Self-healing cable sheaths in extruded polymeric power cables

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The use of undergrounded cabling is becoming increasing prevalent within electricity transmission and distribution networks on-shore due to the need to deliver electricity within heavily urbanised and visually sensitive regions and to connect new generation sources particularly from wind farms. Off-shore requirements are also growing significantly addressing the need to connect new generation capacity from off-shore renewables. Within the UK, the distance of undergrounded cabling has doubled over the past five years (from 420 to 870 miles) while in France, RTE is committed to installing at least 30% of new cabling underground[1].

Although underground cabling is well protected from the elements (and extreme weather in particular) compared to an equivalent overhead line (OHL), the cost of materials and installation are substantially greater. Furthermore, the location of these cables often prohibits preventative maintenance, and should a cable fail, it is a major challenge to locate, diagnose, and fix the fault which can take up to 25 times longer than a comparable failure on an OHL[2].

An ideal solution to these issues would be to develop cable materials capable of a repair-response to damage events, or to the driving forces associated with those events. It is envisaged that this response would take one of two forms: molecular self-repair which would restore sheath mechanical integrity or a sub-sheath response prompted by the presence of a common driving force such as water. In both cases, the aim would be to seal the damaged region and prevent the free ingress of water, which is heavily implicated in accelerated cable deterioration and insulation failure including water treeing[3].

Here, we present an overview and consideration of both approaches to cable sheath repair, with a particular focus on the deployment of these materials in discrete, sub-sheath layers or multi-layer self-repair materials. We consider that this approach greatly simplifies the incorporation of self-healing materials into common cable designs, while minimising the risks and costs associated with more complex approaches to cable protection.

The paper will conclude by highlighting the importance of linking functional self-healing materials to self-repair design in power cables.

1 RTE, “Activity and Sustainable Development Report 2012”, February 2013
2 National Grid, “Undergrounding high voltage electricity transmission lines”, August 2013
3 Steennis, E.F.; Kreuger, F. H., "Water treeing in polyethylene cables," Electrical Insulation, IEEE Transactions on , vol.25, no.5, pp.989,1028, Oct 1990