Extending EPDM Compounds using Thermax® N990

EPDM compounds are often extended with process oils and fillers to achieve good physical properties at low cost. Typically, furnace grade carbon blacks in the N500 and N600 series are used to provide reinforcement. Replacing a portion of the furnace carbon black with thermal carbon black, N990, can result in minimal changes to the physical properties while further extending the compound and reducing cost. In the following studies, we examine the impact of introducing N990 into EPDM formulations containing primarily N500 and N600 series blacks.

The benefits of Thermax® N990 include:

- Significant improvement in dispersion
- **Higher total loadings leading to cost reductions**
- Maintenance of physical properties

The EPDM formulations can be found in Tables 1 and 2. To maintain constant hardness the furnace grades were replaced at 2.0:1.0 and 2.3:1.0 ratios. Dispersion, Mooney viscosity, MDR, Shore A hardness, tensile, and compression set tests were run on all compounds. Testing results can be found in the figures on the following pages.

Table 1. EPDM formulation 1

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

Table 2. EPDM formulation 2

Ingredient	Control	A	B
Royalene 645	70.0	70.0	70.0
Royalene 509	60.0	60.0	60.0
N650	100.0	90.0	66.0
Calcium Carbonate	42.0	42.0	42.0
Thermax® N990	**0.0**	**23.4**	**79.6**
Stearic Acid	1.5	1.5	1.5
Zinc Oxide	10.0	10.0	10.0
Carbowax 3350	4.0	4.0	4.0
Sunpar 2280	31.5	31.5	31.5
Stanplas 2000	31.5	31.5	31.5
DPTT	1.0	1.0	1.0
TMTD 75 EPR	2.0	2.0	2.0
ZDBC 80 EPR	1.9	1.9	1.9
Sulfur 80 EPR	0.4	0.4	0.4
Desical P	10.0	10.0	10.0
Total	**365.8**	**379.2**	**411.4**

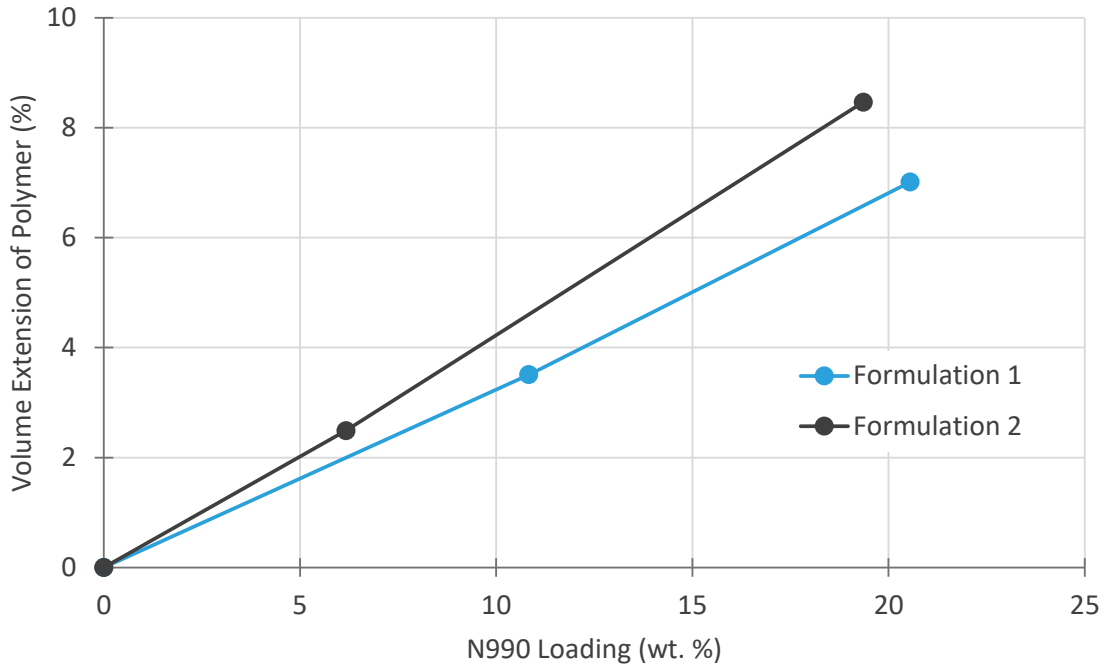

Figure 1. Volume extension of polymer as a function of N990 weight loading. As N990 replaces the furnace grade, the total filler loading of the compound increases. The increase in total loading outweighs the increase in compound density resulting in an increase in the volume of compound obtained per one hundred parts of rubber.

