elastomers
Kautschuk Gummi Kunststoffe, 48(11), 1995, p.784-787.

97. PARKER, Dane K et al.
The preparation, properties and potential applications of 'Dimide-Hydrogenated' styrene butadiene (HSBR) and polybutadiene (HBR) thermoplastic elastomers
Rubber Chemistry and Technology, 67(2), 1994, p.2808-98.

98. PADER, Charles P and AGARWAL, Puru D
Thermoplastic elastomers for automotive applications
Rubber News, 38(2), 1998, p.29-31.

99. ROYCHOUDHURY, A and DE, P.P
Elastomer-carbon black interaction: influence of elastomer Chemical structure and carbon black surface chemistry on bound rubber formation
Journal of Applied Polymer Science, 55(1), 1995, p.9-16.

100. SONG, M.S
A study on the relationship between network structure and mechanical properties of interpenetrating polymer networks. Pt.2. The comparison of the theory of viscoelasticity for thermoplastic polyurethane elastomers with expertiments.
Journal of Elastomers and Plastics, 27(4), 1995, p.348-367.

101. STEINBUCHEL, A
Synthesis and production of biodegradable thermoplastic and elastomers: current state and outlook
Kautschuk Gummi Kunststoffe, 49(2), 1996, p.120-124.

102. SUHARA, F et al.
Stress relaxation of polyester fiber-polyurethane elastomer composite with different interfacial bonding agent
Journal of Elastomers and Plastics, 30(2), 1998, p.103-117.

103. SYKES, P.A
Structure-property relationships in polyurethane elastomers
Progress in Rubber and Plastics Technology, 12(4), 1996, p.236-257.

104. THOMAS, E.V
Thermoplastic elastomers and their influence in future world elastomer consumption
The Planters' Chronicle, 90(10), 1995, p.479-486.

105. TONELLI, C et al.
New fluorinated thermoplastic elastomers
Journal of Applied Polymer Science, 59(2), 1996, p.311-327.

106. VAN DER Pol, J.F
Short p-aramid fiber reinforcement of elastomers
Kautschuk Gummi Kunststoffe, 48(11), 1995, p.799-805.

107. VLADKOVA, T.G and AMAUDOVA, R.V
Influence of digoamidophosphates on some characteristics of elastomer compounds based on SBR
Kautschuk Gummi Kunststoffe, 47(8), 1994, p.571-573.

108. XIE, H.Q et al.
Synthesis and properties of styrene-butadiene-oxyethylene multiblock polymers
Journal of Applied Polymer Science, 61(3), 1996, p.407-413.

109. CHANG, M.C.O and NEMETH, R.L
Rubber particles agglameration phenomena in acronitrile-butadiene-styrene (ABS) polymers. 1. Structure-property relationships study on rubber particle agglomeration and molded surface appearance.
Journal of Applied Polymer Science, 61(6), 1996, p.1003-10.

110. DATTA, S.K. et al.
Electron beam initiated grafting and crosslinking of ethylene vinyl acetate copolymer. Pt.1. Structural characterization
Rubber Chemistry and Technology, 69(1), 1996, p.120-129.

111. DECKER, C. et al.
Photocrosslinking of functionalized rubber III: Polymerization of multifunctional manomers in epoxidized liquid natural rubber.
Journal of Polymer Science: Polymer Chemistry, 34(9), 1996, p.1771-81.

112. DECKER, C et al.
Photocrosslinking of functionalized rubbers. Iv. Synthesis of rubbers bearing acrylate groups.
European Polymer Journal, 32(5), 1996, p.549-557.

113. DECKER, C et al.
Photocrosslinking of functionalized rubbers V.Radical polymerization of rubbers bearing acrylate groups
European Polymer Journal, 32(5), 1996, p.559-567.

114. EL-GHAFFAR, M.A et al.
Emulsion polymerization of vinyl acetate by a semicontinuous polymerization technique and its applications in latex paints.
Journal of Elastomers and Plastics, 27(3), 1995, p.281-293.

115. FANG, Y.E et al.
Study of radiation-induced graft copolymerization of vinyl acetate into ethylene-co-propylene rubber
Journal of Applied Polymer Science, 62(3), 1996, p.2209-13.

116. HE, W.D et al.
Formation mechanism of silicone rubber particles with core-shell structure by seeded emulsion polymerization
Journal of Applied Polymer Science, 61(2), 1996, p.383-388.

117. WOOD, G.A and IROH, J.O
Effect of electrolytes and process parameters on the electropolymerization of pyrole into carbon fibers
Journal of Applied Polymer Science, 61(3), 1996, p.519-528.

118. YANG, J.S and HSIUE, G.H
Graft polymerization of acrylic acid onto silicone rubber film by preirradiation method
Journal of Applied Polymer Science, 55(4), 1995, p.653-654.

119. AHAGON, A
Evaluation of chain scission during mixing of filled compounds
Rubber Chemistry and Technology, 69(5), 1996, p.742-751.

120. ARNAUDOVA, R et al.
Influence of oligoamidephosphates on some characteristics of elastomer compounds based on NBR
Kautschuk Gummi Kunststoffe, 49(3), 1996, p.206-209.

121. GHOSH, A.K et al.
A plant product modified carbon black as a reinforcing filler for rubber.
Journal of Polymer Materials, 12(4), 1995, p.285-295.

122. MOHANDAS, K.S and KURIAKOSE, B
Studies on the effect of fillers on air permiability of natural rubber vulcanizates
Kautschuk Gummi Kunststoffe, 50(7/8), 1997, p.544-548.

123. PRAMANIK, P.K and BAKER, W.E
LLDPE composites filled with corona discharge treated ground rubber tire crumb.
Journal of Elastomers and Plastics, 27(3), 1995, p.253-267.

124. PUSHPA P GOONE TILLEKE, S.A and BILLINGGHAM, N.C
Solubility of antioxidants in rubber
Rubber Chemistry and Technology, 69(5), 1996, p.885-896.

125. YUSOF, et al.
Purification and characterisation of an inhibitor of rubber biosynthesis from C-Serum of Hevea brasiliensis latex
Journal of Rubber Research, 1(2), 1998, p.95-110.

126. ABBATE, M et al.
A novel reactive liquid rubber with maleimide end groups for the toughening of unsaturated polyester resins
Journal of Applied Polymer Science, 62(12), 1996, p.2107-19.

127. ABDEL-AZIZ, M.M et al.
Influence of polyfunctional monomers and fillers on radiation vulcanization of ethylene-propylene diene rubber
Journal of Elastomers and Plastics, 27(3), 1995, p.223-238.

128. AVIRAH, S.A and JOSEPH, R
Studies on natural rubber bound para-phenylenediamine antioxidants in NBR
Journal of Applied Polymer Science, 57(12), 1995, p.1511-24.

129. BIELINSKI, D.M et al.
Influence of chemical modification on tribological properties of elastomers
Journal of Applied Polymer Science, 56(7), 1995, p.853-868.

130. CHO, K et al.
The effect of interfacial adhesion on toughening behaviour of rubber modified poly(methyl methacrylate)
Polymer, 38(20), 1997, p.5161-5167.

131. DEBNATH, S.C and BASU, D.K
Studies on the effect of thiuram disulphide on NR vulcanization accelerated by thiazole-based accelerator systems.
Journal of Applied Polymer Science, 60(6), 1996, p.845-855.

132. DEROUET, D et al.
Phosphorous modification on epoxidized natural rubber to improve flame resistance of vulcanized rubbers.
Journal of Applied Polymer Science, 52(9), 1994, p.1309-1316.

133. DE SARKAR, M et al.
Thermoplastic elastomeric hydrogenated styrene-butadiene elastomer: optimization of reaction conditions, thermodynamics, and kinetics.
Journal of Applied Polymer Science, 66(06), 1997, p.1151-1162.

134. ELLUL, M.D et al.
Crosslink densities and phase morphologies in dynamically vulcanized TPEs.
Rubber Chemistry and Technology, 68(4), 1995, p.573-584.

135. EVANS, L.R and WADDELL, W.H
Ultra-high reinforcing precipitated silica for tire and rubber applications.
Kautschuk Gummi Kunststoffe, 48(10), 1995, p.718-723.

136. GHOSH, A.K et al.
Effect of modified carbon black on the properties of natural rubber vulcanizate
Journal of Applied Polymer Science, 66(04), 1997, p.683-693.

137. HUANG, D.C and TSIANG, R.C
Effects of tetrahydrofuran as a structure modifier in preparation of SBS thermoplastic block copolymers in cyclohexane.
Journal of Applied Polymer Science, 61(2), 1996, p.333-342

138. ISAYEV, A.I et al.
Elastic recovery of rubber vulcanizates at very short times
Journal of Elastomers and Plastics, 28(4), 1996, p.344-381.

139. ISHIAKU, U.S et al.
The effect of di-2-ethylhexyl phthalate on the thermo-oxidative ageing of poly(vinyl chloride)/epoxidized natural rubber blends.
Polymer International, HI(3), 1996, p.327-336.

140. KALI RAY, A et al.
Chemical modification of EPDM rubber and its properties
Journal of Elastomers and Plastics, 29(3), 1997, p.121-215.

141. LEE, S et al.
Method for estimating the chemical crosslink densities of cured natural rubber and styrene-butadiene rubber
Rubber Chemistry and Technology, 67(5), 1994, p.854-864.

142. MYHRE, Marvin and MACKILLOP, D.A
Modification of crumb rubber to enhance physical properties of recycled rubber products.
Rubber World, 214(2), 1996, p.42-46.

143. NASAR, G.M and GOMAN, A.S
Influence of physical ageing on the electrical and swelling behaviour of ternary rubber vulcanizates
Polymer Degradation and Stability, 50(3), 1995, p.249-259.

144. O'CONNOR, B et al.
Role of rubber particles in tensile rupture of high impact polystyrene
Plastics, Rubber and Composites: Processing and Applications, 26(8), 1997, p.360-367.

145. OKIEIMEN, F.E and URHOGHIDE, I.N
Studies on miscibility of poly(vinyl chloride) with natural rubber-graft-polyacrylonitrile and natural rubber-graft-poly (methyl methacrylate)
Journal of Applied Polymer Science, 59(11), 1996, p.1803-08.

