Thermax® N990 in EPDM Coolant Hose Compounds

Automotive coolant hoses are important components in both internal combustion engine (ICE) and electric vehicles (EV). They are necessary to keep engine or battery temperatures within optimal performance ranges. The EV coolant systems are constructed using a combination of aluminum, elastomer (EPDM), and polyamide components. In this study, Thermax® N990 replaced furnace black N550 in an EPDM coolant hose formulation.

The benefits of Thermax® N990 displacing up to 45 phr of N550 include:

- **Up to 20% reduction** in mixing power consumption
- Significant improvement in dispersion
- **Up to 15% reduction** in compound Mooney viscosity allowing for lower energy usage and/or increased throughput in processing
- **Excellent heat and fluid resistance**
- Maintenance of physical properties

The EPDM formulations can be found in Table 1. To maintain constant hardness the N550 was replaced at a 2.0:1.0 N990:N550 ratio. Testing was completed at 15%, 30% and 45% replacement of N550. Dispersion, Mooney viscosity, MDR, Shore A hardness, tensile, heating aging, fluid aging, and compression set tests were run on all compounds. The compounding and testing were completed at Smithers in Akron, Ohio. Testing results can be found in the figures on the following pages.

Table 1. Test formulations

Ingredient	Control	A	B	C
Nordel 4570	100.0	100.0	100.0	100.0
N550	100.0	85.0	70.0	55.0
Thermax® N990	**0.0**	**30.0**	**60.0**	**90.0**
Stan-Lube 60	50.0	50.0	50.0	50.0
Antiox 58	1.5	1.5	1.5	1.5
Antiox DQ	1.0	1.0	1.0	1.0
Sartomer SR350	3.0	3.0	3.0	3.0
VC-40K	6.5	6.5	6.5	6.5
Total	**262.0**	**277.0**	**292.0**	**307.0**

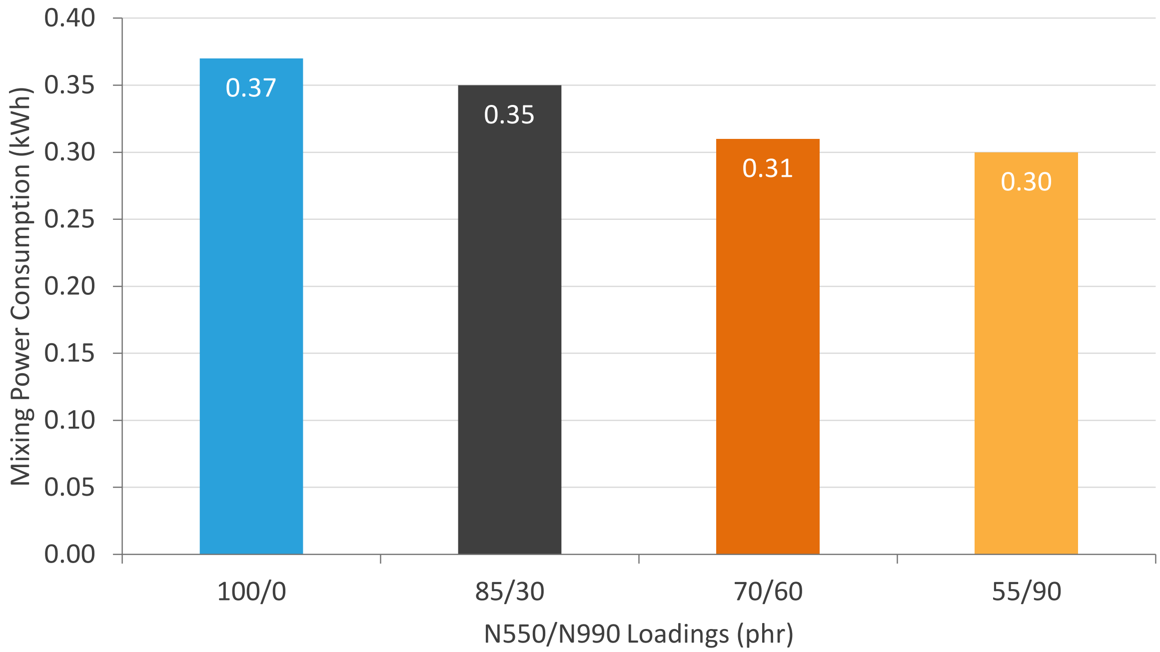

Figure 1. Mixing power consumption of the compounds. Power consumption tended to decrease as N990 replaced N550.

