

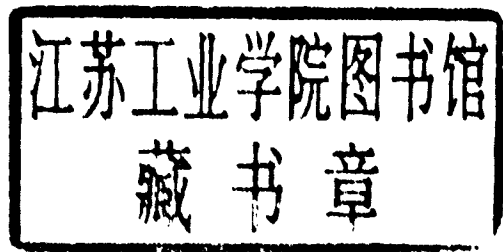
**Hofmann**

# **Rubber Technology Handbook**



**Werner Hofmann**

# **Rubber Technology Handbook**



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Hofmann  
Rubber Technology Handbook

## Preface

The rubber industry, though ranking among the “old established” industries, which are generally held to be conservative, has shown a markedly progressive development over the last decades. Developments in the field of synthetic elastomers have progressed so rapidly that the whole concept of rubber technology has changed. In other fields, rubber technology has expanded greatly.

Although numerous monographs have been written about partial aspects of rubber technology, I know of no modern textbook that treats all fields equally. 25 or more years have passed since the publication of earlier textbooks. A variety of new rubber types, rubber chemicals, processing technologies, analytical techniques and test methods have been developed or improved on since then. Many old concepts have had to be modified in the face of new discoveries, or even completely abandoned and replaced with new ones. The previous exact definitions of rubber and elastomer terminology have become progressively more ambiguous since the boundaries between elastomers and thermoplastics and between elastomers and thermoset materials have broken down. New structural modifications have enabled rubbers to penetrate into previously inconceivable border areas.

The time therefore seems to have come to collect the experience in the field of rubber technology. Two procedures are in principle possible for this, each with its advantages and disadvantages. One is for the author to act essentially as editor, coordinating the sections written individually by experts. This method has the advantages of depth of information and topicality, but the disadvantages of uneven structuring, overlap, repetition, etc. The other possibility is for a single author to conceive the entire work himself. This has the advantage that the structure is a unified whole, all individual aspects are interlinked by cross-references, and a uniform bibliography can be drawn up; the disadvantage of this method is that no author can have specialist knowledge in all fields equal to that of the sum of the experts. Despite this disadvantage, I have chosen the second method. To overcome the stated disadvantage of a non-uniform depth of information across the different areas, I have laid special importance on comprehensive bibliographies.

In addition to complete descriptions, these bibliographies, extending to over 2500 literature references, provide, monographs, current publications, lecture topics and important patents. As far as is necessary and feasible, each major bibliographic section has been subdivided into literature that provides a general survey and the special literature that is quoted in the text. The main importance of the bibliographies for the reader should be the possibility of quick reference to more advanced literature for practically any topic of rubber technology. I have therefore paid particular attention to preparing them. During the two years of compiling this book, I have included the most important new literature sources in the already indexed bibliography, so that the literature is largely up to date as far as 1987/88.

This method allowed me, and this was my first priority, to describe all the partial aspects of rubber technology concisely and with a uniform subdivision. This made it possible to deal with and present all areas in one handy volume. The publication of this English-language international edition was encouraged by a positive review of an earlier German-language edition in *Rubber Chem. Technol.* **55** (1982), whose last sentence read “An English-language version would be of great value”.

The book is subdivided into the following sections: Definition (9 pages); Natural rubber (25 pages), which because of its special means of manufacture and importance is treated separately; the large chapter “Synthetic Rubber” (179 pages), which

is subdivided into over 20 sections describing the individual rubber classes, and includes the section on thermoplastic elastomers, which in turn includes numerous sections for all important classes of materials; the large chapter "Rubber Chemicals and Additives" (136 pages), also with numerous subsections for all important classes of materials; the chapter on processing technology (113 pages) and on testing and analysis (37 pages), which each describe all the essential problems and techniques in a brief space. To increase the value of the new book as a reference work I have compiled a trade marks index based on the documents accessible to me.

This work is founded on my postdoctoral thesis on "Rubber Technology" at the Technical University of Rheinland-Westphalia in Aachen, which was intended as duplicated lecture notes to help my students in approaching this field. My thanks to Bayer AG for the opportunity of preparing these manuscripts. Main emphasis in these manuscripts was placed on an understanding of the materials and a knowledge of the processing technology. Through my innumerable publications (books, book sections, papers in encyclopedias, and technical papers) on the most varied aspects of rubber technology over the 35 years of my professional life, and my cooperation with numerous companies in the supply industry and in rubber manufacturing, I have had to read so much technical literature and have collected so much information on the most varied specific fields, that it was time to prepare an all-embracing unified work form the previous manuscripts. In doing this I have attempted strict neutrality as regards companies.

