# Thermax® N990 in Polyacrylate Rubber

In this report, Thermax® N990 is evaluated in a polyacrylate rubber (ACM) compound. ACM is generally chosen for automotive transmission applications requiring excellent heat and oil resistance. Reinforcing fillers are added to the compound to meet tensile and tear strength specifications. Thermax N990 can be blended with reinforcing fillers for to maintain low compression set and provide improved dynamic properties. High loadings of N990 can be utilized to improve heat and oil resistance while allowing for a reduction in compound cost.

**The benefits of N990 found in the study were**:

- **Reduction in compound viscosity** as N990 replaced N550
- Increased scorch safety
- Decreased cure time
- **Smaller changes in hardness and elongation at break** after heat and oil aging
- **Decrease in volume swell** after aging in automatic transmission fluid
- **Reduction in compound cost** due to higher total filler loading

The ACM test formulations are provided in Table 1. The N550 was replaced at a ratio of 2.3 phr N990:1.0 phr N550 in order to maintain a Shore A hardness of 75. Mooney, MDR, tensile, tear, hardness, heat aging, and fluid aging properties were collected for each compound.

**Table 1. Test Formulations**

| Ingredient | Control | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| AR-825 | 100 | 100 | 100 | 100 | 100 | 100 |
| N550 | 75 | 60 | 45 | 30 | 15 | - |
| **Thermax® N990** | **-** | **35** | **70** | **105** | **140** | **175** |
| Stearic Acid | 1 | 1 | 1 | 1 | 1 | 1 |
| Struktol WB-212 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| Naugard #445 | 2 | 2 | 2 | 2 | 2 | 2 |
| TP-759 | 6 | 6 | 6 | 6 | 6 | 6 |
| Sodium Stearate | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Sulphur | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Potassium Stearate | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| **Total loading** | **188.4** | **208.4** | **228.4** | **248.4** | **268.4** | **288.4** |

Detailed compound test results are provided in the figures on the following pages.