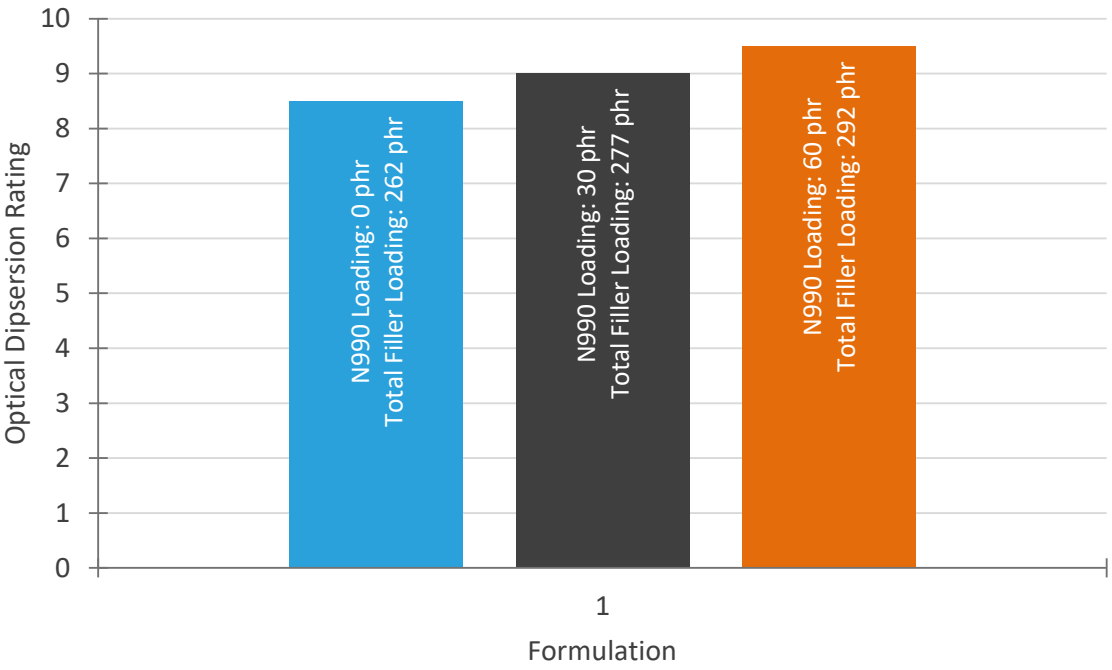

Figure 2. Optical dispersion rating of EPDM formulation 1 compounds. Dispersion improved as N990 was introduced into the compound.

