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TECHNICAL BULLETIN

EPDM Profiles

Thermax® medium thermal carbon black N990 is manufactured by the thermal decomposition of natural gas in the absence of oxygen. The thermal process provides a unique carbon black characterized by a large particle size and low structure. Thermax® is widely used in applications that require excellent dispersion, superior heat, oil and chemical resistance and outstanding dynamic properties. The large particle size (low surface area) and low structure allow for low compression set, high rebound and low viscosity, maintaining the inherent elastomeric properties of the rubber compound. As a non-reinforcing black, thermal black is often blended with furnace carbon blacks with the latter providing reinforcement especially in non-crystallizing polymers such as EPDM, SBR and NBR.

It is well known that high filler loading improves EPDM extruded goods. The benefits include smoother surfaces with a desirable matte finish, sharper edges, better dimensional stability and improved green strength. However, furnace black loading potential is limited as undesirable effects such as difficult processing, heat build-up and scorch, as well as increased compression set, hardness and modulus quickly appear with increasing amounts of furnace black in the compound.

The following study, conducted on behalf of Cancarb Limited at the Indian Rubber Manufacturers Research Association, Thane, India, demonstrates that the extrusion benefits of high filler loading can be achieved while maintaining processing and vulcanizate properties through the partial replacement of furnace black with Thermax®. In addition, users of Thermax® can expect class A surface finish derived from excellent dispersibility and exceptionally low grit content.

Experimental

In extrusions, the largest application for EPDM rubber, a blend of two furnace blacks with different particle size and structure is typically used to balance processing behaviour and vulcanizate properties. The current study examines compounds at three Shore A hardness levels, specifically 50, 60 and 70. In each case, a compound based on a blend of N550 and N774 is used as the control. The experimental compounds replace all of the N774 in the control with Thermax® N990 on the basis of 2 parts of N990 for each part of N774 with the objective of achieving equal hardness.

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Compound Data

	Hardness 50 SH		Hardness 60 SH		Hardness 70 SH	
	A1	A2	B1	B2	C1	C2
EPDM Keltan 512	100	100	100	100	100	100
N550	60	60	80	80	120	120
N774	40	-	50	-	50	-
Thermax® N990	-	80	-	100	-	100
Paraffinic oil	90	90	90	90	90	90
ZnO	5	5	5	5	5	5
Stearic Acid	1	1	1	1	1	1
ZDBC	2	2	2	2	2	2
TMTD	0.5	0.5	0.5	0.5	0.5	0.5
MBT	0.5	0.5	0.5	0.5	0.5	0.5
Sulphur	1.2	1.2	1.2	1.2	1.2	1.2

Compound Properties

Compound	**A1**	**A2**	**B1**	**B2**	**C1**	**C2**
Compound viscosity ML (1+4)@100°c (MU)	14.5	15	19	18	29	30
Mooney Scorch t5 @125°c (min.)	13.33	11	11.33	9.26	7.48	8.11
Rheometric Properties @ 160°c						
ML(lbf.inch)	2.51	2.6	2.43	2.62	3.76	3.71
MH(lbf.inch)	35.32	35	37.18	38.94	47.62	41.79
TS2(minutes)	3.15	2.8	2.73	2.4	2.27	2.44
T90(minutes)	22.91	18	20.56	23.18	20.73	19.91
Vulcanizate Properties						
Hardness On Button (Shore A)	49	50	58	58	69	68
300% Modulus (MPa)	6.2	6.5	7.8	8.3	-NA--	-NA--
Tensile Strength (MPa)	8.4	8.8	9.4	8.9	8.2	8.0
Elongation at Break (%)	405	415	370	320	205	240
Tear Strength (kN/m)	22.6	22.6	25.9	24.5	24.9	22.8
Compression Set (%) ASTM D 395 Method B (@100°C/22hrs/25%)	16	19	17	23	21	24
Heat Aging Properties						
Change in Properties after being aged in air @ 100°c/ 168 hrs.						
Hardness change , points	+8	+9	+9	+10	+9	+10
Tensile Strength, Change %	+5.2	+4.5	+5.2	+3.3	+10.7	+4.9
Elongation at Break, Change %	-39.5	-44	-47.3	-39	-31.7	-37.5

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Discussion

For all compound pairs, Mooney viscosity, Mooney scorch time and cure time were maintained at similar levels despite total carbon black loading in the Thermax® compounds being higher by 40 phr in the case of the 50 hardness recipe and by 50 phr in the 60 and 70 hardness compounds. The vulcanizate properties were also largely unaffected by the carbon black loading increases. A relatively modest increase in compression set is seen due to the increase in total carbon black loading. However, Thermax® N990 is known to have the least negative effect on compression set when compared with other blacks at equal loading. As expected, the heat aging results were generally comparable across all compounds.

EPDM Rubbers from Metallocene Technology

EPDM rubbers produced by Metallocene catalyst technology have higher molecular weights compared to EPDM rubbers produced from solution and suspension polymerization technology. They therefore have superior mechanical properties. However, they are also somewhat more difficult to process. Blending of Thermax® N990 in partial replacement of furnace black becomes even more relevant and significant for Metallocene catalyst based EPDM rubbers (see also Technical Bulletin 036 of January 2003).