A book of this kind cannot and does not try to be a substitute for personal experience; rather it should, on the one hand, be a textbook to help the emerging generation of rubber technologists obtain a rapid grasp of this material. On the other hand it should aid the experienced user as a reference book for various topics, and permit rapid access to the original literature. If it has succeeded in this, then the attempt to create a comprehensive description of rubber technology has been worthwhile.

I have received much help in conceiving this manuscript, for which I would like to use this opportunity to give my heartfelt thanks. The following persons helped me by conceiving, updating or correcting the individual sections: *Mr. Stagracziński* (Weber und Schär, Hamburg), and *Dr. Klinkhammer* (D.O.G. Hamburg), in correcting and updating the chapter "Natural Rubber", *Mr. Hübsch* and *Mr. Heiling* (Du Pont, Bad Homburg), as well as other employees of this company for checking and supplementing various sections on elastomers that concerned Du Pont; *Mr. Grigat* (Cabot, Hanau) for checking and updating the chapter "Fillers"; *Dr. Graf* (Klößner-Ferromatik-Desma, Achim) for updating and supplementing the chapter "Injection Molding", and the supply of graphic materials; *Mr. Cappelle*, (Berstorff, Hannover), *Mr. Koch* (Werner & Pfleiderer, Stuttgart), *Dr. Küttner* (Speyer) and *Dr. Targiel* (Troester, Hannover) for correcting parts of the manuscript on "Process Technology" and providing graphic material; *Dr. Seeberger* (Akzo Chemie, Düren), and *Mrs. Wülfsken* (D.O.G., Hamburg) for correcting and supplementing the "Trade Marks Index". I thank *Dr. Bauer* (Dunlop, Mississauga, Canada) for his expert translation of Chapters 1-3 and *Prof. Dr. Meinecke* (University of Akron, USA) for his expert translation of Chapters 4-6; *Mrs. Gertrud Wülfsken* (D.O.G. Hamburg) for her help with the proofreading, Clouth, Cologne, for the opportunity to use their library, D.O.G., Hamburg, for the realization of this work. Finally I thank my daughter *Regine* for her help in preparing the Trade Names Index, and, last but not least, my wife *Ruth* for her tireless patience with me during the drafting of this work.

# Buyer's Guide

Materials, equipment and services for the rubber and ancillary industries. All entries are paid for by and are the responsibility of the companies concerned. No claim is made as to the completeness of the index and the editor assumes no responsibility for omissions or errors.

<b>Group 1: Natural rubber</b> . . . . .	<b>BG 1</b>
<b>Group 2: Synthetic rubber</b> . . . . .	<b>BG 2</b>
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<b>Group 7: Laboratory equipment</b> . . . . .	<b>BG 15</b>

Further details from

Hanser Publishers, P.O.B. 860420, D-8000 München 86, FRG.

## Group 1: Natural Rubber

### Chem. modified natural rubber

Nordmann, Rassmann GmbH & Co.  
Kajen 2, D-2000 Hamburg 11  
T. 040/3687-0, Tx. 211122+212087  
Fax. /3687-249, T# : nordrascos

### Modified hevea natural rubber

Nordmann, Rassmann GmbH & Co.  
Kajen 2, D-2000 Hamburg 11  
T. 040/3687-0, Tx. 211122+212087  
Fax. /3687-249, T# : nordrascos

### Non-classified or -specified natural rubber

Nordmann, Rassmann GmbH & Co.  
Kajen 2, D-2000 Hamburg 11  
T. 040/3687-0, Tx. 211122+212087  
Fax. /3687-249, T# : nordrascos

### Techn. classified or specified natural rubber

Nordmann, Rassmann GmbH & Co.  
Kajen 2, D-2000 Hamburg 11  
T. 040/3687-0, Tx. 211122+212087  
Fax. /3687-249, T# : nordrascos