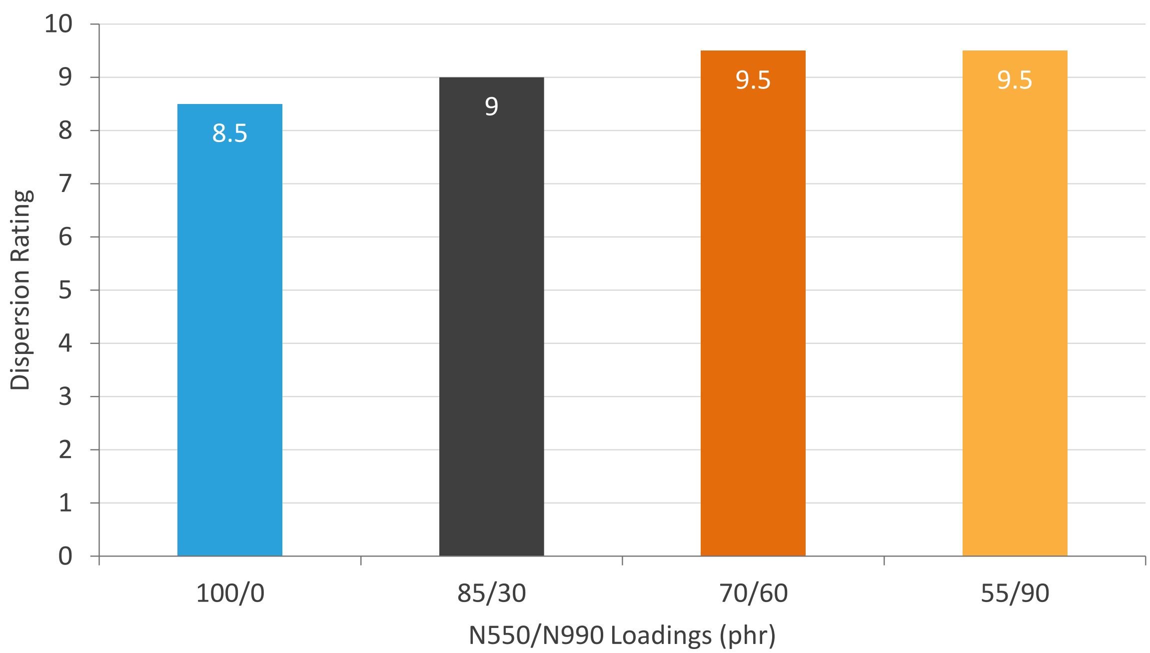

Figure 2. Dispersion rating of the compounds measured by optical microscopy. Dispersion tended to improve as N990 replaced N550.

