kuraray

Leveraging sustainability while improving performance

Kuraray Liquid Rubber

Kuraray Liquid Rubber

for long lasting product solutions

Kuraray Liquid Rubber functions as "reactive plasticizers", they help reduce Mooney viscosity and facilitate the mixing process.

Features

- Transparent
- Colorless
- Odorless
- Low VOCs

Types

- Liquid Butadiene Rubber (L-BR)
- Liquid Isoprene Rubber (L-IR)
- Liquid Styrene-Butadiene Rubber (L-SBR)
- Functionalized: carboxylated, UV-curable, graft silane
- Bio-based: Liquid Farnesene Rubber (L-FR)

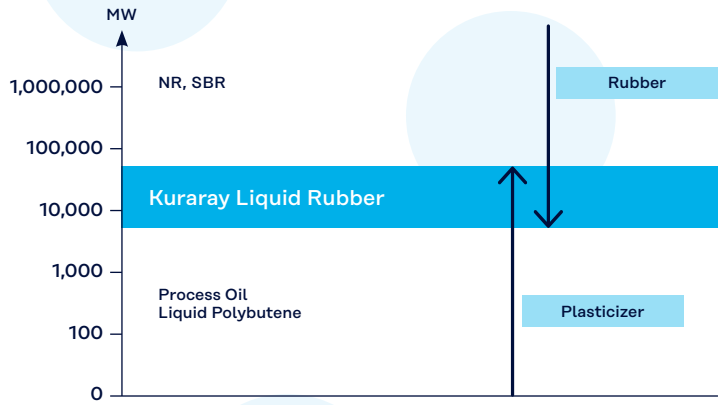
Tires

Rubber goods

Adhesives

Automotive sealants

Kuraray Liquid Rubber beyond a reactive plasticizer



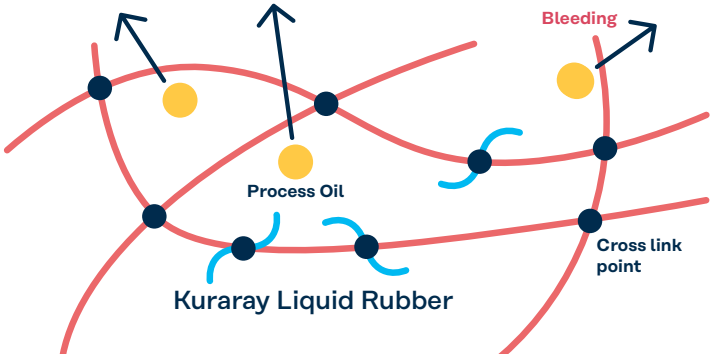
Depending on molecular weight (MW), Kuraray Liquid Rubber can act as rubber replacement or a reactive plasticizer.

Benefits:

- Plasticizing effect
- Enhanced properties
- Improved final product shelf-life

Benefits:

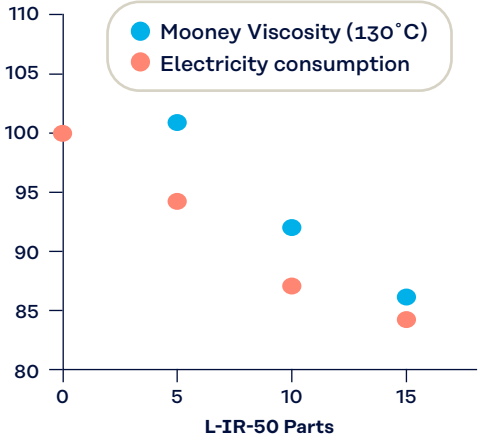
- Co-vulcanizable with solid rubber
- Significant reduction in migration
- Reduces processing time



Kuraray Liquid Rubber is cross-linkable with base rubber and acts like a process oil, but does not bleed.

Significant performance and environmental advantages with Kuraray Liquid Rubber

Mooney, Electric (Index)

