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Update on Kuraray Liquid Rubber (KLR)

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Update on Kuraray Liquid Rubber (KLR)

Kuraray has developed a series of liquid rubbers with molecular weights ranging from 5,000 to 70,000. Kuraray Liquid Rubbers (KLR) are low molecular weight polydiene and act as reactive or co-vulcanizable plasticizers. KLR can be used for a wide range of applications including rubber goods, (tires, belts), adhesives (solution, hot melt, latex, UV curable), automotive and construction sealants and others (printing plate, coating). Their main field of application today is in tire compounds. KLR can be used for various parts of the tire, including tread, carcass, side wall, and bead filler.

NR compositions

Typical properties of KLR are summarized in **table 1.** The effects of KLR in natural rubber and carbon black composition have been described in detail in previous publications [1 – 4].

The plasticizing effect of KLR was equivalent to TDAE in NR formulations. Furthermore, low molecular weight KLR showed a better level of plasticizing effect in comparison to TDAE. All KLR formulations maintained tensile strength and elongation with TDAE formulations. LBR formulations showed a better level of wear resistance compared with TDAE.

SBR and silica compositions

KLR were mixed with SBR, silica and vulcanizing agents with a Banbury mixer and laboratory roll mill in the formulation (SBR/silica/plasticizer = 100/50/10). Effects on viscosity are shown in **figure 1.** The plasticizing effect of KLR was almost equivalent to TDAE in SBR formulations. Especially LBR showed an excellent level of plasticizing effect and LBR-307 formulations showed better elongation compared to TDAE formulations. Properties of DIN abrasion are shown in **figure 2.** LBR showed a better level of wear resistance compared to TDAE as well as natural rubber and carbon black composition.

Fig. 1: Mooney viscosity

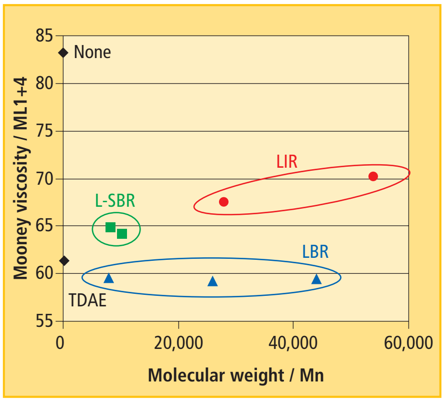
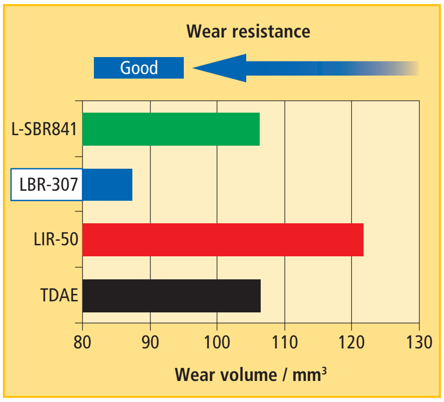


Fig. 2: Wear resistance (method DIN abrasion, JIS-K6248)



Performance in tires

Tan δ and E' were measured with an Eplexor (Gabo) under conditions of static strain of 10 % and dynamic strain of 5 %. The tan δ of the L-SBR at 0 °C was much higher than that of TDAE but L-SBR also increased tan δ at 60 °C slightly because L-SBR has the higher T_g **(fig. 3a, b).** From these results, L-SBR is expected to improve wet grip although it slightly deteriorates rolling resistance [5].

Summary

We expect KLR to have a growth potential as environmentally friendly plasticizers. The effect of co-vulcanizability at a higher level of molecular weight compared to standard oils like TDAE results in low migration and a better environmental protection with longer life durability.

References

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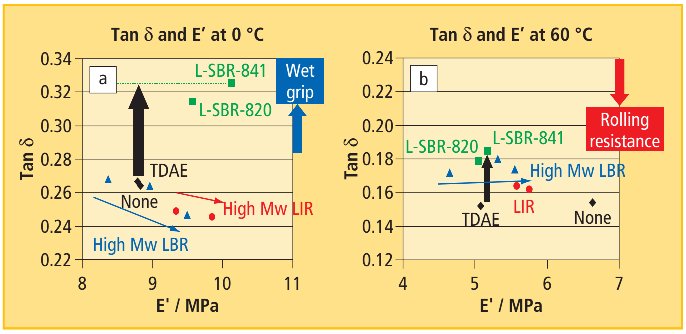
Fig. 3: Tan δ and E' at 0 °C and at 60 °C



Tab. 1: Overview of liquid rubber materials

Liquid rubber	Structure	Molecular weight	Melt viscosity at 38 °C / Pa·s	T_g / °C
LIR-50	IR	54,000	500	–63
LIR-30	IR	28,000	70	–63
LBR-300*	BR	44,000	225	–95
LBR-305	BR	26,000	40	–95
LBR-307	BR	8,000	1.5	–95
L-SBR-820	SBR	8,300	350	–14
L-SBR-841*	SBR	10,000	130 (60 °C)	–6

*Developing grade