Electrical Connection of Power Cables Filled with longitudinal Water-Blocking Materials

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ABSTRACT

Nowadays, power cables are an indispensable asset of the energy transmission industry. The life of an extruded power cable can deteriorate more rapidly under AC voltage stress when moisture is present [1], because of e.g. water-treeing. Therefore, a popular solution the stranded conductor is often filled with water-blocking materials. The first longitudinal water-blocking compounds exist since the 1970s. Nowadays, an ever-increasing share of MV underground cables with stranded conductor are water-blocked with compound fillers or yarns [2].

However, these water-blockers are not specified in any standard and thus, the cable manufacturers enjoy great freedom in the design of their water-blocking cables. On the other hand, this makes it more difficult to connect all of these cables with different filles. Usually, different fillers could need different connectors respectivally lugs. This would lead to a higher complexity and a big variaty of different connectors / lugs in the field, which would lead to a higher rate of installation failures. But the question is can this be avoided? Is there a way or a method to connect all of these cables with the same connector?

This contribution will adress these difficulties and the dependancy of quality of the elecrical connection on the water-blocking filler and will answer the questions above. As a final result, a recommendation will be presented, what is the most effective way to connect such cables with water-blocking materials and how to establish the highest quality of electrical connection. The results will be presented and discussed using tabular and graphical representations.

KEYWORDS

Electrical connection, mechanical screw connector, water-block, conductor filler, connection quality, cable connector, cable joint, medium voltage

INTRODUCTION

State of the art to connect conductors of power cables in the area of high, medium and low voltage is by using ferrules or lugs. There are two main installing techniques: compression or crimping and bolted mechanical connections [3, 4].

MV cables, which were subjected to water ingress, can deteriorate more rapidly under alternate current voltage stress [1]. To minimize the detrimental effects of water, longitudinal water-blocked (LWB) cable designs have gained popularity among electrical assets in Europe. These types of cables are used in wet environments, especially in marine and offshore applications, where water tree deterioration of the insulation and corrosion of the metallic components are of primary concern [1, 2].

There are many situations under which a medium voltage cable cross-section may be subjected to water during the cable's life. In the case of an external damage moisture can ingress into the cable [1, 2]. Upon contact with water the water-blocking tape will swell and thus stopping water from longitudinal propagation. MV cable conductors can contain watertight yarns, powders, tapes or compounds to make them longitudinally watertight (see Fig. 1).

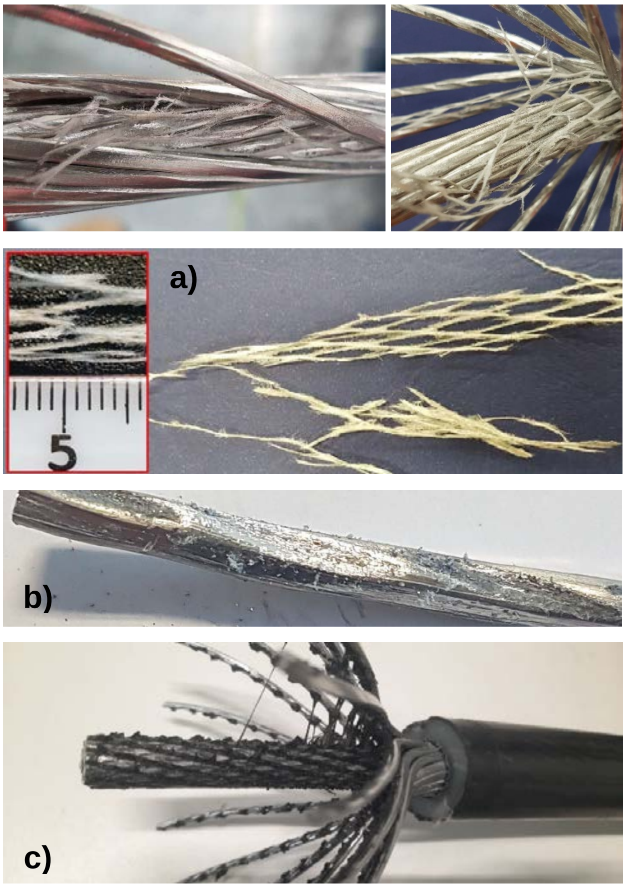

Fig. 1: Aluminium conductor with water-blocking materials: a) Yarn; b) Powder; c) Compound

These water-blockers can hinder the current flow inside a connector because they represent low conductive barriers between the wires. Thus, the cross conductivity between the conductor wires and thus the current carrying capability of the connection are reduced. Especially after short circuits the connection resistivity can be increased and thus the connector may heat up until it fails (thermal runaway).

This could be solved with heavy bolted connectors which have a big mass and big surface, thus being able to dissipate the heat better by acting like a temperature sink. However, these heavy bolted connectors are expensive and require also larger accessories. Therefore, a slim bolted solution is favorable.