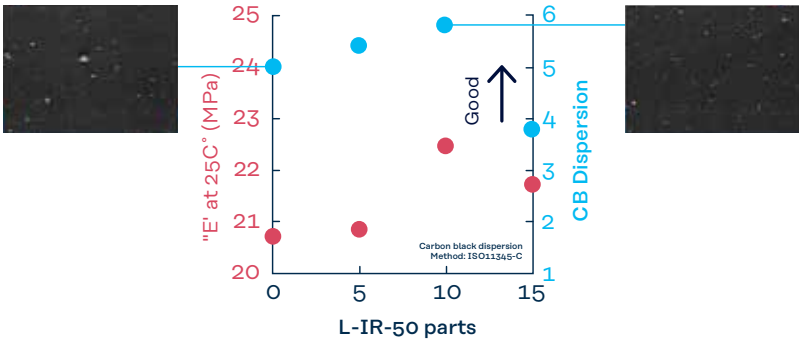


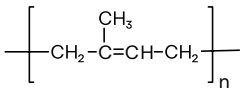
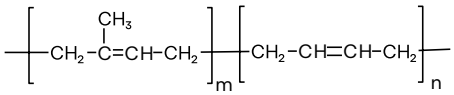
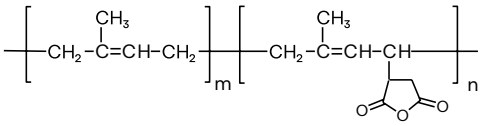
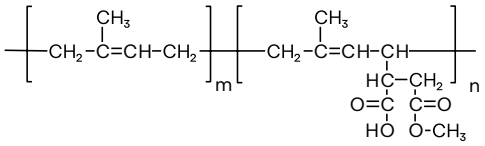
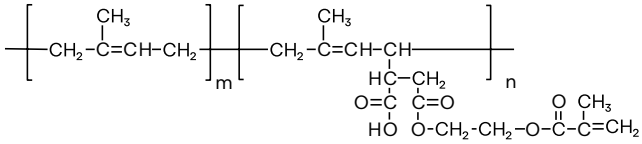
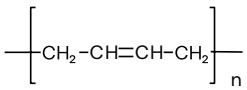
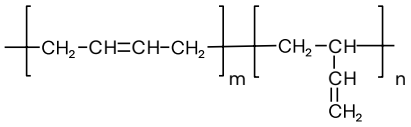
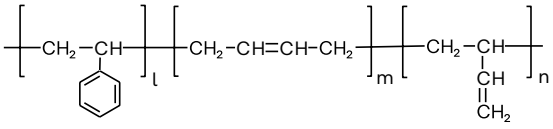
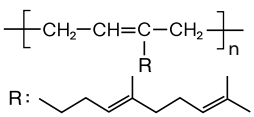
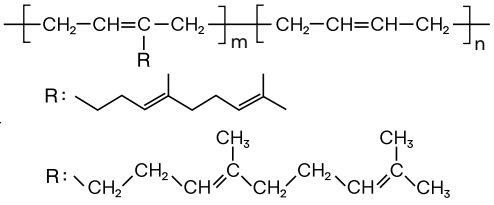
Formulation
NR (STR20) 100 - 85, L-IR-50 0 - 15, CB (N330) 70, TDAE 5, Vulcanization, Antioxidant ZnO (5), Stearic Acid (2), AO 6C (1), AO RD (1), Phenol resion (10), HDOT20 (4), Accelerator NS (1.7), HMT (1)

Benefits:

- Reduces electric power consumption
- Lower processing cost
- Better sustainability performance (less energy)

Dynamic viscoelasticity/CB Dispersion



Category	Type	Grade name	Structure
L-IR (Isoprene)	Homopolymer	L-IR-30	
		L-IR-50	
	Block Copolymer	L-IR-390	
	Carboxylated	L-IR-403	
		L-IR-410	
	UV Curable	UC-102M	
		UC-203M	
L-BR (Butadiene)	Homopolymer	L-BR-302	
		L-BR-307	
		L-BR-305	
		L-BR-352	
		L-BR-361	
	GS-L-BR (Graft silane)	GS-L-BR-114	
L-SBR (Styrene/ Butadiene)	Random Copolymer	L-SBR-870	
		L-SBR-822*	
		L-SBR-841N	
L-FR (Farnesene)	Homopolymer	L-FR-107L	
	Random Copolymer	L-FBR-742	
		L-FBR-746	

