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Influence of Properties of Double-Insulated Materials on the Maximum Permissible Current of a Cable Product

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Abstract. A thermodynamic model of the operation of a loaded double-insulated cable product has been developed. The obtained mathematical relation makes it possible to determine the maximum permissible current of a single-core double-insulated cable product depending on the materials and dimensions of the insulation layers and the conditions of installation. The dependence of the maximum permissible current for a hypothetical cable product with a copper core and double insulation on the ratio of the radii of the insulation layers when laid in air is constructed for cases where the first insulation layer is a material with a higher thermal conductivity coefficient, the second layer – with a lower one, and vice versa. In the first case, with an increase in the ratio of the radii of the insulation layers, the maximum permissible current decreases, and in the second case, the dual current increases by almost 15 %. The dependence of the maximum permissible current of a real H07V-K cable of typical dimensions on the ambient air temperature, which is real for the territory of Ukraine, is calculated. Recommendations on the practical application of the H07V-K cable for connecting mobile power sources in war conditions are given.

Introduction

An integral part of construction materials are cable products, in particular, electric cables and electric wires [1].

According to the statistical report [2] on fires in Ukraine, cable products are the most dangerous among electrical products in terms of fire hazard (up to 60 % of fires, 20 % of deaths and 70 % of direct material damage).

As a result of the open military attack of the Russian Federation and the ongoing hostilities in Ukraine, there is a shortage of power generating capacity, instability of electricity quality, and blackouts. A large number of different mobile electric generating sets are used, which require appropriate cable products to connect.

Ensuring the fire and operational safety of cable products to ensure the reliability of power supply is an urgent task in today's Ukraine. There is a problem of improving the fire and operational safety of cable products in wartime.

Analysis of Publications

Few papers have been devoted to the issue of ensuring fire and operational reliability of cable products. Paper [3] investigated changes in the properties of cable products materials over time. In [4], a mathematical model was developed to assess the fire safety of a loaded cable line in the form of an openly laid electric wire with single-layer insulation (unprotected electric wire). The