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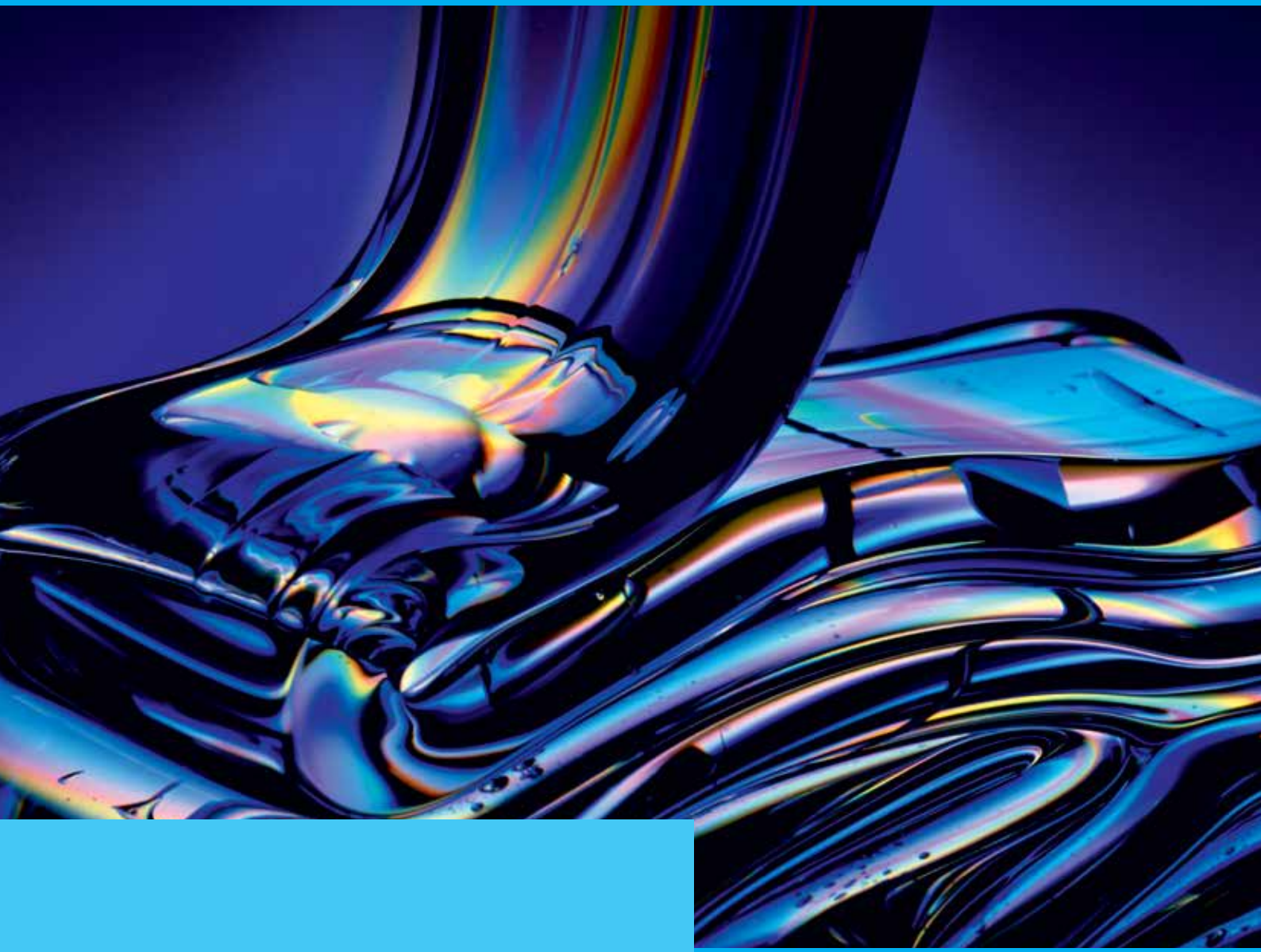
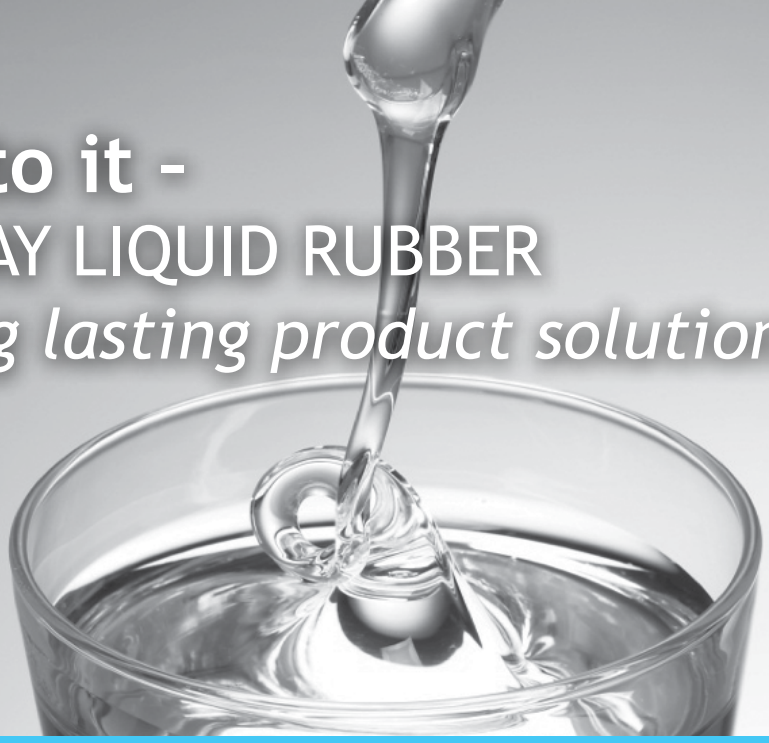