## Group 2: Synthetic Rubber

### Elastomer

#### **Acrylonitrile-butadiene elastomer, NBR**

BFGoodrich Chemical  
Görlitzer Str. 1, D-4040 Neuss  
Tel. 02101/18050

#### **Acrylate-based elastomer, ACM, EAM**

BFGoodrich Chemical  
Görlitzer Str. 1, D-4040 Neuss  
Tel. 02101/18050

#### **Epichlorohydrin elastomer, CIO, ECO, ETER**

BFGoodrich Chemical  
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Tel. 02101/18050

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DSM Marketing and Sales  
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6130 AA Sittard, Netherlands  
Tel. 04490/69222, Telex 36775  
Fax. 04490/63853  
Keltan

Bunawerke Hüls GmbH  
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Fluorine containing elastomers  
FLUOREL™ Fluorelastomers

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Tlx. 529 121 56  
Elastosil®, Wacker HDK®

### *Elastomer (cont.)*

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Tel. 04490/69222, Telex 36775  
Fax. 04490/63853  
Kelprox

Hüls AG  
Referat 1122/RTH  
D-4370 Marl

Monsanto Europe S.A., Brussels  
Avenue de Tervuren 270  
Tel. 32-2-761.41.11, Tx. 62927  
Santoprene®

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Fax. 04490/63853  
Kelrinal

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05980-17911/77246/05980-90437



**Rubber compounds**

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compounds, P.O. Box 257  
NL-8200 AG Lelystad - Holland  
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Tlx. 47410  
Fax. (0)3200-49170

**Trans-Polyoctenamer**

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D-4370 Marl

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**Benzothiazole accelerators**

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Ethasan, Methasan  
Rhein-Chemie Rheinau GmbH  
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D-6800 Mannheim 81  
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Schering Ind. Chemicals  
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**Aromatic polyethers**

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Telefax 05321/681-29

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D-4370 Marl

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Rhein-Chemie Rheinau GmbH  
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D-6800 Mannheim 81  
Tel. 0621/890 70, Tx. 4 62282

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Mount Pleasant House  
Huntingdon Rd., Cambridge, UK  
Tel. 0223/323222, Tx. 8 1654  
GENITRON

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Croxton & Garry Ltd.  
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Fax. 0306/887780  
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HOESCHALIN 821

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T. 040/733501-0, Fax. /7335094  
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Tel. 08221/980, Tx. 531121

Peroxid-Chemie GmbH  
D-8023 Höllriegelskreuth  
T. 089/7279-0. Tx. 523482 pcm

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PF 110533, D-6000 Frankfurt 11  
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Fax. /218-3218, TTX 69917 = DGHV  
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methacrylate (BDMA), Ethylene-  
glycoldimethacrylate (EDMA),  
Triethyleneglycoldimethacrylate  
(TEDMA), Trimethylolpropantri-  
methacrylate (TRIM)

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Tx. 8591839, Tel. 0202/81046

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Tx. 212164, Fax. 040/3192748

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Tx. 643746 fuh, Fax. 09281/66951

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Fax. /3687-249, T # : nordrascos

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Tx. 643746 fuh, Fax. 09281/66951

**Calcites**

Ulmer Füllstoff Vertrieb GmbH  
PF 1126, D-7906 Blaustein  
Tel. 07304/8171, Tx. 712464

**Fibers**

Monsanto Europe S.A., Brussels  
Avenue de Tervuren 270  
Tel. 32-2-761.41.11, Tx. 62927  
Santoweb®

Schwarzwälder Textil-Werke  
Heinrich Kautzmann GmbH  
D-7623 Schenkenzell  
Tel. 07836/2031, Tlx. 7525612

*Fillers (cont.)***Silica**

Degussa AG  
 GB Anorganische Chemieprodukte  
 PF 11 0533, D-6000 Frankfurt 11  
 T. 069/218-01, Tx. 412220 dg d  
 Fax. /218-3218, TTX 69917 = DGHV

**Silicates**

Degussa AG  
 GB Anorganische Chemieprodukte  
 PF 11 0533, D-6000 Frankfurt 11  
 T. 069/218-01, Tx. 412220 dg d  
 Fax. /218-3218, TTX 69917 = DGHV

Hoffmann Mineral  
 Franz Hoffmann & Söhne KG  
 Münchener Str. 75  
 D-8858 Neuburg (Donau)  
 Tx. 55214-18  
 T.08431/53-1, Fax. 08431/53-330