146. OU, Yu-chun et al.
Effects of alkylation of silica filler on rubber reinforcement
Rubber Chemistry and Technology, 67(5), 1994, p.834-844.

147. TANAKA, Y et al.
Structural characterization of natural rubber
Kautschuk Gummi Kunststoffe, 50(1), 1997, p.6-11.

148. PUSKAS, Judit E and WILDS, Christopher
Kinetics of the epoxidation of butyl rubber: development of high precision analytical method for unsaturation measurement.
Rubber Chemistry and Technology, 67(2), 1994, p.329-341.

149. ROYCHOUDHURY, A et al.
Chemical interaction between carbon black and elastomers: crosslinking of chlorosulfonated polyethylene by carbon black.
Rubber Chemistry and Technology, 67(4), 1994, p.662-671.

150. TANGPAKDEE, J and TANAKA, Y
Branching in natural rubber
Journal of Rubber Research, 1(1), 1998, p.14-21.

151. THAMMATHADANUKUL, V et al.
Comparison of rubber reinforcement using various surface-modified precipitated silicas
Journal of Applied Polymer Science, 59(11), 1996, p.1741-50.

152. ANACHKOV, M.P et al.
DSC study of thermal decomposition of partially ozonized diene rubbers
Journal of Applied Polymer Science, 61(4), 1996, p.585-590.

153. ANSARIFAR, M.A and LAKE, G.J
The mechanics of rubber-to-metal bond failure.
Journal of Adhesion, 53(3/4), 1995, p.183-199.

154. BANDYOPADHYAY, S et al.
3-Aminopropyltriethoxysilane as a promotor in the crosslinking of carboxylated nitrile rubber by surface-oxidised carbon black
Journal of Applied Polymer Science, 61(10), 1996, p.1813-20.

155. BANDYOPADHYAY, S et al.
Interaction between carboxylated nitrile rubber and precipitated silica: role of (3-aminopropyl) triethoxysilane
Rubber Chemistry and Technology, 69(4), 1996, p.637-647.

156. BAYERS, John T
Silane coupling agents for enhanced silica performance
Rubber World, 218(6), 1998, p.38-47.

157. BHAUMIK, S and DATTA, N.K
Thermal analysis of ethylene propylene rubber-chlorosulphonated polyethylene rubber blends.
Plastics, Rubber and Composites: Processing and Applications, 25(5), 1995, p.319-323.

158. BLUME, A et al.
Analysis of N-Hitrosamines in rubber and vulcanizates: influence of inhibitors
Kautschuk Gummi Kunststoffe, 49(7/8), 1996, p.532-537.

159. BOHIN, F et al.
Analysis of power requirements and disperson quality in batch compounding using a dispersion model for single agglomerates
Rubber Chemistry and Technology, 69(1), 1996, p.1-7.

160. BONFILS, F et al.
Steric exclusion chromatography study of natural rubber films prepared from fresh field latex.
Journal of Natural Rubber Research, 10(3), 1995, p.143-153

161. BROWN, P.S and TINKER, A.J
The use of FT-NMR in the analysis of rubber blends: crosslink distribution in carbon black filled blends of NR and cis BR
Kautschuk Gummi Kunststoffe, 48(9), 1995, p.606-610.

162. BUDING, H et al.
Peptizer influence on rubber-to-steel and adhesion
Rubber World, 218(6), 1998, p.32-36, 47.

163. BURBANK, Frederick R and POLOSKI, Walter A
continuous processing high quality compounds on a co-rotating twin screw extruder
Rubber India, 47(11), 1995, p.23-25.

164. CAMPBELL, D.S et al.
Characterisation of the chemical structure of sulphur vulcanizates of natural rubber using IH NMR spectroscopy
Journal of Natural Rubber Research, 9(3), 1994, p.155-171.

165. CAMPBELL, D.S and FARLEY P.S
Acid catalysed hydrolysis of epoxidised natural rubber: get formation during latex epoxidation
Journal of Natural Rubber Research, 10(4), 1995, p.242-254.

166. CHANDRA, A.K et al.
Scanning electron microscopy (SEM)/energy dispersive x-ray studies of the influence of a cobalt adhesion promoter on the interface between rubber skin compounds and tyre steel cord.
Journal of Adhesion Science and Technology, 10(5), 1996, p.431-460.

167. CHATTARAJ, P.P et al.
Effect of trans-polyoctenylene on crosslink structure of NR and SBR using solid state ^{13}C NMR spectroscopy and RPA 2000
Rubber Chemistry and Technology, 70(1), 1997, p.90-105

168. CHETRI, Prafulla and DASS, Narendra, N
Homogeneous acetalization and esterification of poly (vinylalcohol) in non-aqueous medium
Journal of Polymeric Materials, 15(1), 1998, p.51-55.

169. CHOUGH, S.H and CHANG, D.H
Kinetics of sulfur vulcanization of HR, BR, SBR, and their blends using a rheometer and DSC
Journal of Applied Polymer Science, 61(3), 1996, p.449-454.

170. COUSINS, W and DICK, J.S
Effective processability measurements of acrylonitrite butadiene rubber
Rubber India, 50(3), 1998, p.27-37.

171. DE, D.K and GENT, A.N
Crack growth in twisted rubber. Pt.2. Experimental results
Rubber Chemistry and Technology, 71(1), 1998, p.84-94.

172. DEHNICKE, S
Aqueous, adhesives as an alternative to conventional rubber–to-metal adhesives
Rubber World, 219(3), 1998, p.18-19,34.

173. EISENBACH, C.D and RIBBE, A
Investigation on the distribution of fillers in natural rubber by element spectroscopic transmission electron microscopy
Kautschuk Gummi Kunststoffe, 47(5), 1994, p.316-318.

174. ELLUL, M.D and HAZELTON, R.D
Chemical surface treatments of natural rubber and EPDM thermoplastic elastomers: effects on fiction and adhesion
Rubber Chemistry and Technology, 67(4), 1994, p.582-601.

175. ENG, A.H et al.
Reaction of moist ozone with natural rubber: a study by attenuated total reflectance spectroscopy
Journal of Rubber Research, 1(3), 1998, p.133-145.

176. ENG, A.H et al.
Epoxide groups in natural rubber: "Cp-NMR study of oxidative degraded rubbers.
Journal of Rubber Research, 1(2), 1998, p.67-76.

177. FONG, C.F et al.
Mathematical model of diffusion of solvents in rubbers
Rubber Chemistry and Technology, 71(2), 1998, p.285-288.

178. GAN, S.N et al.
Hydrogenation of natural rubber using nickel 2-ethylhexanate catalyst in combination with triisobutylaluminium
Journal of Applied Polymer Science, 59(1), 1996, p.63-70.

179. GANG HOFFER, J.F and SCHULTS, J
A new theoretical approach to cavitation in rubber
Rubber Chemistry and Technoloy, 68(5), 1995, p.757-772.

180. GEETHAMMA, V.G et al.
Short coir fiber-reinforced natural rubber composites: effects of fiber length, orientation, and alkali treatment
Journal of Applied Polymer Science, 55(4), 1995, p.583-594.

181. GONZALEZ, L et al.
A new interpretation of the crosslinking mechanism of NR with dicumyl peroxide.
Kautschuk Gummi Kunststoffe, 51(2), 1998, p.83-87.

182. GUO, C.J et al.
Diffusion of organic solvents in rubber membrances measured via a new permeation cell.
Journal of Applied Polymer Science, 56(7), 1995, p.823-830.

183. GUO, C.J et al.
Free volume model and diffusion of organic solvents in natural rubber
Journal of Applied Polymer Science, 56(7), 1995, p.817-822.

184. HACALOGLU, J et al.
Thermal degradation of polythiophene-natural rubber and polythiophene-synthetic rubber conducting polymer composites
Polymer, 38(20), 1997, p.5119-5124.

185. HAMED, G.R and ZHAO, J
Longitudinal cracking in a carbon black filled natural rubber vulcanizate during chemical stress relaxation
Rubber Chemistry and Technology, 71(2), 1998, p.157-167.

186. HAHN, J et al.
Vulcanization and sulfur degradation with model compounds: an attempt to analyze the network structure of BR and SBR vulcanizates.
Kautschuk Gummi Kunststoffe, 51(3), 1998, p.206-211.

187. HARDIMAN, S and KARTHIKA, B
The study of stabilizing mooney viscosity of natural rubber using sodium phenolate, sodium metabisulphite, and acetaldehyde
Indonesian Journal of Natural Rubber Research, 13(2) 1995, p.157-163.

188. HARRIS, R.K et al.
Proton NMR studies of molecular level mobility in vulcanized and epoxidised natural rubber
Polymer International, 40(1), 1996, p.63-71.

189. HOFER, F et al.
Characterisation of rubber-brass bonding layers by analytical electron microscopy (AEM)
Journal of Adhesion Science and Technology, 10(5), 1996, p.473-490.

190. HULL, C.D et al.
Analysis of vulcanisate blends of swollen state ^{13}C NMR spectroscopy
Journal of Natural Rubber Research, 9(1), 1994, p.23-32.

191. HUMMEL, K et al.
Rubber-brass bonding: morphology of cross-sections through bonding layers as a possible basis for classification
Journal of Adhesion Science and Technology, 10(5), 1996, p.461-471.

192. ISMAIL, H et al.
A comparative study of the effect of thermo-oxidative aging on the physical properties of rice husk ash and commercial fillers in opoxidised natural rubber compounds.
Journal of Elastomers and Plastics, 29(4), 1997, p.270-289.

193. JOB, L and JOSEPH, R
Studies of the adhesives for rubber to rubber bonding
Journal of Adhesion Science and Technology, 9(11), 1995, p.1427-34.

194. KRALEVICH, M.L et al.
FTIR analysis of silica-filled natural rubber
Rubber Chemistry and Technology, 71(2), 1998, p.300-309.

195. LINOS, A and STEINBUCHEL
Microbial degradation of natural and synthetic rubbers by novel bacterial belonging to the genus 'Gordona'
Kautschuk Gummi Kunststoffe, 51(7), 1998, p.496-499.