KURARAY LIQUID RUBBER

Stick to it -
KURARAY LIQUID RUBBER
for long lasting product solutions



KURARAY LIQUID RUBBER includes Liquid Isoprene Rubber (LIR) and Liquid Butadiene Rubber (LBR). These high-viscosity synthetic rubbers are based on isoprene, butadiene and styrene. They are colorless, transparent and almost entirely odorless with low VOC's.

KURARAY LIQUID RUBBER grades function as reactive plasticizers but have far higher molecular weight than normal plasticizers. They are co-vulcanizable and reduce migration significantly which improves the product's shelf life. Using KURARAY LIQUID RUBBER during the rubber compounding phase significantly reduces processing time while maintaining the rubber compounds' physical properties. This results in a product with lower processing costs.

The functionalized grades can be bonded to a wide variety of matrices for improved performance.

Common applications include tires, belts, hoses and other rubber goods. In addition, KURARAY LIQUID RUBBER is used to produce high performance coatings, adhesives and sealants.

FOR TIRES

FOR RUBBER APPLICATIONS

FOR ADHESIVES

FOR COATINGS & SEALANTS

KURARAY LIQUID RUBBER IN TIRES

KURARAY LIQUID RUBBER is a favored component in the production of high performance tires. It reduces Mooney viscosity which minimizes migration while improving the processability of the rubber compound in tires.
KURARAY LIQUID RUBBER enhances tire performance significantly by simultaneously controlling the balance of grip, fuel efficiency and wear resistance. KURARAY LIQUID RUBBER is crosslinkable for superior performance and longer shelf life.

- Functionalized grades improve adhesion to metal
- Co-vulcanizable characteristics prevent oil migration
- Improved silica/carbon black dispersion in certain formulations
- Glass transition temperature (Tg) control enables grip control in a wide temperature range

KURARAY LIQUID RUBBER ***offers various application possibilities for tire manufacturing. Different grades can be processed in certain tire parts to contribute to a long lasting high quality product.***

1 *Beadfiller/APEX:*

High hardness with excellent processability
Improved dimensional stability
Better filler dispersion
Applicable grades: LIR-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:
LIR-50, LBR-302, LBR-307

3 *Rim cushion:*

Good balance of processability and physical properties
Improved abrasion resistance
Applicable grades: LIR-50

