cancarb
TOKAI CARBON GROUP

Thermax® N990 in Conveyor Belt Compounds

Conveyor belts typically consist of multiple layers: a top cover layer, a carcass which consists of alternating fabric plies and rubber skim coats, and a bottom cover layer. Other carcass types exist such as steel cords encased in rubber. The main purpose of the cover compounds is to protect the carcass. The top cover layer will be in contact with the materials being conveyed and must adequately resist abrasion, cut, tear, and impact for the given application. The bottom cover layer will be in contact with the rollers and must have adequate wear resistance. The bottom cover also contributes significantly to the indentation rolling resistance of the belt. A reduction in rolling resistance can provide substantial energy savings over the life of the belt. In this study, Thermax® N990 replaced furnace black N234 in a NR/BR model conveyor belt cover formulation.

The benefits of Thermax® N990 confirmed in the study were:

- **Up to 10% reduction** in compound Mooney viscosity allowing for lower energy usage and/or increased throughput in processing
- **Up to 25% reduction** in hysteresis which can result in a decrease in indentation rolling resistance of the belt
- Maintenance of physical properties

The NR/BR formulations can be found in Table 1. To maintain constant hardness the N234 was replaced at a 2.0:1.0 N990:N234 ratio. Testing was completed at 10%, 20% and 30% replacement of N234. Mooney viscosity, MDR, Shore A hardness, tensile, abrasion resistance, tear resistance, cut resistance, and dynamic property 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
NR – RSS#1	60.0	60.0	60.0	60.0
BR – Buna CB 25	40.0	40.0	40.0	40.0
N234	55.0	49.5	44.0	38.5
Thermax® N990	**0.0**	**11.0**	**22.0**	**33.0**
Naphthenic oil	10.0	10.0	10.0	10.0
ZOCO 104	3.0	3.0	3.0	3.0
Stearic acid	2.0	2.0	2.0	2.0
TMQ	1.0	1.0	1.0	1.0
6PPD	2.0	2.0	2.0	2.0
Akrowax 195	2.5	2.5	2.5	2.5
TBBS	1.5	1.5	1.5	1.5
Sulfur	2.5	2.5	2.5	2.5
Total	**179.5**	**185.0**	**190.5**	**196**