*Developmental grade

Viscosity (Pa•s at 38°C)	Glass Transition Temp. (°C)	Features and main applications
70	-63	▪ Reactive plasticizer (NR, IR, SBR, BR, IIR etc.) ▪ Tire, conveyor belt, rubber goods ▪ Pressure sensitive adhesives/hot melts ▪ Automotive sealants, coatings and adhesives ▪ Plasticizer for printing plates ▪ Binder for brake pads, grinding wheels, etc.
500	-63	
400	-95	▪ Hot melt adhesives/PSA (SIS, SBS, EVA) ▪ Automotive sealants, coatings and adhesives
200	-60	▪ Improves adhesion to metals and fibers ▪ Automotive sealants, coatings and adhesives ▪ Hot melt adhesives/PSA (SIS, SBS, EVA) ▪ Binder for brake pads, grinding wheels, etc.
430	-59	
30	-60	▪ Low temperature reactivity ▪ Crosslinkable using UV ▪ Pressure sensitive adhesives (UV curing adhesives)
190	-60	
0.6	-85	▪ Reactive plasticizer (NR, IR, SBR, BR etc.) ▪ Tire, printing plate ▪ Coagent for EPDM (peroxide curing) ▪ Automotive sealants, coatings and adhesives ▪ Hot melt/PSA ▪ Vinyl content: 5-70% ▪ Thermoset PU modification
1.3	-95	
40	-95	
6	-60	
5.5	-49	
7	-50	▪ Tires, truck and bus tires and rubber goods ▪ Improve silica-polymer interaction ▪ Improve silica dispersion
250	-18	▪ Good compatibility with S-SBR and E-SBR ▪ Tires, ultra-high-performance (UHP) tires and rubber goods ▪ Automotive sealants, coatings and adhesives ▪ Partially hydrogenated grades are available ▪ Damping ▪ Flexo printing plates
8.3	-60	
100 (at 60˚C)	-6	
70	-70	▪ Tire, rubber goods, adhesives and sealants ▪ Bio-based ▪ Significant GHG reduction
15	-78	
520	-78	

Kuraray Liquid Rubber in tires

Three key parameters determine tire performance: grip, fuel efficiency and durability. **Kuraray Liquid Rubber** offers advantages for tire geometry, dynamic tire properties, heat generation and processability.

Kuraray Liquid Rubber functions as reactive plasticizers but have far higher molecular weight than normal plasticizers, that reduces bleeding and soiling of molds.

Benefits:

- Improves grip performance (ice, wet and dry)
- Improves rolling resistance
- Improves abrasion resistance
- Low migration
- Improves filler dispersion

1 Beadfiller/APEX:

- High hardness with excellent processability
- Improved dimensional stability
- Better filler dispersion
- Improve green tack

Applicable grades: L-IR-50

2 Side wall / Carcass:

- Improved dimensional stability
- Enhanced surface smoothness of calendered sheet
- Lower mill shrinkage
- Better green tackiness
- Higher production rates

Applicable grades: L-IR-50, L-BR-302, L-BR-307

3 Rim cushion:

- Good balance of processability and physical properties
- Improved abrasion resistance

Applicable grades: L-IR-50

4 Tread:

- Improved dynamic and physical proterties (tanδ)
- Excellent abrasion resistance, wet and ice grip
- Excellent extrudability

Applicable grades: L-IR-50, L-BR-302, L-BR-307, L-SBR-870, L-SBR-841N, L-FR-107L, L-FBR-742, L-FBR-746, GS-L-BR-114

5 Cushion:

- Enhanced surface smoothness of calendered sheet
- Reduced extrusion temperature
- Better green tackiness
- Improvement of dynamic properties

Applicable grades: L-IR-50, L-BR-302, L-BR-307

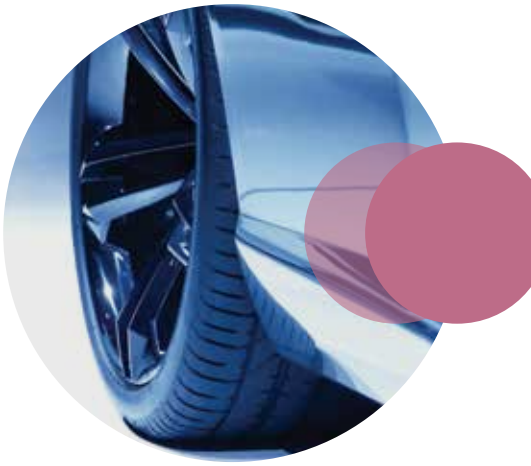
Silane-modified GS-L-BR

Silane coupling agents are used in silica-filled rubber compounds to increase filler-polymer interactions and lower the filler-filler interactions.

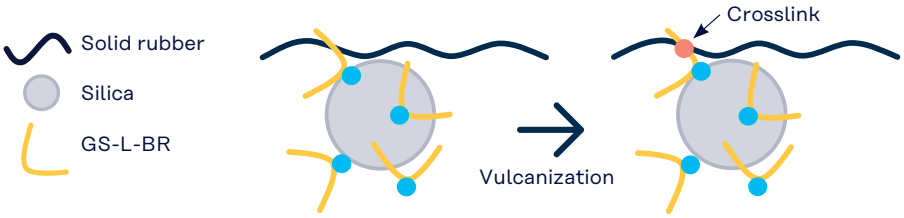
In addition, silane functionalized low molecular weight 'liquid' polymers can be used. Our silane-modified GS-L-BR is one of the latest development of functionalized liquid rubber grades.