196. LITVINOV, V.M et al.
The density of chemical crosslinks and chain entanglements in unfilled EPDM vulcanizates as studied with low resolution, solid state IH NMR.
Rubber Chemistry and Technology, 71(1), 1998, p.105-118.

197. MASS, S and GRONSKI, W
Study of the microdispersion of carbon black in rubber by atomic force microscopy and digital image analysis
Kautschuk Gummi Kunststoffe, 47(6), 1994, p.409-415.

198. MCBRIETY, V.J and KENNY, J.C
Structural investigations of carbon black-filled elastomers using NMR and ESR.
Kautschuk Gummi Kunststoffe, 47(5), 1994, p.342-348.

199. MENON, A.R.R et al.
Chemical crosslink density and network structure of natural rubber vulcanizates modified with phosphrylated cardanol prepolymer
Journal of Applied Polymer Science, 51, 1994, p.2157-64.

200. MILCZAREK, Roman
Rubber-to-metal bonding agents
Rubber World, 214(1), 1996, p.41-46.

201. MORI, Makio and KOENIG, Jack L
Solid-state C13 NMR studies of vulcanized elastomers: TBBS accelerated, sulfur-vulcanization of carbon black filled natural rubber
Rubber Chemistry and Technology, 68(4), 1995, p.551-562.

202. MORI, Makio and KOENIG, Jack L
Solid state C13 NMR studies of vulcanized elastomers: effect of carbon black grade on the network structure in natural rubber vulcanizates.
Rubber Chemistry and Technology, 70(4), 1998, p.671-680.

203. MORRIS, M.D and THOMAS
Solubility of sulfur and dithiocarbamates in natural rubber
Rubber Chemistry and Technology, 68(5), 1995, p.794-803.

204. MUN, Lau Chee
Concentration of natural rubber serum by reverse osmosis
Journal of Natural Rubber Research, 9(4), 1994, p.226-240.

205. MURRAY, G.A.W et al.
The dark field cut surface (DFCS) test for estimating the dispersion of carbon black in rubber compounds
Rubber Chemistry and Technology, 70(1), 1997, p.50-59.

206. NIEDERMEIER, W et al.
The microstructure of carbon black investigated by atomic force microscopy
Kautschuk Gummi Kunststoffe, 47(11), 1994, p.806-811.

207. OHYA, Norimasa and TANAKA, Yasuyuki structural characterisation of rubber from lactarium mushrooms: IH-NMR analysis of terminal groups in the rubber chain
Journal of Rubber Research, 1(2), 1998, p.84-94.

208. PAROLI and DELGADO, A.H
Evaluating the performance of polymeric roofing materials with thermal analysis
Rubber World, 214 (4), 1996, p.27-32.

209. QUIGLEY, Claudia J et al.
Large strain viscoelastic constitutive models for rubber. Pt.2. Determination of material constants.
Rubber Chemistry and Technology, 68(2), 1995, p.230-247.

210. RICHARDS, S.C and ROBERTS, A.D
The friction of various rubber articles lubricated with acid and allcaline water.
Journal of Natural Rubber Research, 10(4), 1995, p.218-227.

211. SELDEN, R
Fracture mechanics analysis of fatigue of rubber: a review
Progress in Rubber and Plastics Technology, 11(1), 1995, p.56-83.

212. SUN, Shochang and CHANG, W Victor
Nonlinear elastic analysis of the adhesive strength between rubber like materials and rigid surfaces
Rubber Chemistry and Technologym 68(1), 1995, p.1-12.

213. TANGPAKDEE, J and TANAKA, Y
Characterization of sol gel in Hevea natural rubber
Rubber Chemistry and Technology, 70(5), 1997, p.707-713.

214. URABE, W et al.
Studies of rubber mixing. Pt.1. Action of zinc oxide
International Polymer Science and Technology, 22(12), 1995, p.37-42.

215. VAN OOIJ, W.J
Rubber to metal bonding
Rubber Chem Review, 26(8), 1996, p.23-32.

216. VEERALAKSHMANAN, B et al.
Chlorination of liquid natural rubber
Indian Journal of Natural Rubber Research, 8(2), 1995, p.85-90.

217. WILLOUGHBY, Bryan G and SCOTT, Keith W
Nitrosamine formation in rubber: influence of mixing history
Rubber Chemistry and Technology, 71(2), 1998, p.310-322.

218. YEOH, O.H
Hyperelastic material models for finite element analysis of rubber
Journal of Natural Rubber Research; 12(3), 1997, p.142-153.

219. AFTAB ALAM
Estimation of protein contamination in latex
Rubber India, 48(6), 1996, p.9-10.

220. AKASAWA, A et al.
A novel acidic allergen, Hev b 5, in latex
Journal of Biological Chemistry 271 (41), 1996, p.25389-93.

221. AMIR-HASHIM, M.Y et al.
Effect of leaching and humidity on prevulcanized NR latex films
Rubber Chemistry and Technology, 70(4), 1997, p.560-571.

222. AZIZAH, M.R et al.
Latex protein allergy: a prevalence study of factory workers
Journal of Natural Rubber Research, 11(4), 1996, p.240-246.

223. BEEZHOLD, D et al.
Rapid test for surface-bound latex protein antigens on surgical gloves.
Rubber Developments, 48(1/2), 1995, p.18-20.

224. BRADLEY, D.Z et al.
Stability of antigenic protein in latex extracts
Rubber Developments, 49(1/2), 1996, p.15-18.

225. CARDOSA, M.J et al.
Immunoassays for determination of antigens and allergens in latex products
Journal of Natural Rubber Research, 9(2), 1994, p.63-69.

226. CARDOSA, M.J et al.
Monoclonal antibodies identify different antigens in proteins eluted from natural rubber latex gloves obtained from different sources.
Journal of Natural Rubber Research, 9(4), 1994, p.270-277.

227. CLARAMMA, N.M et al.
Effect of storage of natural rubber latex concentrate on properties of prevulcanized latex film
Kautschuk Gummi Kunststoffe, 50(12), 1997, p.857-860.

228. CLARAMMA, N.M et al.
Influence of storage on properties of natural rubber latex concentrate and vulcanizates.
Indian Journal of Natural Rubber Research, 8(1), 1995, p.1-7.

229. COOK, S et al.
The microstructure of natural rubber latex films
Rubber Chemistry and Technology, 70(4), 1997, p.549-559

230. CUDBY, P.E.F and DAVIES, R.T
Microstructure of peroxide prevulcanized latex films
Journal of Natural Rubber Research, 12(2), 1997, p.67-81.

231. DAFADER, N.C et al.
Evaluation of the properties of natural rubber latex concentrated by creaming method for gama ray irradiation
Macromolecular Reports, A33(2), 1996, p.73-81.

232. DILLON, J.G and SCHROEDER, L.W
Permeability and material characteristics of vulcanized latex film during and following cyclic fatigue in a saline environment.
Journal of Applied Polymer Science, 64(3), 1997, p.553-566.

233. DOBLER, F and HOLL, Y
Mechanisms of latex film formation
Trends in Polymer Science, 4(5), 1996, p.145-151

234. ELIZABETH, K.I et al.
Treatment of examination gloves for reducing extractable protein content
Indian Journal of Natural Rubber Research, 9(1), 1996, p.6-11.

235. GEURTS, John M et al.
Molecular mass control in methacrylic copolymer latexes containing glycidyl methacrylate.
Journal of Applied Polymer Science, 61(1), 1996, p.9-19.

236. GHAZALY, Hatsah M.
Factory production of examination gloves from low protein latex.
Journal of Natural Rubber Research, 9(2), 1994, p.96-108.

237. GIDROL, X et al.
Hevein, a lectin-like protein from Hevea brasiliensis (rubber trees) is involved in the coagulation of latex
Journal of Biological Chemistry, 269(12), 1994, p.9278-9283.

238. HASMA, H and AMIR-HASIM, M.Y
Changes to NR latex proteins on processing the latex to its products
Journal of Natural Rubber Research, 12(1), 1997, p.21-32.

239. HASMA, H.M et al.
Binding patterns of IgE antibodies in sera of rubber tappers to fresh hevea latex serum proteins
Journal of Rubber Research, 1(3), 1998, p.146-153

240. HE, Y et al.
Elastomeric films from structural latexes.
Journal of Applied Polymer Science, 64(6), 1997, p.1143-1152.

241. HE, Y et al.
Grafting behaviour of n-Butyl acrylate onto poly (butadiene-co-styrene) latexes.
Journal of Applied Polymer Science, 65(3), 1997, p.511-523.

242. HE, Y et al.
Hydrogenation of styrene-butadiene rubber (SBR) latexes
Journal of Applied Polymer Science, 64(10), 1997, p.2047-56.

243. JACOB J.L et al.
The concentrated natural latex sector: from latex vessel to surgical glove.
Plantations, Recherche, Developpement, 2(6), 1995, p.36-37.

244. KARNIKA DE SILVA, K.G and DENEWAKA, Indra.
Natural rubber latex based adhesives to bond various materials.
Bulletin of the Rubber Research Institute of Sri Lanka, 33, 1996, p.13-16.

245. KARNIKA DE SILVA, K.G and HAMIELEC, A.E
Kinetic study of the graft polymerization of unsaturated monomers with natural rubber latex and with deproteinized natural rubber latex
Journal of the Rubber Research Institute of Sri Lanka, 74, 1994, p.57-78.

246. KHALID, Kaida et al.
Dielectric properties of hevea latex at various moisture contents.
Journal of Natural Rubber Research, 9(3), 1994, p.172-189.

247. KOYAMA, T et al.
Isopentenyl disphosphate isomerase in rubber latex
Phytochemistry, 43(4), 1996, p.769-772.

248. LAILAMMA JOSE and RANI JOSEPH
An accelerator for transparent latex products
Journal of Natural Rubber Research, 11(2), 1996, p.69-76.

249. LEGGE, N.R
TPE condoms impervious to ozone levels that damage NR latex condoms.
Rubber World, 211(1), 1994, p.43-47.

250. LLOSENT, M.A et al.
Particle size distribution of SBR and NBR latexes by UV-VIS turbidimetry near the rayleigh region.
Rubber Chemistry and Technology, 69(4), 1996, p.696-712.