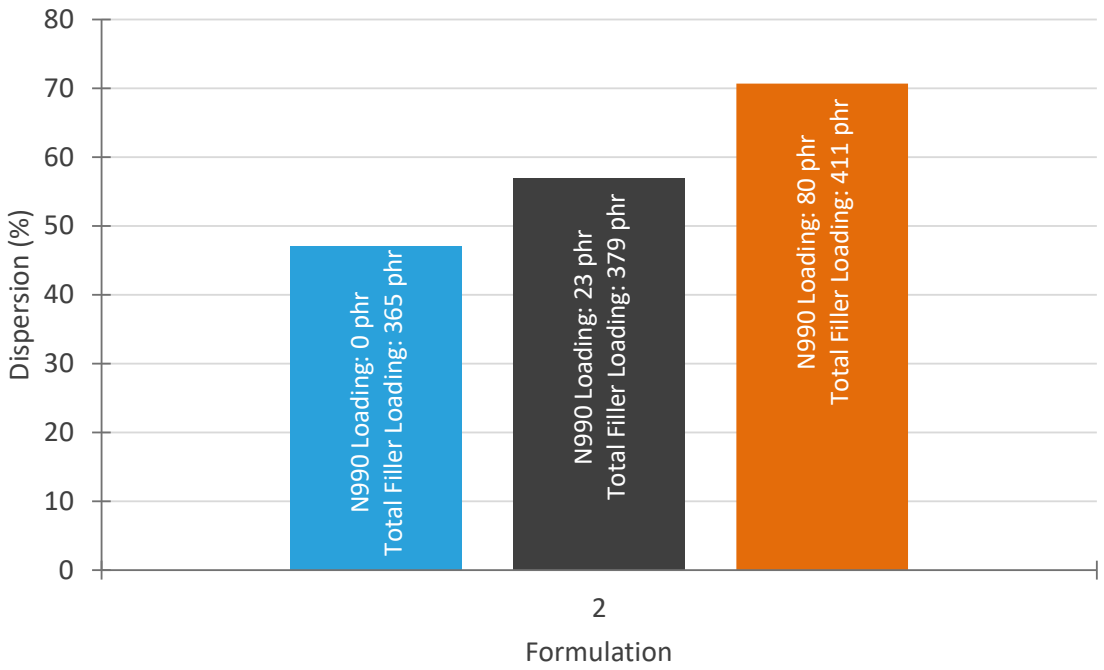

Figure 3. Dispersion percentage of the EPDM formulation 2 compounds as measured by the disperGrader. Dispersion improved as N990 was introduced into the compound.

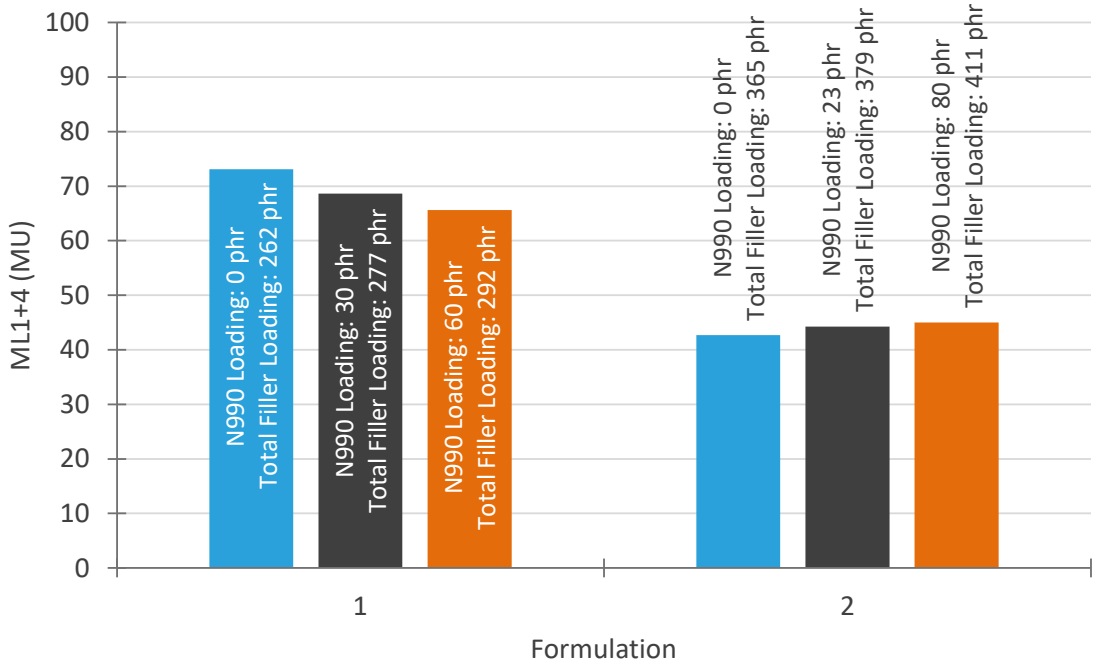

Figure 4. Mooney viscosity of the compounds measured at 100°C. There was a reduction in viscosity in the higher viscosity formulation as N990 replaced N550.