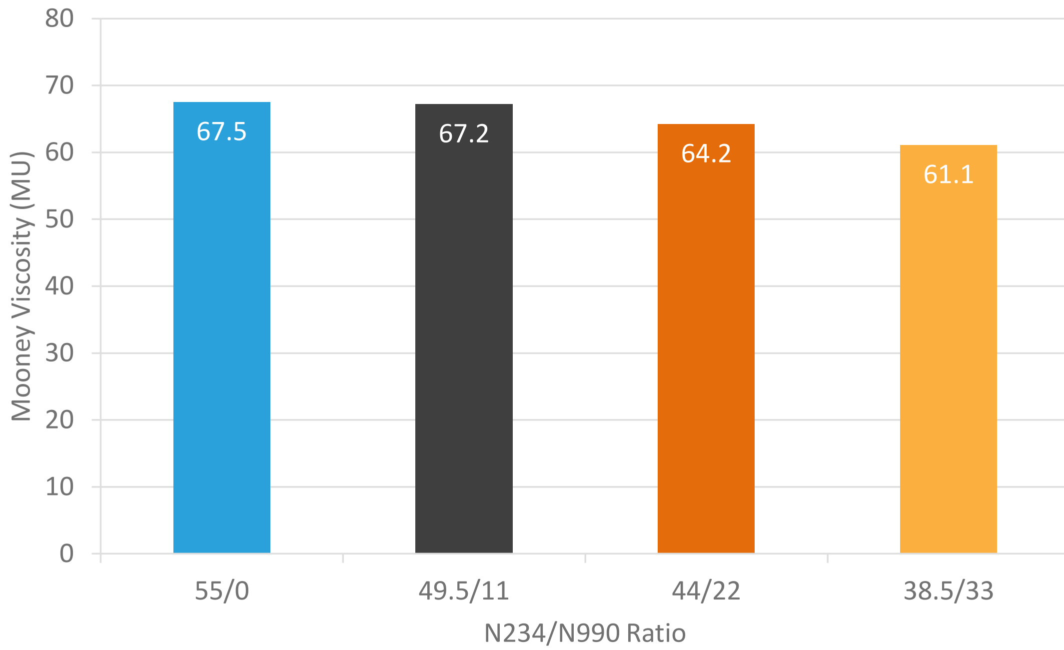

Figure 1. Mooney viscosity, ML1+4, measured at 100°C for the compounds. Viscosity tended to decrease as N990 replaced N234.

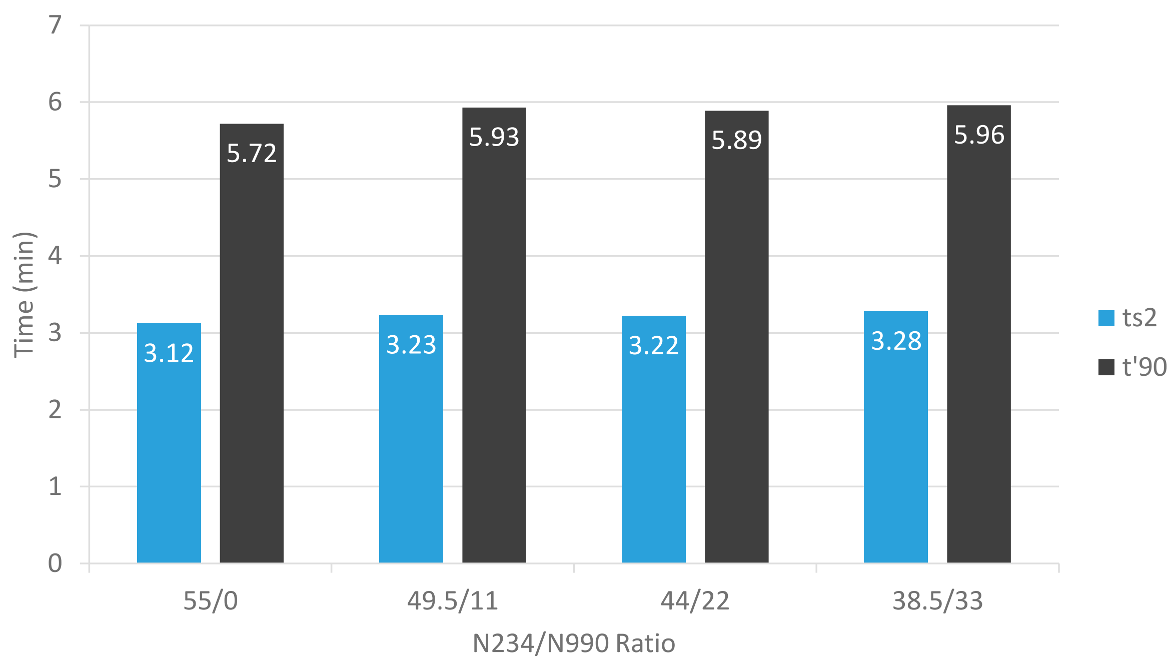

Figure 2. MDR scorch and cure times for the compounds. There were no significant differences in scorch or cure times.