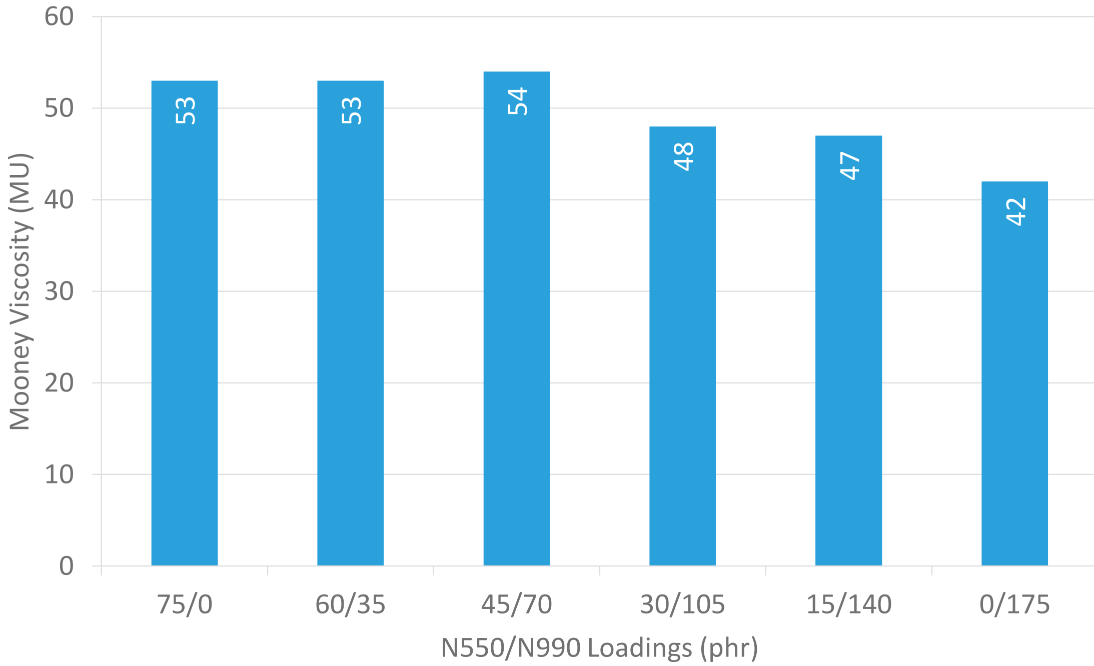


**Figure 1.** Mooney viscosity of the compounds measured at 121°C. Viscosity tended to decrease as N990 replaced N550.

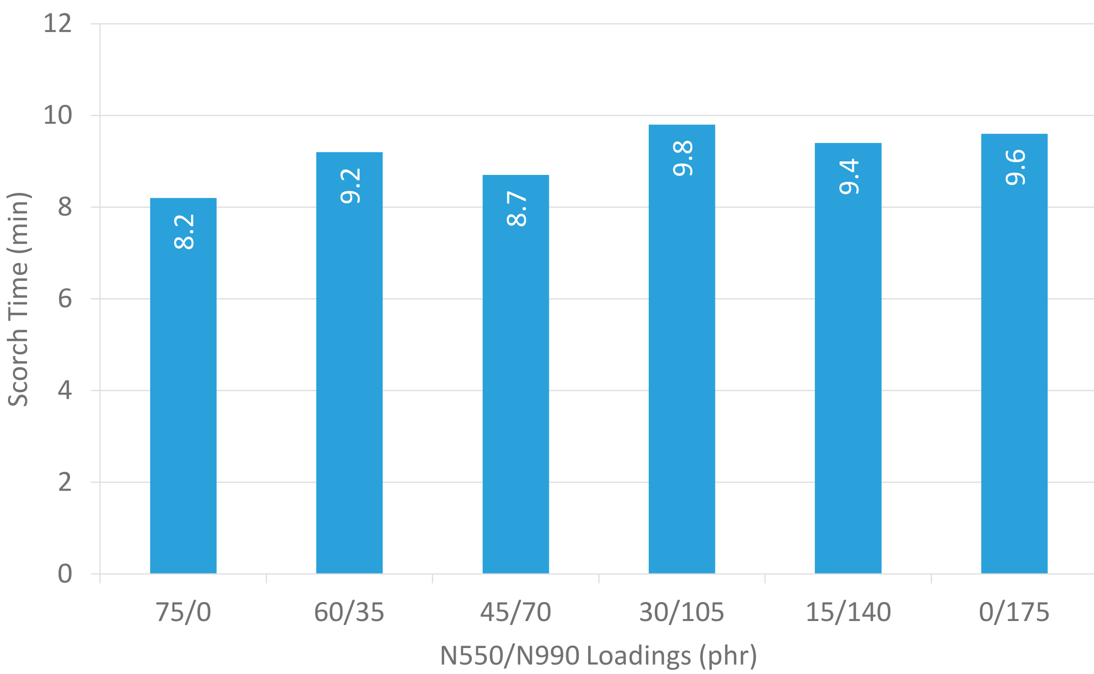


**Figure 2.** Mooney scorch times of the compounds measured at 121°C. Scorch times tended to increase as N990 replaced N550.