**Talcum**

Scheruhn Talkum-Bergbau  
 POB 1329, D-8670 Hof/Saale  
 Tx. 643746 fuh, Fax. 09281/66951

**Other fillers**

Wacker-Chemie GmbH  
 D-8000 München 22  
 Tel. (089) 2109-0  
 Tlx. 529121 56  
 Elastosil®, Wacker HDK®

**Finishing agents**

Hans W. Barbe  
 Chemische Erzeugnisse GmbH  
 PF 130223, D-6200 Wiesbaden 13  
 T. 06121/22081, Tx. 4186470 hwb d  
 PROMOL

**Flame retardants**

Martinswerk GmbH  
 PF 1209, D-5010 Bergheim  
 Tel. 02271/9020, Tx. 888712  
 MARTINAL®

Nordmann, Rassmann GmbH & Co.  
 Kajen 2, D-2000 Hamburg 11  
 T. 040/3687-0, Tx. 211122 + 212087  
 Fax. /3687-249, T #: nordrascos

*Flame retardants (cont.)*

NORIMPEX A/S, Hochdählerstr. 16  
 D-4000 Düsseldorf  
 T. 0211/292505, Tx. 8587955  
 Zinborate

Rhein-Chemie Rheinau GmbH  
 Mülheimer Str. 24-28  
 D-6800 Mannheim 81  
 Tel. 0621/89070, Tx. 462282

VAW Vereinigte  
 Alumium-Werke AG  
 Sparte Spezialoxide  
 P.O.B. 1860, D-8460 Schwandorf  
 Tel. 09431/53-461, Tx. 65341  
 "Apyral®"

**Homogenizers**

D.O.G. Deutsche Oelfabrik  
 P.B. 111929, D-2000 Hamburg  
 Tx. 212164, Fax. 040/3192748

**Initiators, hydroperoxide**

Hüls AG  
 Referat 1122/RTH  
 D-4370 Marl

**Lead compounds, elastomer bound**

Croxtan & Garry Ltd.  
 Curtis Road  
 GB Dorking, Surrey RH4 1XA  
 Tel. 0306/886688, Tx. 859567  
 Fax. 0306/887780  
 MULTISPERSE

**Lubricating agents**

Hans W. Barbe  
 Chemische Erzeugnisse GmbH  
 PF 130223, D-6200 Wiesbaden 13  
 T. 06121/22081, Tx. 4186470 hwb d  
 PROMOL

**Mastication and regeneration aids**

D.O.G. Deutsche Oelfabrik  
 P.B. 111929, D-2000 Hamburg  
 Tx. 212164, Fax. 040/3192748

Rhein-Chemie Rheinau GmbH  
 Mülheimer Str. 24-28  
 D-6800 Mannheim 81  
 Tel. 0621/89070, Tx. 462282

*Mastication and regeneration aids (cont.)*

Schill & Seilacher (GmbH & Co.)  
Moorfleeter Straße 28  
D-2000 Hamburg 74, Tx. 212932  
T. 040/73 3501-0, Fax. /733 5094  
"Struktol®"

**Mold lubricants**

Hans W. Barbe  
Chemische Erzeugnisse GmbH  
PF 13 0223, D-6200 Wiesbaden 13  
T. 06121/22081, Tx. 4186470 hwb d  
PROMOL

**Phenolic resins/compounds**

N. V. Occidental Chemical SA  
Av. Louise 222, B-1050 Brussels  
Tel. (2)6 48 56 35, Tx. 23 046  
DUREZ® Tackifier and reinforcing  
resins

**Pigments**

**colored**

Julius Hoesch GmbH & Co. KG  
PF 100855, D-5160 Düren  
Tel. 02421/83081, FS 833 896

**white**

Julius Hoesch GmbH & Co. KG  
PF 100855, D-5160 Düren  
Tel. 02421/83081, FS 833 896

**Plasticizers**

**Adipates**

Kettlitz-Chemie GmbH & Co. KG  
POB 80, D-8859 Rennertshofen  
Tlx. 55237, Fax. 08434/719

Unichema Chemie GmbH  
P.O. Box 1280, D-4240 Emmerich  
Tel. 02822/720, Tlx. 8125 113  
Fax. 02822/72276  
PRIPLAST