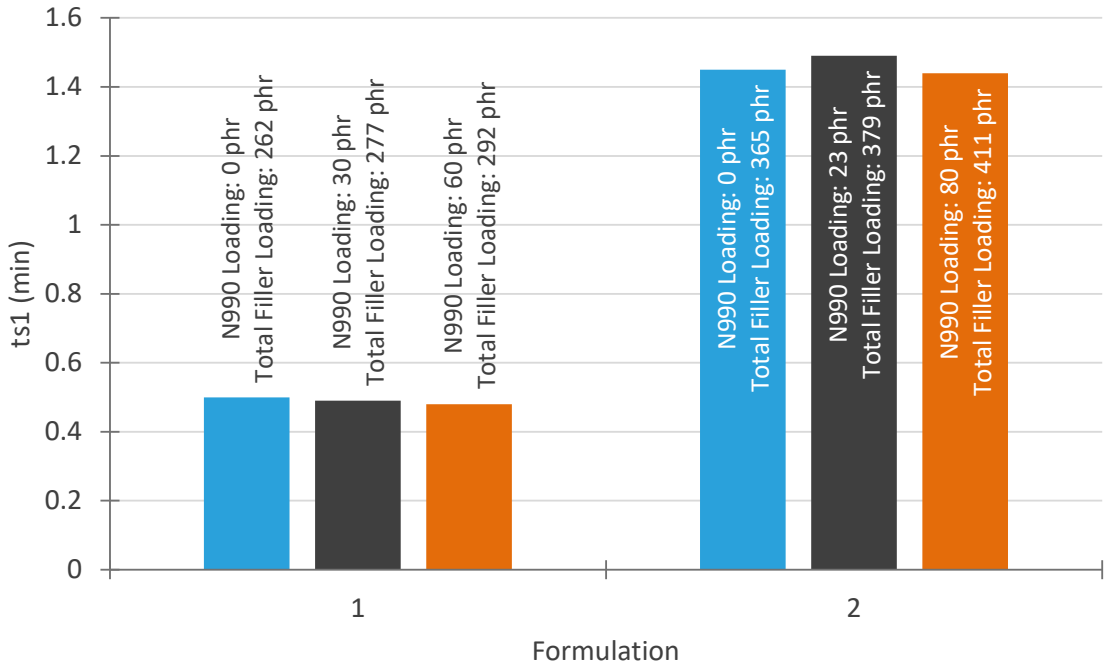

Figure 5. Scorch times of the compounds measured at 177°C for formulation 1 and 160°C for formulation 2. There were no significant differences in scorch times.