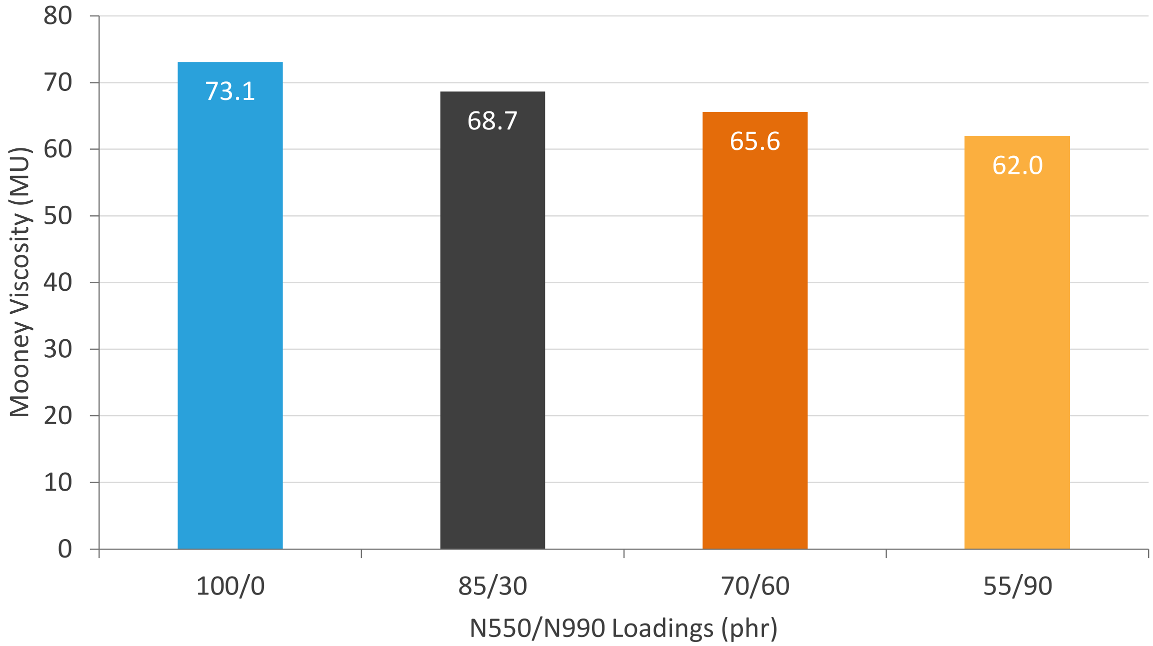

Figure 3. Mooney viscosity, ML1+4, of the compounds measured at 100°C. Viscosity tended to decrease as N990 replaced N550.

