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Influence of corroded conductor on the performance of medium voltage extruded cables

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In the underground distribution network, it may occur that "milky" water is found in the inner aluminum stranded conductor of extruded cables. The water has possibly enter into the cable either during installation or aging, or even through an unseal termination. When the inner conductor is in aluminum, the water may corroded it to form alumina, explaining the white color. This observation raise the question does the milky water or the corrosion left on the conductor surface have an influence on the performance of the cable? To answer this question, results are presented here on the characterization of medium voltage extruded cables, having corroded aluminum conductor and aged under various simulated conditions. The cables are of the 28 kV class, crosslinked polyethylene (XLPE) insulated, with 750 kcm compact aluminum conductor, steam cured and aged in service 15 years. Four conditions were selected for the conductor strands: without water, with tap water, with an aqueous sodium chloride solution (0,1 M), and with silicone XL. These conditions unable to evaluate the cables once internally dry, with more or less further corrosion of the aluminum strands, and under a possible solution of rejuvenation. The laboratory aging of the cables was performed in water tanks (2000 l) at a conductor temperature 90°C, measured in air, 8 hours/ON and 16 hours/OFF and with $1xU_o$ (14,4 kV) applied. After 6 months of aging, all the cables, three samples per condition, were removed and characterized by: insulation water content, water treeing analysis and AC breakdown tests (ACBD). The results indicate that the water content in the cable insulation increases significantly for the conditions without and with water in the strands, but the ACBD strength is statistically less in the second condition. Less water ingress in the insulation was observed with the salted solution, as the latter blocked with time the space between the strands, preventing water circulation inside. However, in that case the ACBD strength was the least obtained. With the silicone XL condition, the insulation water content was quite small, < 50 ppm, and the ACBD strength between 1,8 and 2,8 times greater compared with the other conditions. This indicates that the silicone has decreased the presence of (free) water in the insulation, while increasing significantly the performance of the cables. It is observed finally that the more numerous and longuest water trees are found with the salted solution, and the contrary with the silicone XL condition. In general, these results show that the presence of water in the conductor strands decreases the performance of the cable.