Thermax® N990 in Flame Retardant EVM

Typically additives are added to compounds which require flame retardancy. Lately the industry has been moving to low smoke, zero halogen (LSZH) formulations for health and safety reasons. These formulations utilize high loadings of aluminum hydroxide (ATH) and/or magnesium hydroxide (MDH) along with small amounts of zinc borate and/or triaryl phosphates such as tricresyl phosphate (TCP). Ethylene-vinyl acetate rubber (EVM) is a great choice for applications requiring flame retardancy as it is halogen free and burns with non-corrosive emissions. In this study, Thermax® N990 was added to an EVM formulation.

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

- **Reduction in compound viscosity**
- **Improvement in smoothness of extrudate edges**
- **Increase in tensile strength**
- **Reduction in damaged length after UL94 vertical burn testing**
- **Maintenance of physical properties and high electrical resistivity**
- **Reduction in compound cost**

The EVM formulations can be found in Table 1. To maintain constant hardness while increasing the total filler loading, the amount of plasticizer was also increased. Mooney viscosity, Garvey die, MDR, Shore A hardness, tensile, electrical resistivity, and UL94 vertical burn tests were run on both compounds. The compounding and testing were completed at Alttran in Hudson, Ohio.

Table 1. Test formulations

Ingredient	Control	N990
Levapren® 500	100.0	100.0
Hydral® 710	190.0	190.0
Firebrake® ZB	15.0	15.0
Santicizer® 148	6.0	20.0
Struktol® WB 16	2.0	2.0
VulCup® 40KE	6.0	6.0
72% TAC	1.4	1.4
Lubrazinc® W	1.0	1.0
Thermax® N990	**-**	**30.0**
Akrosperse® 626 Blue	1.0	-
Total	**322.4**	**365.4**
Specific Gravity	**1.62**	**1.60**

Table 2. Mooney and MDR results

	Control	N990
Mooney Viscosity, 100°C		
ML1+4, MU	58	37
MDR, 160°C, 0.5° arc		
t_s2, min	6.0	20.0
t'90, min	2.0	2.0
ML, dNm	0.71	0.40
MH, dNm	25.2	17.7

Table 3. Garvey die extrusion comparison of edges. Scale from 1-5 with 5 being very smooth and 1 being very rough. All compounds had excellent swelling, surface, and corner ratings. Incremental additions of N990 clearly improved the smoothness of the edges.

Compound	Edge 3	Edge 2	Edge 1	30°
Control	5	4	3	3
N990	5	5	5	5

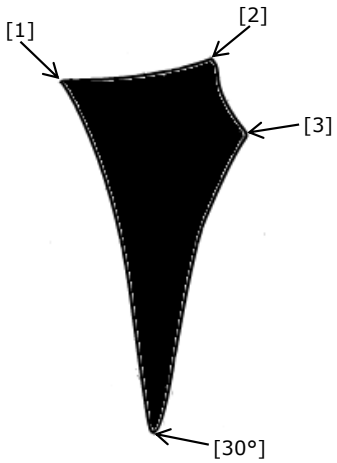

Table 4. Physical and electrical property results

	Control	N990
Shore A hardness	78	75
Stress at 300% strain, MPa	2.5	3.9
Tensile strength, MPa	3.2	4.3
Elongation at break, %	369	338
Volume resistivity, Ω·cm	2.7e+13	1.7e+12

Table 5. Vertical burn test results for 30 second flame application. Compounds did not catch fire with flame applied for only 10 seconds. Results are median values taken from 3 samples. Samples were self-extinguishing and did not drop flaming pieces.

	Control	N990
Sample weight loss, g	2.9	2.8
Time of 1st burn, min	0.61	0.18
Time of 2nd burn, min	0.07	0.43
Damaged length, in	1.88	1.50
Burn rate, in/min	2.78	2.43

Table 6. Relative cost of compounds

	Control	N990
Cost, $/kg	1.00	0.98
Cost, $/L	1.00	0.97