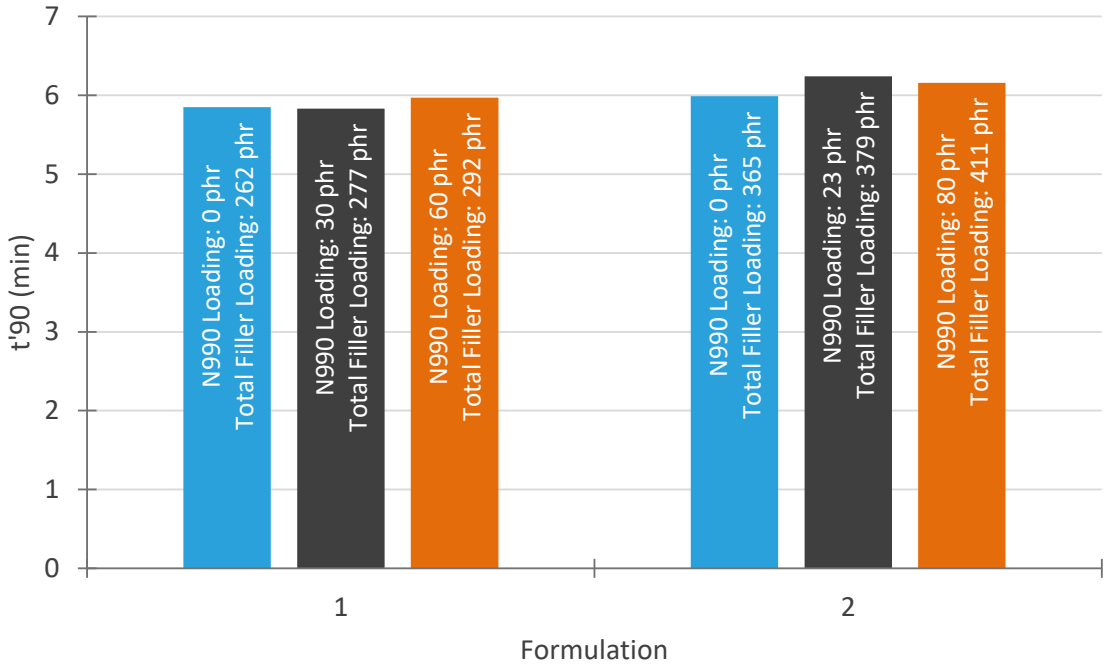

Figure 6. Cure times of the compounds measured at 177°C for formulation 1 and 160°C for formulation 2. There were no significant differences in cure times.

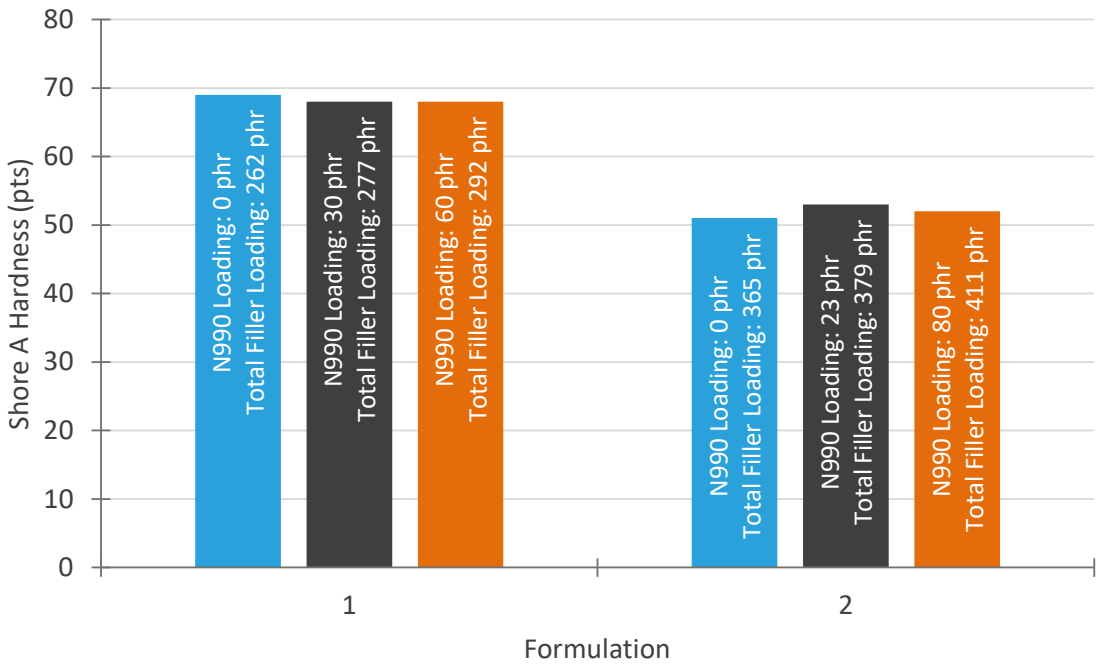

Figure 7. Shore A hardness of the compounds. Formulation 1 was 70±5 pts and formulation 2 was 50±5 pts.