**Ester plasticizers**

Schill & Seilacher (GmbH & Co.)  
Moorfleeter Straße 28  
D-2000 Hamburg 74, Tx. 212932  
T. 040/73 3501-0, Fax. /733 5094  
"Struktol®"

Unichema Chemie GmbH  
P.O. Box 1280, D-4240 Emmerich  
Tel. 02822/720, Tlx. 8125 113  
Fax. 02822/72276  
PRIPLAST

*Plasticizers (cont.)*

**Naphthenic mineral oil plasticizer**

Nynäs GmbH  
Immermannstraße 65a  
D-4000 Düsseldorf 1, BRD  
Tel. 0211/352046, Tx. 8586352  
Nynäs Naphthenics AB  
P.O. Box 78 56  
S-10399 Stockholm, Schweden  
Tel. 08/7885030, Tx. 19042  
NYFLEX 800, 810, 820, 220  
NYTEX 800, 810, 820, 830  
NYTENE 800, 810, 830, 230

**Phosphates**

Monsanto Europe S.A., Brussels  
Avenue de Tervuren 270  
Tel. 32-2-761.41.11, Tx. 62927  
Santicizer®

**Phthalates**

Julius Hoesch GmbH & Co. KG  
PF 100855, D-5160 Düren  
Tel. 02421/83081, FS 833 896

Monsanto Europe S.A., Brussels  
Avenue de Tervuren 270  
Tel. 32-2-761.41.11, Tx. 62927  
Santicizer®

**Other plasticizers**

Kettlitz-Chemie GmbH & Co. KG  
POB 80, D-8859 Rennertshofen  
Tlx. 55237, Fax. 08434/719

Monsanto Europe S.A., Brussels  
Avenue de Tervuren 270  
Tel. 32-2-761.41.11, Tx. 62927  
Santicizer®

Unichema Chemie GmbH  
P.O. Box 1280, D-4240 Emmerich  
Tel. 02822/720, Tlx. 8125 113  
Fax. 02822/72276  
PRIPLAST

**Processing aids**

**Fatty acids**

Rhein-Chemie Rheinau GmbH  
Mülheimer Str. 24-28  
D-6800 Mannheim 81  
Tel. 0621/89070, Tx. 462282

*Processing aids (cont.)*

Unichema Chemie GmbH  
P.O. Box 1280, D-4240 Emmerich  
Tel. 02822/720, Tlx. 8125113  
Fax. 02822/72276  
UNIWAX/PRISORINE

**Factice**

D.O.G. Deutsche Oelfabrik  
P.B. 111929, D-2000 Hamburg  
Tx. 212164, Fax. 040/3192748

Rhein-Chemie Rheinau GmbH  
Mülheimer Str. 24-28  
D-6800 Mannheim 81  
Tel. 0621/89070, Tx. 462282

**Fat and oil derivatives**

Rhein-Chemie Rheinau GmbH  
Mülheimer Str. 24-28  
D-6800 Mannheim 81  
Tel. 0621/89070, Tx. 462282

**Fatty acid and fatty alcohol derivatives**

D.O.G. Deutsche Oelfabrik  
P.B. 111929, D-2000 Hamburg  
Tx. 212164, Fax. 040/3192748

Kettlitz-Chemie GmbH & Co. KG  
POB 80, D-8859 Rennertshofen  
Tlx. 55237, Fax. 08434/719

Rhein-Chemie Rheinau GmbH  
Mülheimer Str. 24-28  
D-6800 Mannheim 81  
Tel. 0621/89070, Tx. 462282

Schill & Seilacher (GmbH & Co.)  
Moorfleeter Straße 28  
D-2000 Hamburg 74, Tx. 212932  
T. 040/733501-0, Fax. /7335094  
"Struktol®"

**Fatty acid derivatives**

Rhein-Chemie Rheinau GmbH  
Mülheimer Str. 24-28  
D-6800 Mannheim 81  
Tel. 0621/89070, Tx. 462282

Unichema Chemie GmbH  
P.O. Box 1280, D-4240 Emmerich  
Tel. 02822/720, Tlx. 8125113  
Fax. 02822/72276  
UNIWAX/PRISORINE

*Processing aids (cont.)***Processing aids for special elastomers**

D.O.G. Deutsche Oelfabrik  
P.B. 111929, D-2000 Hamburg  
Tx. 212164, Fax. 040/3192748