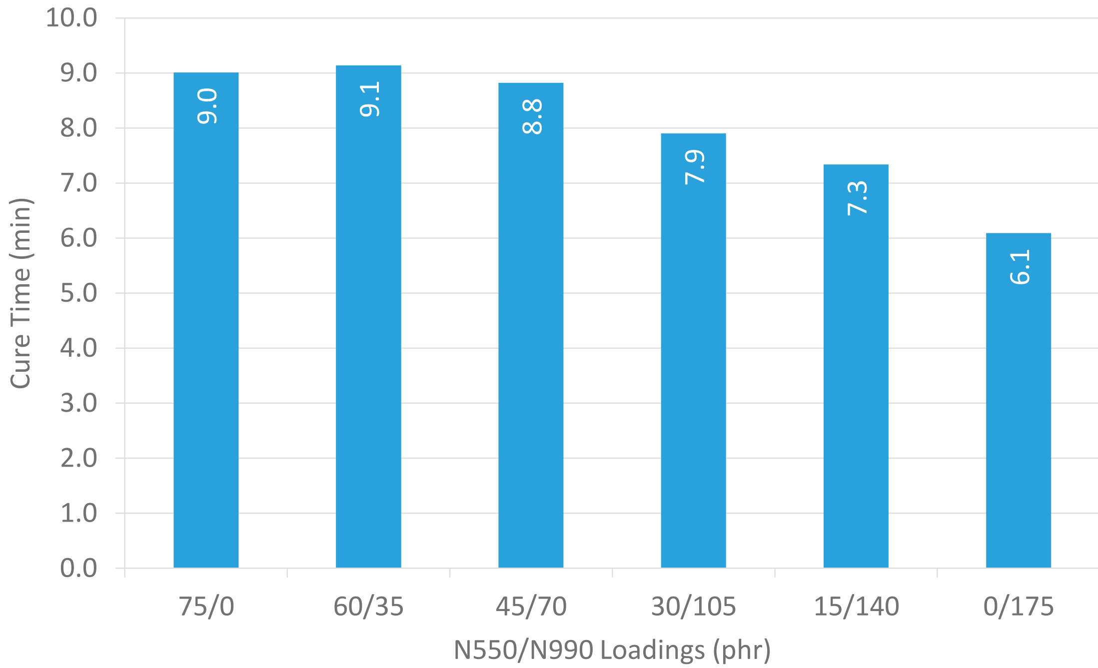


**Figure 3.** MDR cure times of the compounds measured at 177°C. Cure times tended to decrease as N990 replaced N550.

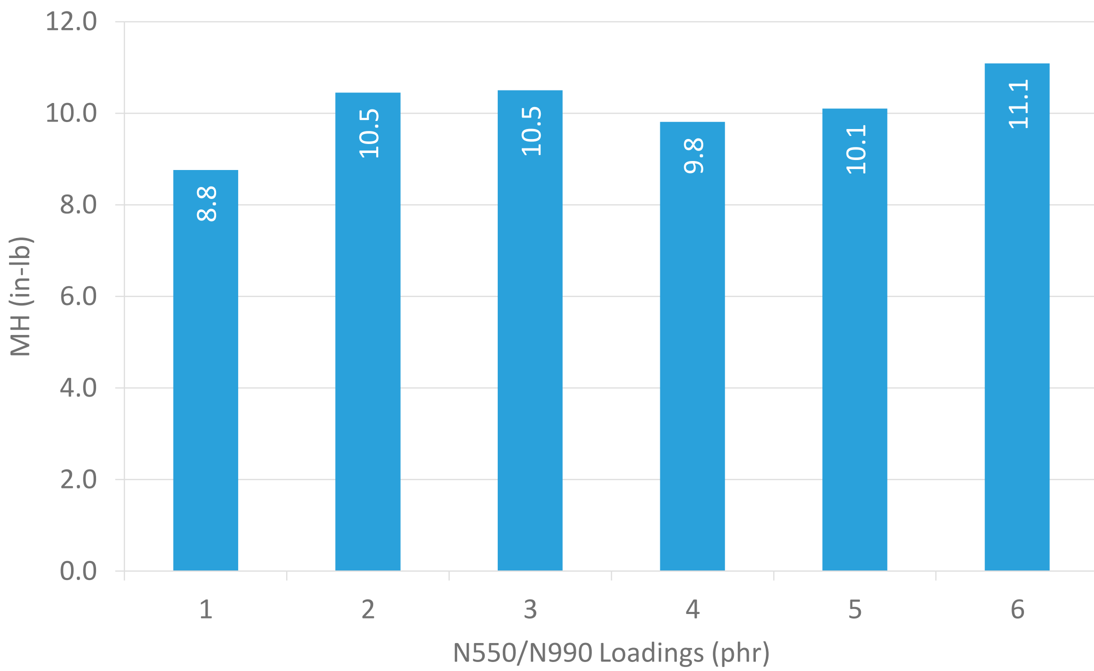


**Figure 4.** MDR maximum torque, MH, of the compounds measured at 177°C. MH tended to be higher with the addition of N990 indicating higher crosslink density.