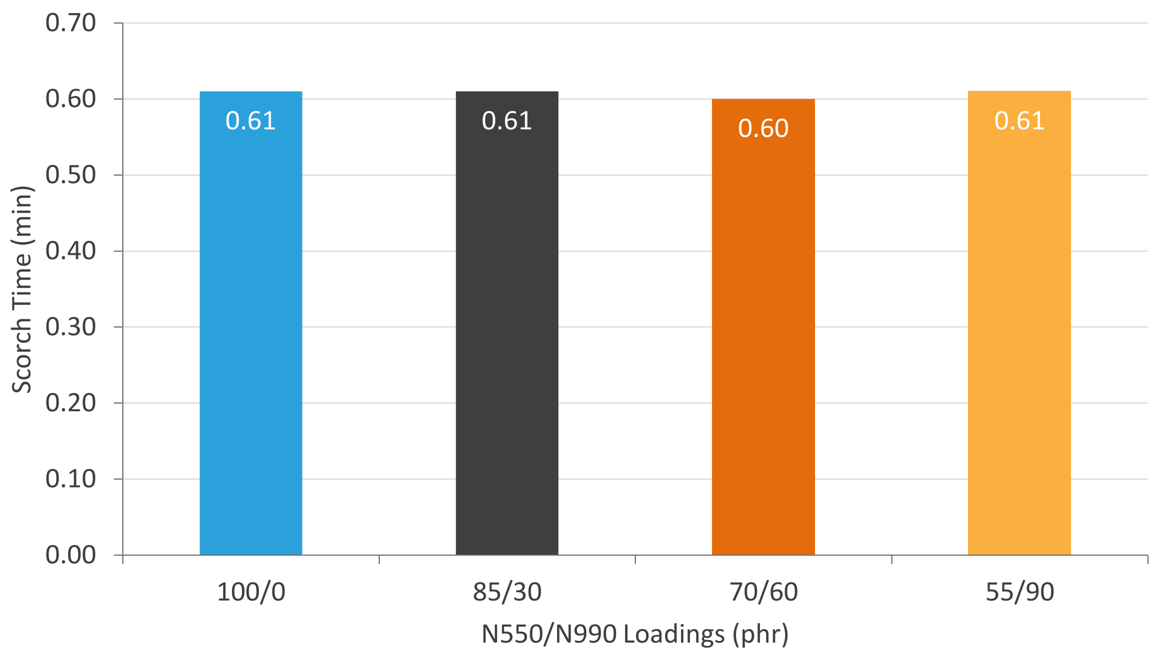

Figure 4. Scorch time, t'10, of the compounds measured using an MDR at 177°C. No significant differences were observed.

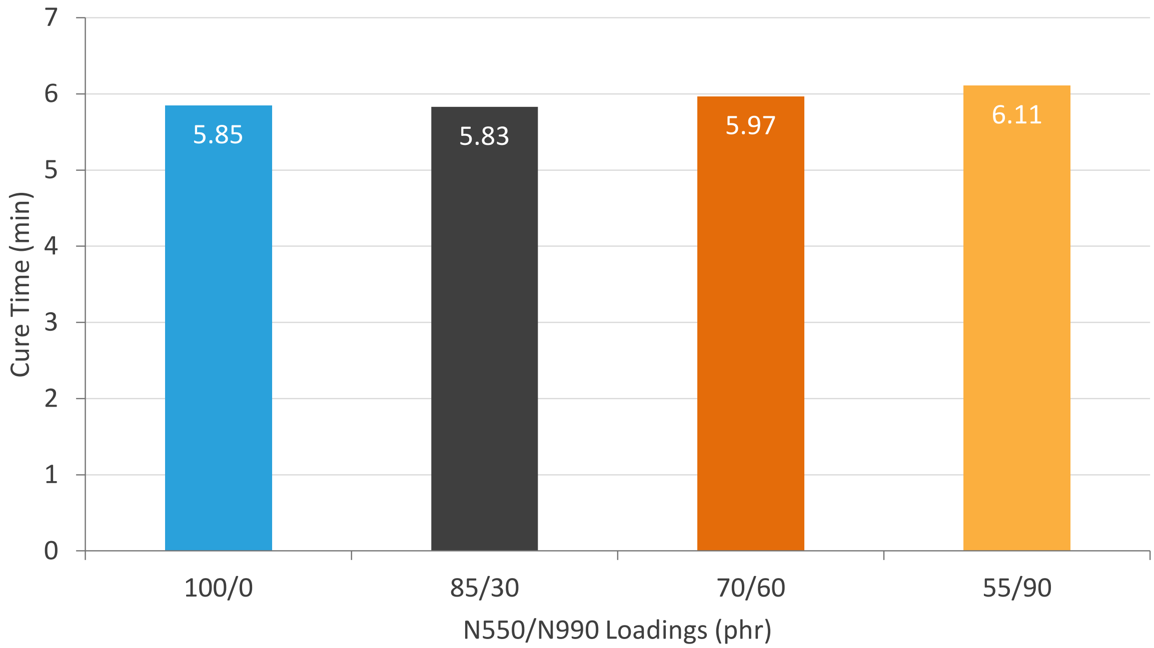

Figure 5. Cure time, t'90, of the compounds measured using an MDR at 177°C. No significant differences were observed.