Features

- Improves silica dispersion
- Crosslinkable with rubber base
- High reactivity with silica
- Improves silica-polymer interaction
- Lower silica-silica interaction



What is the function of GS-L-BR in rubber compounds?



Expectation

- Good silica dispersion
- Improved abrasion resistance
- Low tanδ → enhanced fuel economy

Formulation & mixing conditions

	Control	Formulation
S-SBR	80	80
BR	20	20
TDAE	40	30
Kuraray liquid rubber	-	10
Silica	100	100
SCA (Si-75)	8.0	8.0
ZnO	3.0	3.0
Stearic Acid	2.5	2.5
Anti oxidant 6C	2.5	2.5
Wax	2.0	2.0
OT-20	1.9	1.9
Accelerator DPG	0.5	0.5
Accelerator CBS	3.5	3.5
Accelerator TBTD	1.5	1.5

Mixing Conditions		
NP1	**Banbury-type mixer**	
	0'00"	Solid rubber (60˚C)
	0'20"	Filler, SCA, Oil, LR, AO, ZnO, Stearic acid
	5'30"	Dump out (150-160˚C)
NP2	**Banbury-type mixer**	
	0'00"	First mixed compound (90˚C)
	4'30"	Dump out (150-160˚C)
FM	**Banbury-type mixer**	
	0'00"	Compound, S, Accelerator (50˚C)
	0'75"	Dump out (90-100˚C)

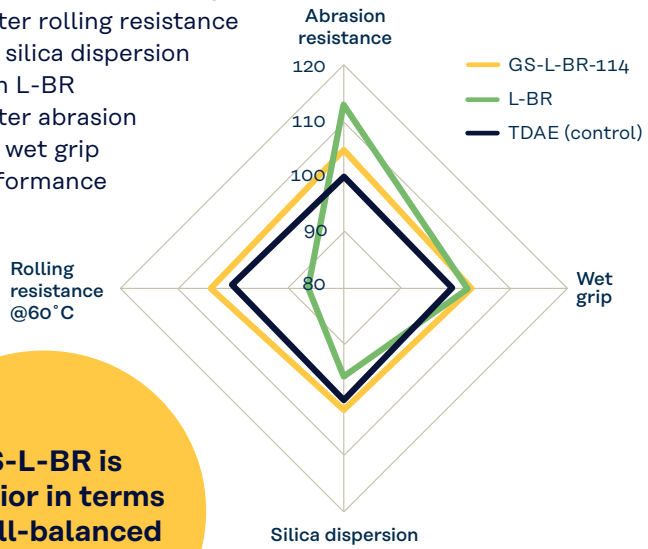
Structure & typical properties of GS-L-BR

Development code	Structure	Tg (˚C)
GS-L-BR-114	Graft functionalized	-50
L-BR	Non-functionalized	-49

Summary

Feature of GS-L-BR-114

- Better rolling resistance and silica dispersion than L-BR
- Better abrasion and wet grip performance



GS-L-BR is superior in terms of well-balanced properties.

Kuraray Liquid Rubber in automotive sealants

For automotive adhesives, grades of Kuraray Liquid Rubber, which are high-viscosity synthetic rubbers, offer different functionalities: improving adhesion to metal surfaces while tailoring damping performance.

In addition, Kuraray Liquid Rubber improves adhesion to oily surfaces and is used where low-temperature performance and quick curing are required. With liquid farnesene rubber, Kuraray even offers a bio-based alternative for automotive sealants.

Benefits:

- Bio-based grades available
- High reactivity - curable with both sulfur and peroxide
- Good low temperature properties thanks to low Tg
- Provides damping properties over a wide temperature range combined with high Tg liquid rubber
- Foams with fine cells

Applications:

