Effect of Thermax® N990 on EPDM UL 94 Vertical Burn

EPDM is used in certain applications which require flame retardancy such as battery enclosures and wire and cable. In order to meet flame retardancy specifications, large amounts of flame retardants (FR) are added to the compound. Stricter regulations regarding low smoke, zero halogen material (LSZH) have led to the use of halogen free flame retardant (HFFR) systems utilizing aluminum trihydrate (ATH), magnesium hydroxide (MDH), and zinc borate among other additives. Good dispersion of these ingredients is required in order to achieve optimal performance; however, their polarity can lead to dispersion difficulties in non-polar elastomers such as EPDM. It has been hypothesized that N990 could act as a dispersion aid for a highly loaded HFFR system while also improving extrusion quality.

The benefits of Thermax® N990 found in this study include:

- Improvement in physical properties
- **Improvement in flame resistance performance, particularly at 5 and 10 phr loading**
- Good processability
- Extension of polymer leading to potential cost reduction

The EPDM formulations can be found in Tables 1. Mooney viscosity, MDR, Shore A hardness, tensile, electrical resistivity, and UL 94 vertical burn (VB) tests were run on all compounds. UL 94 is the standard for safety of flammability of plastics materials for parts in devices and appliances. It is also used to evaluate the flame resistance of rubber compounds. Testing results can be found in the figures on the following pages. The compounding and testing were completed at Alttran in Hudson, Ohio.

Table 1. EPDM formulation 1

Ingredient	Control	A	B	C	D
Nordel IP 4520	100.0	100.0	100.0	100.0	100.0
Thermax® N990	**0.0**	**1.0**	**3.0**	**5.0**	**10.0**
Vertex 60HST (MDH)	72.5	72.5	72.5	72.5	72.5
Hydral 710 (ATH)	72.5	72.5	72.5	72.5	72.5
ZnO	5.0	5.0	5.0	5.0	5.0
Dicup 40KE	6.0	6.0	6.0	6.0	6.0
72% TAC	1.4	1.4	1.4	1.4	1.4
Merrox PPD	5.0	5.0	5.0	5.0	5.0
Total	**262.4**	**263.4**	**265.4**	**267.4**	**272.4**

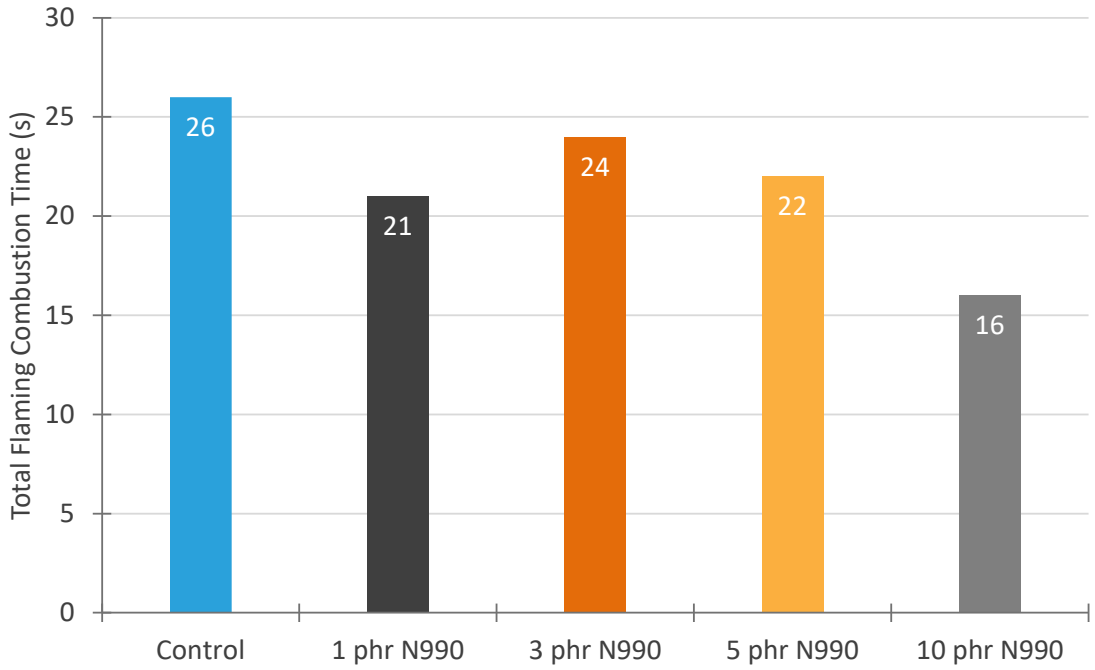

Figure 1. Total flaming combustion time of the room temperature conditioned samples. Samples were conditioned at room temperature for 2 days at a humidity of 22%. The addition of N990 reduced the total flaming combustion time.