251. MAKUUCHI, K et al.
Allergic response to radiation cured natural rubber latex.
International Polymer Science and Technology, 23(2), 1996, p.28-32.

252. MARTIN, L.R and URBAN, M.W
Surface and interfacial fourier transform infrared spectroscopic studies of latexes: orientation of the sodium dioctyl sulfosuccinate surfactant molecules in core/shell-type styrene/butyl acrylate latex films at the film-air and film-substrate interfaces.
Journal of Applied Polymer Science, 62(11), 1996, p.1893-01.

253. MATTHAN, R.K
Underexploited export potential for the Indian latex glove industry
Rubber India, 46(4), 1994, p.75-78.

254. MEHTA, R.I et al.
Cause of cessation of viral passage through artificially-induced holes in latex condoms
Journal of Rubber Research, 1(1), 1998, p.1-13.

255. MILLER, J
Latex sales not hurt by allergies
Rubber and Plastics News, 53(4), 1996, p.4,17.

256. MORRIS, M.D
Health considerations for synthetic alternatives to natural rubber latex.
Journal of Natural Rubber Research, 9(2), 1994, p.121-126.

257. NAGARAJAN, P et al.
Latex interpenetrating polymer networks based on polystyrene: synthetic variations.
Journal of Applied Polymer Science, 59(2), 1996, p.191-195.

258. NAGARAJAN, P et al.
Latex interpenetrating polymer networks based on polyacrylates and polystyrene: effect of methacrylic acid concentration in the seed.
Journal of Applied Polymer Science, 59(2), 1996, p.197-202.

259. NAGARAJAN, P et al.
Latex interpenetrating polymer networks based on polyacrylates and poly (methyl methacrylate).
Journal of Applied Polymer Science, 59(2), 1996, p.203-208.

260. NAGARAJAN, P
Latex interpenetrating polymer networks based on polyacrylates and network II comprised of poly (styrene-methyl methacrylate)
Journal of Applied Polymer Science, 59(2), 1996, p.209-213.

261. NAKEDE, S et al.
Studies of high purity natural rubber: provisional guidelines on the design of latex allergy free NRL products
International Polymer Science and Technology, 25(3), 1998, p.29-32.

262. NAKADE, S et al.
Highly purified natural rubber: preparation and characteristics of gloves and condoms
Journal of Natural Rubber Research, 12(1), 1997, p.33-42.

263. NAON, B et al.
Drying of granules from natural rubber latex
Journal of Natural Rubber Research, 10(4), 1995, p.228-241.

264. NG, K.P
Production of natural rubber latex gloves with low extractable protein content: some practical recommendations
Journal of Natural Rubber Research, 9(2), 1994, p.87-95.

265. NIU, B.J and URBAN, M.W
Surface and interfacial FTIR spectroscopic studies of latexes: the effect of homopolymer and copolymer structures on surfactant mobility in sty/BA latices
Journal of Applied Polymer Science, 56(3), 1995, p.377-386.

266. NIU B.J and URBAN, M.W
Surface and interfacial fourier transform infrared spectroscopic studies of latexes: quantitative analysis of surfactant in multilayered films.
Journal of Applied Polymer Science, 62(11), 1996, p.1903-11.

267. NORDIN, A.K.B and ISA, Zaid
Effluent treatment system for RRIM rubber glove manufacturing plant.
Journal of Natural Rubber Research, 12(3), 1997, p.176-185.

268. ODEBERG, J et al.
Influence of spacer groups on grafting ability curing ability, and film properties of water-based radiation curable latexes
Journal of Applied Polymer Science, 70(5), 1998, p.897-906.

269. ODERBERG. J et al.
Water-based radiation-curable latexes
Journal of Applied Polymer Science, 62(2), 1996, p.435-445.

270. PEKCAN, O and CANPOLAT, M
Fluorescence method of studying void closure kinetics during film formation from high-T latex particles.
Journal of Applied Polymer Science, 66(4), 1997, p.655-661.

271. PENDLE, T.D
Natural rubber latex products: problems and solutions
Plastics, Rubber and Composites: Processing and Applications, 26(4), 1997, p.147-152.

272. SCHLOMAN, W.W et al.
Characterization and performance testing of guayle latex
Rubber Chemistry and Technology, 69(2), 1996, p.215-222.

273. SHAMSUL BAHRI, A.R and HAMZAH, S
Immunocytochemical localisation of rubber membrane protein in hevea latex
Journal of Natural Rubber Research, 11(2), 1996, p.88-95.

274. SINGHA, Nikhil K et al.
A new method to hydrogenate nitrile rubber in the latex form
Rubber Chemistry and Technology, 68(2), 1995, p.281-286.

275. SOEDJANAATMADIA, U.M.S et al.
Processed products of the hevein precursor in the latex of the rubber tree (Hevea brasiliensis)
FEBS Letters, 363(3), 1995, p.211-213.

276. SOLICHIN, M
Preparation of constant viscosity stabilized rubber from thin slab derived from latex in the presence of hydroxylamine neutral sulphate.
Indonesian Journal of Natural Rubber Research, 13(1), 1995, p.80-84.

277. SOWKA, S
cDNA cloning of the 43 kDa latex allergen Hev b 7 with sequence similarity to patatins and its expression in the yeast Pichia pastoris.
European Journal of Biochemistry, 255(1), 1998, p.213-219.

278. SUBRAMANIAM, N et al.
Use of mechanistic principles to make modified natural rubber latex products by emulsion polymerisation
Journal of Natural Rubber Research, 12(4), 1997, p.223-231.

279. SUNDERASAN, E et al.
Allergenic proteins of hevea brasiliensis latex fractions.
Journal of Natural Rubber Research, 9(2), 1994, p.127-130.

280. SUNDERASAN, E et al.
Latex B-serum B-1, 3-glucanase (Hev b II) and a component of the microhelix (Hev IV) are major latex allergens.
Journal of Natural Rubber Research, 10(2), 1995, p.82-99.

281. SUWARDIN, D
Simultaneous latex coagulation in the bamboo tube
Indonesian Journal of Natural Rubber Research, 14(1), 1996, p.108-110.

282. TANGBOIBOONRAT, P et al.
Characterisation of non-crosslinked natural rubber latex by phase transfer technique.
Polymer, 35(23), 1994, p.5144-45.

283. TANGBORIBOONRAT, P et al.
Phase transfer technique for the study of deproteinised natural rubber latex.
Journal of Natural Rubber Research, 11(1), 1996, p.26-31.

284. TANRATTANAKUL, V
Toughening polycarbonate with·core-shell structured latex particles.
Journal of Applied Polymer Science, 62(12), 1996, p.2005-13.

285. TEBELIUS, L.K and URBAN, M.W
Surface and interfacial FTIR spectroscopic studies of latexes: the effect of coalescence on surfactant exudation in polystyrene and poly (n-butyl acrylate) latex films.
Journal of Applied Polymer Science, 56(3), 1995, p.387-396.

286. TEBELIUS, L.K et al.
Surface and interfacial fourier transform infrared spectroscopic studies of latexes: surface phase seperation in polystyrene/poly-n-butyl acrylate latex films.
Journal of Applied Polymer Science, 62(11), 1996, p.1887-92.

287. THIANDCHANYA, A et al.
Degradability testing of radiation-vulcanized natural rubber latex films.
Journal of Applied Polymer Science, 54(5), 1994, p.525-531.

288. TRIWIYOSO, U and HANDOKO, B
Preservation of field latex to increase the production of latex shares in NES project.
Indonesian Journal of Natural Rubber Research, 13(2), 1995, p.173-177.

289. TUCCI, M.G et al.
Structural features of latex gloves in dental practice
Biomaterials, 17(5), 1996, p.517-522.

290. VARGHESE, L et al.
Use of sulphuric acid as coagulant for natural rubber latex: long term effects on rubber and machinery.

Indian.Journal of Natural Rubber Research, 9(1), 1996, p.22-27.

291. WHITE, J.L
Managing latex protein allergy.
European Rubber Journal, 178, (4), 1996, p.27-30.

292. YAGAMI, Takeshi et al.
Plant defense-related proteins eluting from latex gloves and ammoniated latex: potential latex allergens.
Journal of Natural Rubber Research, 10(2), 1995, p.100-107.

293. YAPA, P.A.J
Manufacture of low protein natural rubber (LPNR) by pineapple juice (or bromelain) treatment of hevea latex
Bulletin of the Rubber Research Institute of Sri Lanka, 32(1), 1995, p.1-4.

294. YAPA, P.A.J
Proteolytic action of bromelain o hevea latex
Journal of the Rubber Research Institute of Sri Lanka, 75(1), 1995, p.39-50.

295. YEANG, H.Y et al.
New approaches in the quantitation of total proteins from latex gloves.
Journal of Natural Rubber Research, 9(2), 1994, p.70-78.

296. YEANG, H.Y et al.
Latex allergy studies: extraction of natural rubber latex proteins with reference to film thickness, latex D.R.C and protein migration behaviour.
Journal of Natural Rubber Research, 10(1), 1995, p.46-62.

297. YIP, Esah et al.
Correlation between total extractable proteins and allergen levels of natural rubber latex gloves
Journal of Natural Rubber Research, 12(2), 1997, p.120-130.

298. YIP, Esah et al.
Allergic responses and levels of extractable proteins in NR latex gloves and dry rubber products.
Journal of Natural Rubber Research, 9(2), 1994, p.79-86.

299. YUEN, Chooi Siew
Determination of dithiocarbamyl compounds in natural latex concentrate.
Journal of Natural Rubber Research, 10(4), 1995, p.255-265.

300. ZEHR, Bradley D et al.
Extraction of antigenic protein from latex films and gloves
Rubber Development, 47(3/4), 1994, p.58-61.

301. ABO-HASHEM, A and ELSHOKROFY, K.M
Thermal effects of carbon black-rubber composites: 1-chlorobutyl rubber mixed with HAG carbon black
Plastics, Rubber and Composites: Processing and Applications, 22(1), 1994, p.61-65.

302. BUSFIELD, J.J.C et al.
Crack growth and strain induced anisotropy in carbon black filled natural rubber.
Journal of Natural Rubber Research, 12(3), 1997, p.131-141.