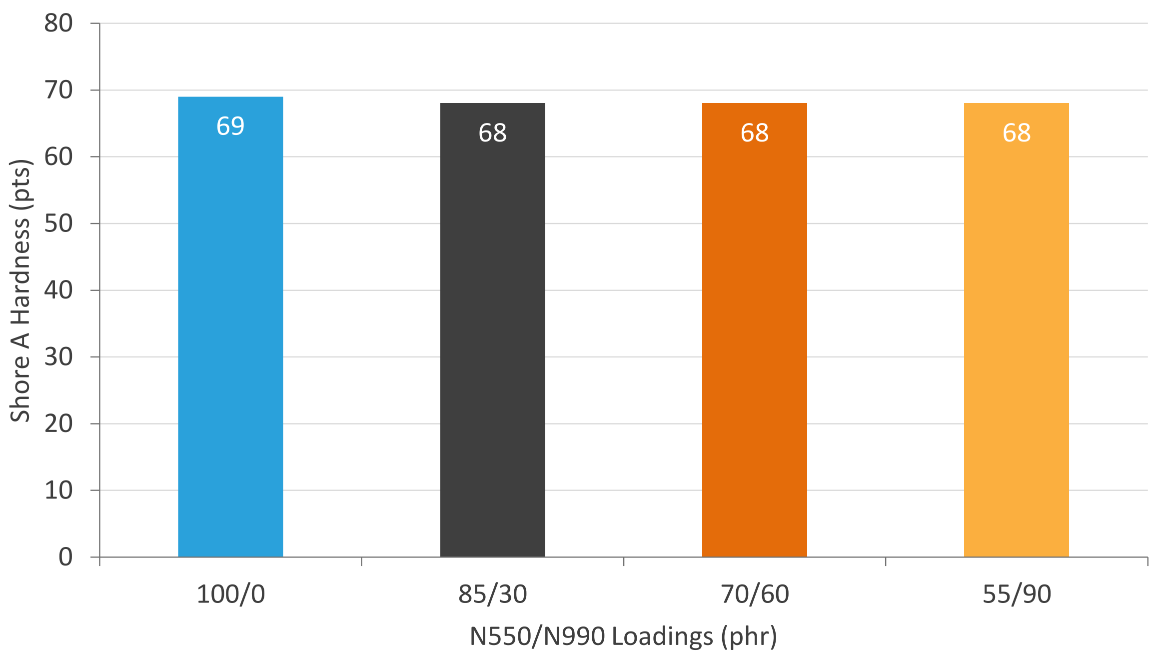

Figure 6. Shore A hardness of the compounds. No significant differences were observed.