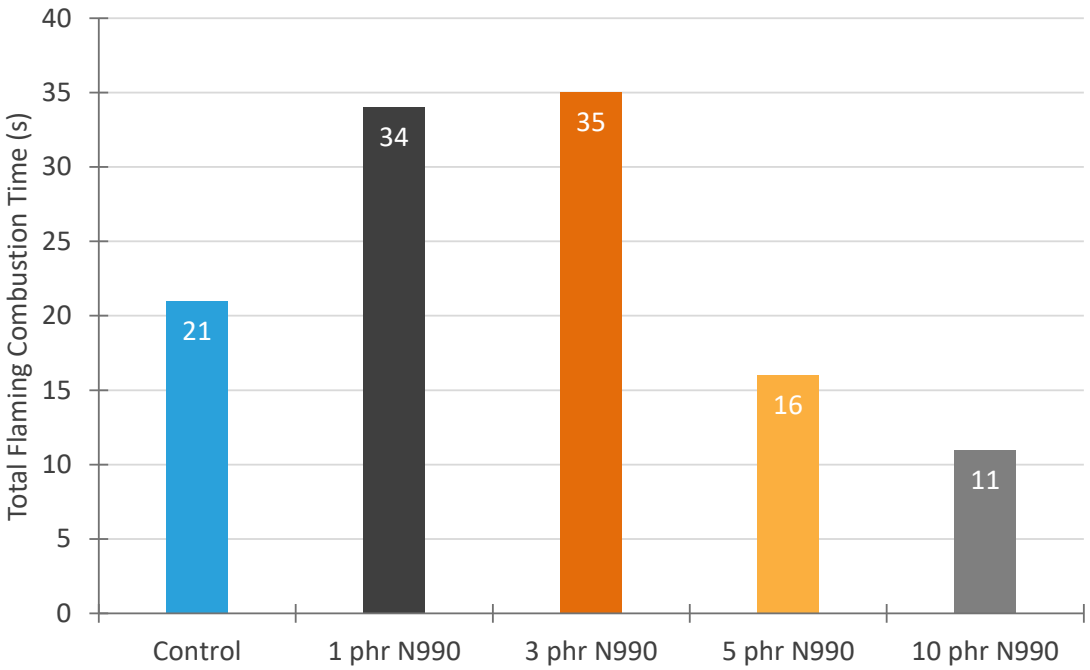

Figure 2. Total flaming combustion time of the heat aged samples. Samples were conditioned at 158°F for 7 days. Best performance was achieved with N990 loadings of 5 and 10 phr.