303. DE CANDIA, F et al.
Carbon black filled rubbers: molecular motions in the rubbery matrix and structural organization of the filler
Kautschuk Gummi Kunststoffe, 49(2), 1996, p.99-101.

304. DYRDA, V.I and MESHCHANINOV, S.K
Relaxation of dielectric permitivity of rubber in a complex stress-strain state.
International Polymer Science and Technology, 22(7), 1995, p.7-8.

305. EGGERS, H and SCHUMMER, P
Reinforcement mechanisms in carbon black and silica loaded rubber melts at low stresses.
Rubber Chemistry and Technology, 69(2), 1996, p.253-265.

306. ERTONG, S et al.
Steady state shear flow properties of carbon black filled rubber compounds.
Rubber Chemistry and Technology, 67(2), 1994, p.207-216.

307. FULTON, W.S and GROVES, S.A
Determination of the molecular architecture of synthetic and natural rubber by the use of thermal field-flow fractionation and multi-angle laser light scattering.
Journal of Natural Rubber Research, 12(3), 1997, p.154-165.

308. GENT, A.N and LAI, S.M
Adhesion and autohesion of rubber compounds: effect of surface roughness.
Rubber Chemistry and Technology, 68(1), 1995, p.13-25.

309. GERLACH, E
Additives for the modification of silicone rubber
Kautschuk Gummi Kunststoffe, 48(11), 1995, p.793-798.

310. GERSPACHER, M et al.
High frequency viscoelasticity of carbon black filled compounds.
Rubber Chemistry and Technology, 69(5), 1996, p.786-800.

311. GHOSH, A.K et al.
Modified carbon black as reinforcing filler for SBR
Rubber Chem Review, 26(4), 1996, p.13-20.

312. GIBALA, D et al.
Cure and mechanical behaviour of rubber compounds containing ground vulcanizates. Pt.2. Mooney viscosity
Rubber Chemistry and Technology, 69(1), 1996, p.115-119.

313. GORI, U and NORDSIEK, K.H
Rubber/filler batches in powder form: contribution to the simplified production of rubber compounds.
Kautschuk Gummi Kunststoffe, 51(4), 1998, p.250-258.

314. GUERBE, L and FREAKLEY, P.K
A comparison of some indirect methods of measuring carbon black dispersion in rubber compounds.
Kautschuk Gummi Kunststoffe, 48(4), 1995, p.260-269.

315. ISMAIL, H et al.
Modes of action of a multifunctional additive in a carbon black filled natural rubber compound.
Plastics, Rubber and Composites: Processing and Applications, 23(1), 1995, p.43-52.

316. ISMAIL, H et al.
Determination of the modes of action of a cationic surfactant for property development in carbon black filled natural rubber compounds.
Polymer International, 39(4), 1996, p.309-316.

317. JURKOWSKI, B et al.
Radioisotopic determination methods of sulphur dispersion and sulphur blooming in rubber compounds
Journal of Applied Polymer Science, 59(4), 1996, p.639-645.

318. KLASEK, A et al.
Efficiency of some novel carbon black/rubber coupling agents
Journal of Applied Polymer Science, 61(7), 1996, p.1137-46.

319. KLUPPEL, M and HEINRICH, G
Fractal structures in carbon black reinforced rubbers
Rubber Chemistry and Technology, 68(4), 1995,
p.623-651.

320. KOCZOROWSKA, E and JURKOWSKA, B.B
Studies of sulfur behaviour in rubber compounds
Journal of Applied Polymer Science, 69(8), 1998,
p.1531-36.

321. LI, Q et al.
A Simple methodology for the modeling of carbon
black aggregate structure.
Rubber Chemistry and Technology, 69(1), 1996,
p.8-14.

322. MAGEE, R.W
Evaluation of the external surface area of carbon
black by nitrogen adsorption.
Rubber Chemistry and Technology, 68(4), 1995,
p.590-600.

323. MANTIA, Ajoy K et al.
Chemical interaction between surface oxidized carbon
black and epoxidised natural rubber.
Rubber Chemistry and Technology, 70(4), 1997,
p.624-633.

324. MARWEDE, G.W and SUMNER, A.J.M
New development in the field of general purpose
synthetic rubber
Rubber News, 37(10), 1998, p.21-28.

325. MAAS, G and GRONSKI, W
Deformation of filler morphology in strained carbon
black loaded rubbers: a study by atomic force
microscopy.
Rubber Chemistry and Technology, 68(4), 1995,
p.652-659.

326. MATHESON, M.J et al.
The effect of carbon black filling on the pyrolysis of
natural and synthetic rubber.
Rubber World, 213(4), 1996, p.14-53.

327. MEDALIA, A.I
Effects of carbon black on abrasion and tread wear
Kautschuk Gummi Kunststoffe, 47(5), 1994,
p.364-368.

328. POND, T.J
Cavitation in bonded natural rubber cylinders
repeatedly loaded in tension
Journal of Natural Rubber Research, 10(1), 1995,
p.14-25.

329. SANGTANI, S.B
Introduction to practical rubber compounding
Rubber India, 49(2), 1997, p.41-46.

330. VARGHESE, S et al.
Effect of adhesion on the equilibrium swelling of short
sisal fiber reinforced natural rubber composites
Rubber Chemistry and Technology, 68(1), 1995,
p.37-49.

331. SRILATHAKUTTY, R et al.
Use of amine terminated liquid natural rubber as a
plasticizer in filled NR and NBR compounds
International Journal of Polymeric Materials, 32(1),
1996, p.23-24.

332. TOKITA, N et al.
Carbon black elastomer interaction modelling
Kautschuk Gummi Kunststoffe, 47(6), 1994,
p.416-421.

333. WADDELL, W.H et al.
Mechanism by which precipitated silica improves
brass-coated wire-to-natural rubber adhesion.
Rubber Chemistry and Technology, 69(1), 1996,
p.48-58.

334. ANON
NR mountings for Pakistan
Plastics and Rubber Weekly, 1609(7), 1995.

335. HOLOWNIA, B.P
Rubber cylinders under hydrostatic pressure with variable poissons ratio
Rubber Chemistry and Technology, 68(4), 1995, p.585-589.

336. HUYBRECHTS, F
Compound developments in truck tyre retreading
Kautschuk Gummi Kunststoffe, 48(10), 1995, p.713-717.

337. KARNIKA DE SILA, K.G
Analysis of extractable proteins in rubber products.
Bulletin of the Rubber Research Institute of Sri Lanka, 33, 1996, p.29-33.

338. KUHN-STOFFERS, P et al.
Determination of carbonyl compounds in emissions from manufacture and storage of rubber products
Kautschuk Gummi Kunststoffe, 50(5), 1997, p.380-385

339. LAMBILLOTTE, Bruce and EIBER, Gray S
Truk tire technology for developing countries
Rubber India, 46(8), 1994, p.29-34.

340. LECA, M and RUNCAN, I.F
Reclaiming of rubber from waste tyres by physical methods
Kautschuk Gummi Kunststoffe, 49(12), 1996, p.855-858.

341. MITRA, Bijay Kumar
The tyres: its properties and choice of materials.
Rubber Chem Review, 24(6), 1995, p.17-25.

342. MOHAMED NOR, Zairossani et al.
Biosorption of zinc from effluent of rubber product manufacturing
Journal of Rubber Research, 1(3), 1998, p.167-178.

343. MUKHOPADHYAY, R et al.
Future directions of development of tyre technology
Rubber Chem Review, 27(7), 1998, p.19-21.

344. NAKACDHI, H
Consideration on the decay and service life of rubber products
Kautschuk Gummi Kunststoffe, 49(12), 1996, p.843-848.

345. READER, Gail
Medical and anatomical models from limbs and things.
Rubber Developments, 49(1/2), 1996, p.7-10.

346. VEITH, Alan G
Rubber vs countersurface frictional behaviour: how this influences the traction of pneumatic tyres
Progress in Rubber and Plastics Technology, 14(1), 1998, p.1-49.

347. WILL, T and GIESE, U
The influence of plasticizer aerosols on sampling and analysis of air pollutants in the rubber industry.
Kautschuk Gummi Kunststoffe, 49(3), 1996, p.200-205.

348. YIP, Esah et al.
The non-allergenicity of NR dry rubber products, with reference to type 1 protein allergy.
Rubber Developments, 48(3/4), 1995, p.48-52.

349. ABDEL-AZIZ, M.M et al.
Effect of polyfunctional monomers on radiation vulcanization of styrene-butadiene rubber.
Journal of Elastomers and Plastics, 28(4), 1996, p.288-305.

350. BOTROS, S.H and ABDUL EL-GHAFFAR, M.A
Efficiency of modified phthalocyanine compounds as antioxidants and UV stabilizers for SBR vulcanizates
Journal of Elastomers and Plastics, 29(3), 1997, p.216-238.

351. CHANDRAN, K.R and KURIAKOSE, A.P
Utilization of coconut pith and coir waste as a filler in natural rubber vulcanizates.
Kautschuk Gummi Kunststoffe, 48(1), 1995, p.29-33.

352. CLARAMMA, N.M and MATHEW, N.M
Effect of temperature on sulfur prevulcanization of natural rubber latex.
Journal of Applied Polymer Science, 65(10), 1997, p.1913-20.

353. COLVIN, Howard and BULL, Charles
Sulfur/olefin copolymers as vulcanizing agents for rubber
Rubber Chemistry and Technology, 68(5), 1995, p.746-756.

354. CONVENEY, V.A et al.
A triboelastic model for the cyclic mechanical behaviour of filled vulcanizates.
Rubber Chemistry and Technology, 68(4), 1995, p.660-670.

355. DEIBER, Julio A and BORTOLOZZI, Raul A
Comparison of two oscillating bicone cells for vulcanization of rubber compounds.
Journal of Elastomers and Plastics, 27(4), 1995, p.329-347.

356. DING, R and LEONOV, A.I
A kinetic model for sulfur accelerated vulcanization of a natural rubber compound
Journal of Applied Polymer Science, 61(3), 1996, p.455-463.