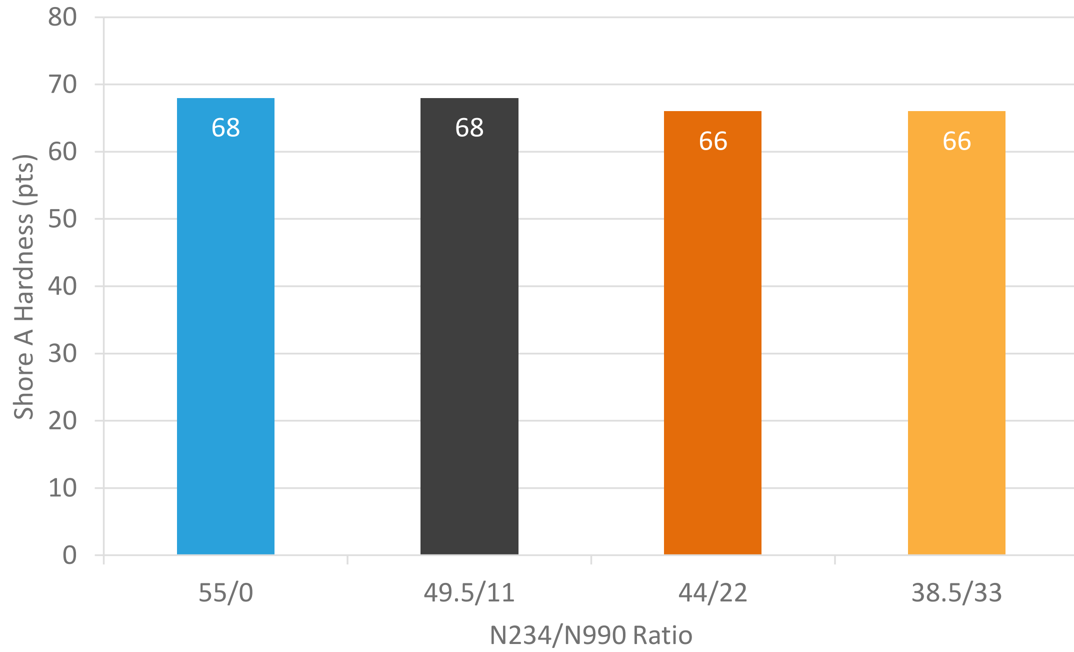

Figure 3. Shore A hardness for the compounds. All compounds had similar hardness.