4 *Tread:*

Improved dynamic and physical proterties (tanδ)
Excellent abrasion resistance, wet and ice grip
Excellent extrudability
Applicable grades:
LIR-50, LBR-302, LBR-307,
L-SBR-820, L-SBR-841

5 *Cushion:*

Enhanced surface smoothness of calendered sheet
Reduced extrusion temperature
Better green tackiness
Improvement of dynamic properties
Applicable grades: LIR-50, LBR-302, LBR-307

KURARAY LIQUID RUBBER IN RUBBER APPLICATIONS

KURARAY LIQUID RUBBER is processed in various rubber goods besides tires. Typical applications include anti-vibration rubber compounds, fenders, conveyer belts, rubber hoses and gaskets. LIR and LBR deliver a balanced performance including longer shelf life with minimal migration.

- Selected grades are suitable for EPDM applications
- Improved processability due to lower Mooney viscosity
- Co-vulcanizable with base rubber such as NR/IIR/SBR/BR/EPDM which reduces migration
- Improved adhesion to metal possible with functionalized grades
- Colorless and odorless with low VOC's

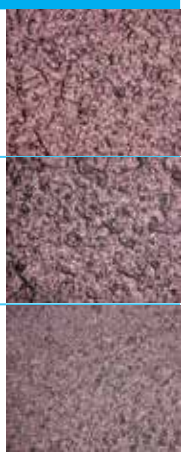
The following formulation illustrates the benefit of using LIR-50 in an extrusion.

Formulation	Control 1	Control 2	LIR-50 formulation
NR (RSS #3)	70	66	**66**
SBR 1502	30	30	**30**
Process Oil (Aromatic)	-	4	**-**
KURARAY LIQUID RUBBER LIR-50	-	-	**4**
CB (FEF)	50	50	**50**
ZnO No. 1	5	5	**5**
Stearic Acid	2	2	**2**
Sulfur	2.2	2.2	**2.2**
Accelerator CBS	1.2	1.2	**1.2**
Antioxidant IPPD	1	1	**1**

[Mixing]
1 BR Banbury Mixer : 6min
2 8 inch Roll : 10min

[Garvey die extrusion test (ASTM D2230)]
(Test Conditions)
- Cylinder temp. : 90°C
- Die temp. : 90°C
- Screw rotation speed : 20rpm

	Extruded Sample	Edge*	Surface*
Control 1		6	B
Control 2		6	B
LIR-50 formulation		10	A



*) EDGE: 10 (excellent) ↑ 1 (poor)
SURFACE: A (excellent) ↑ E (poor)

KURARAY LIQUID RUBBER IN ADHESIVES

KURARAY LIQUID RUBBER is commonly used in adhesive applications such as pressure sensitive adhesives and hot melts. The lower molecular weight grades improve tack and adhesive properties. The UV crosslink-able grades provide excellent flexibility, tack, low shrinkage and moisture resistance which are ideal for flexible electronic applications.

