ANACONDA Cable Lore

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CABLE EXCELLENCE

A long time ago a gentleman by the name of Publius Syrus stated that "it is a bad plan that admits no modification." He also stated that "it takes a long time to bring excellence to maturity." These philosophical quotations offer a cable engineer both a challenge and encouragement.

A challenge because a perfect cable does not exist -- no individual or group of individuals claim total knowledge of cable application parameters and concepts to accommodate these parameters.

Encouragement because excellence is possible and can grow in degree. Excellence in this instance would be a cable having or approaching measurable characteristics considered ideal according to latest cable technology.

Reflection on the flow of R & D work during the past four decades will put into perspective the quest for power cable excellence. It will also assist in extrapolating future power cable design.

Cable engineers involved with solid dielectric medium voltage power cable some 40 years ago were deeply engaged in obtaining insulations with a degree of ozone resistance, modest thermal properties, and adequate electrical characteristics. Cable designs were relatively unsophisticated and rather bulky by today's standards and generally limited to a modest voltage range.

The next decade bore fruitful results. Synthetic polymers with a more favorable chemistry than natural rubber presented for the first time compounds with inherent ozone resistance. Thermal characteristics at both low and high limits were much improved, physical properties were advanced and electrical properties improved. The new compounds for the most part were introduced into cable concepts prevalent during the previous decade. Solid dielectric cables were underway.

Synthetic polymers spurred R & D activity by an increasing number of investigators in the next ten years. Properties of compounds were optimized, design concepts included the use of semi-conducting tapes for strand shields and insulation shield bedding. Attention was given to voids in cable insulations and corona level measuring techniques introduced to determine the presence of voids and imperfections. The utilization voltage of solid dielectric cables were increasing.

The decade prior to the 1970's was an extremely busy period in medium voltage cable development. Factors that accelerated this development were many:

(1) The trend from paper-lead cables to solid dielectric insulation in the 5 - 35 kv voltage range.

(2) The trend from overhead to underground distribution.

(3) Greater sophistication in both laboratory and factory testing of cables.

(4) Customer demands for maximum reliability.

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(5) New materials with excellent electrical properties.

(6) Advances in the art of processing.

(7) Miniaturization in cable dimensions (reduced insulation walls).

Both new cable concepts and new materials were introduced during the 1960's. Two outstanding features in cable design were the UniBlend concept and URD cables. The UniBlend concept offered a smooth round electrode, special attention to homogenous and clean insulations and improved processing techniques. URD cables provided a new look in shielding systems utilizing extruded semi-conducting extrusions in intimate contact with the insulation and enhanced by copper drain wires.

Utilization of the UniBlend and URD concepts in medium voltage cable design has contributed significantly to:

(1) Maximum performance of a specific insulation in the cable core.
(2) Improvement in corona levels.
(3) Streamlined and simplified cable designs.
(4) Cable miniaturization.
(5) Demonstrated the feasibility of controlled resistance shielding systems, efficiency and other desirable properties difficult to obtain with conventional shielding systems.

A review of medium voltage cable design and performance over the past four decades brings into focus cable characteristics, concepts, materials and evaluation techniques that provides reference points or goals for cable excellence. Quantitative evaluation of present resources indicates that these goals are within reach, for example:

(1) XLP and EP compounds offer unprecedented ozone resistance.

(2) XLP and EP compounds exhibit electrical properties in line with those exhibited by paper-oil combinations.

(3) The Uniblend concept contributes a round smooth electrode.

(4) XLP and EP compounds have both excellent low temperature and high temperature properties.

(5) The Uniblend concept introduced a new era of compound cleanliness.

(6) The URD cable concept provides an expanded scope of cable shielding practice.

(7) Corona detection dequipment of a high degree of sensitivity is available for sophisticated evaluation of cables in this final state.

(8) Testing techniques that contributed significantly to the enviable performance record of paper-lead cables are now applied to solid dielectric cables.

A careful scrutiny of these resources projects a clue for the future. Imaginative combination of these resources provide a new cable concept -- "UniShield" -- cable core excellence combined with excellence in the shielding system.

Years of development covering a broad spectrum of activity including core and shield design, testing and equipment design have made UniShield Cable a reality.

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