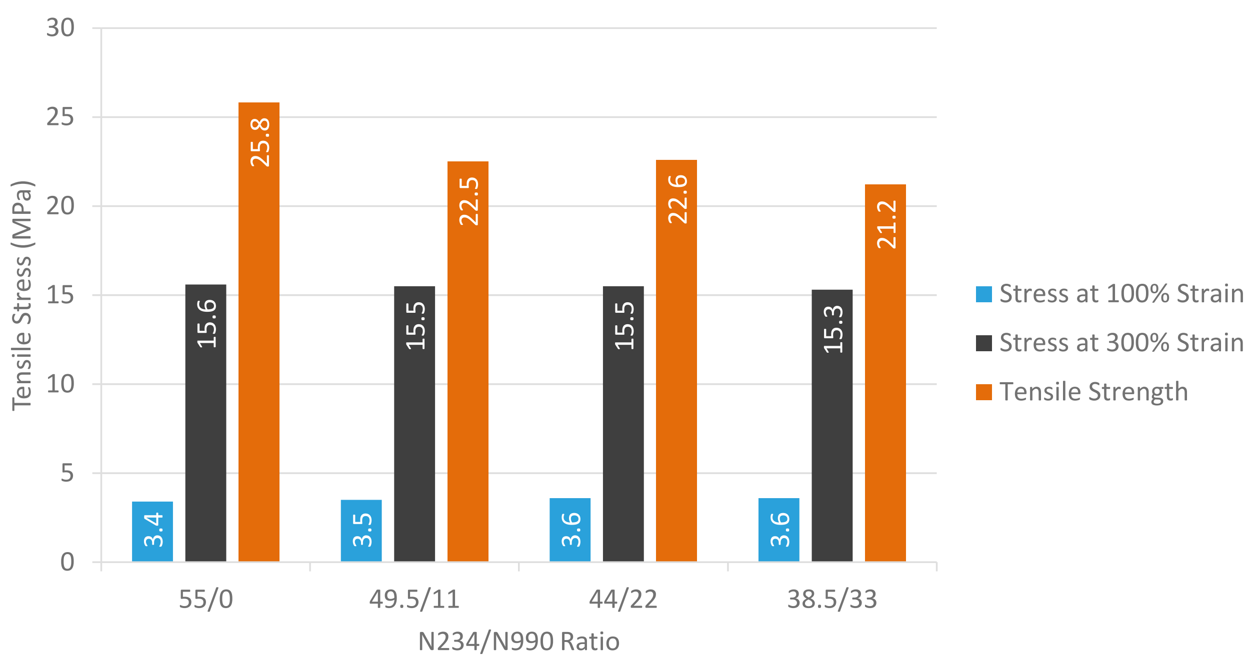

Figure 4. Tensile stress of the compounds as measured by ASTM D412. There were no significant differences in tensile modulus. The tensile strength tended to decrease as N990 replaced N234.

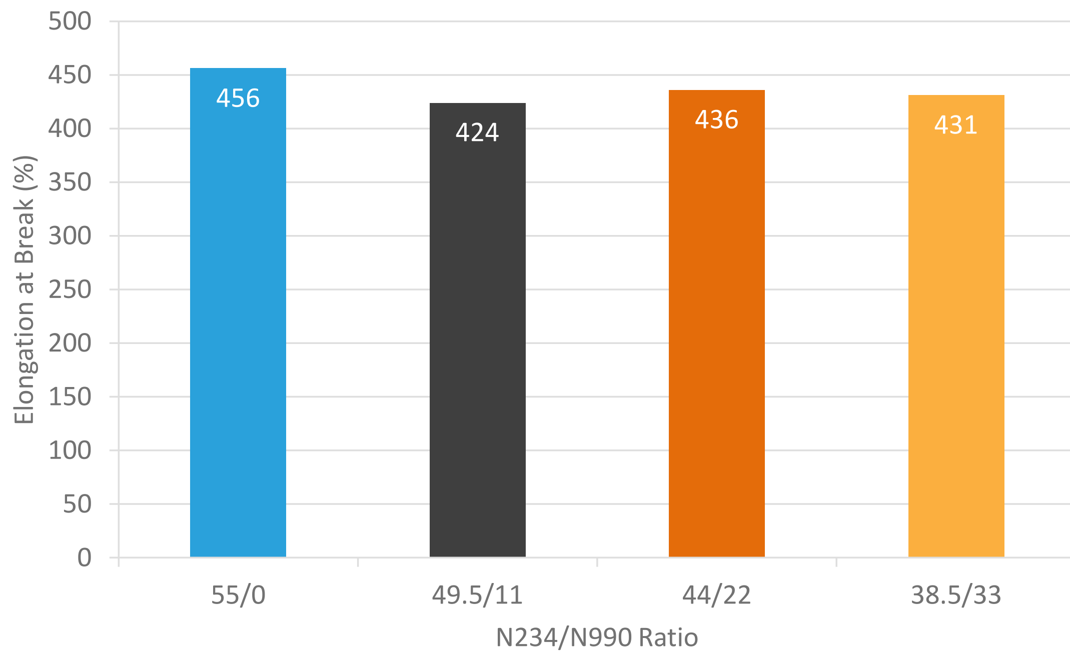

Figure 5. Elongation at break of the compounds as measured by ASTM D412. There were no significant differences in elongation.