- Mastic sealant
- Foam sealant
- Anti-flutter

Automotive applications and benefits

Grade	Applications	Benefits
L-IR-390	▪ Sealants ▪ Sprayable/foam-able sealants ▪ Anti-flutter adhesives ▪ Oil replacement	▪ Cold temperature properties ▪ Ip/Bd structure provides good crack resistance, better damping performance, good compatibility with BR, hydrocarbon and rosin resins ▪ Good solubility in aliphatic, aromatics and ethers ▪ High reactivity due to Ip/Bd structure ▪ Improves expansion in foams ▪ Improves heat and abrasion resistance
L-IR-403 **L-IR-410**	▪ Spot welding sealants ▪ Anti-flutter adhesives ▪ Flexibility improver for Multi-substrate bonding	▪ Good bonding to wide variety of substrates ▪ Joining of dissimilar materials ▪ Improved adhesion to oily surfaces ▪ Softness ▪ Higher Mw helps prevent sagging
L-IR-30 **L-IR-50**	▪ Mastic sealants ▪ Extrudable rubber-based patches ▪ Oil replacement ▪ Underbody coatings	▪ Better processability and reactivity in mastic sealants (BR, SBR, IR) ▪ No migration ▪ Compatible with a broad range of vegetable oils ▪ Higher Mw helps prevent sagging
L-SBR	▪ Sprayable/foam-able sealants ▪ Spot welding sealants ▪ High damping foams and acoustic baffles (LASD)	▪ Excellent sound and vibration damping ▪ High tanδ over a wide temperature range ▪ Improves reactivity ▪ Improves expansion in foams

Promote adhesion to metal: L-IR-403 & L-IR-410

L-IR-30

Shear strength test	Al Plate	Steel Plate
Max load (N)	82	77
Elongation (mm)	1.8	0.9

L-IR-403

Shear strength test	Al Plate	Steel Plate
Max load (N)	721	650
Elongation (mm)	4.4	4.1