357. DING, R et al.
A study of the vulcanization kinetics of an accelerated-sulfur SBR compound.
Rubber Chemistry and Technology, 69(1), 1996, p.81-91.

358. GIBBESCH, B et al.
Evaluation of product constancy in the vulcanization of rubber lining for corrosion protection
Kautschuk Gummi Kunststoffe, 48(10), 1995, p.735-741.

359. GURIYA, K.C and TRIPATHY, D.K
Dynamic viscoelastic properties of silica-filled closed-cell microcellular ethylene propylene diene rubber vulcanizates: effect of blowing agent, temperature and strain.
Journal of Elastomers and Plastics, 27(4), 1995, p.305-328.

360. GURIYA, K.C and TRIPATHY, D.K
Morphology and physical properties of closed cell microcellular ethylene propylene diene terpolymer (EPDM) rubber vulcanizates-effect of silica filler and blowing agent.
Plastics, Rubber and Composites: Processing and Applications, 23(3), 1995, p.193-200.

361. HILL, D.J.T el al.
Mechanism of radiation vulcanization of natural rubber latex sensitized by monocyclates.
Journal of Applied Polymer Science, 57(10), 1995, p.1155-72.

362. ISAYEV, A.I et al.
Novel ultrasonic technology for devulcanization of waste rubbers.
Rubber Chemistry and Technology, 68(2), 1995, p.267-280.

363. ISAYEV, A.I et al.
Modelling of ultrasonic devulcanization of tyre rubbers and comparison with experiments
Plastics, Rubber and Composites: Processing and Applications, 25(1), 1996, p.1-12.

364. JANOWSKA, G
Flammability of cis-1, 4-Polyisoprene vulcanizates
International Polymer Science and Technology, 24(12), 1997, p.89-92.

365. JURKOWSKA, B and JURKOWSKI, B
Computer simulation of changing the rubber network structure during vulcanization
Kautschuk Gummi Kunststoffe, 51(7), 1998, p.534-539.

366. KAWABATA, Sueo et al.
Mechanism of carbon-black reinforcement of rubber vulcanizate
Rubber Chemistry and Technology, 68(2), 1995, p.311-329.

367. KIM, Sang Goo and LEE, Suck-Hyun.
Effect of crosslink structures on the fatigue crack growth behaviour of NR vulcanizates with various aging conditions.
Rubber Chemistry and Technology, 67(4), 1994, p.649-661.

368. KRESJA, M.R et al.
Analysis of the mechanism of N-t-butyl-2-benzothiazole sulfenamide accelerated sulfur vulcanization of cis-polyisoprene
Rubber Chemistry and Technology, 67(2), 1994, p.348-358.

369. KRETZSCHMAR, H.J and WEIGEL, H
Isothiocyanates formed during accelerated vulcanization. Pt.1. Thiuram and dithocarbamate accelerators
Kautschuk Gummi Kunststoffe, 50(5), 1997, p.386-391.

370. LEVIN, V.Y et al.
Effect of crosslink type on the ultrasound devulcanization of SBR vulcanizates.
Rubber Chemistry and Technology, 70(4), 1998, p.641-649.

371. LEVIN, V.Y et al.
Vulcanization of ultrasonically devulcanized SBR elastomers
Rubber Chemistry and Technology, 70(1), 1997, p.120-128.

372. MATHUR, M.L et al.
Quarternary ammonium salts: new curatives for vulcanization of natural rubber.
Rubber World, 213(5), 1996, p.34-36..

373. MENON, A.R.R
Stress relaxation characteristics of natural rubber modified with phosphorylated cashew nut shell liquid prepolymer
Journal of Applied Polymer Science, 65(11), 1997, p.2183-89.

374. NIEUWENHUIZEN, P.J et al.
Homogeneous catalysis by zinc complexes during accelerated vulcanization
Kautschuk Gummi Kunststoffe, 51(5), 1998, p.336-341.

375. POH, B.T et al.
Cure characteristics of unaccelerated sulfur vulcanization of epoxidised natural rubber.
Journal of Applied Polymer Science, 60(10), 1996, p.1569-74

376. PUROHIT, Chandra and MUKHOPADHYAY, R
Accelerator activity of TBAB in NR vulcanization
Rubber Chem Review, 26(11), 1997, p.15-17

377. SHAKER, Manal et al.
UHMW-PE fiber as reinforcing materials in EPDS rubber vulcanized by E-beam radiation.
Journal of Elastomers and Plastics, 27(2), 1995, p.117-137.

378. RAMSINGWANI, Rajesh
Sulphur: a vulcanizing agent
Rubber India, 47(11), 1995, p.13-14.

379. TAPLE, M and ISAYEV, A.I
Continuous ultrasonic devulcanization of unfilled NR vulcanizates.
Journal of Applied Polymer Science, 70(10), 1998, p.2007-19.

380. TUKACHINSKY, A et al.
Devulcanization of waste tyre rubber by powerful ultrasound
Rubber Chemistry and Technology, 69(1), 1996, p.92-103.

381. VAN DUIN, Martin and SOUPAHANTHONG, Aniko
The chemistry of phenol-formaldehyde resin vulcanization of EPDM. Pt.1. Evidence for methylene crosslinks.
Rubber Chemistry and Technology, 68(5), 1995, p.717-727.

382. VERSLOOT, P et al.
Sulfur vulcanization of simple model olefins: double bond isomerization during accelerated sulfur vulcanization as studied by model olefins.
Rubber Chemistry and Technology, 70(1), 1997, p.106-119.

383. VERSLOOT, P et al.
Sulfur vulcanization of simple model olefins: vulcanization of 2,3 dimethyl-2-butene in the presence of different metal complexes
Rubber Chemistry and Technology, 67(2), 1994, p.263-279.

384. VERSLOOT, P et al.
Sulfur vulcanization of simple model olefins: vulcanizations of 2,3-dimethyl-2-butene with TMTD and activated zinc dithiocarbamate/xanthate accelerator at different temperatures.
Rubber Chemistry and Technology, 68(4), 1995, p.563-572.

385. YUSHANOV, S.P
Ultrasonic devulcanization and percolation theories
Rubber Chemistry and Technology, 71(2), 1998,
p.168-190.

386. OTHMAN, A.B et al.
Stress relaxation behaviour of natural rubber
vulcanizates containing non-rubber constituents.
Journal of Natural Rubber Research, 11(3), 1996,
p.183.199.

387. PINGYUE, W
Effect of stearic acid level on tear and heat build-up of
natural rubber-based tread compounds.
Rubber Developments, 47(1/2), 1992, p.19-21.

388. POPOVIC, R.S et al.
The resolution of natural rubber (NR)/polydimethylsiloxane (MQ) binary blend properties by stress-strain
modeling.
Kautschuk Gummi Kunststoffe, 49(12), 1996,
p.826-830.

389. DIAS, A.J and GALUSKA, A.A
Curative migration in rubber compounds containing
brominated poly (isobutylene-co-4-methylstyrene)
Rubber Chemistry and Technology, 69(4), 1996,
p.615-627.

390. GORL, U et al.
Investigation of the influence of white fillers on the
formation of N-nitrosoamines in rubber compounds.
Kautschuk Gummi Kunststoffe, 47(6), 1994,
p.430-435.

391. GRAF, H.J
Applications, performance and mode of action of
promoters in rubber compounds.
Kautschuk Gummi Kunststoffe, 49(3), 1996,
p.210-218.

392. GRAF, H.J and KNORR, K
Accelerator systems for injection moulding compounds
International Polymer Science and Technology, 23(2), 1996, p.7-13.

393. HASHIM, A.S et al.
The effect of Bis (3-triethoxysilylpropyl) tetrasulfide on silica reinforcement of styrene-butadiene rubber.
Rubber Chemistry and Technology, 71(2), 1998, p.289-299.

394. MICHAELI, M and MEIERTOBERENS, U
The influence of clearance variation between the rotors of an internal mixer on the mixing process: an analysis performed on the laboratory internal mixer VIC 1.9 using a natural rubber compound.
Kautschuk Gummi Kunststoffe, 47(5), 1994, p.359-363.

395. NANDANAN, V et al.
Linseed oil as a multipurpose ingredient in NBR vulcanizate
Journal of Elastomers and Plastics, 28(4), 1996, p.326-334.

396. TERAKAWA, K et al.
Application of epoxidized NR/diamine vulcanizates for tyre tread.
Kautschuk Gummi Kunststoffe, 51(5), 1998, p.326-330.

397. ROUSE, Michael M
Applications of CRM in asphaltic materials
Rubber World, 212(2), 1995, p.23-29.

398. UNNIKRISHNAN, G et al.
Sorption and diffusion of aromatic hydrocarbons through filled natural rubber.
Polymer, 37(13), 1996, p.2687-93.

399. VAN DE WALLE, A et al.
Modeling carbon black reinforcement in rubber compounds.
Kautschuk Gummi Kunststoffe, 49(3), 1996, p.172-179.

400. WOLFF, W
Special carbon blacks for applications in mechanical rubber goods.
Kautschuk Gummi Kunststoffe, 49(7/8), 1996, p.488-494.

401. WOLFF, S et al.
Surface energy of fillers and its effect on rubber reinforcement.
Kautschuk Gummi Kunststoffe, 47(11), 1994, p.780-798.

402. WOLFF, S et al.
Surface energy of fillers and its effect on rubber reinforcement. Pt.2.
Kautschuk Gummi Kunststoffe, 47(12), 1994, p.873-884.

403. BISWAS, S.K
Rubber reclaiming: processing, control, growth
Rubber Chem Review, 23(8), 1994, p.23-26.

404. GANDHI, R.V
Reclaimed rubber: immense potential remains untapped
Rubber Asia, 8(3), 1994, p.51-54.

405. OSBORN, John D
Reclaimed tire rubber in TPE compounds
Rubber World, 212(1), 1995, p.34-35.

406. ABBATE, M et al.
Thermosetting bismaleimide/reactive rubber blends: curing kinetics and mechanical behaviour
Journal of Applied Polymer Science, 65(5), 1997, p.979-990.

407. ABDULLAH, I et al.
Blending of natural rubber with linear low-density polyethylene
Journal of Applied Polymer Science, 58(7), 1995, p.1125-34.