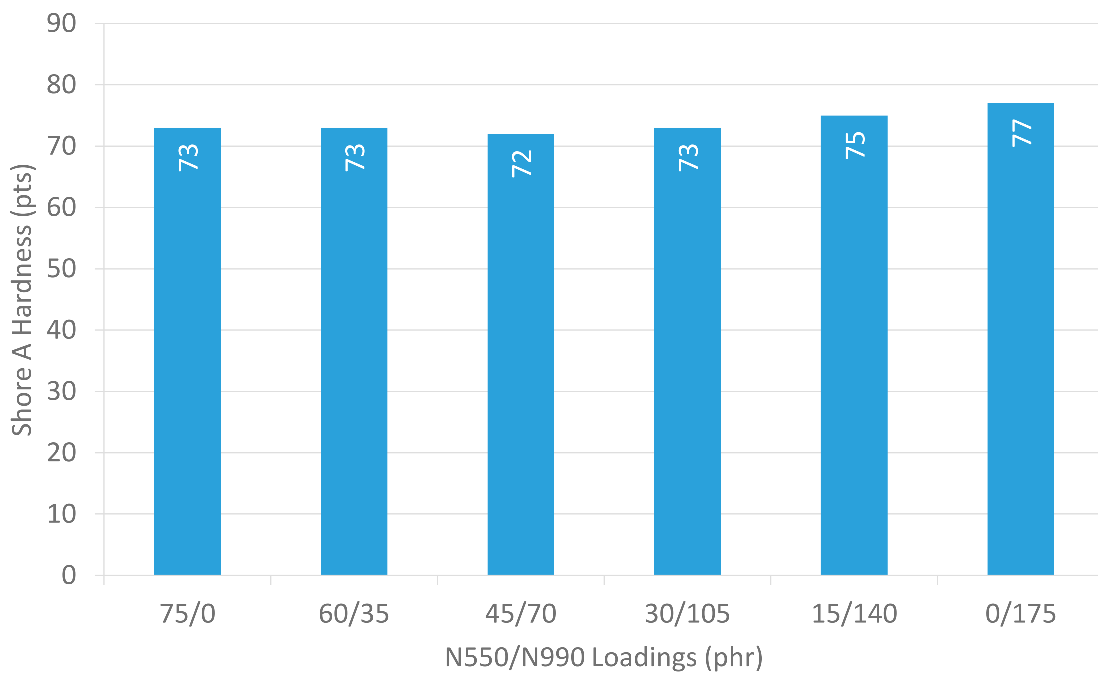


**Figure 5.** Shore A hardness of the compounds. All compounds fell within the 75±5 specification.

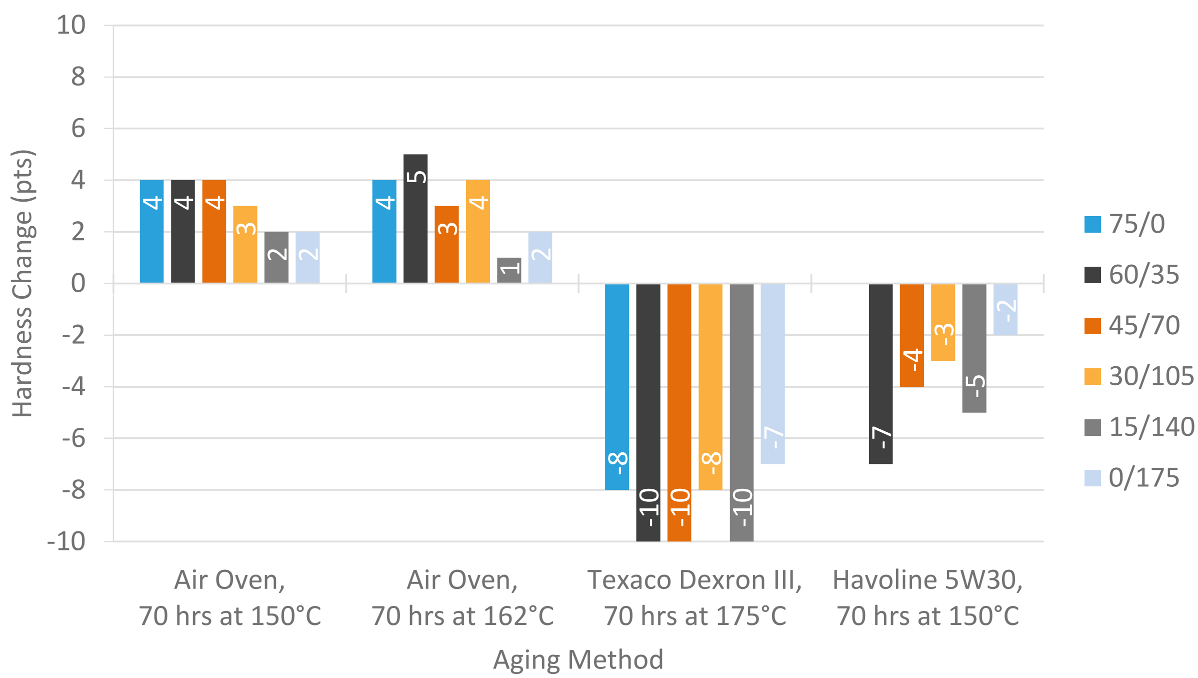


**Figure 6.** Change in hardness under different aging conditions of the compounds. Heat and oil aging tended to improve as N990 replaced N550.