Adhesion failure

Cohesion failure

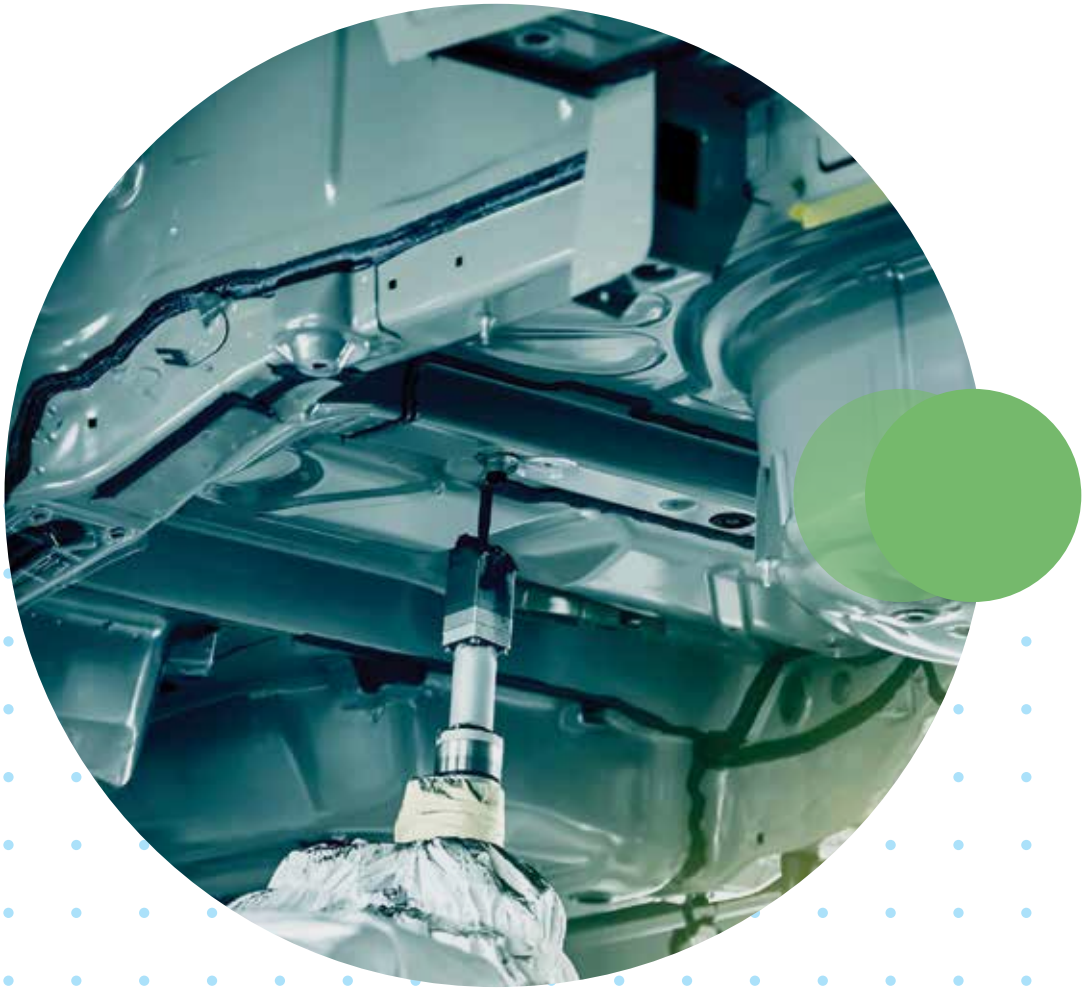
Adhesion area: 25 mm x 25 mm

Kuraray Liquid Rubber in adhesives

Kuraray Liquid Rubber is commonly used in applications such as pressure sensitive adhesives and hot melts. The lower molecular weight grades improve tack and adhesive properties. The UV crosslinkable grades provide excellent flexibility, tack, low shrinkage and moisture resistance, which are ideal for flexible electronic applications.

Benefits:

- Preservation of rubber-like properties at low temperatures
- Colorless, transparent, odorless without halogen residuals
- Certain grades are suitable for food contact applications
- Improved adhesion to metal and glass possible with functionalized grades
- Crosslinkable by UV with methacrylic grades



Solvent	L-IR-30, 50	L-IR-410
Hexane, Heptane, Cyclohexane	A	A
Toluene, Xylene	A	A
Methyl Acetate	C	C
Ethyl Acetate	C	A
n-Butyl Acetate	A	A
Acetone	C	C
MEK	C	A
MIPK	B	A
MIBK	A	A
Methanol, Ethanol	C	C
Chloroform	A	A
Carbon Tetrachloride	A	A
Carbon Disulfide	A	A
Cyclohexanone/Xylene (50/50 wt/wt)	A	A

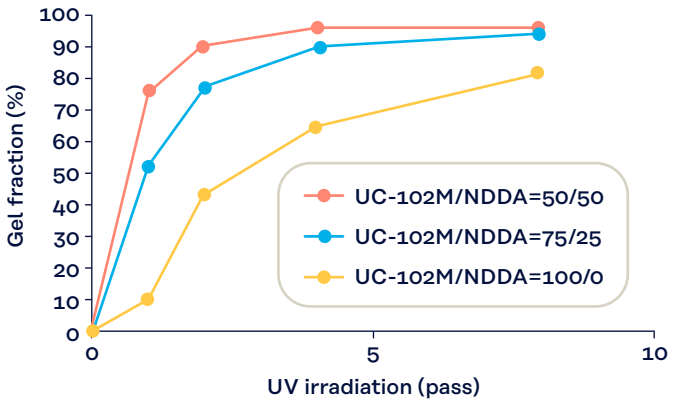
Polymer content: 20 wt% at 25˚C

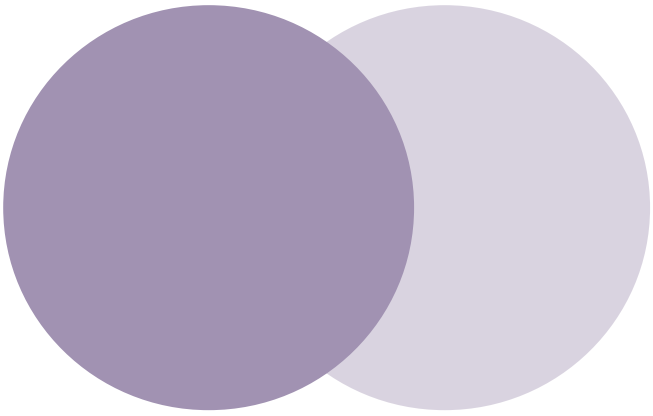
A: Soluble

B: Partially soluble

C: Insoluble

UV Crosslinking system for UC-102M





Lamp: High pressure mercuray lamp

Curing conditions: Light intensity : 40 mW/cm², Conveyor speed : 2 m/ min, 1 Pass = 188 mJ/cm²