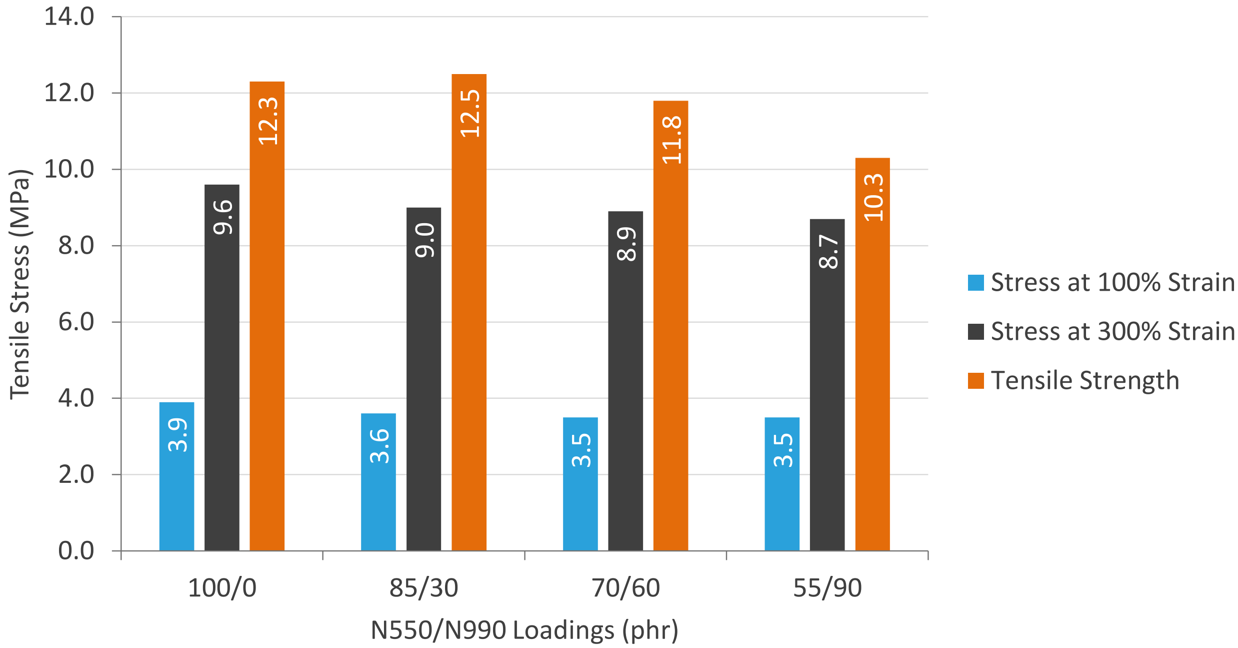

Figure 7. Tensile stress of the compounds as measured by ASTM D412. Stress at 100% and 300% strain tended to decrease as N990 replaced N550. At 15% and 30% replacement, the tensile strength was maintained. At the highest replacement level, a reduction in tensile strength was observed.

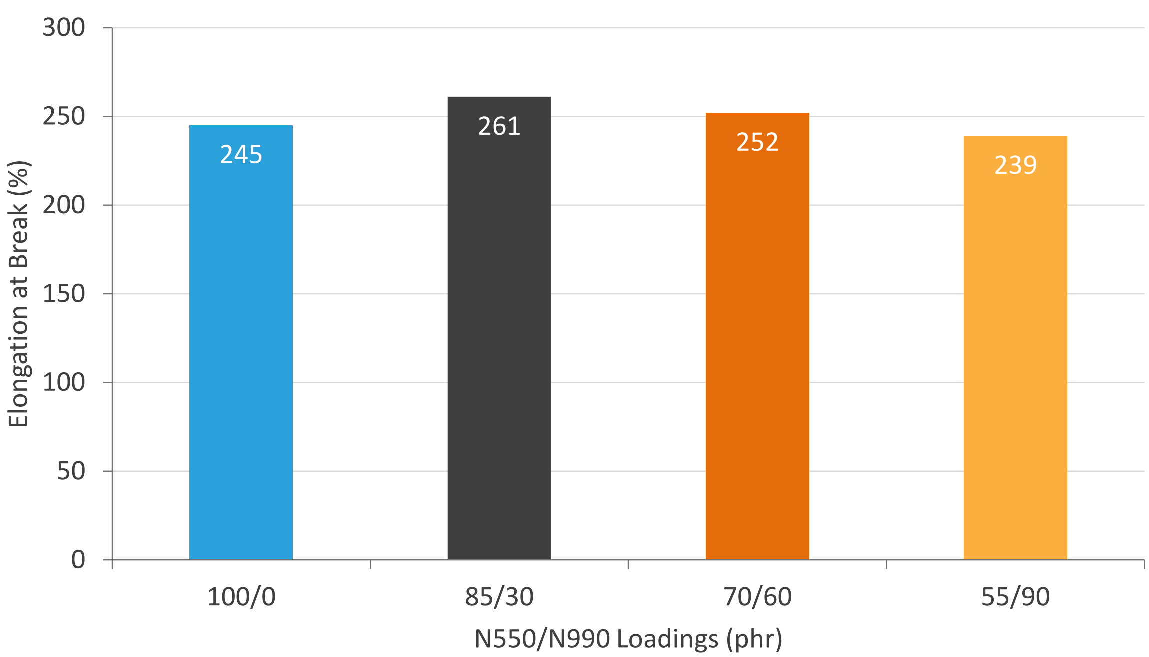

Figure 8. Elongation at break of the compounds as measured by ASTM D412. No significant differences were observed.