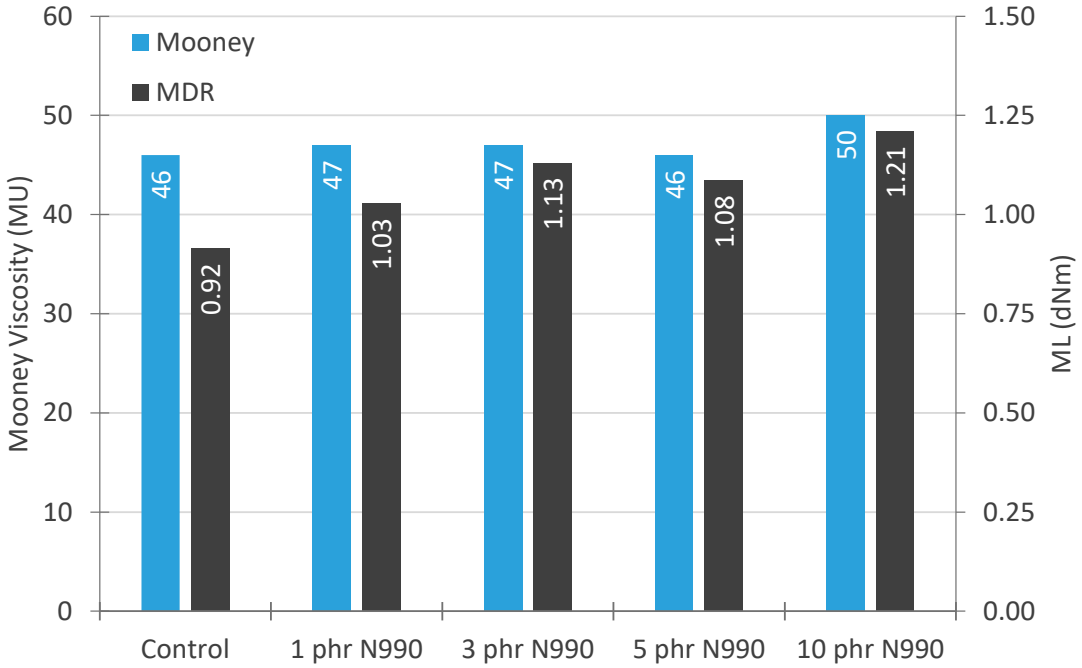

Figure 3. Mooney viscosity of the compounds measured at 100°C and MDR minimum torque (ML) measured at 177°C. Viscosity tended to increase slightly as N990 was added to the compound.

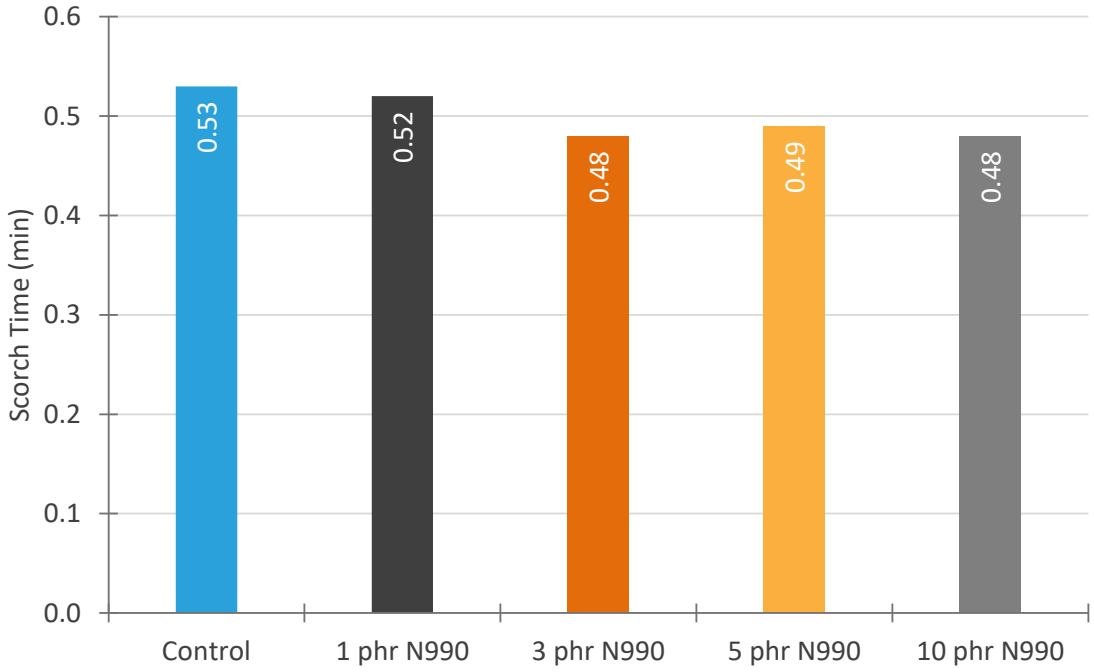

Figure 4. Scorch time of the compounds measured at 177°C. Scorch time decreased slightly as N990 was added to the compound.