Thickness: 0.8 mm

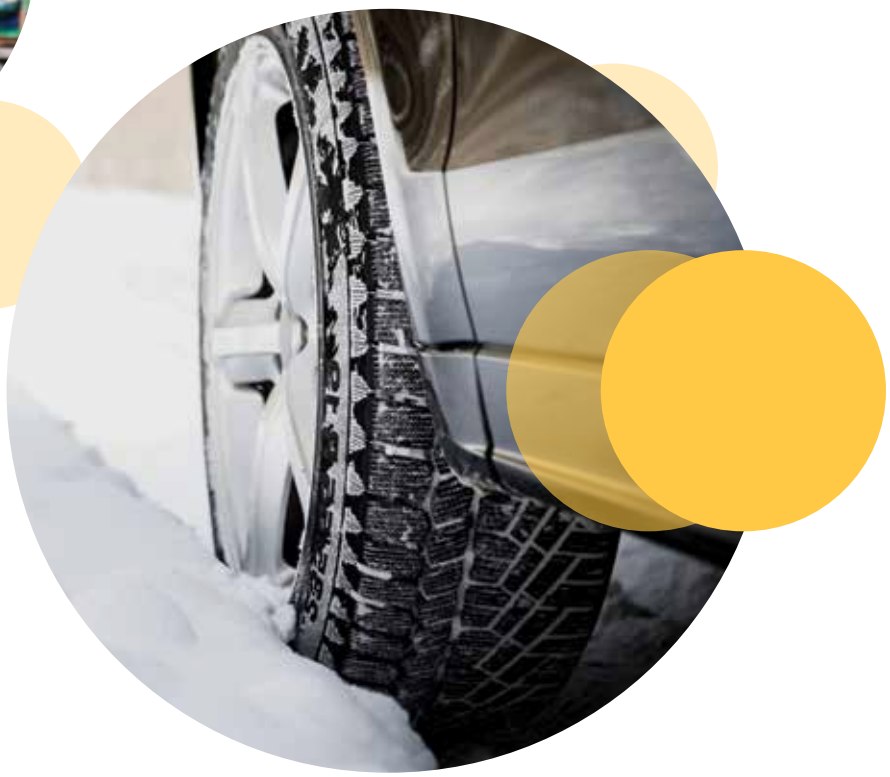
Gel fraction test: Toluene extraction at 25˚C for 24 hours

Liquid Farnesene Rubber

Sustainability and performance side-by-side

With liquid farnesene rubber, Kuraray is expanding its portfolio of liquid rubbers with a product based on natural and renewable raw materials.

As an additive in rubber compounds, liquid farnesene rubber gives them high plasticity. The material also retains excellent flexibility at low temperatures and improves ice grip while preventing the rubber compounds from hardening over time, making it ideal for use in winter tires.



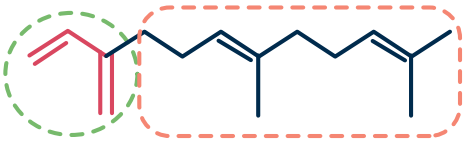
Applications*:

- Tires
- Rubber goods
- Footwear
- Adhesives, sealant and coatings

Sugarcane

Benefits:

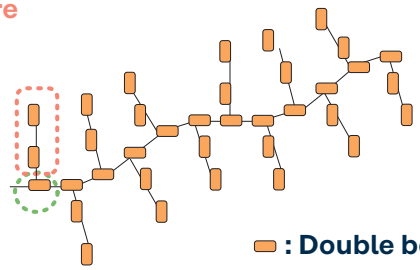
- Renewable monomer
- Low viscosity
- High reactivity