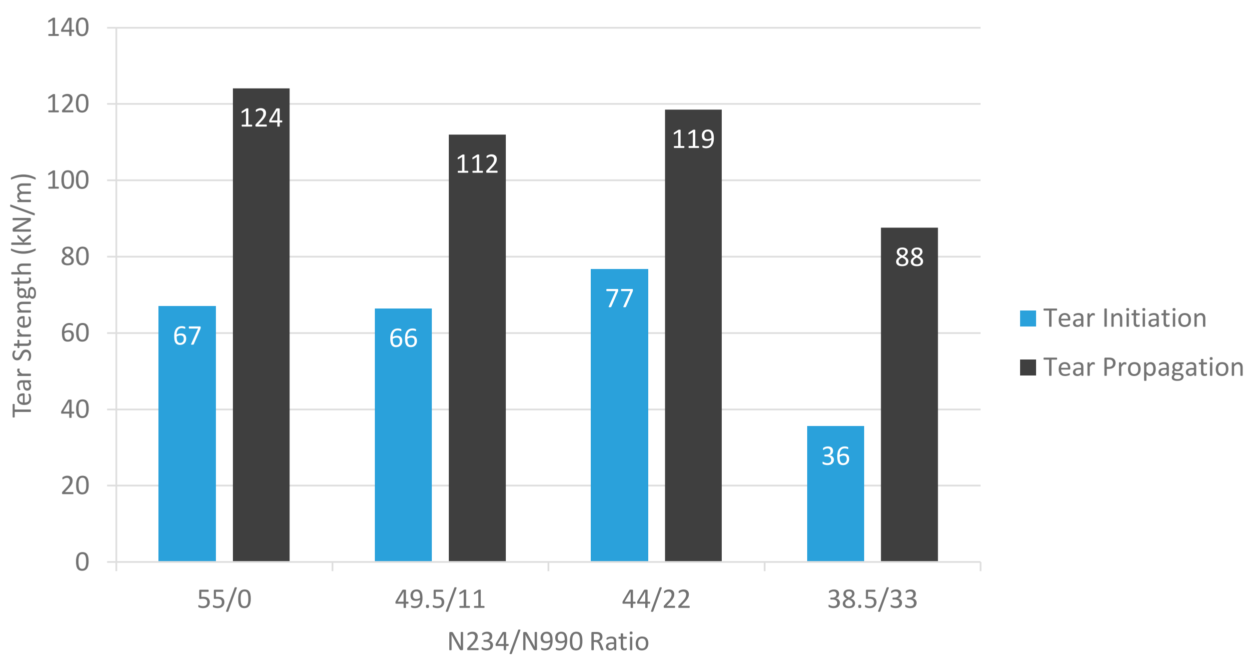

Figure 6. Tear initiation and propagation strength as measured by ASTM D624. Tear strength values decreased at the highest replacement level. There were no significant differences in tear strength for the compounds with 11 phr and 22 phr N990.