- 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

Suitable grades of KURARAY LIQUID RUBBER in adhesives

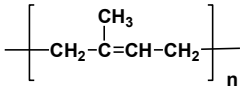
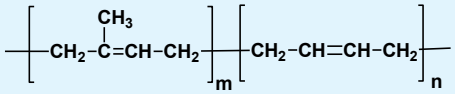
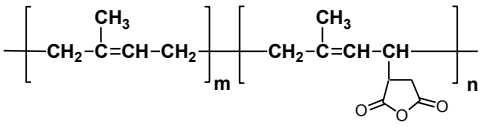
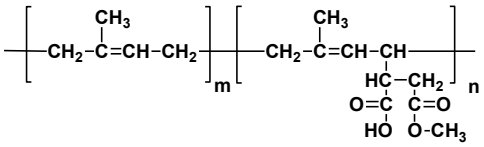
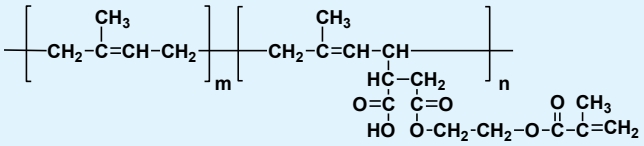
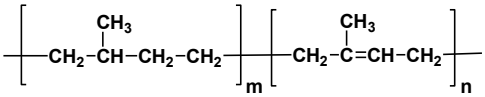
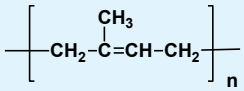
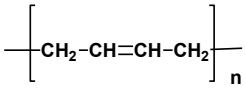
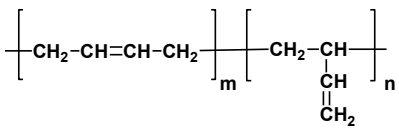
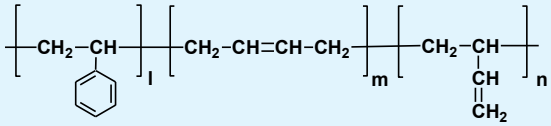
		LIR-30 LIR-50	LBR-302 LBR-307 LBR-305 LBR-352 LBR-361	LIR-390	LIR-290	LIR-403 LIR-410	UC-102M UC-203M	LIR-700	L-SBR-820 L-SBR-841
Solution	NR,IR	▪	▪						
	SBR	▪	▪						▪
	IIR	▪	▪		▪				
Latex	NR, SBR latex							▪	
Hot melt	SIS	▪	▪	▪	▪				▪
	SBS	▪	▪	▪	▪				▪
	SEBS, SEPS				▪				
	EVA				▪				
Crosslink	NR					▪			
	NR/SBR					▪			
	KURARAY LIQUID RUBBER LIR-403, LIR-410 as base rubber					▪			
	UV radiation						▪		

▪ : applicable

KURARAY LIQUID RUBBER IN COATINGS & SEALANTS

KURARAY LIQUID RUBBER is also used in coatings and sealants. Typical applications include automotive, construction and marine coatings and sealants.
KURARAY LIQUID RUBBER‘s narrow molecular weight distribution ensures minimal residuals for improved quality.

- Colorless, transparent and odorless without halogen residuals
- Selected grades are suitable for food contact applications
- Low glass transition temperature (Tg) improves low temperature properties
- Isoprene/butadiene block copolymer grade, LIR 390, provides faster reactivity

Category	Type	Grade name	Structure
LIR (Isoprene)	Homopolymer	LIR-30 LIR-50	
	Block Copolymer	LIR-390	
	Carboxylated	LIR-403	
		LIR-410	
	UV Curable	UC-102M UC-203M	
	Hydrogenated	LIR-290	
	Latex	LIR-700	
LBR (Butadiene)	Homopolymer	LBR-302 LBR-307 LBR-305	
		LBR-352 LBR-361	
L-SBR (Styrene/ Butadiene)	Random Copolymer	L-SBR-820 L-SBR-841	

Number of functional groups per molecule	Molecular Weight	Viscosity (Pa·s at 38°C)	Glass Transition Temp. (°C)	Features and main applications
-	28,000	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.
-	54,000	500	-63	
-	48,000	400	-95	▪ Hot melt adhesives/PSA (SIS, SBS, EVA) ▪ Automotive sealants, coatings and adhesives
3	34,000	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.
10	30,000	430	-59	
2	17,000	30	-60	▪ Low temperature reactivity ▪ Crosslinkable using UV ▪ Pressure sensitive adhesives (UV curing adhesives)
3	35,000	190	-60	
-	31,000	1,200	-59	▪ Reactive plasticizer (EPDM) ▪ Hot melt adhesives (SEBS, SEPS) ▪ Superior heat and weather resistance
-	28,000	7.5 (at 25°C) (Solid cont.= 60wt%)	-63	▪ Good compatibility with NR latex ▪ Reactive plasticizer (NR latex, SBR latex) ▪ Adhesives
-	5,500	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
	8,000	1.5	-95	
	26,000	40	-95	
-	9,000	6	-60	
-	5,500	5.5	-49	
-	8,500	350	-14	▪ Good compatibility with S-SBR and E-SBR ▪ Tire and rubber goods ▪ Automotive sealants, coatings and adhesives ▪ Partially hydrogenated grades are available ▪ Damping material
-	10,000	100 (at 60°C)	-6	

