POLYMERS FOR USE IN WIRE AND CABLE COMPOUNDS

ENTEC

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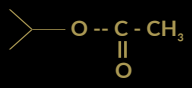
Many wire & cable compounds are formulated for specific end use applications such as high and low voltage power cables, telecommunications, telephone wire, coaxial cable, jacketing, etc. Many of these cable compounds are required to be flame retardant. In addition, many of the olefinic wire & cable compounds are cross-linked to improve their temperature, tear and abrasion resistance.

There are a number of polymers that can be used as the base polymer in wire & cable compounds. In addition to polyethylene, many of these polymers tend to be elastomeric as they have the ability to hold high levels of solids (flame retardants and minerals) while still maintaining ductility, flexibility and other properties.

THESE POLYMERS INCLUDE:

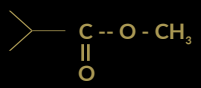
Ethylene Vinyl Acetate (EVA)



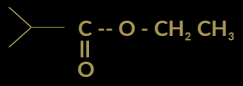
EVA resins used for wire & cable compounds are generally medium to high vinyl acetate content (18% – 33%). The higher vinyl acetate content allows for high filler loadings, retention of properties and moderate cold temperature flexibility. The melt flow index is often below 7 g/10 minutes although higher melt flow index grades may be used depending on the specific application requirements. EVA based wire & cable compounds can be cross-linked to improve their end use performance.

Ethylene Acrylate Copolymers

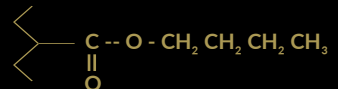
Ethylene Methyl Acrylate (EMA)



Ethylene Ethyl Acrylate (EEA)

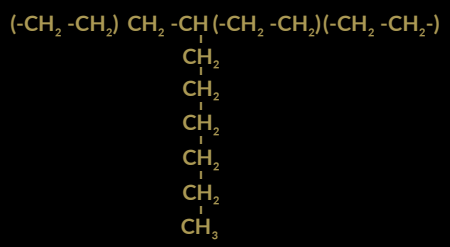


Ethylene Butyl Acrylate (EBA)



Ethylene acrylate copolymers are also used in wire & cable compounds. Their advantage over EVA is better cold temperature flexibility, especially with ethylene butyl acrylate. In addition, the acrylate copolymers offer better thermal stability compared to EVA, both during compounding and extrusion and in end use applications. In addition, they do not form acetic acid degradation products like EVA does. Similar to EVA, ethylene acrylate copolymers use medium to high acrylate content (15% – 24%).

Polyolefin Elastomers (POE)



Polyolefin elastomers have low crystallinity which allows for high filler loadings and their elastomeric characteristics allow them to better retain their properties, even with the high loading levels of fillers. While they offer good low temperature flexibility, their high temperature performance is more limited due to lower melting temperatures, especially for the softer, lower density grades. These compounds can be cross-linked with peroxides, silane or by E-beam.

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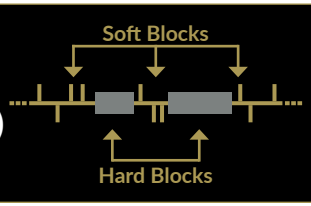
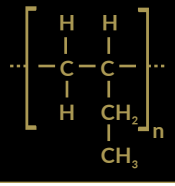
Olefinic Block Copolymers (OBC)



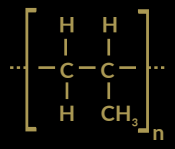
Olefinic block copolymers offer a higher temperature option compared to the polyolefin elastomers due to their higher melting temperature (120°C). They also offer high filler loading levels and excellent low temperature flexibility. These compounds can be cross-linked with peroxides, silane or by E-beam.

Polybutene-1 (PB-1)



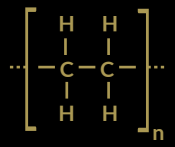
While Polybutene-1 could be used as the base resin in wire & cable compounds, its primary use would be as a modifier in the compound formulation. PB-1 offers the benefit of helping to disperse additives, minerals and flame retardants in polyolefin-based compounds. In addition to dispersing additives, PB-1 also helps to prevent re-agglomeration of these additives therefore improving the properties and performance of the final wire & cable compound.

Reactor TPOs (rTPO)



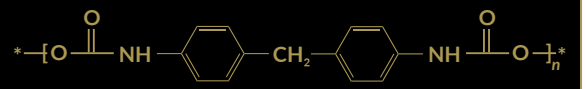
Because reactor TPOs are based on polypropylene, they offer higher temperature performance and higher mechanical properties than the polyethylene based wire & cable compounds. Reactor TPOs also allow for high filler loadings (depending on the specific grade) and good cold temperature flexibility. In addition, some of the reactor TPOs can be cross-linked using peroxides.

Polyethylene (LDPE, LLDPE, HDPE)



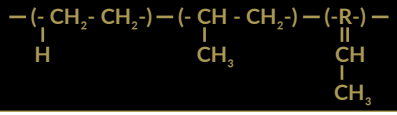
Polyethylene materials, especially low density polyethylene, are very commonly used in wire & cable formulations because of their low cost, the wide variety of types and grades available, their easy processability and their ability to be cross-linked by peroxides, silanes or E-Beam. A wide variety of high density, low density and linear low density polyethylene's could be used for formulating wire & cable compounds depending on the specific end use requirements.

Thermoplastic Polyurethane (TPU)



TPUs can be used in wire & cable formulations and in particular for those compounds that require excellent abrasion resistance, toughness and weather resistance. Various grades of TPU, both polyether and polyester based, can be used to produce both soft and hard wire & cable formulations. Polyether based TPUs are used when low temperature flexibility, good weather resistance and resistance to wet environments is required. Polyester based TPUs are used when applications require higher temperature resistance, chemical resistance or higher mechanical properties.

Ethylene Propylene Diene Rubber (EPDM)



EPDM is often used in wire & cable compounds because of its excellent overall properties such as electrical resistivity, chemical resistance, weather resistance and resistance to heat, oxidation, and ozone.

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While Entec Polymers does not offer formulated wire & cable compounds they do offer a wide range of polymers from various suppliers that can be used in producing wire & cable formulations and compounds. Refer to Table 1 below for a summary of these polymers and suppliers.

TABLE 1: Summary of base polymers used in wire & cable formulations and compounds.

POLYMER TYPE	SUPPLIER / TRADENAME	CROSS-LINKABLE		
		Peroxide	Silane	E-Beam
EVA	Celanese ATEVA®	√	√	√
Acrylate Copolymers	Dow ELVALOY™ AC	√	√	√
	Dow AMPLIFY™ EA	√	√	√
Polyolefin Elastomers	Dow ENGAGE™	√	√	√
	Dow AFFINITY™	√	√	√
Olefin Block Copolymers	Dow INFUSE™	√	√	√
Polybutene-1	Lyondell Basell *Koattro*	X	X	X
Reactor TPO	Lyondell Basell *Hifax*	√	X	X
	Lyondell Basell *Softell*	√	X	X
TPU	Lubrizol ESTANE®	Possible	In blends with EVA	√
Polyethylene	Dow LDPE, HDPE, LLDPE	√	√	√
	Nova SCLAIR® & NOVAPOL®	√	√	√
	Formosa FORMOLENE®	√	√	√