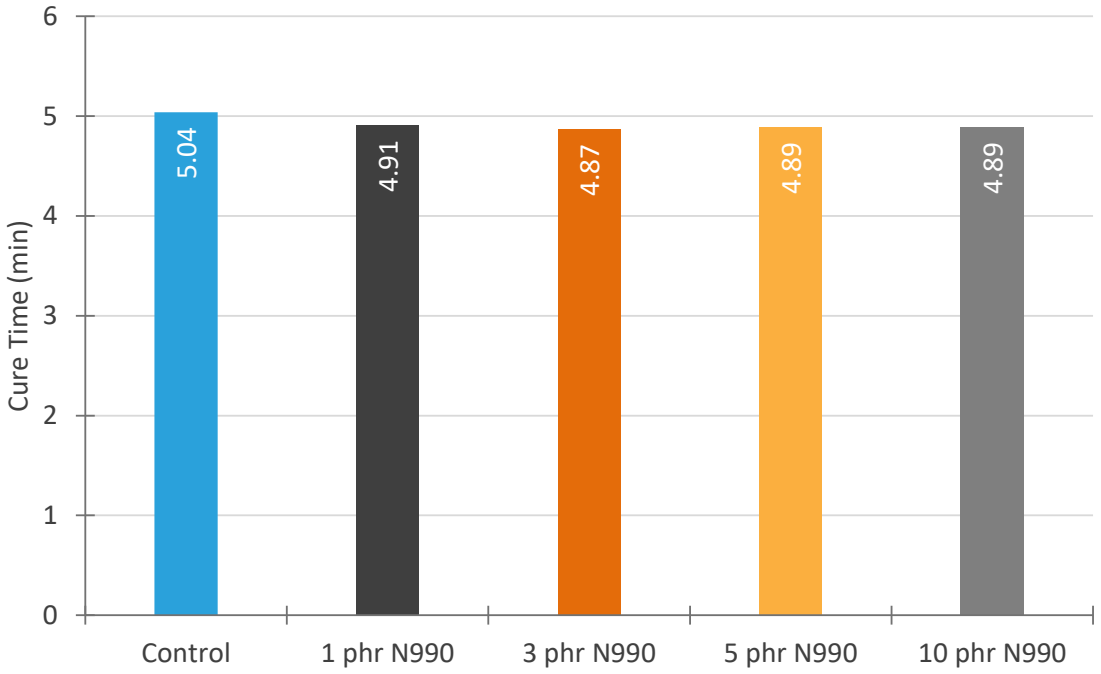

Figure 5. Cure time of the compounds at 177°C. There were no significant differences in cure time observed.