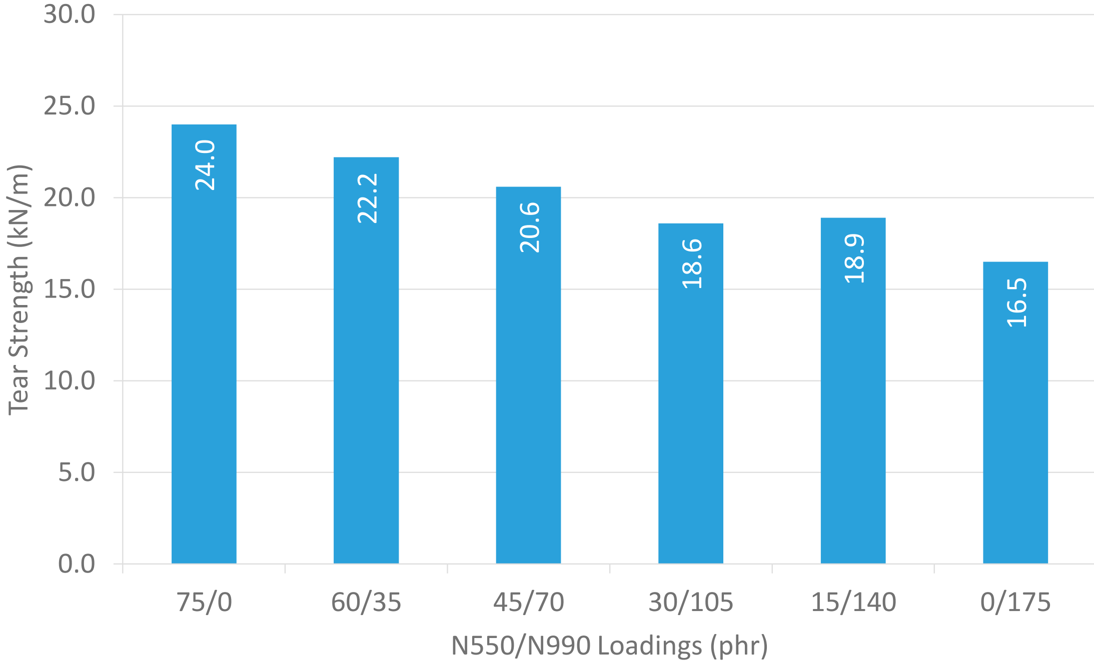


**Figure 7.** Die C tear strength of the compounds. Tear strength tended to decrease as N990 replaced N550.

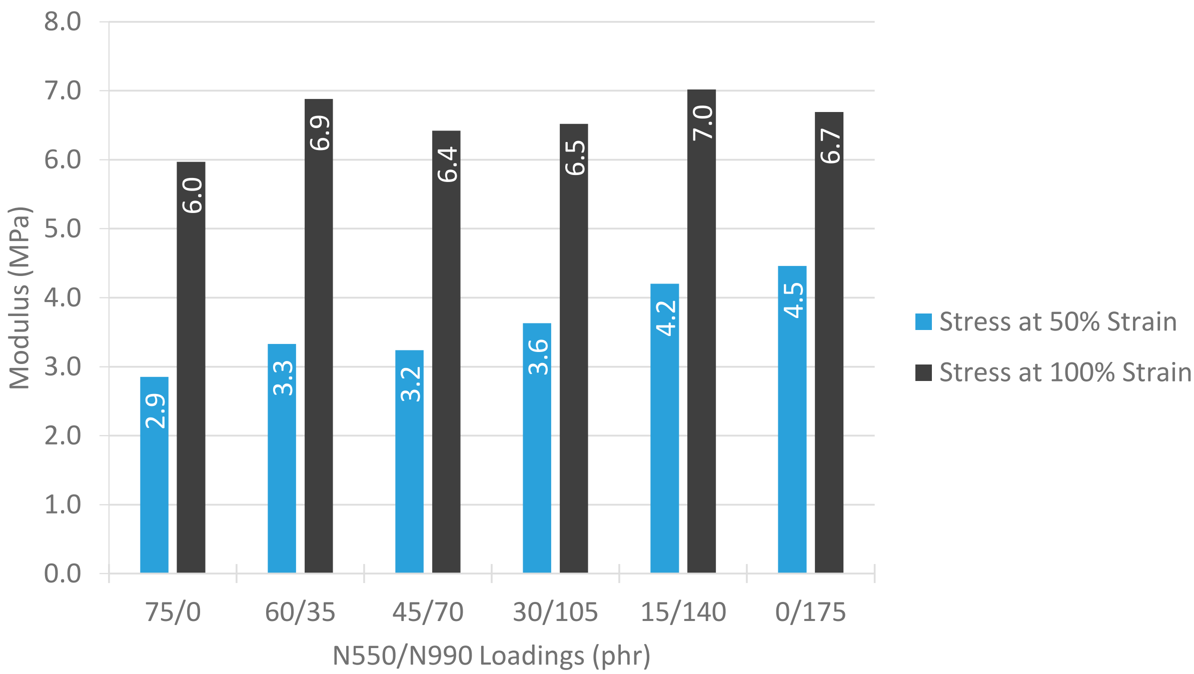


**Figure 8.** Tensile modulus of the compounds. Modulus tended to increase as N990 replaced N550.

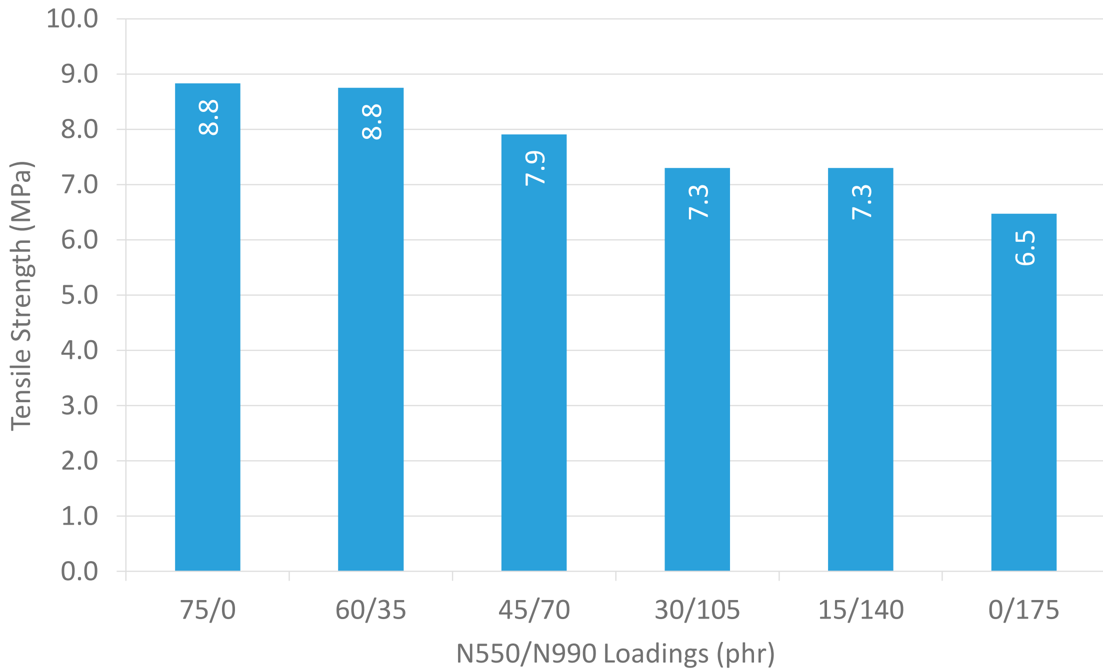