408. AHMAD, A et al.
Distribution of ester plasticisers between two rubber phases: estimation of partition coefficients and comparison with theory.
Journal of Natural Rubber Research, 10(1), 1995, p.1-13.

409. ARIRI AMRAEE, I et al.
Qualitative and quantitative analysis of SBR/BR blends by thermogravimetric analysis
Rubber Chemistry and Technology, 69(1), 1996, p.130-136.

410. ASALETHA, R et al.
The technological compatibilization of natural rubber/polystyrene blends by the addition of natural rubber-graft-polystyrene.
Rubber Chemistry and Technology, 68(4), 1995, p.671-687.

411. BANDYOPADHYAY, G.G et al.
Viscoelastic behaviour of NBR/EVA polymer blends: application of models
Rubber Chemistry and Technology, 70(4), 1998, p.650-662.

412. BENSASON, S et al.
Damage zone in PVC and PVc/MBs blends.1. The effect of rubber content and temperature.
Journal of Applied Polymer Science, 63(6), 1997, p.703-713.

413. BENSASON, S et al.
Damage zone in PVC and PVC/MBS blends. II. Analysis of the stress-whitened zone.
Journal of Applied Polymer Science, 63(6), 1997, p.715-723.

414. BHOWMICK, A.K
Influence of international on the properties of rubber-rubber and rubber-plastics blends.
Rubber Chem Review, 25(10), 1996, p.19-27.

415. BISWAS, T et al.
Thiophosphoryl disulfides: novel coupling agents for styrene-butadiene rubber/carboxylated nitrile rubber blends
Journal of Applied Polymer Science, 58(6), 1995, p.981-995.

416. BLOM, H.P et al.
IPP/HDPE blends: interactions at lower HDPE contents
Journal of Applied Polymer Science, 58(6), 1995, p.995-1006.

417. BROWN, P.S and TINKER, A.J
Effect of modifying EPDM on the crosslink distribution in NR/EPDM blends
Journal of Natural Rubber Research, 11(4), 1996, p.227-239.

418. BROWN, P.S and TINKER A.J
High damping NR/epoxidised NR blends
Journal of Natural Rubber Research, 12(2), 1997, p.90-101.

419. BUSSI, P and ISHIDA, H
Partially miscible blends of epoxy resin and epoxidised rubber: structural characterisation of the epoxidised rubber and mechanical properties of the blends.
Journal of Applied Polymer Science, 53(4), 1994, p.441-454.

420. CARRIERE, C.J and SILVIS, H.C
The effects of short-chain branching and comonomer type on the interfacial tension of polypropylene-polyolefin elastomer blends.
Journal of Applied Polymer Science, 66(6), 1997, p.1170-1181.

421. CHAKRABORTHY, S.K and SETH, D
Studies on blends of high styrene resin master batch (synaprene-1958) and natural rubber.
Rubber Chem Review, 27(5), 1998, p.17-20.

422. COOK, J.W et al.
Thermal behaviour of natural rubber and chlorinated rubber blends.
Journal of Applied Polymer Science, 65(7), 1997, p.1379-84.

423. COOK, W.D et al.
Morphology-property relationships in ABS/PET blends. II. Influence of processing conditions on structure and properties
Journal of Applied Polymer Science, 62(10), 1996, p.1709-14.

424. COOK, W.D
Morphology-property relationships in ABS/PET blends 1. Compositional effects
Journal of Applied Polymer Science, 62(10), 1996, p.1699-1708.

425. CORAN, A.Y et al.
The phase morphology of rubber/plastic blends.
Kautschuk Gummi Kunststoffe, 51(5), 1998, p.342-347.

426. CUDBY, Paul E.F and GILBERY, Barry A
Scanning transmission imaging of elastomer blends using an unmodified conventional scanning electron microscope.
Rubber Chemistry and Technology, 68(2), 1995, p.342-350.

427. DAS, G and BANERJEE, A.N
Role of methods of blending on polymer-polymer compatibility
Journal of Applied Polymer Science, 61(9), 1996, p.1473-1476.

428. DUTTA, S.P et al.
Ionic elastomer blends of zinc salts of maleated EPDM rubber and carboxylated nitrile rubber
Journal of Applied Polymer Science, 69(1), 1998, p.153-160.

429. FUJITA, M
Miscibility between natural rubber and tackifiers: phase diagrams of the blends of natural rubber and petroleum resins
Journal of Applied Polymer Science, 67(2), 1998, p.221-229.

430. GROVES, S.A and TINKER, A.J
Distribution of crosslinks between the phases of vulcanized natural rubber/cis-poly (butadiene) blends.
Journal of Natural Rubber Research, 11(3), 1996, p.125-148.

431. HUANG, Y.H et al.
Studies on the blends of carbon dioxide copolymer: NBR/PPC system.
Journal of Applied Polymer Science, 61(9), 1996, p.1479-86.

432. IBAR, J.P
Control of performance of polymers and their blends through melt vibration technology: critical review
Progress in Rubber and Plastics Technology, 13(1), 1997, p.17-25.

433. ISHIAKU, U.S et al.
Thermo-oxidative ageing of poly(vinyl chloride) based thermoplastic elastomers
Kautschuk Gummi Kunststoffe, 50(4), 1997, p.292-298.

434. JANSEN, P et al.
The use of EVA-containing mercapto groups in natural rubber-EVA blends. II. The effect of curing system on mechanical and thermal properties of the blends.
Journal of Applied Polymer Science, 61(4), 1996, p.591-598.

435. JANSEN, P and SOARES, B.G
Effect of compatibiliser and curing system on the thermal degradation of natural rubber/EVA copolymer blends.
Polymer Degardation and Stability, 52(1), 1996, p.95-99.

436. KANNAN, S et al.
Structure-property relationship of blends of ethylene-co-vinyl acelate and epoxidised natural rubber
Journal of Elastomers and Plastics, 27(3), 1995.
P.268-280.

437. KAZUO, Naito et al.
Studies on oil distribution in polymer blends
Journal of Applied Polymer Science, 61(5), 1996,
p.755-762.

438. KIDA, N et al.
Studies on the structure and formation mechanism of carbon gel in the carbon black filled polyisoprene rubber composite.
Journal of Applied Polymer Science, 61(8), 1996,
p.1345-50

439. KIM, J.K
Effect of blending thermoplastic elastomer with natural rubber compound and studies of short fiber reinforced rubber composite.
Journal of Applied Polymer Science, 61(3), 1996,
p.431-438.

440. KIM, B.K and DO, I.H
Effect of viscosity ratio, rubber composition, and peroxide/coagent treatment in PP/EPR blends.
Journal of Applied Polymer Science, 61(3), 1996,
p.439-447.

441. KOLE, S et al.
Influence of the nature of diene in EPDM rubbers on the properties of silicone-EPDM blends.
Kautschuk Gummi Kunststoffe, 47(12), 1994,
p.910-913.

442. LUO, T and ISAYEV, A.I
Rubber/plastic blends based on devulcanized group tire rubber.
Journal of Elastomers and Plastics, 30(2), 1998,
p.133-160.

443. MALLICK, A et al.
Effect of HAF carbon black filler or chemorheological behaviour of poly (acrylic acid): epoxidised natural rubber blends.
Journal of Applied Polymer Science, 65(1), 1997, p.135-142.

444. MALLICK, A and GUPTA, B.R
Effect of mixing time on filler-matrix interactions in polyacrylic acid, epoxidised natural rubber and carbon black composites.
Journal of Elastomers and Plastics, 29(3), 1997, p.239-261.

445. OSHINSKI, A.J et al.
The effect of polyamide end-group configuration on morphology and toughness of blends with maleated elastomers.
Journal of Applied Polymer Science, 61(4), 1996, p.623-640.

446. PETROVIC, Z.S et al.
Effect of addition of polyethylene on properties of polypropylene/ethylene-propylene rubber blends.
Journal of Applied Polymer Science, 59(2), 1996, p.301-310.

447. POH, B.T and WONG, K.W
Effect of blend ratio on mooney scorch time of rubber blends
Journal of Applied Polymer Science, 69(7), 1998, p.1301-05.

448. POPOVIC, R.S et al.
Mechanical properties, crosslink density and surface morphology of SBR/silicone rubber blends.
Kautschuk Gummi Kunststoffe, 50(12), 1997, p.861-867.

449. RADUSCH, H.J and MERSEBURG, T.P
Morphology formation in dynamic vulcanized PP/EPDM blends
Kautschuk Gummi Kunststoffe, 49(4), 1996, p.249-257.

450. RAHMAN, H.A et al.
Influence of phase morphology on the properties of natural rubber and epoxidised natural rubber blends
Journal of Natural Rubber Research, 9(4), 1994, p.213-225.

451. ROY, S.K Singha and DAS, C.K
Speciality polyblend system of carboxylated nitrile rubber and polyacrylic rubber
Journal of Elastomers and Plastics, 27(3), 1995, p.239-252.

452. ROZMAN, H.D et al.
Rubberwood-polymer composites based on glycidyl methacrylate and diallyl phthalate blends
Journal of Applied Polymer Science, 67(7), 1998, p.1221-26.

453. SANKARAPANDIAN, M and KISHORE, K
Comparison of the miscibility strategies in poly(benzyl methacrylate)-polystyrene blends.
Journal of Applied Polymer Science, 61(3), 1996, p.507-511.

454. SIDDARAMAIAH and ROOPA, S
Sorption and diffusion of alkanes into natural rubber blends.
Journal of Polymer Materials, 15(1), 1998, p.31-37.

455. SIDDARAMAIAH et al.
Sorption and diffusion of aldehydes and ketones into natural rubber blends.

456. THOMAS, G.V and GOPINATHAN NAIR, M.R
Viscosity behaviour of PVC-modified liquid natural rubber blends.
Journal of Applied Polymer Science, 62(13), 1996, p.2229-36.

457. TRIPATHY, A.R and DAS, C.K
Effect of blending on the dispersion and flow behaviour of carbon black filled NBR and chlorosulphonated polyethylene rubber
Kautschuk Gummi Kunststoffe, 48(11), 1995, p.788-792.