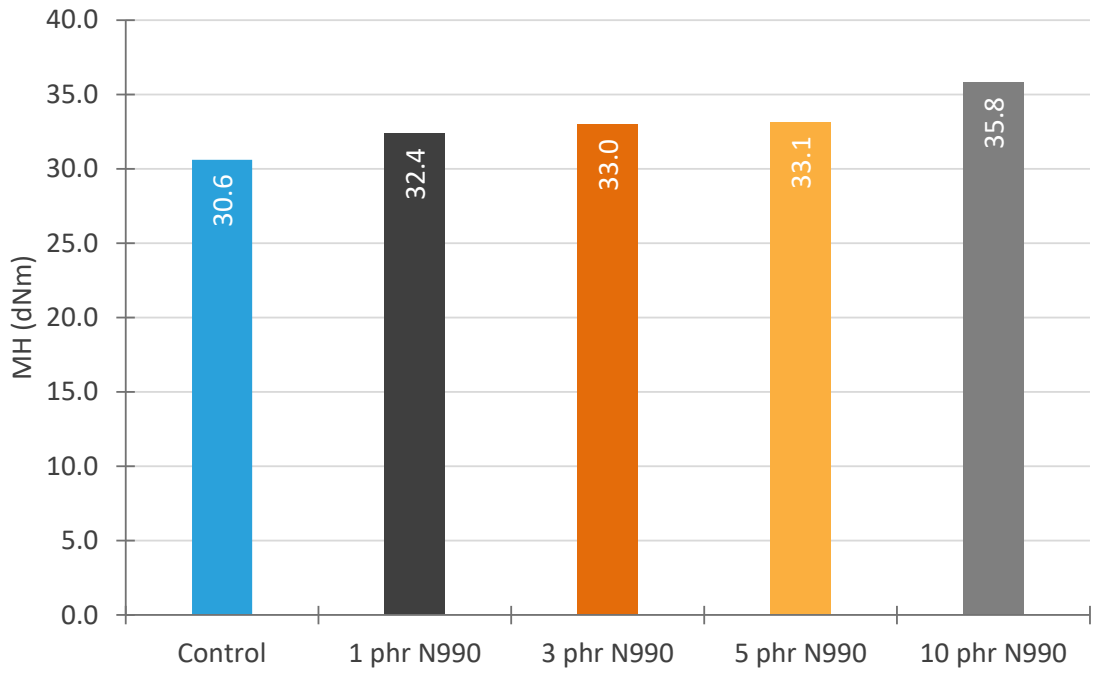

Figure 6. MDR maximum torque (MH) of the compounds measured at 177C. MH increased as N990 was added to the compound.

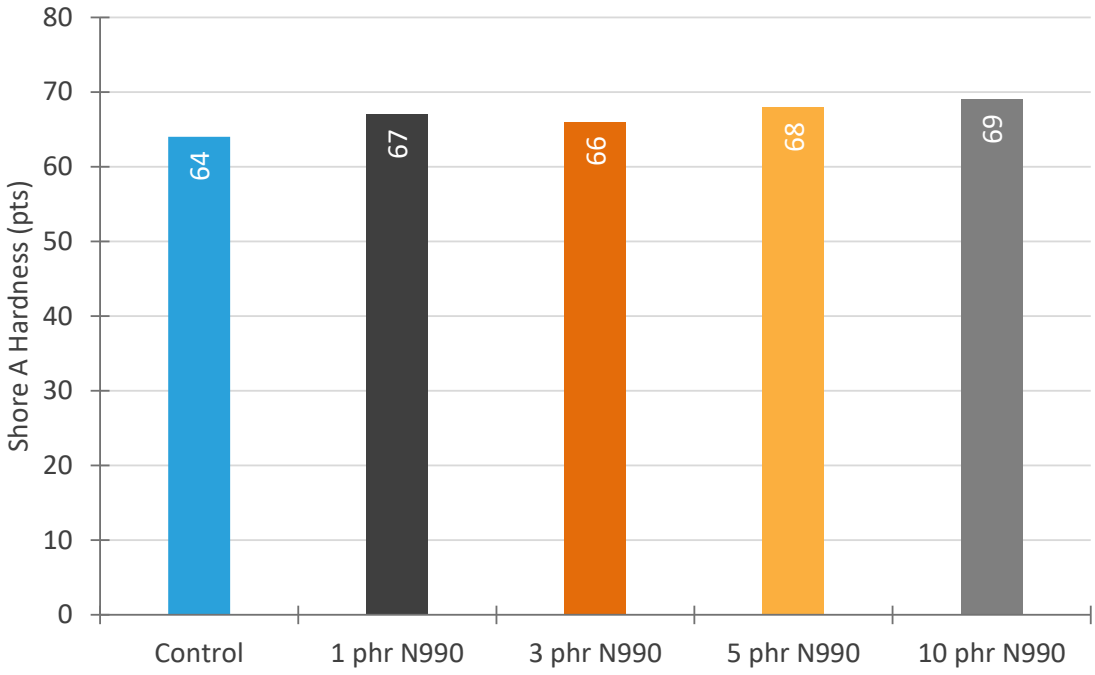

Figure 7. Shore A Hardness of the compounds. Hardness increased as N990 was added to the compound.

