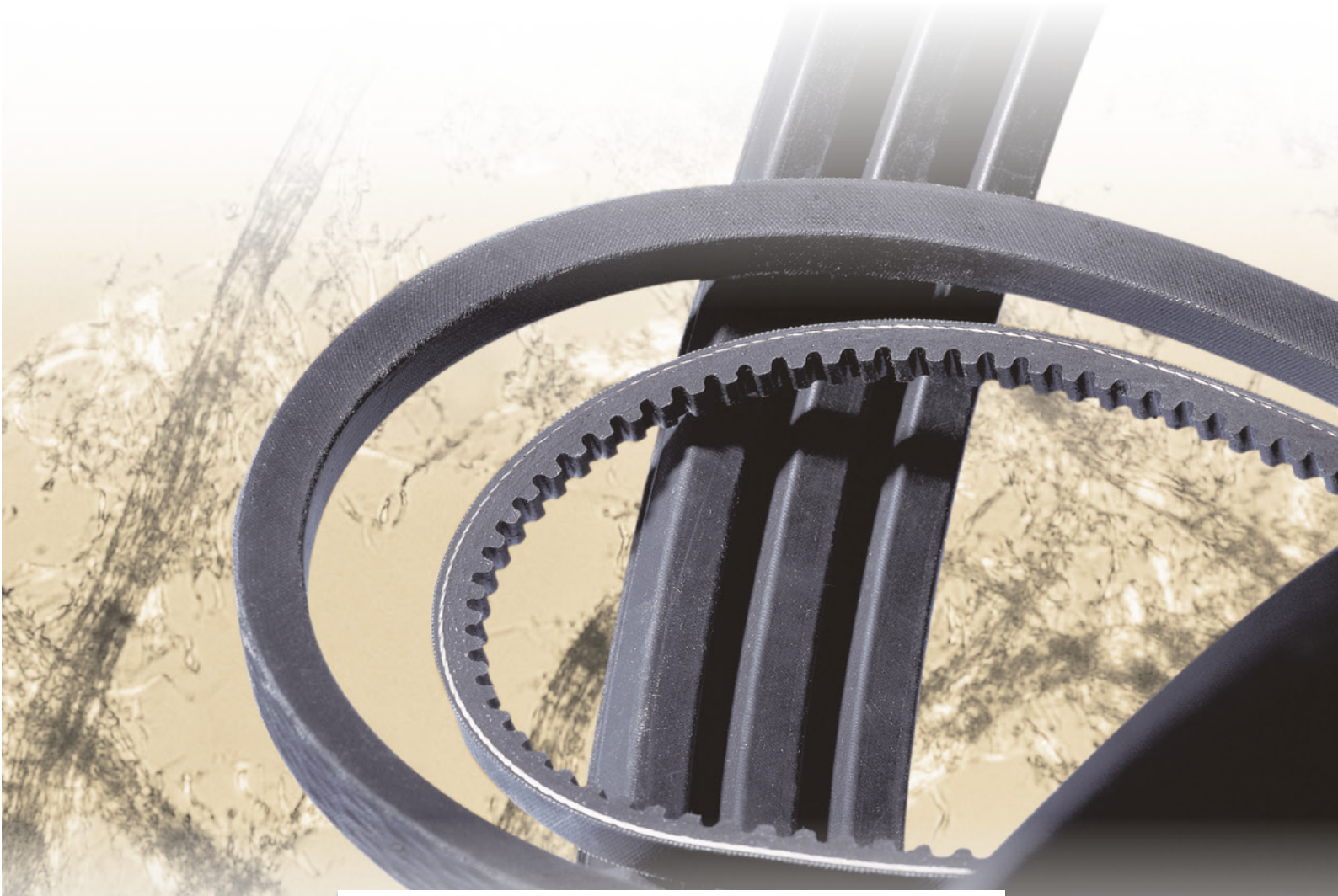
QUALITY PERFORMS.



Short fiber reinforcement for rubber

Rhenogran® P / Rhenogran® WP




RheinChemie Additives

QUALITY WORKS.

LANXESS Energizing Chemistry

SHORT FIBER
REINFORCEMENT FOR RUBBER

Short fibers such as glass, carbon, aramid or natural fibers have been embedded into many types of polymers to improve and modify certain mechanical properties of the matrix polymer for specific use and to reduce the cost of molded articles. Application areas include V-belts, hose, tire components and miscellaneous molded goods.

