

[54] TRANSMISSION CABLE FILLING
COMPOUND

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[58] Field of Search 252/63.2, 64, 65, 66;
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[57] ABSTRACT

Communication transmission cable, method of protecting a transmission cable, and composition for such method are provided, whereby a cable filling composition for transmission cable is employed which is a combination of a low molecular weight polymerization product of a C₄ 1-olefin and an insoluble, substantially inert powdered resin, which is either naturally occurring or synthetic cellulosic material, an addition polymer which is hydrocarbon or substituted hydrocarbon, or a condensation polymer. The product has good rheological properties, low dielectric constant, and low dissipation factor, while having no detrimental effect on the other materials present in the transmission cable.

8 Claims, No Drawings

TRANSMISSION CABLE FILLING COMPOUND

BACKGROUND OF THE INVENTION

1. Field of the Invention

In the manufacture of transmission cables for communication, it is customary to enclose insulated metal conductors within an outer sheath to provide protection to the conductors. The conductors which are usually copper wires insulated with polyethylene, polyvinyl chloride, impregnated paper or other insulating material are encompassed in an outer sheath which is usually a metal-plastic composite structure, where the metal is most commonly aluminum, but steel and copper are also employed.

An outer protective layer is then applied to the composite sheath, to protect the composite sheath from the corrosive effect of ground waters as well as other agents with which the sheath may come in contact. The outer protective layer is commonly polyethylene, but polyvinyl chloride also finds use.

Because the conductors are round, when a plurality of conductors are bound together and enclosed in the sheath, voids inherently exist. Where the voids are filled with moisture containing air, internal corrosion of the cable may occur with reduced effectiveness of the insulated conductor wires. A number of different ways have been devised in order to minimize or eliminate the potential internal corrosion.

2. Description of the Prior Art

One method of inhibiting internal corrosion from moisture-laden air is to fill the cable with a dry inert gas under pressure. However, this method is costly, since the entire cable must be maintained under pressure and a source for the inert gas is necessary throughout the length of the installed cable. When the cables are broken or when connections must be made, the cable must be repressurized each time and constant monitoring for leaks is essential.

An alternative method which may be employed is the use of a filler composition which fills the voids between the conductor wires and the sheath, eliminating the presence of water. Materials commonly employed today include low molecular weight polyethylene resins combined with waxes. A typical formulation includes 85% paraffin wax, microcrystalline waxes and petrolatum and 15% of a polyethylene resin e.g. Union Carbide polyethylene resin DYLP. In addition to the above composition, anti-oxidants may be included as well as isobutylene resins to improve the rheological properties of the composition and enhance flexibility at room temperature.

The filling compounds based on wax show poor flexibility at low temperatures and at 20°F or below, transmission cable laying becomes difficult and uneconomic.

SUMMARY OF THE INVENTION

An improved transmission cable for communications and transmission cable filler composition are provided. The improved communication transmission cable is filled, so as to substantially remove any voids or gas pockets. The filler composition contains a significant amount of a low molecular weight C_4 1-olefin polymer and a powdered substantially insoluble low dielectric constant resin powder. The resin will usually be a natural or synthetic cellulosic material, an addition polymer which is hydrocarbon or alternately substituted along

the backbone of the polymer with a chloro or acetoxo group, or a cured condensation polymer employing formaldehyde in combination with urea or phenol. The resulting compositions have good rheological properties, low dielectric constants, acceptable dissipation factors and are substantially inert to the other materials commonly employed in communication transmission cables.

DESCRIPTION OF THE SPECIFIC EMBODIMENTS

Transmission cables are provided having new filler compositions to fill the voids between the conductor and the outer sheath. The filler compositions comprise a low molecular weight polybutene polymer and a substantially inert polybutene insoluble polymeric powder, either naturally occurring or synthetic. The polybutene will be present in from about 10-50 parts by weight, while the insoluble powder will be present in from about 50-90 parts by weight. Usually, the polybutene will be employed in 20-50 parts to 50-80 parts of the powdered resin. Normally, the parts by weight of the two major components will add up to 100 parts. Other materials may also be present in minor amount, such as conventional anti-oxidants, colorants, stabilizers, and the like.

The individual materials will now be considered. The first material is the polybutene, which is a 4 carbon atom 1-olefin, i.e. 1-butene or isobutylene polymer. The polymer may have a broad or narrow range molecular weight profile and will normally have a viscosity in the range of 500-20,000 S.U.S. (Saybolt Universal Seconds) at 20°C. The viscosity can be achieved by using mixtures of polybutene polymers having various viscosity ranges, preferably at least 60%, more usually at least 80% by weight of the polymer fractions being within the range indicated.

The polymeric powdered material employed is a stable, inert solid polymer which is substantially insoluble in the polybutene. The material will have a dielectric constant, when measured at 1,000 hz at 20°C, of less than about 5, preferably less than about 4, and particularly preferred, less than about 3. When combined with the polybutene resin, it is preferred that the final composition have a dielectric constant of less than about 4, and preferably less than about 3.

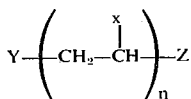
The final product should have a dissipation factor (ASTM Method D 9-4) of less than about 0.05 per cent at 100°C.