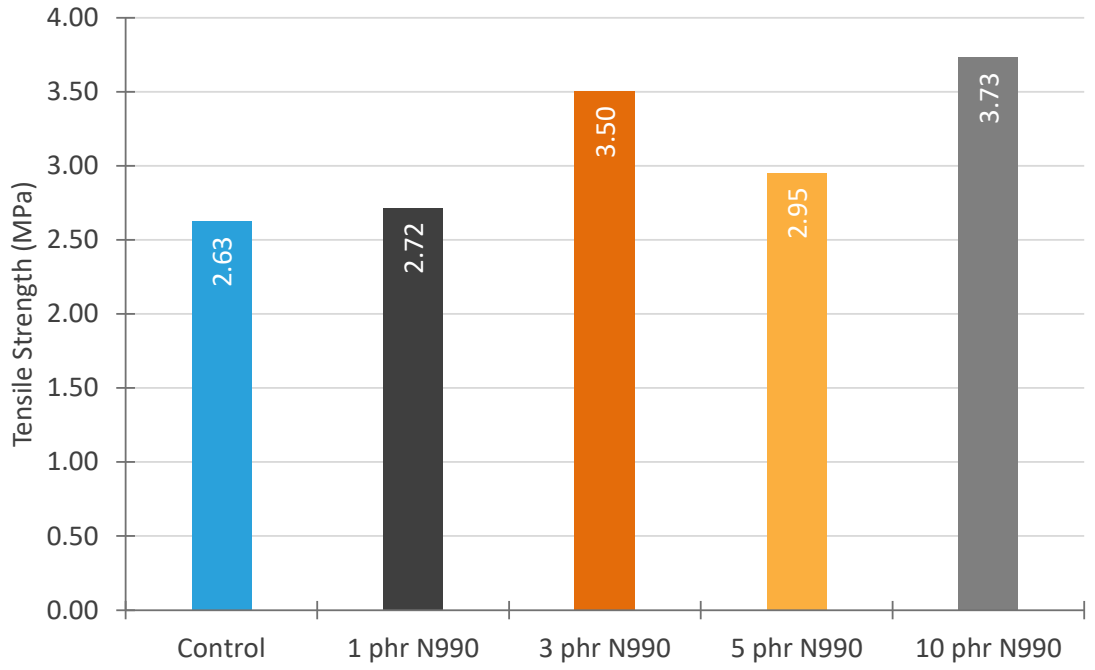

Figure 8. Tensile strength of the compounds. Tensile strength tended to increase as N990 was added to the compound.

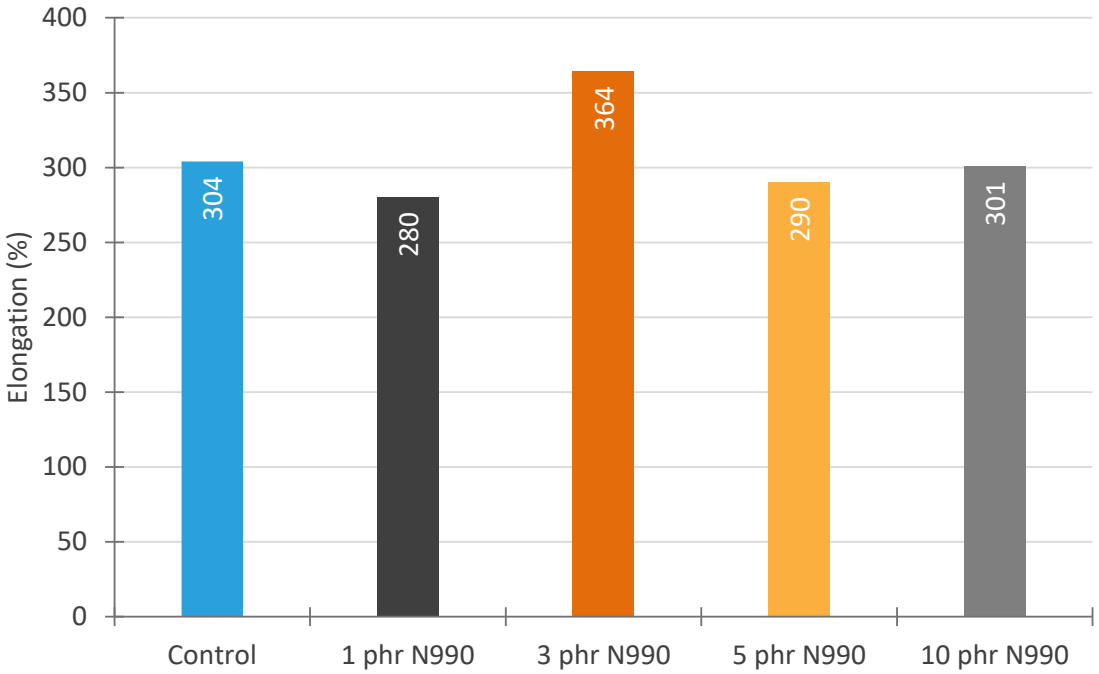

Figure 9. Elongation at break of the compounds. No significant differences in elongation were observed.