- **Reinforcement**
  - Cost reduction in manufacturing
  - Increased quality and service life of rubber articles
  - Improved resistance on exposure to high temperatures, media and pressures
  - Easy curing due to dimensional stability

Property		Stiffness	Reinforcement	Flexibility	Degradation
Fiber	**Density (g/cm³)**	**Youngs modulus [GPa]**	**Tensile strength [GPa]**	**Elongation at break [%]**	**Decomposition temp. [°C]**
Cotton	1.5 – 1.6	6 – 13	0.3 – 0.6	3.0 – 10	> 150
Sisal	1.3 – 1.5	9 – 38	0.4 – 0.7	2.0 – 3.0	> 180
Flax	1.4	60 – 80	0.1 – 1.5	1.2 – 1.6	> 160
Cellulose (wood)	1.4	30 – 60	0.4 – 1.0	0.1 – 0.4	> 180
Carbon (PAN)	1.8 – 2.0	160 – 450	3.5 – 7.0	0.7 – 2.0	> 3700
E-glass*	2.6	72	1.5 – 3.0	1.8 – 3.2	825 melting
Nylon/Polyester	1.1 – 1.4	n.a.	0.9 – 1.1	10 – 25	260 melting
Twaron® aramid	1.4 – 1.5	60 – 120	2.4 – 3.6	2.2 – 4.4	> 500

* Fibers break down during mixing

Selected advantages in applications:

- Tire innerliner: reduced cord strike-through during cure
- Wire-reinforced hose: wire braiding step eliminated
- Hand-wrapped hose: increased strength of rubber sheet in building
- Tire chafer: increased strength to accommodate tire building process
- Roofing materials: increased green strength for unvulcanized sheeting

Application	Quality improvement
Belts (V-belts, toothed belts, drive belts, conveyor belts)	Service life, wear, noise reduction, material fatigue, tooth hardness, creep, load capacity, fracture tendency
Hoses	Thermal stability, rigidity, dimensional stability also at curing, replacement for fabric, solvent swell resistance
Tires	Abrasion resistance, puncture stability, rigidity, running properties, stability
Shoes, treads	Green strength, dimensional stability, abrasion resistance, cutting resistance
Membranes	Puncture resistance, rigidity
Gaskets, leathering	Thermal stability, shrinkage tendency, replacement for fabric, solvent swell resistance
Cables	Modulus, cutting resistance, dimensional stability
Tank pads	Abrasion resistance, cutting resistance
Roller covers	Printing properties, service life

RHENOGRAN® P91/P95
ARAMID FIBERS

Under high mechanical, dynamic and thermal stresses, an excellent reinforcement performance can be achieved in the finished product with Rhenogran® P91-40, which incorporates the highly resilient and very lightweight Twaron® aramid short-fiber pulp evenly in the rubber compound. Rhenogran® P91-40 is suitable for many rubber grades including NR, IR, BR, SBR, EPDM, CR, NBR and HNBR.

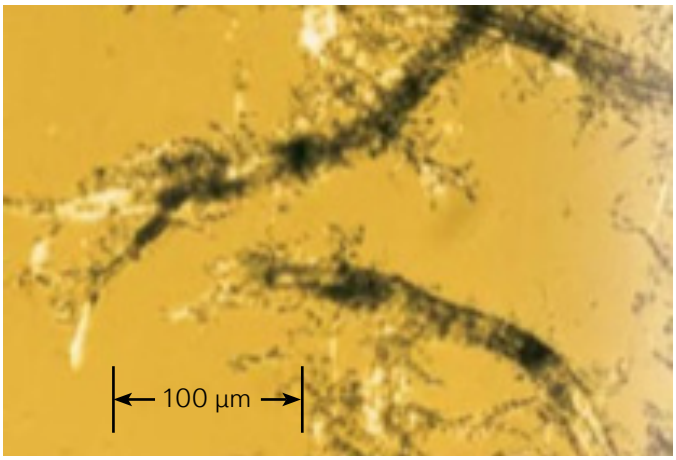
Fiber:
Twaron®, Teijin Aramid's para-aramid high-performance fiber, commonly used in ballistic protection, optical fiber cables, heat and cut protection, oil and gas as well as the automotive industry.

Fiber pulp generation:
Step 1: Polymerization of monomers to para-aramid grains
Step 2: Dissolving grains and spinning of filament yarn, orientation parallel to the axis
Step 3: Cutting of filament yarn to specific length, suspension in water
Step 4: Fibrillation (mechanical) to specific surface area, followed by drying