3M Deutschland GmbH  
Abt. Chemische Produkte  
PF 100422, D-4040 Neuss 1  
Tel. 02101/142511, Tx. 8517511  
DYNAMAR™ Polymer Processing  
Aids

Kettlitz-Chemie GmbH & Co. KG  
POB 80, D-8859 Rennertshofen  
Tlx. 55237, Fax. 08434/719

Rhein-Chemie Rheinau GmbH  
Mülheimer Str. 24-28  
D-6800 Mannheim 81  
Tel. 0621/89070, Tx. 462282

Schill & Seilacher (GmbH & Co.)  
Moorfleeter Straße 28  
D-2000 Hamburg 74, Tx. 212932  
T. 040/733501-0, Fax. /7335094  
"Struktol®"

**Protectants****Hindered amine light stabilizers**

CIBA-GEIGY AG (AD 5.4)  
4002 Basel/Switzerland  
Tel. 061/6971111, Tx. 962355  
Fax. 061/6964354  
®TINUVIN, ®CHIMASSORB

**Physically active ozone protectants**

D.O.G. Deutsche Oelfabrik  
P.B. 111929, D-2000 Hamburg  
Tx. 212164, Fax. 040/3192748

ELASTOCHEM  
W. Koblizek & Co.  
Schäferweg 5  
D-3000 Hannover 51  
Tel. 0511/5499410, Tx. 9230559  
OSM ozone protecting waxes

Rhein-Chemie Rheinau GmbH  
Mülheimer Str. 24-28  
D-6800 Mannheim 81  
Tel. 0621/89070, Tx. 462282

*Protectants (cont.)*

**UV-absorbers**

CIBA-GEIGY AG (AD 5.4)  
4002 Basel/Switzerland  
Tel. 061/6971111, Tx. 962355  
Fax. 061/6964354  
®TINUVIN, ®CHIMASSORB

**Reinforcements**

amohr - Technische Textilien  
PF 200336, D-5600 Wuppertal 2  
Tx. 8591839, Tel. 0202/81046  
Ribbons and fabrics in cotton  
and synthetics

**Rubber blacks**

Degussa AG  
GB Anorganische Chemieprodukte  
PF 110533, D-6000 Frankfurt 11  
T. 069/218-01, Tx. 412220 dg d  
Fax. /218-3218, TTX 69917 = DGHV

**Rubber curing salt**

Goerig GmbH  
POB 101362, D-6800 Mannheim 1  
T. 0621/313051, Tx. 176211811  
Fax. 0621/311320  
"Effge®"

**Separation agents**

Hans W. Barbe  
Chemische Erzeugnisse GmbH  
PF 130223, D-6200 Wiesbaden 13  
T. 06121/22081, Tx. 4186470 hwb d  
PROMOL

Henkel KGaA  
D-4000 Düsseldorf 1  
T. 0211/797-4475, Fax. /797-8596  
CHEMOSIL®, SIPIOL®

Kettlitz-Chemie GmbH & Co. KG  
POB 80, D-8859 Rennertshofen  
Tlx. 55237, Fax. 08434/719

Rhein-Chemie Rheinau GmbH  
Mülheimer Str. 24-28  
D-6800 Mannheim 81  
Tel. 0621/89070, Tx. 462282

Scheruhn Talkum-Bergbau  
POB 1329, D-8670 Hof/Saale  
Tx. 643746 fuh, Fax. 09281/66951

*Separation agents (cont.)*

Schill & Seilacher (GmbH & Co.)  
Moorfleeter Straße 28  
D-2000 Hamburg 74, Tx. 212932  
T. 040/733501-0, Fax. /7335094  
"Struktol®"

**Silanes**

Degussa AG  
GB Anorganische Chemieprodukte  
PF 110533, D-6000 Frankfurt 11  
T. 069/218-01, Tx. 412220 dg d  
Fax. /218-3218, TTX 69917 = DGHV

**Stabilisators**

Monsanto Europe S.A., Brussels  
Avenue de Tervuren 270  
Tel. 32-2-761.41.11, Tx. 62927  
Duralink® HTS as post-vulcanization stabilizer

**Sulfur**

**Elastomer bound sulfur**

Croxton & Garry Ltd.  
Curtis Road  
GB Dorking, Surrey RH4 1XA  
Tel. 0306/886688, Tx. 859567  
Fax. 0306/887780  
MULTISPERSE