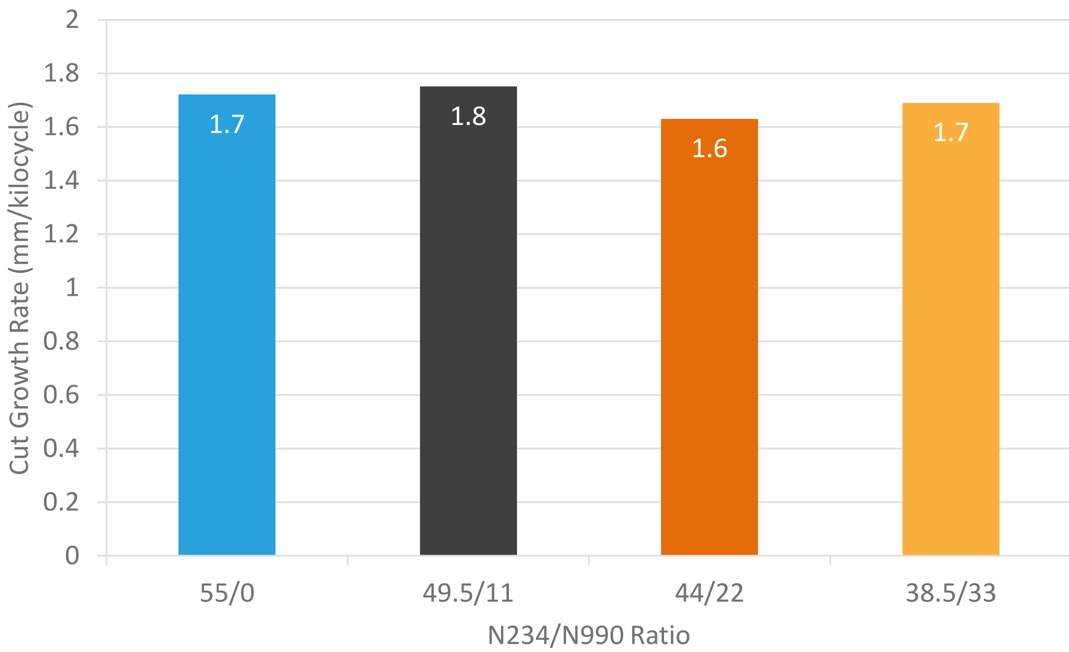

Figure 7. Cut growth rate for the compounds as measured by ASTM D813. There were no significant differences in cut growth rate.

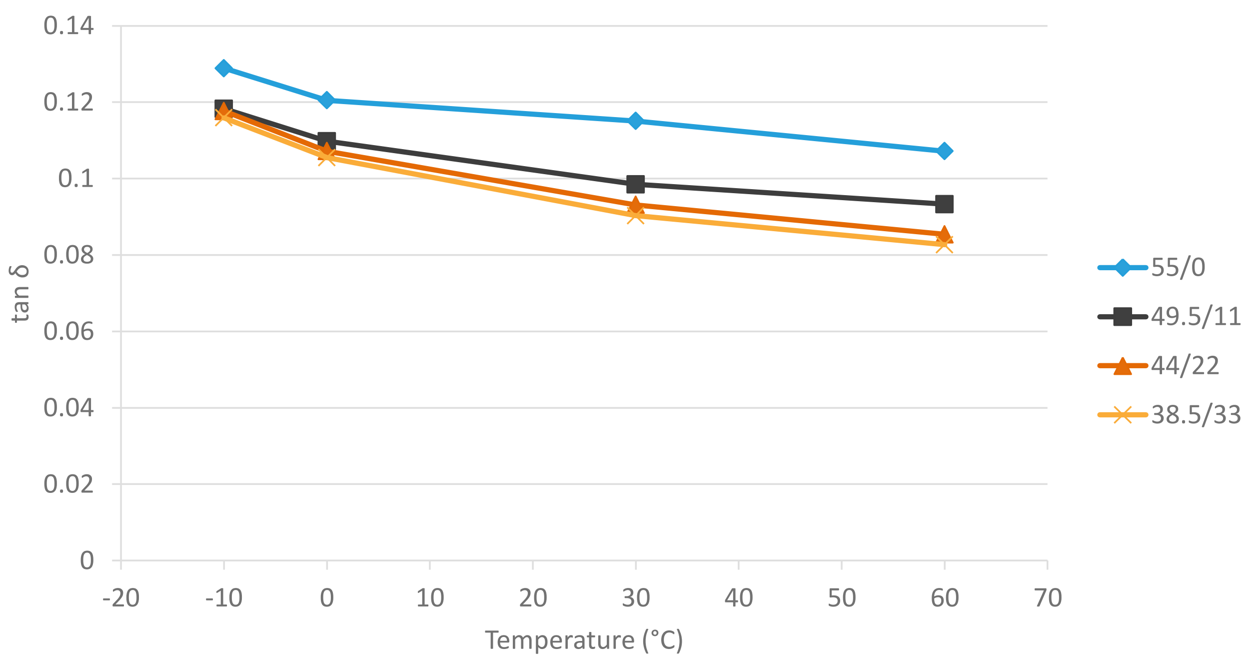

Figure 8. Tan δ versus temperature measured at 1 Hz and 0.25% strain. Tan δ tended to decrease as N990 replaced N234 indicating lower energy loss. Lower hysteresis translates to lower indentation rolling resistance of the belt.