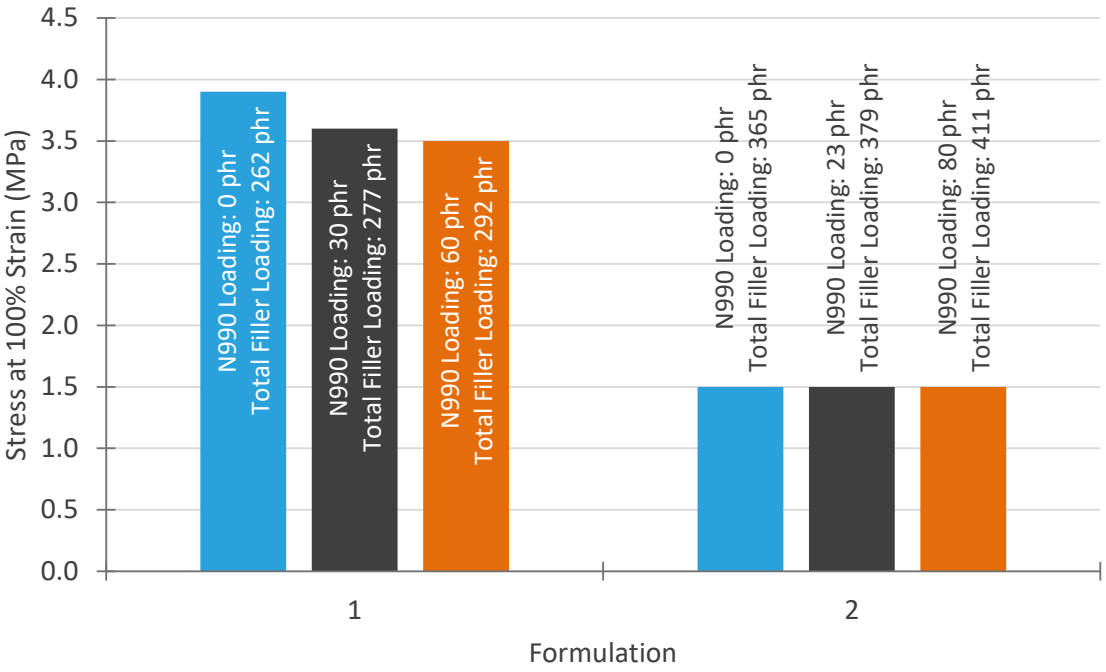

Figure 8. Stress at 100% strain of the compounds. A slight decrease in 100% modulus was observed in formulation 1 as N990 replaced N550.

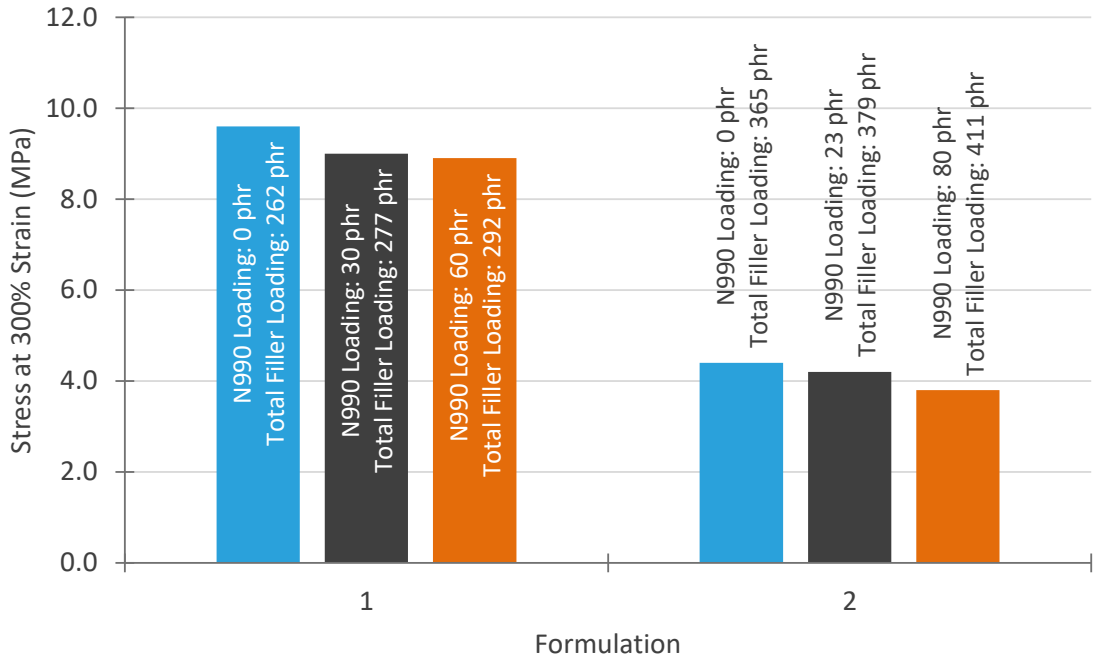

Figure 9. Stress at 300% strain of the compounds. Slight decreases in 300% modulus were observed as N990 replaced N550.