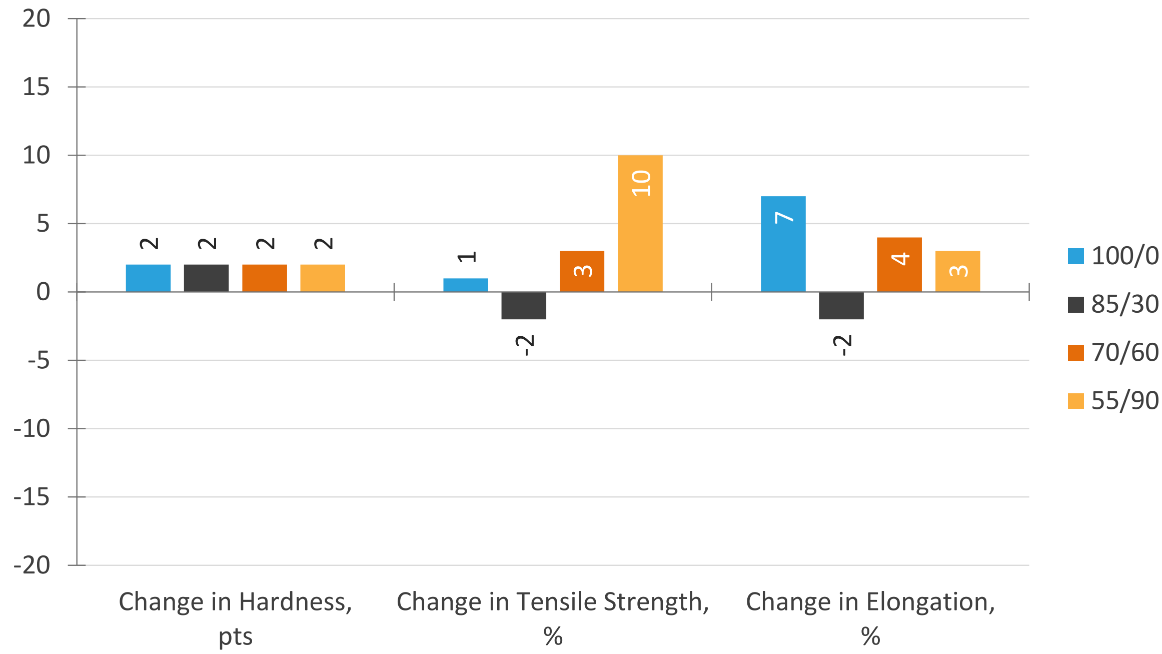

Figure 9. Change in properties of the compounds after heat aging for 168 hours at 100°C. All compounds displayed good heat resistance.

