ANACONDA Cable Lore

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EXTRUDED INSULATION SHIELDS

Three factors have accelerated interest in the use of a semi-conducting extruded layer as part of an insulation shielding system.

(1) URD cable acceptance and application by cable users.
(2) Rigorous specification requirements concerning corona levels.
(3) Intimate contact with insulation surface possible with extruded layers.

Early URD cables were made up with a semi-conducting tape over the insulation and concentric wires applied around this taped core. It is apparent that there would be concern as to whether fabric tapes would hold up without deterioration. Tapes were also limited in the amount of physical protection they could afford.

The development of semi-conducting compounds suitable for use over the insulation and under the concentric wires of URD cables was a notable achievement. It gained acceptance quickly and became a standard design in a very short time. The advantages over a tape bedding are best indicated by the excellent performance record of type URD cables in a wide range of environment and locations.

Corona level testing techniques were developed primarily to determine whether an insulation contained voids. Improvements in instrumentation and sensitivity were paralleled by improvements in manufacture techniques. The void problem in insulations has been minimized but improved corona level measuring techniques focused attention on two other major locations for corona.

(1) Conductor-insulation interface.
(2) Insulation surface - Shielding system interface.

The limitations of semi-conducting tapes became apparent, for example wide range in conductivity, splices, fiber ends, uneven tensions and tape laps. This range of variables made the obtaining of a smooth electrode or cable core most difficult. Movement in the cable resulting from bending during handling and installation or expansion during cycling generated voids. The voids are normally of a different geometry than voids within the insulation but appear to be even more vulnerable to the initiation of corona.

Extruded semi-conducting layers provided smooth round electrodes and intimate contact with the insulation both in the strand shield and insulation shield. The similarity in expansion characteristics with the insulation assists in the prevention of delamination or void formation.

Properly applied and grounded insulation shielding systems consisting of semi-conducting extruded layers in intimate contact with the insulation and copper wires for desired electrical characteristics provide a most efficient means for keeping the insulation surface at ground potential.

(continued)

Extruded semi-conducting compounds for insulation shields are available in both thermosetting and thermoplastic types. Choice is dependent on cable type, thermal rating, emergency and short-circuit ratings-either will function as an electrostatic shield. The following lists characteristics of each type that must be considered before a choice is made.

Thermoplastic Semi-Conducting Compounds

(1) Will deform at elevated temperatures.
(2) Rather sharp increase in resistance at higher temperatures.
(3) Most compounds are not inherently flame resistant.
(4) Very favorable from manufacturing viewpoint -- does not subject insulation to the high temperatures of vulcanization or crosslinking.
(5) Adhesion control possible for easy stripping.
(6) Good performance record in URD type applications.
(7) Not recommended in oil-hydrocarbon environment.

Thermosetting Semi-Conducting Compounds

(1) Excellent deformation characteristics.
(2) Appear to be more consistent in resistant characteristics over a temperature range.
(3) Most compounds are not inherently flame resistant.
(4) Requires heat for vulcanizator or cross-linking -- this can lead to two problems (1) Drifting of conductor in some types of insulation (2) Very tight bond with the insulation.
(5) Not recommended in oil-hydrocarbon environment.

Inspection and comparison of the above attributes of thermosetting and thermoplastic compounds suggests that a highly desirable objective would be a compound combining the best performance of each type. In addition the flame resistance usually associated with PVC and Neoprene jackets would make an excellent contribution. With this objective in mind development work was initiated to develop a compound combining the favorable characteristics of each type. Test results have been most rewarding. A semi-conducting compound with the following attributes has been developed.

(1) Low deformation at elevated temperatures.
(2) Retention of a relatively low resistance over a temperature range.
(3) Inherent flame resistance similar to PVC and Neoprene jackets.
(4) Does not require a separate vulcanizing or cross-linking operation to develop optimum properties.
(5) Amenable to processing for controlled adhesion.
(6) Improved oil resistance.

This new semi-conducting compound has excellent potential in present cable designs and even more promise in new cable concepts.

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