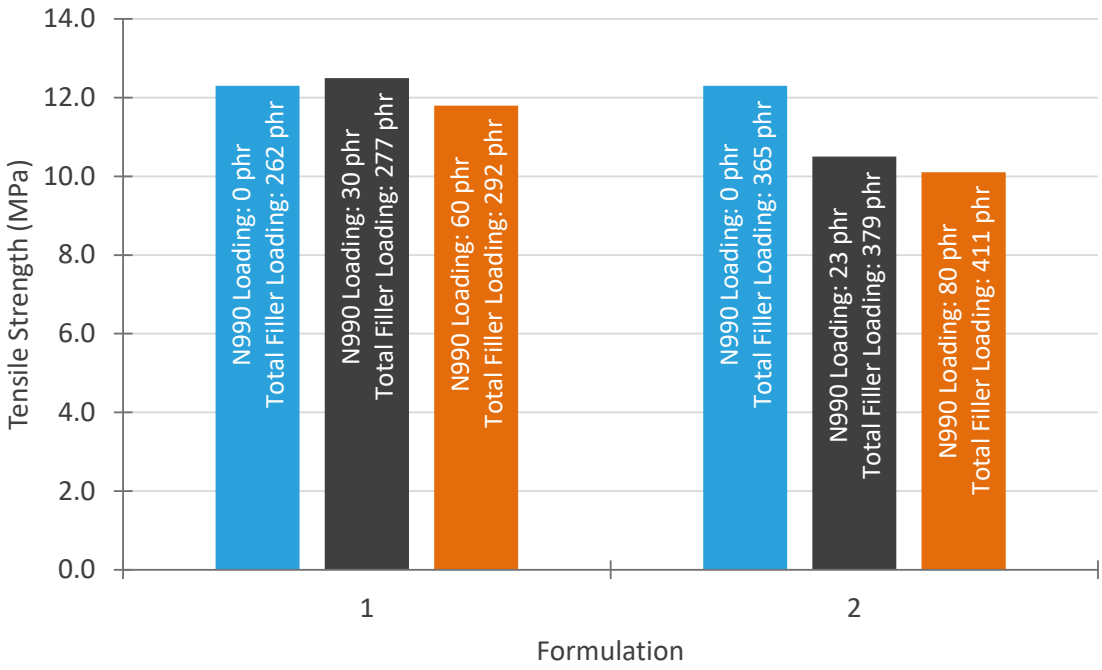

Figure 10. Tensile strength of the compounds. There was no significant difference in tensile strength in formulation 1. Tensile strength declined slightly in formulation 2 as N990 replaced N650.