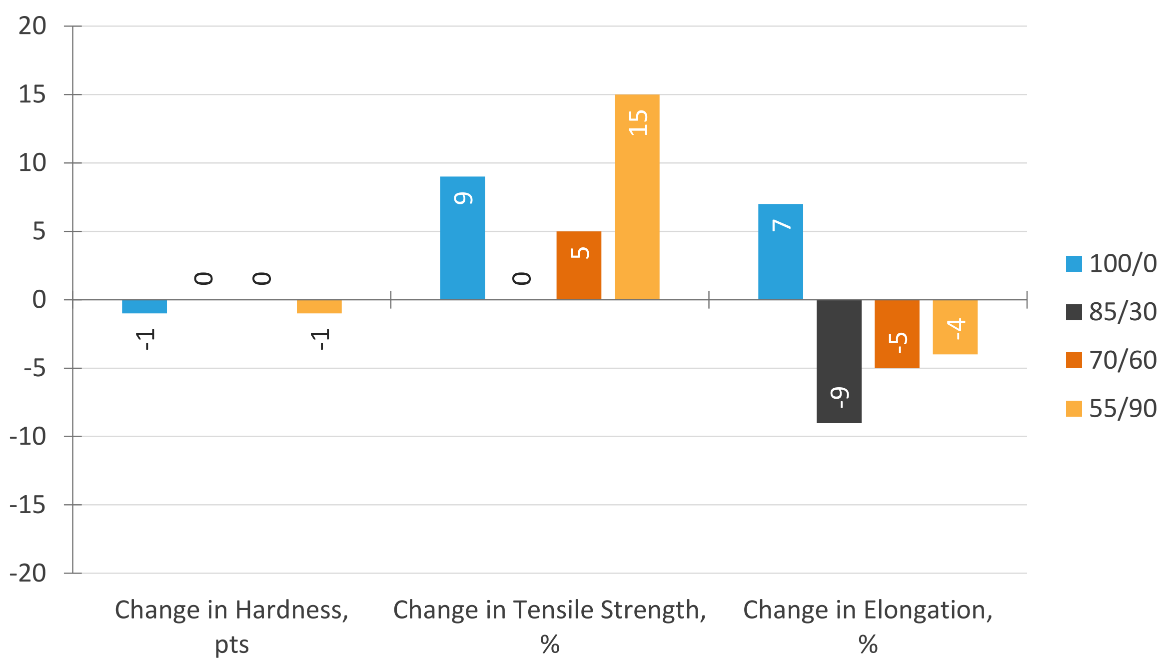

Figure 10. Change in properties of the compounds after fluid aging in 50/50 Dexcool for 70 hours at 100°C. All compounds displayed good fluid resistance. Volume swell was zero for all compounds.

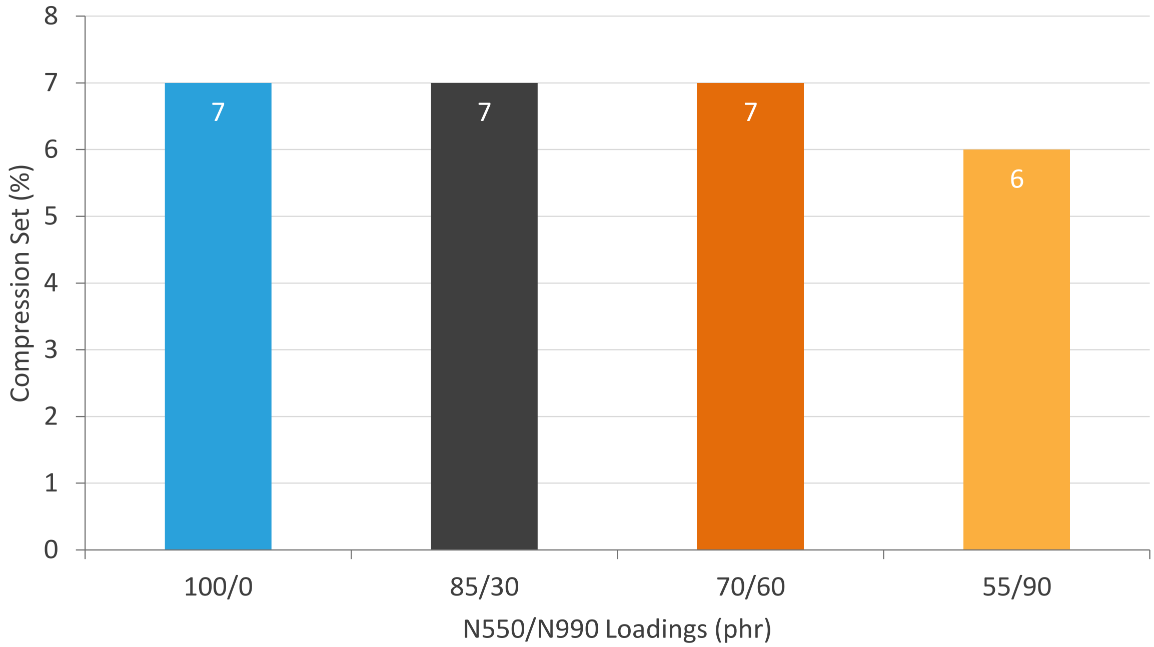

Figure 11. Compression set of the compounds measured after 22 hours at 70°C. All compounds had excellent compression set.