458. TRIPATHY, A.R and DAS C.K
Interchain crosslinking between NBR and Thiokol rubber and its effect on processability and structure-property relations of blends.
Plastics, Rubber and Composites: Processing and Applications, 21(5), 1994, p.283-290.

459. TSAI, C.H and CHANG, F.C
Polymer blends of PBT and PP compatibilized by ethylene-co-glycidyl methacrylate copolymers
Journal of Applied Polymer Science, 61(2), 1996, p.321-332.

460. VAINIO, T et al.
Functionalized polypropylene prepared by melt free radical grafting of low volatile oxazoline and its potential in compatibilization of PP/PBT blends.
Journal of Applied Polymer Science, 61(5), 1996, p.843-852.

461. VARKEY, J.T et al.
Flow behaviour of natural rubber/epoxidised natural rubber-latex blends.
Polymer Plastics Technology Engineering, 35(1), 1996, p.1-11.

462. VILGIS, T.A and HEINRICH, S
Crosslinked polymer blends: theoretical problems from rubber physics to technology.

463. VINOD, V.S et al.
Effect of adhesion on the equilibrium swelling of natural rubber-aluminium powder composites.
Journal of Applied Polymer Science, 70(12), 1998, p.2427-38.

464. WANG, Shengjie et al.
Study on nitrile-butadiene rubber/poly (propylene carbonate) elastomer as coupling agent of poly (vinyl chloride)/poly (propylene carbonate) blends: effect on mechanical properties of blends.
Journal of Applied Polymer Science, 63(9), 1997, p.1107-1111.

465. WEFRINGHAUS, R and GRUBER, W
Water based rubber to metal bonding agents.
Kautschuk Gummi Kunststoffe, 48(10), 1995, p.729-734.

466. YOON, J.R et al.
Blends of brominated EPDM and NR.
Rubber World, 213(4), 1996, p.20-24.

467. ZACHARIA OOMMEN and THOMAS, S
Mechanical properties and failure mode of thermoplastic elastomers from natural rubber/poly (methyl methacrylate)/natural rubber-g-poly(methyl methacrylate) blends
Journal of Applied Polymer Science, 65(70), 1997, p.1245-55

468. ABOUTORABI, H et al.
Crack growth in twisted rubber disks. Pt.1.Fracture energy calculations.
Rubber Chemistry and Technology, 71(1), 1998, p.76-83.

469. AZEMI BIN SAMSURI
Tearing of unvulcanized black-filled natural rubber
Journal of Natural Rubber Research, 10(3), 1995, p.170-181.

470. CHARLTON, D.J and TEH, K.K
Athermo-mechanical FEA for rubber components
Plastics, Rubber and Composites: Processing and Applications, 23(3), 1995, p.185-192.

471. KAANG, Shinyoung et al.
Some physical characteristics of double-networked natural rubber.
Journal of Applied Polymer Science, 65(5), 1997, p.917-924.

472. KASNER, A.I and MEINECKE, E.A
Effect of porosity on mechanical properties of rubber
Rubber Chemistry and Technology, 68(2), 1995, p.219-229.

473. KIM, J.W et al.
Preparation and physical properties of rubber-modified epoxy resin using poly (urethane acrylate)/poly (glycidyl methacrylate-co-acrylonitrile) core-shell composite particles
Journal of Applied Polymer Science, 63(12), 1997, p.1589-1600.

474. KONAR, Bidyut Baran
A kinetic and rheometric investigation of hexamethylo melamine derivative on the cure of natural rubber compounds.
Journal of Applied Polymer Science, 63(2), 1997, p.233-237.

475. LEE C.F et al.
Morphology, thermal property and mechanical property of core-shell latex polymers: effect of heating and pressuring on PBA/PS linear composite polymer.
Journal of Applied Polymer Science, 69(1), 1998, p.13-23.

476. MARIANI, M.C
An improvement in the determination of thermal properties of elastomeric compounds
Kautschuk Gummi Kunststoffe, 50(1), 1997, p.39-42.

477. NAIR, N.R et al.
Flow properties of thermally depolymerized liquid naturl rubber
Journal of Applied Polymer Science, 55(5), 1995, p.723-732.

478. NAIR, M.M and COHEN, Robert E
Mechanical properties of blends of crystallizable polybutadienes containing amorphous polybutadiene diblock copolymers
Rubber Chemistry and Technology, 67(2), 1994, p.342-347.

479. OKEL, Timothy A and WADDELL, Walter H
Effect of precipitated silica physical properties on silicone rubber performance
Rubber Chemistry and Technology, 68(1), 1995, p.59-76.

480. OKIEIMEN, F.E and ALIGBODION, A.I
Estimation of dilute solution viscosity parameters of rubber seed oil alkyds.
Journal of Applied Polymer Science, 67(12), 1998, p.1987-92.

481. SANTANGELO, P.G and ROLAND, C.M
The mechanical behaviour of double network elastomers
Rubber Chemistry and Technology, 67(2), 1994, p.359-365.

482. WANG, M.J et al.
Carbon-silica dual phase filler, a new generation reinforcing agent for rubber: characterization.
Kautschuk Gummi Kunststoffe, 51(5), 1998, p.348-363.

483. YOON, J.R et al.
Effect of bromination on the properties of ethylene-propylene diene rubber in the presence of divinylbenzene.
Rubber Chemistry and Technology, 68(5), 1995, p.824-835.

484. ABD-EL-MESSIEH, S.L and YOUNAN, A.F
Dielectric relaxation and mechanical properties of natural and chloroprene rubber with some nitroaniline additives.
Journal of Applied Polymer Science, 62(5), 1996, p.805-812.

485. AHMADI, H.R and MUHR, A.H
Modelling dynamic properties of filled rubber
Plastics, Rubber and Composites: Processing and Applications, 26(10), 1997, p.451-461.

486. BANDYOPADHYAY, S et al.
Role of rubber-filler bonding on low strain dynamic properties of carboxylated nitrile rubber-carbon black system.
Kautschuk Gummi Kunststoffe, 49(2), 1996, p.115-119.

487. BHOWMICK, A.K and JHA, A
Influence of level of interaction on the mechanical and dynamic mechanical properties of thermoplastic elastomers.
Journal of Natural Rubber Research, 12(4), 1997, p.215-222.

488. BORTOLOTTI, M et al.
Dynamic properties of batch polymerized SSBR based compounds.
Kautschuk Gummi Kunststoffe, 51(5), 1998, p.331-335.

489. DICK, John S and PAWLOWSKI, A
Application of a new dynamic mechanical rheological tester in measuring carbon black and oil effects on rubber compound properties.
Journal of Elastomers and Plastics, 27(1), 1995, p.11-38.

490. GOODCHILD, I.R and POND T.J
Effect of aerobic ageing at elevated temperatures on dynamic mechanical properties of certain natural rubber vulcanisates.
Journal of Natural Rubber Research, 12(1), 1997, p.1-10.

491. HANHI, K and STENBERG, B
Friction and the dynamic mechanical and thermal properties of polyurethane elastomers: microcellular polyurethanes.
Progress in Rubber and Plastics Technology, 10(1), 1994, p.54-78.

492. LEBLANC, J.L
Dynamic strain methods to probe the morphology of uncured rubber compounds.
Kautschuk Gummi Kunststoffe, 49(4), 1996, p.258-267.

493. LUO, D.Z
Evaluating dynamic properties of polymeric isolators.
Rubber World, 214(2), 1996, p.21-24.

494. MALLICK, A et al.
Thermally induced crosslinking between polyacrylic acid and epoxidised natural rubber: effect of carbon black filler on strain dependent dynamic mechanical properties.
Rubber Chemistry and Technology, 67(5), 1994, p.845-853.

495. MANDAL, U.K and TRIPATHY, D.K
Dynamic mechanical properties of an ionic elastomer based on carboxylated nitrile rubber: effect of calcium carbonate and clay.
Kautschuk Gummi Kunststoffe, 50(9), 1997, p.630-633.

496. MANDAL, U.K et al.
Dynamic mechanical spectroscopic studies on plasticization of an ionic elastomer based on carboxylated nitrile rubber
Polymer, 37(15), 1996, p.3437-40.

497. MATTEO, C.L et al.
Dynamic mechanical properties of a NR/BR blend at different cure levels.
Kautschuk Gummi Kunststoffe, 48(3), 1995, p.166-172.

498. SCHAEFER, Ronald J
Dynamic properties of rubber
Rubber World, 212(1), 1995, p.22-24.

492. LEBLANC, J.L
Dynamic strain methods to probe the morphology of uncured rubber compounds.
Kautschuk Gummi Kunststoffe, 49(4), 1996, p.258-267.

493. LUO, D.Z
Evaluating dynamic properties of polymeric isolators.
Rubber World, 214(2), 1996, p.21-24.

494. MALLICK, A et al.
Thermally induced crosslinking between polyacrylic acid and epoxidised natural rubber: effect of carbon black filler on strain dependent dynamic mechanical properties.
Rubber Chemistry and Technology, 67(5), 1994, p.845-853.

495. MANDAL, U.K and TRIPATHY, D.K
Dynamic mechanical properties of an ionic elastomer based on carboxylated nitrile rubber: effect of calcium carbonate and clay.
Kautschuk Gummi Kunststoffe, 50(9), 1997, p.630-633.

496. MANDAL, U.K et al.
Dynamic mechanical spectroscopic studies on plasticization of an ionic elastomer based on carboxylated nitrile rubber
Polymer, 37(15), 1996, p.3437-40.

497. MATTEO, C.L et al.
Dynamic mechanical properties of a NR/BR blend at different cure levels.
Kautschuk Gummi Kunststoffe, 48(3), 1995, p.166-172.

498. SCHAEFER, Ronald J
Dynamic properties of rubber
Rubber World, 212(1), 1995, p.22-24.

499. SUGIYA, M et al
Dynamic mechanical properties and morphology of silica-reinforced butadiene rubber by the sol-gel process
Kautschuk Gummi Kunststoffe, 50(7/8), 1997, p.538-543.

500. YOUNAN, A.F et al.
Electrical and mechanical properties of ethylene propylene diene monomer-chloroprene rubber blend loaded with white and black filters.
Journal of Polymeric Materials, 15(1), 1998, p.73-80.