**Figure 9.** Tensile strength of the compounds. Tensile strength tended to decrease as N990 replaced N550.

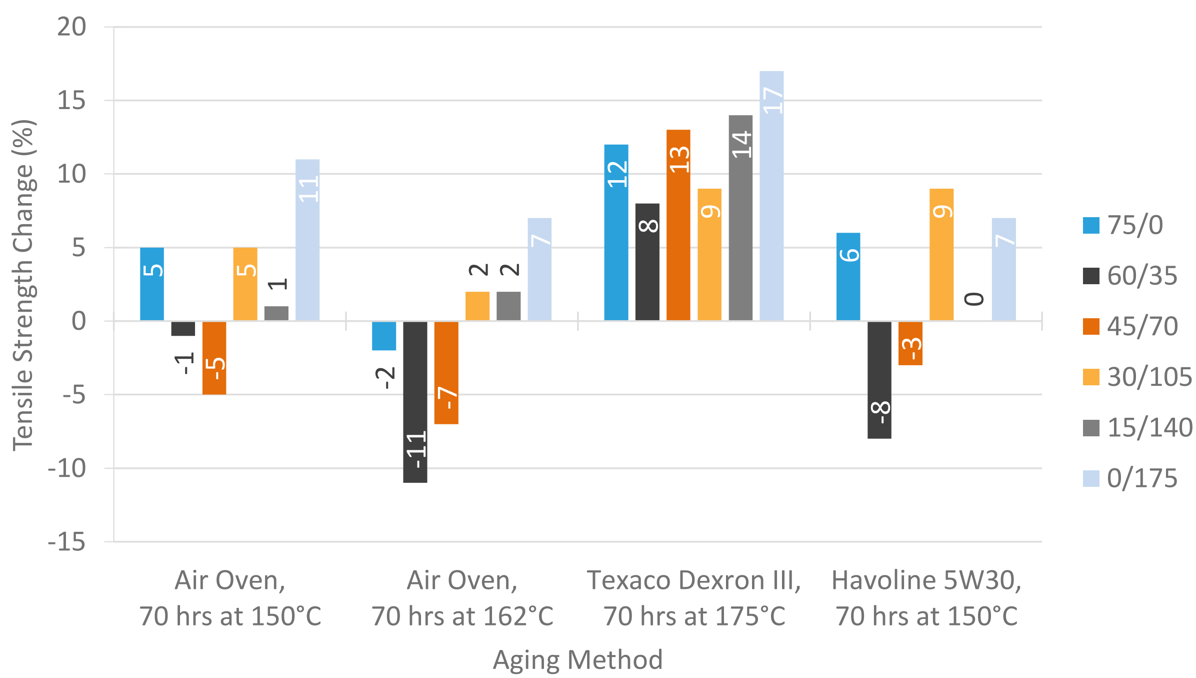


**Figure 10.** Change in tensile strength under different aging conditions of the compounds. No significant improvements were observed.