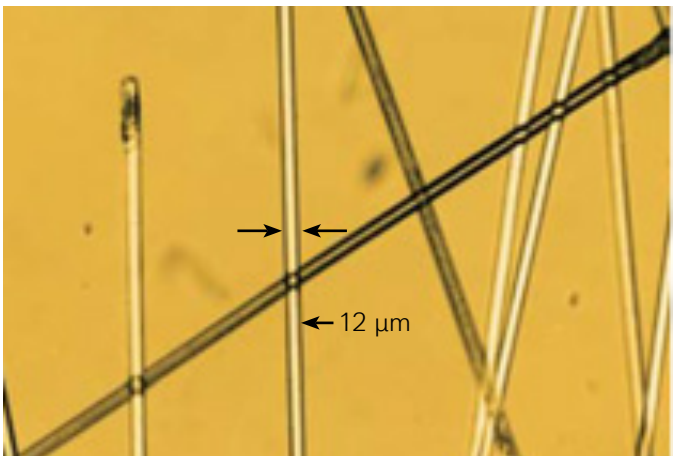
Rhenogran® masterbatch:
Pure fiber pulp predispersed in rubber matrix. No treatment necessary to disperse and bind in compound matrix.

Properties:
- Excellent reinforcement, high flexibility
- Extremely durable; heat, cut and chemical-resistant
- Lightweight applications
- Non-conductive
- No melting point, low flammability

Pulp



Fiber



RHENOGRAN® WP
CELLULOSE FIBERS

In Rhenogran® WP, cellulose fiber pulp enables the reinforcement of finished products made of polymers such as EPDM, SBR, NR and PVC. This is an economical solution for increasing the quality and service life of end products that are exposed to high temperatures, media and pressures.

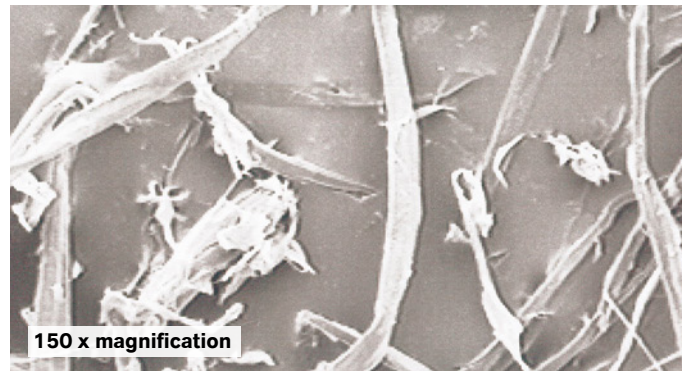
Fiber:
Naturally occurring non-regenerated cellulose from hardwood, commonly used in paper industry or (bio-) composites

Fiber pulp generation:
Step 1: Preparation of wood chips from trees
Step 2: Pulping of chips (chemical or mechanical breakdown and refining)
Step 3: Drying of pulp to approx. 10 % moisture

Rhenogran® masterbatch:
Cellulose pulp plus resorcinol-based resin. Additional methylene donor (e. g. Cohedur A 200) should be used to maximize bonding to rubber matrix.

Properties:
- Effective reinforcement, less flexibility
- Bio-degradable material
- Higher reinforcement than cotton or sisal
- Low conductivity
- Cost-efficient

Pulp



Fiber

RHENOGRAN® FIBER MASTERBATCH
TYPES AND GRADES

Rhenogran® fiber pulp masterbatches offer all the advantages of predispersed additives: increased process safety, dust-free properties and thereby reduced loss of material and lower cleaning effort. Rhenogran® fiber masterbatches can simplify processing and provide substantial improvement to the properties of final products.

We offer comprehensive technical support, starting with recommendations for formulations and continuing with the development of application-specific fiber pulp masterbatches.

The advantages of Rhenogran® fiber masterbatches compared to continuous cord or pure fiber pulp:

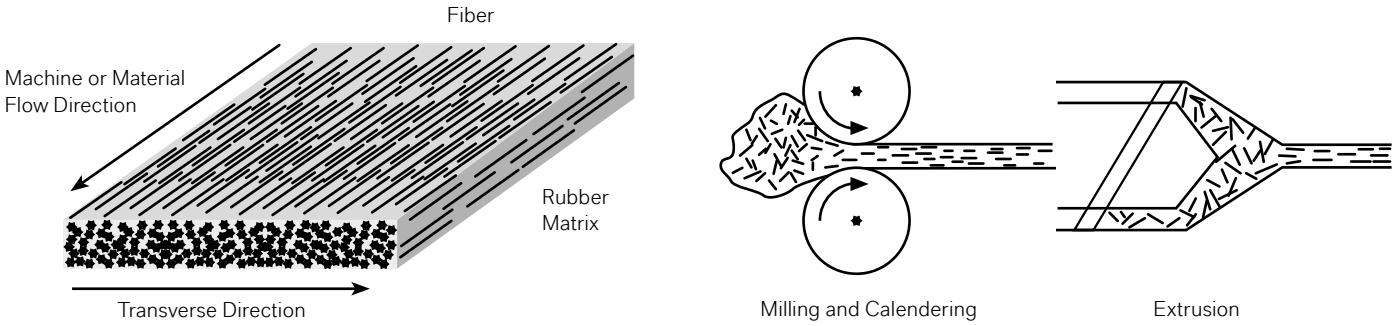
- No pre-treatment and manual preparations
- Mixing and processing using common elastomer equipment
- Shorter mixing cycles
- Better dispersion in rubber compound
- Better uniformity in products
- Higher anisotropy at equal concentration