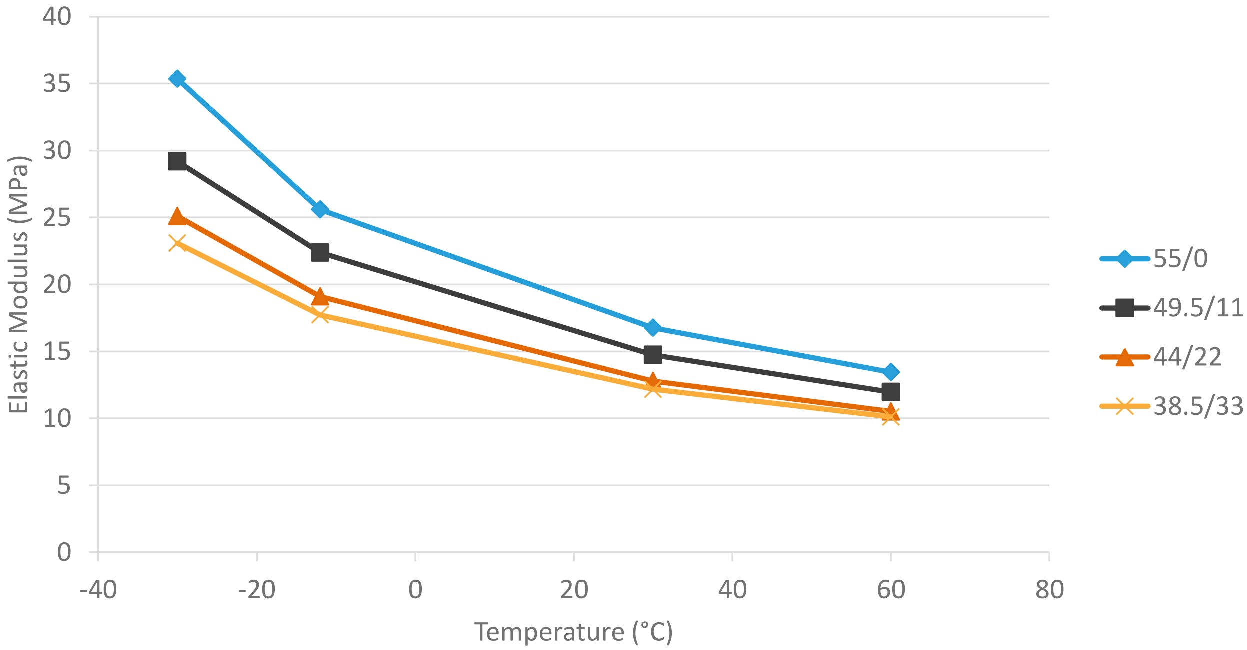

Figure 9. Elastic modulus versus temperature measured at 1 Hz and 0.25% strain. Elastic modulus tended to decrease slightly as N990 replaced N234.