The materials which find use fall into three categories: cellulosic, natural and synthetic; addition polymers; and formaldehyde condensation polymers. These materials are employed as powders, generally from about 5 to 100 microns average mesh size more usually of from about 10 to 50 microns average mesh size. The mesh size will vary in accordance with the desired flow characteristics and melting properties of the final composition, with the smaller particles providing greater reduction of the flow of the final composition. Therefore, smaller particles would generally be employed with the lower viscosity polybutene.

The first resin material to be considered will be the cellulosic powders. These cellulosic powders include synthetic cellulose, such as cellulose ethers having alkyl groups of from 1 to 3 carbon atoms, e.g. methyl cellulose, ethyl cellulose and propyl cellulose; and cellulose esters, wherein the carboxylic acid group is of from 2 to 3 carbon atoms, e.g. cellulose acetate and cellulose

propionate. The naturally occurring cellulose sources include such materials as wood flour and ground nut shells, such as walnut flour, pecan flour, and the like.

The addition polymers are polymers of monomers of from 2 to 4 carbon atoms and may be hydrocarbon or have halogen or acetate groups. The polymers will be of the following formula:



wherein n is the number of monomeric groups in the polymer, X is hydrogen, methyl, chloro, or acetoxy, and the X's in the polymer may be the same or different; and Y and Z are end groups depending on the method of polymerization.

The hydrocarbon polymers, i.e., polyethylene and polypropylene or copolymers thereof will have melt points greater than 150°F. The non-hydrocarbon polymers, polyvinyl chloride, polyvinyl acetate, and copolymers thereof may have the vinyl chloride or vinyl acetate in any proportion.

Finally, the formaldehyde condensation polymer will be a cured polymer employing phenol-formaldehyde or urea-formaldehyde.

The subject compositions can be readily prepared by combining the polybutene resin with the inert powder and mixing the material until homogeneity is achieved. These compositions are then introduced into the cable to at least substantially fill all voids in the cable so as to minimize or eliminate the presence of any moisture containing gas.

A composition was prepared employing Indopol polybutylene H100, 100 parts by weight (35,944 S.U.S. at 100°F) and polyethylene, Union Carbide resin DKPQ, 100 parts. To this mixture was added Indopol polybutene L50 (107 S.U.S. at 100°F) 10 parts by weight, to adjust the mixture to the desired viscosity. The polyethylene powder could be replaced by the other powders to obtain the desired filler composition.

The subject compositions are found to retain the desired flexibility at temperatures as low as -40°F. Furthermore, the compositions retain flexibility properties and mechanical properties as high as 150°F, so that filler composition is not lost by flowing out of the ends of the cable and the filler composition protects the cable by retaining sufficient rigidity.

Furthermore, relatively constant rheological properties are maintained in the temperature range -40°F to +150°F. The dielectric constant of the subject compositions are less than about 3, have satisfactory insulation constants, acceptable dissipation factors and are unreactive or inert toward the insulation materials customarily employed on the conductor wire and in the outer sheath.

Although the foregoing invention has been described

in some detail by way of illustration and example for purposes of clarity of understanding, it will be obvious that certain changes and modifications may be practiced within the scope of the appended claims.

What is claimed is:

1. In a communication transmission cable, having a plurality of conducting wires and an outer sheath, the improvement which comprises having the voids between the conducting wires and the outer sheath filled with a composition having 10 to 50 parts by weight of a polybutene polymer having a viscosity at 20°C in the range of 500-20,000 S.U.S. and from 90 to 50 parts by weight of an inert, polybutene insoluble polymeric powder having a dielectric constant of less than 5 and a softening temperature above about 150°F, wherein said insoluble polymeric powder is selected from the group consisting of cellulosic materials and addition polymers of ethylene, propylene, vinyl acetate and vinyl chloride.

2. In a transmission cable, according to claim 1, wherein said composition has from about 20 to 50 parts by weight of said polybutene resin and from 80 to 50 parts by weight of said powder, and wherein said powder is of an average size in the range of 5 to 100 microns.

3. In a transmission cable according to claim 1, wherein said powder is an addition polymer of ethylene, propylene, vinyl acetate, vinyl chloride or copolymers thereof having a particle size in the range of 10 to 50 microns.

4. In a transmission cable according to claim 1, wherein said powder is a cellulosic material having a particle size in the range of 10 to 50 microns.

5. A composition useful as a filler in communication transmission cables comprising from 10 to 50 parts of a polybutene resin having a viscosity in the range of 500-20,000 S.U.S. at 20°C and from 50 to 90 parts by weight of an inert polymeric powder of from 5 to 100 microns mesh size having a softening temperature above 150°F and a dielectric constant below about 5, wherein said polymeric powder is selected from the group consisting of cellulosic materials and addition polymers of ethylene, propylene, vinyl acetate and vinyl chloride.

6. A composition according to claim 5, wherein said powder is of a size in the range of 10 to 50 microns and is an addition polymer of ethylene, propylene, vinyl chloride or vinyl acetate and copolymers thereof.

7. A composition according to claim 5, wherein said powder is of a size in the range of 10 to 50 microns and is a cellulosic material.

8. A method for protecting a communications transmission cable from internal corrosion which comprises: introducing into said cable so as to substantially fill all the voids in said cable, a composition according to claim 5.

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