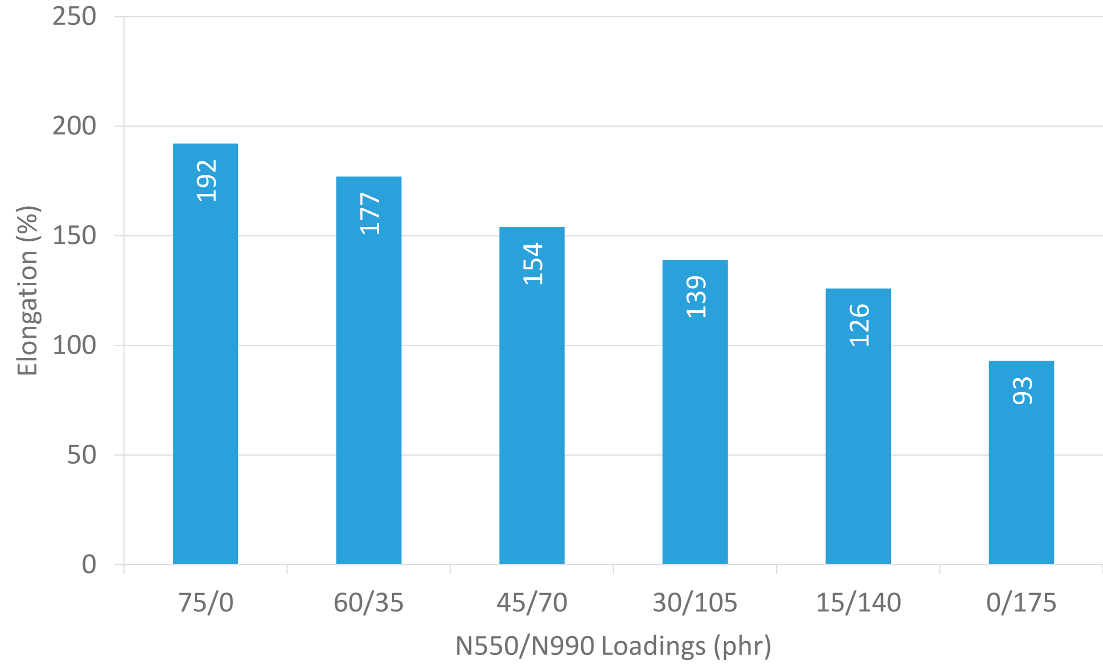


**Figure 11.** Elongation at break of the compounds. Elongation tended to decrease as N990 replaced N550.

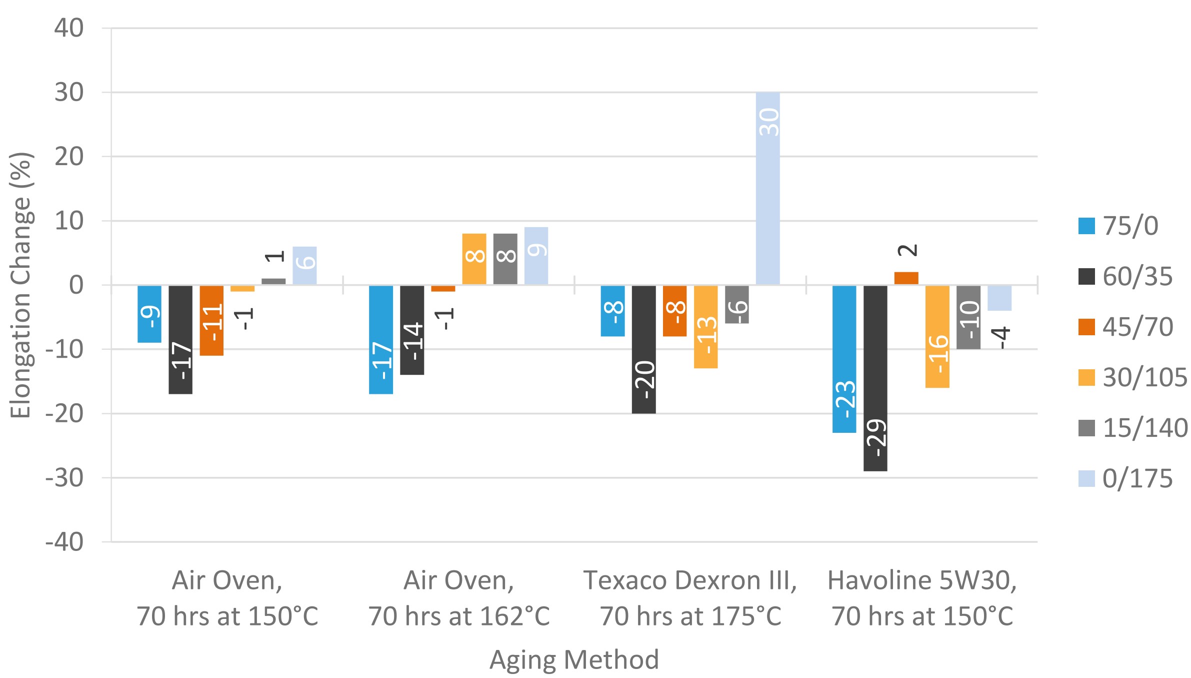


**Figure 12.** Change in elongation under different aging conditions of the compounds. Heat and oil aging tended