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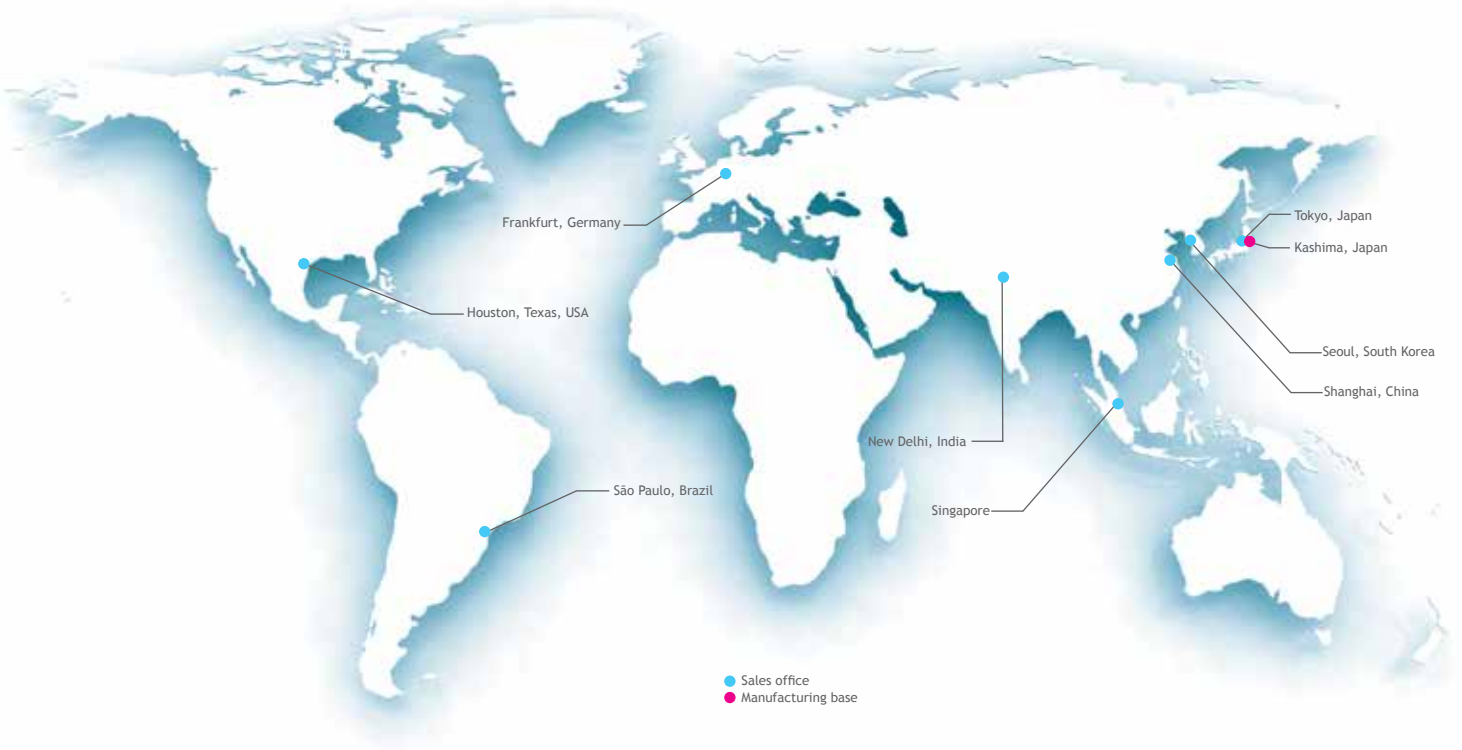
Adding value to your products – worldwide



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.

The history of 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 KURARAY LIQUID RUBBER, ISOBAM™, SEPTON™, HYBRAR™, and KURARITY™.

Kuraray strives to develop new and innovative high performance products for customers around the globe. If you would like to know more about Kuraray's Elastomer products please also visit our website *www.elastomer.kuraray.com*

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01/2020