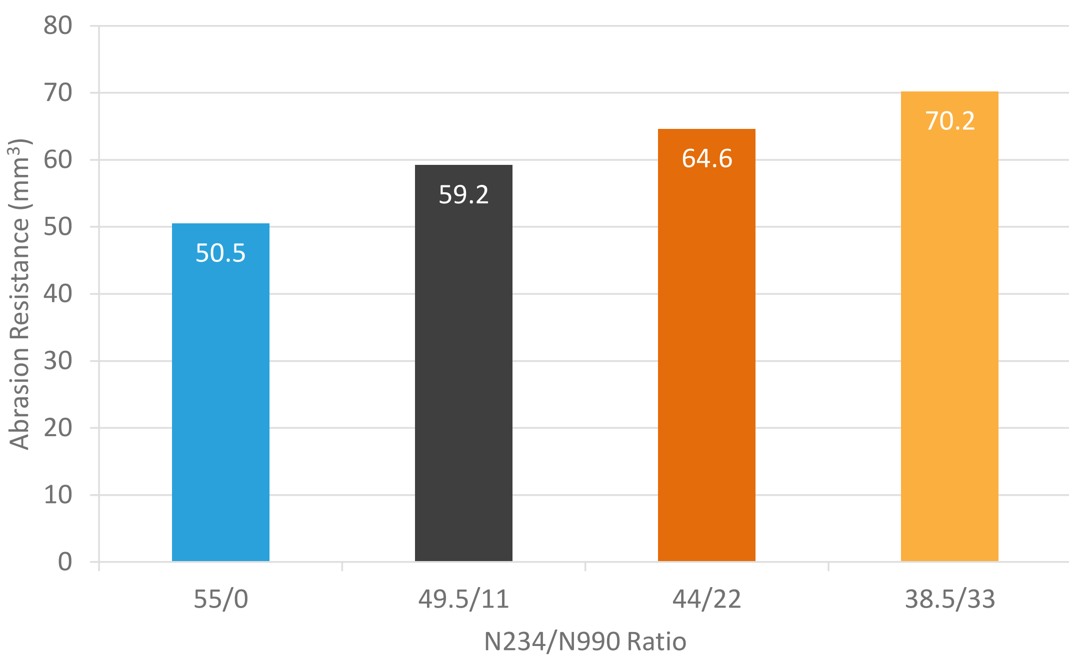

Figure 10. Abrasion resistance of the compounds as measured by ASTM D5963. Abrasion resistance tended to decrease as N990 replaced N234.

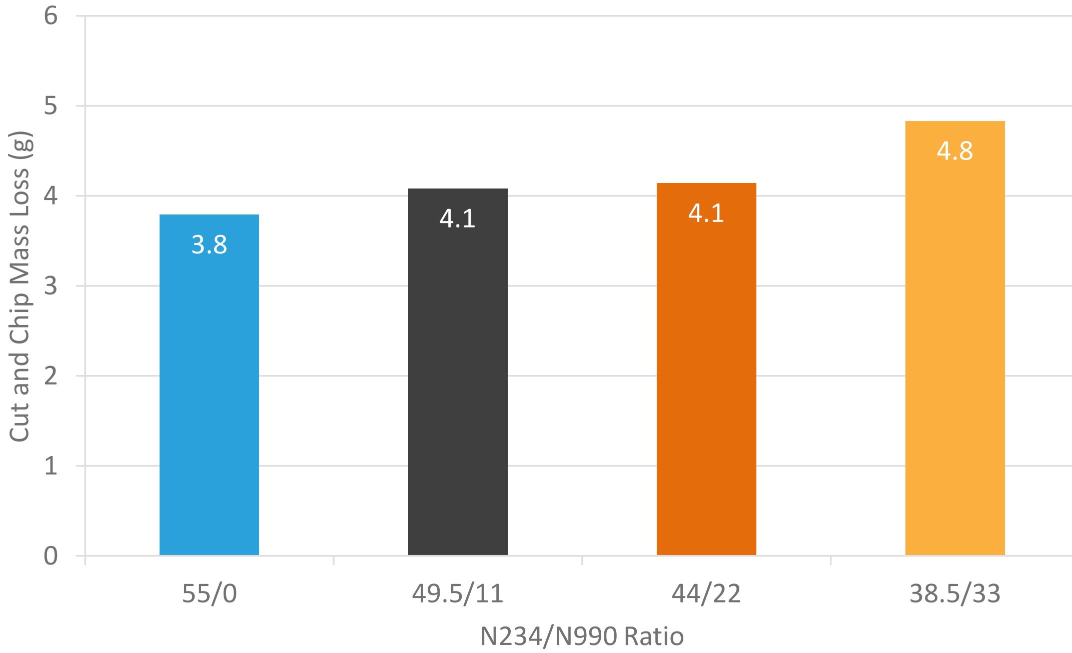

Figure 11. Cut and chip mass loss for each compound. Mass loss tended to increase slightly as N990 replaced N234.