to be better for compounds with higher N990 loadings.

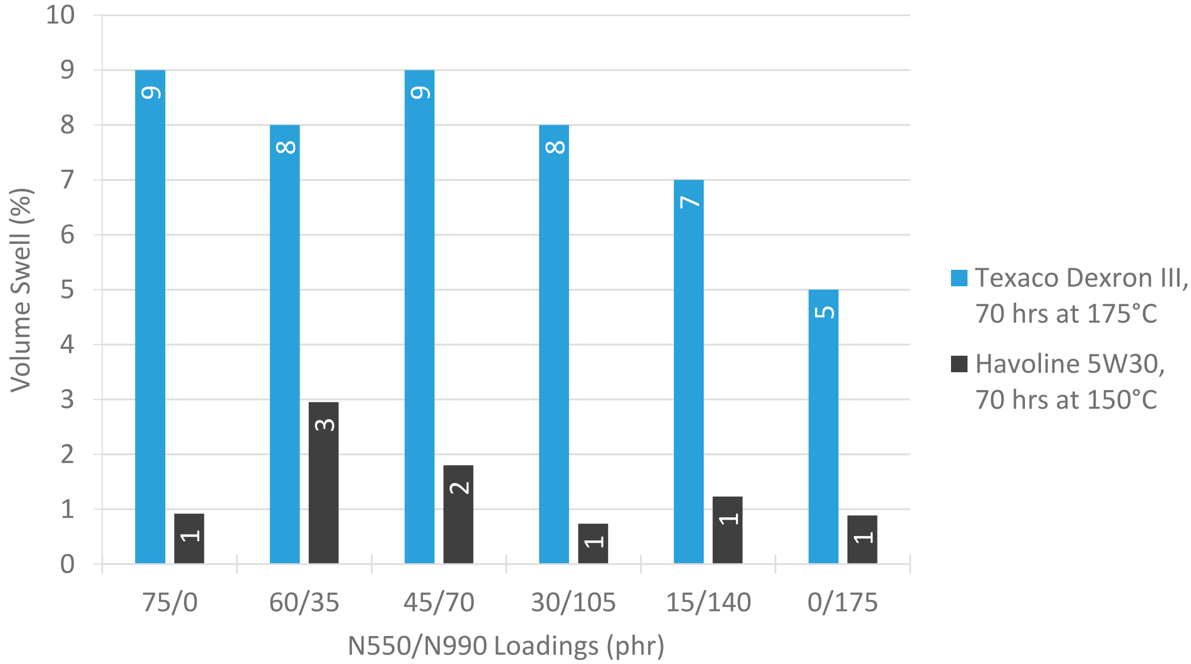


**Figure 13.** Volume swell of the compounds in automatic transmission fluid (ATF) and oil. Volume swell tended to decrease in ATF as N990 replaced N550. No significant differences were observed in oil.