Fiber	Product*	Active content	Polymer binder	Color
Aramid (Twaron® 1091)	Rhenogran® P91-40/EPDM	40%	EPDM	Yellow
Aramid (Twaron® 1091)	Rhenogran® P91-40/NBR	40%	NBR	Yellow
Aramid (Twaron® 1091)	Rhenogran® P91-40/NR	40%	NR	Yellow
Aramid (Twaron® 1095)	Rhenogran® P95-50/EPDM	50%	EPDM	Yellow
Wood pulp	Rhenogran® WPD-70/SBR	70%	SBR	Black
Wood pulp	Rhenogran® WPDX-73/SBR	73%	SBR	Black
Wood pulp	Rhenogran® WPH-65/EPDM	65%	EPDM	Black
Wood pulp	Rhenogran® WPW-77/PVC	77%	PVC	Gray

*Available on request: Rhenogran® P91-40/CR, Rhenogran® P91-50/HNBR, Rhenogran® P95-50/NBR

Fiber orientation

Rhenogran® fibers strongly affect mechanical properties such as strength, dimensional stability, compression modulus, creep, and cut growth characteristics depending on the orientation of the fibers. During calendering or extrusion, the fibers will orient in the direction of shear; thus, one can obtain a product which is, for example, relatively stiff in one direction and flexible in the other.



LANXESS Deutschland GmbH
BU Rhein Chemie
Kennedyplatz 1
50569 Cologne, Germany
Phone: +49 (0)221 8885-0

LANXESS Deutschland GmbH
BU Rhein Chemie
Duesseldorfer Str. 23-27
68219 Mannheim, Germany
Phone: +49 (0)621 8907 0

OOO LANXESS Moscow
BU Rhein Chemie
MIBC Moscow City,
Federation Tower „B“,
46th Floor, Office 1B
Presnenskaya Naberezhnaya 12
123100 Moscow, Russian Federation
Phone: +7 495 232 0610

LANXESS Corporation
BU Rhein Chemie
111 RIDC Park West Drive
Pittsburgh, PA 15275-1112, USA
Phone: +1 412 809 1000

LANXESS Corporation
BU Rhein Chemie
145 Parker Court
Chardon, OH 44024, USA
Phone: +1 440 285 3547

LANXESS Corporation
BU Rhein Chemie
5701 Murray Street
Little Rock, AR 72209, USA
Phone: +1 501 562 5410

LANXESS Indústria de Produtos Químicos e Plásticos Ltda.
BU Rhein Chemie
Av. Maria Coelho Aguiar 215
Bloco B, 2º Andar
05804-902 Jardim São Luis
São Paulo-SP, Brazil
Phone: + 55 11 3741 2879

LANXESS S.A.
BU Rhein Chemie
Luis María Drago 1555
B1852LGS Burzaco/Buenos Aires, Argentina
Phone: +54-11 4002 4100-260

LANXESS Hong Kong Limited
BU Rhein Chemie
36/F, Cambridge House,
Taikoo Place, 979 King's Road
Island East, Hongkong, PR China
Phone: +852-35268885

Rhein Chemie (Qingdao) Ltd.
BU Rhein Chemie
43 Siliubei Road
Li Cang District
Qingdao 266043, PR China
Phone: +86-532-8482 9196

LANXESS Chemical (China) Co., Ltd.
BU Rhein Chemie
6F, 5 Corporate Avenue
150 Hu Bin Road, Huangpu District
200021 Shanghai, PR China
Phone: +86 21 6109 6624

LANXESS K.K.
BU Rhein Chemie
Marunouchi Kitaguchi, Bldg. 23 F
1-6-5 Marunouchi, Chiyoda-ku
Tokyo 100-8215, Japan
Phone: +81-3-5293-8041

LANXESS India Private Limited
BU Rhein Chemie
LANXESS House
Plot No. A-162-164
Road No. 27, MIDC, Wagle Estate
Thane (W) – 400 604
Maharashtra, India
Phone: +91 22 2587 1000

LANXESS
Energizing Chemistry

rubber.additives@lanxess.com
rch.lanxess.com

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