**Insoluble sulfur**

Kali-Chemie Stauffer GmbH  
PF 220, D-3000 Hannover 1  
Tel. 0511/857-1, Tx. 922755  
CRYSTEX (R)

Rhein-Chemie Rheinau GmbH  
Mülheimer Str. 24-28  
D-6800 Mannheim 81  
Tel. 0621/89070, Tx. 462282

**Rubber maker's sulfur**

Kali-Chemie AG  
PF 220, D-3000 Hannover 1  
Tel. 0511/857-1, Tx. 922755

**Soluble sulfur**

Koch & Reis N.V.  
Ijzerlaan 3, B-2008 Antwerpen  
Tel. 3/233.12.05, Tx. 32876  
K R Ventilated sulfur  
K R Triturated sulfur  
Oil treated sulfur  
Free flowing sulfur



**Sulfur (cont.)**

Rhein-Chemie Rheinau GmbH  
Mülheimer Str. 24-28  
D-6800 Mannheim 81  
Tel. 0621/89070, Tx. 462282

**Sulfur donors****Caprolactam disulfide**

Rhein-Chemie Rheinau GmbH  
Mülheimer Str. 24-28  
D-6800 Mannheim 81  
Tel. 0621/89070, Tx. 462282

**Dithiomorpholine**

D.O.G. Deutsche Oelfabrik  
P.B. 111929, D-2000 Hamburg  
Tx. 212164, Fax. 040/3192748

Monsanto Europe S.A., Brussels  
Avenue de Tervuren 270  
Tel. 32-2-761.41.11, Tx. 62927  
Sulfasan®

Rhein-Chemie Rheinau GmbH  
Mülheimer Str. 24-28  
D-6800 Mannheim 81  
Tel. 0621/89070, Tx. 462282

**Tackifiers**

D.O.G. Deutsche Oelfabrik  
P.B. 111929, D-2000 Hamburg  
Tx. 212164, Fax. 040/3192748

**Titanium dioxide extenders, silicates**

Degussa AG  
GB Anorganische Chemieprodukte  
PF 110533, D-6000 Frankfurt 11  
T. 069/218-01, Tx. 412220 dg d  
Fax. /218-3218, TTX 69917 = DGHV

**Vulcanization agents**

Rhein-Chemie Rheinau GmbH  
Mülheimer Str. 24-28  
D-6800 Mannheim 81  
Tel. 0621/89070, Tx. 462282

**Vulcanization retarders**

Monsanto Europe S.A., Brussels  
Avenue de Tervuren 270  
Tel. 32-2-761.41.11, Tx. 62927  
Santogard® PVI, Retarder TSA

Rhein-Chemie Rheinau GmbH  
Mülheimer Str. 24-28  
D-6800 Mannheim 81  
Tel. 06 21/89070, Tx. 462282

**Water absorbers**

Kettlitz-Chemie GmbH & Co. KG  
POB 80, D-8859 Rennertshofen  
Tlx. 55237, Fax. 08434/719

**Waxes**

H. B. Fuller GmbH  
An der Roten Bleiche 2/3  
D-2120 Lüneburg, Tx. 2182102  
T. 04131/705-107, Fax. /705-227  
PROTEKTOR® G

Rhein-Chemie Rheinau GmbH  
Mülheimer Str. 24-28  
D-6800 Mannheim 81  
Tel. 0621/89070, Tx. 462282

**Zinc oxides, elastomer bound**

Croxton & Garry Ltd.  
Curtis Road  
GB Dorking, Surrey RH4 1XA  
Tel. 0306/886688, Tx. 859567  
Fax. 0306/887780  
MULTISPERSE

**Group 4: Machines for Elastomer Processing****CAD-standard elements software**

HASCO, D-5880 Lüdenscheid  
Tel. 02351/4320, Tx. 826842

**Calender, rubber-**

Berstorff Maschinenbau GmbH  
D-3000 Hannover 1, Box 629  
Tel. 0511/5702-0, Tx. 921348

**Extruders****Lead extruders**

H. Folke Sandelin AB  
Box 6064, S-12606 Hägersten  
Tel. 468880240, Tx. 17461  
Fax. 468883230

Hanson-Robertson continuous  
lead extruders lead-melting  
systems, -stripping machines