IMPROVEMENTS IN SUPERABSORBENT WATER BLOCKING MATERIALS FOR NEW POWER CABLE APPLICATIONS

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ABSTRACT

Cables that are not longitudinally water blocked are vulnerable to water ingress over long lengths of hundreds of meters or more. In these events, electric utilities and/or cable producers may suffer high cable replacement costs or delays caused by long cable lead times or right-of-way problems. Conversely, properly water blocked cables limit water ingress to a distance of typically less than 1 meter.

Recently, cable and water blocking material producers have witnessed and reacted to a clear industry trend towards complete longitudinal water blocking of power cables, including the conductor, rather than the traditional requirement for "screen only" water blocking. To address these new challenges, new water blocking materials were developed by Geca Tapes for use under the strenuous conditions of CV extrusion and decades of service at conductor operating temperatures. The new materials included a thin water blocking tape for use in power conductors, a new high-capacity water blocking yarn designed for use in conductors and two new water blocking filler yarns designed for use in the interstitial areas between conductors in LV and MV multicore cables

In addition, methods were developed to analyze power cable geometry and produce an estimated bill of materials for water blocking. This information proved useful to cables makers for verification trials of new water blocked cable designs.

KEYWORDS

Longitudinal water blocking, superabsorbent polymer, water blocking yarn, water blocking filler, water blocking tape

INTRODUCTION

It is well accepted in the power industry that longitudinal water ingress can cause cable failures, a reduction in cable network reliability, an increase in maintenance costs and/or a reduction in cable lifetime [1][2][3]. Reported problems encountered by power utilities due to water ingress into cables include:

- High cable repair and replacement costs that result when water catastrophically invades a long, rather than limited, distance into the cable
- Corrosion to metallic cable components due to the presence of moisture
- Insulation degradation, water trees [4]

Historically, a common manifestation of water ingress into cables was the formation of water trees in XLPE insulation. The problem was particularly serious in early versions of XLPE but recent improvements in insulation technology have greatly reduced the occurrence of water trees. Nonetheless, improved XLPE may not be economically or technically viable for all types of conductor insulation and other concerns over water ingress remain.

Some electric utilities have described in confidence to Geca Tapes personnel that water ingress into cables over long lengths has caused serious problems and costly repairs. It was further explained that failures of the water seals in power cable joints are on the increase and as a result, utilities have experienced a corresponding surge in cable problems and an increased frequency and severity of water damage. One postulated root cause of the increased power cable joint problems is the general reduction of in-house cable installation, splicing and commissioning skills due to privatization/deregulation and a concurrent trend toward subcontracting cable works via lowest-price tendering.

To address these issues in a power industry international document, the IEEE is now working on a major upgrade to IEEE-1142. Plans call for the document to be renamed "*Guide for the Selection, Testing, Application and Installation of Cables Having Radial Moisture Barriers and/or Longitudinal Water Blocking*".

ROOT CAUSES AND AN IMPORTANT CAVEAT

The real world conditions under which cables are transported, stored, installed and operated provide opportunity for longitudinal water ingress including:

- Storage, especially if the cable end is left uncapped
- Damage during transport, trans-shipping, drum handling, forklifts, etc
- Cable installation - pulling, laying in trenches, backfilling, laminar flow blowing, newly-developed water flowing techniques
- Cable systems catastrophically exposed to water – flooded tunnels, dam & levee breaches, rising seawater levels due to global warming, etc.
- A joint is improperly assembled or a joint seal fails
- Civil works damage, accidents, theft, pests, weather

Historically, these dangers have been addressed on a limited basis by longitudinal water blocking of the screen in MV and HV cables. More recently, many electric utilities began to specify longitudinal water blocking of other parts of the cable structure including ①circular conductors, ②segmented conductors, ③the interstitial areas in multicore MV cables, ④steel wire armoring and ⑤steel tape armoring. It is these new, non-traditional water blocking requirements that drive the need to verify performance of existing materials under more strenuous conditions or to develop new materials as needed.