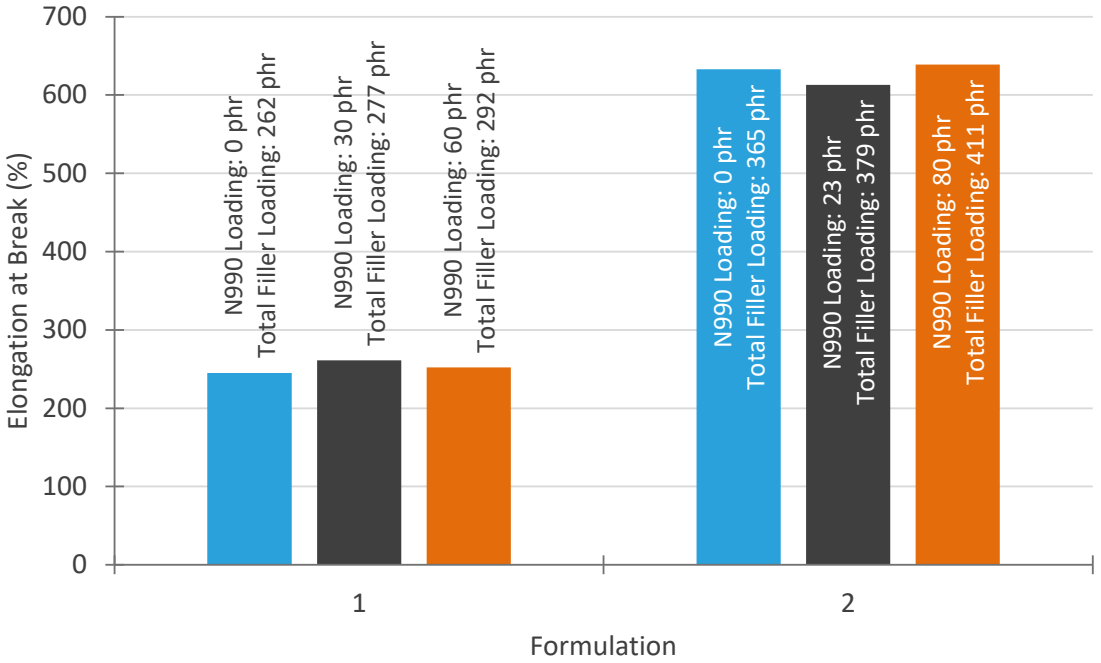

Figure 11. Elongation at break of the compounds. There were no significant differences in elongation.

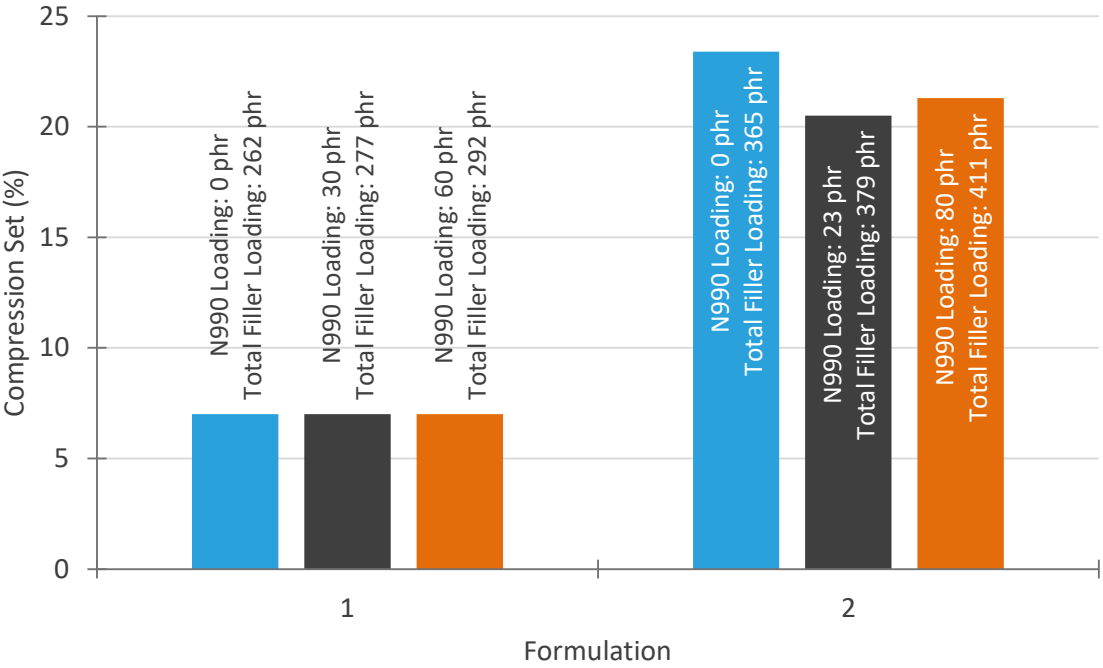

Figure 12. Compression set of the compounds. Compression sets were the same or lower for compounds with N990.