Copper-clad aluminum as an alternative to copper flexible conductors for electric power cables: opportunities and challenges

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ABSTRACT
The majority of flexible conductors for LV power cables is today made with Copper. Use of alternative metals for these cables is investigated, under the push of significant cost reduction. Aluminum is an alternative but some technical concerns are considered in terms of mechanical and corrosion resistance properties. Bimetallic conductors like copper-clad aluminum can combine advantages of the 2 metals, with attractive cost. LV flexible cables were produced with Cu, CCA, tinned CCA and Al class 5 conductors; CCA conductors were evaluated in terms of quality and integrity of copper layer; an evaluation of main cable properties was considered.

KEYWORDS
Cu, CCA, copper-clad aluminium, aluminum, flexible conductors, class 5 conductors, LV cables.

INTRODUCTION
The pressure of high copper prices during the last decade requires innovative solutions to reduce its strong impact on material costs for wire and cable (W&C). Aluminum is a well-known material for producing conductors with a good cost/performance ratio (conductive and lightweight) that has been used for many years. Nowadays, copper is still largely used in W&C and its replacement with aluminum presents challenges for various reasons: a larger diameter of aluminum is required to match the resistance of a copper conductor, aluminum’s mechanical properties (tensile strength) are inferior to those of copper, aluminum presents processing difficulty in fine wires (i.e. down to 0.20 mm diameter at 20m/sec production speed, in conventional copper drawing equipment) with no impact on the Al/Cu volume ratio and maintains a strong bond at the interface between the two metals.

Prototype cables manufactured with high-quality CCA conductors showed performance comparable to that of copper, even in severe high-humidity conditions, whereas aluminum conductor cables failed.

ALTERNATIVE METALS TO SUBSTITUTE COPPER AS FLEXIBLE CONDUCTORS FOR LV CABLES : AL AND CCA
Copper has been predominantly used in power cable applications as it provides the best conductivity for the best price as compared to silver or gold. Increasing copper price and copper theft lead to the search for a cost saving and theft deterrent product. Aluminum has been investigated and used in LV and MV power cable applications as a cost saving alternative. Cables such as building wire, service drop, parallel aerial cable, secondary UD cable, and 600 V power cables can be manufactured using aluminum and are available commercially in the US market. Even though aluminum has been widely used in US market, there are still significant concerns in special applications due to its oxidation and creep phenomena. Two people died in a house fire due to an overheated aluminum wire connection at a wall receptacle [1].