Reactive site

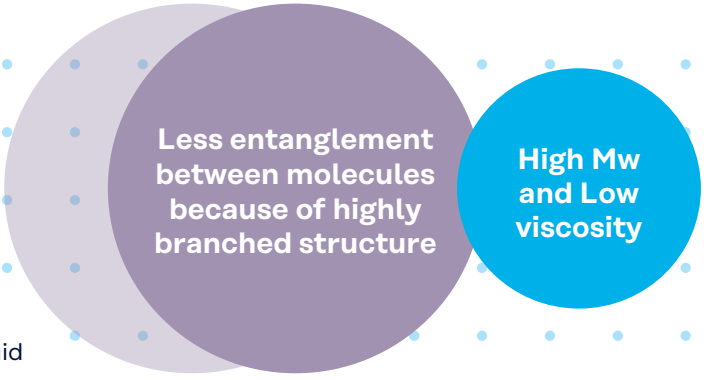
β-Farnesene

Branched Structure



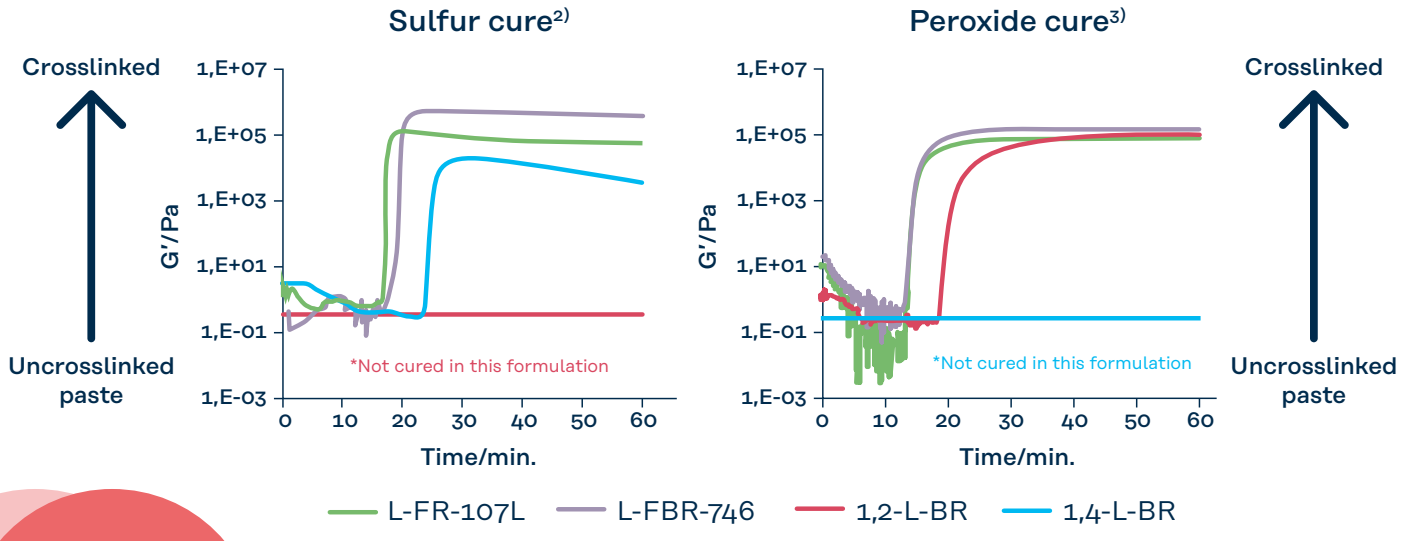
: Double bond

Liquid farnesene rubber: Branched polymer



*For certain applications, liquid farnesene rubber cannot be introduced due to raw material supply relations. Please contact our sales representatives.

Curability of liquid rubbers changes when curing agent is changed.



L-FR/L-FBR show fast crosslinking with both sulfur and PO.

2) Formulation
Liquid Rubber 100, ZnO 2, SA 1, AO 1, S 3, DM 1.5, DT 0.5

3) Formulation
Liquid Rubber 100, PO 1

Adding value to your products—worldwide

Kuraray is a world leader in specialty chemicals and functional materials. We are committed to developing products that ensure quality and value while helping our customers differentiate themselves from their competition.

Kuraray's Elastomer Division started in 1972 with the production of polyisoprene rubber and the development of new rubber materials based on Isoprene in the Kashima Plant. From the first production line, the Elastomer Division continuously grew and invented new products such as SEPTON™, HYBRAR™, KURARAY LIQUID RUBBER, and ISOBAM™.

Kuraray strives to develop new and innovative high-performance products for customers around the globe. Learn more about Kuraray's Elastomer products, visit .

Kuraray Co., Ltd.
Tokiwabashi Tower
2-6-4, Otemachi, Chiyoda-ku,
Tokyo 100-0004, Japan

P +81 3 6701 1616

kuraray.liquidrubber@kuraray.com

Kuraray Europe GmbH
Philipp-Reis-Straße 4
65795 Hattersheim am Main
Germany

P +49 69 305 85300

elastomer@kuraray.com

Kuraray America, Inc.
3700 Bay Area Blvd., Suite 680
Houston, Texas 77058
United States of America

P 1.800.423.9762

septon.sales@kuraray.com

Kuraray Trading (Shanghai) Co., Ltd.
3 Hongqiao Road, Xuhui District
Shanghai 200030, China

P +86 21 6407 9182

elastomer.china@kuraray.com

Kuraray India Private Limited
Unit No.1620, 16th Floor, WTT Tower-B, Plot No.C-1, Sector -16, Noida, Uttar Pradesh -201301, India

P +91-120-6923800

inquiry.kid@kuraray.com

Kuraray South America Ltda.
Av. Paulista, 1636 - Sala 405
01310-200 Sao Paulo, Brasil

P +55-11-2615-3531

elastomer.sa@kuraray.com

kuraray

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For the latest information visit: elastomer.kuraray.com