Use of aluminium conductors in submarine power cables

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The majority of installed submarine power cables have copper conductors. While it is widely acknowledged that power cables with aluminium conductors are less expensive than copper cables and this paved the road for a widespread use in underground power applications, some utilities are reluctant in choosing aluminium conductors for their submarine cable projects. Corrosion, mechanical stability and lightweight-related issues are usually invoked as argument against aluminium conductors. In spite of these perceived drawbacks many minor and some notable large submarine power cables with aluminium conductors have been installed successfully.

This paper gives a short review of the present use of aluminium conductors for underground and submarine cables.

This paper demonstrates the opportunities and limitations of aluminium conductors for submarine cables. It identifies aluminium properties that are relevant for submarine power cable conductors. Mechanical aspects and sea bottom stability of aluminium cables are addressed. From the analysis of relevant properties it is evident that the suitability of aluminium as a conductor material is different over the range of different submarine power cables. Experiences from one type of cables cannot easily be transferred to other types.

It is explained why the corrosion processes that have occasionally been observed in low and medium voltage underground cables are not relevant for modern submarine cables.

Aluminium submarine cables and the equivalent copper cables are compared with respect to weight, volume and logistics. As expected, aluminium cables are lighter but larger in diameter than their copper equivalents. For high-voltage submarine cables involving a lead sheath the differences are surprisingly small. In most cases the choice between aluminium and copper cable has no or little influence on the number of cable laying campaigns.

The tensional strength of welded aluminium conductors and their welded joints has been measured and found suitable for single-layer armored aluminium submarine cables for 150 m water depth or more. Aluminium cables with double-layer armoring have been used for very large water depth.

Accessories for aluminium cables deserve special attention; lack of knowledge and poor engineering have caused contacting problems in the past. If some basic principles are taken into account the jointing and termination of aluminium conductors can be managed reliablely.

Aluminium conductors weigh only about the half of copper conductors with equivalent transmission capacity. Combined with a lower unit price of aluminum on the metal market than copper, this leads to considerable economic advantages of aluminium cables over copper cables.

The characteristics of a few important submarine power cables (both HVDC and 3-core) with aluminium conductors are presented.