11th. World Congress on Computational Mechanics (WCCM XI)
5th. European Conference on Computational Mechanics (ECCM V)
6th. European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

STUDY ON IMPROVEMENT OF PASSIVE COOLING IN DISTRIBUTION TRANSFORMERS

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Key Words: *Heat Transfer, Passive Cooling, Distribution Transformer, CFD.*

Thermal management is important aspect in design of electrical apparatus like transformers, which are responsible for power distribution. Operational temperature has direct influence on the reliability and lifetime of those devices and thus keeping temperature limits and preventing from overheating is vital. Transformers and other power distribution equipment are expected to have long operational time, even up to 30 years, with minimized service and for that reason the passive cooling methods, e.g. natural convection of air, are dominating in their thermal management.

The heat transfer coefficient for natural convection of air is relatively low. The required cooling rate is obtained by increasing of the heat transfer surface using ribs or fins. The geometry of the fins and in particular the distance (air gap) between surfaces of the adjacent fins, has direct influence on the heat dissipation efficiency. The optimum spacing between fins may be found using various analytical formulas [1][2] or by computer simulations. However, in practice the fin-to-fin distance may be larger than optimum one because of technical or manufacturing limitations. That is common situation in distribution transformers with so called corrugated fin tanks.

The study on improvement of passive cooling in distribution transformers with corrugated fins is discussed in this paper. The presented method is applicable for devices in which distance between the fins is larger than optimum one. In the proposed solution the additional panels are placed between the fins and parallel to them in order to increase radiative heat transfer from the fins' surface (Figure 1). The radiation is important heat transfer mechanism in passive cooling, however in structures with fins its share in total heat dissipation is minor comparing to convection.

The paper includes the results of evaluation of the proposed method basing on the analytical formulas describing convection and radiation in passive cooling systems. These results are compared with numerical solution, i.e. CFD calculations, and laboratory measurements. It is confirmed that the additional barriers placed between the fins cause significant increase of the radiative heat transfer from surface of the fins and may be utilized for improving heat dissipation in passive cooling systems. However, it is also shown that the obtained improvement is strongly dependent on the distance between the surfaces of the adjacent fins. Finally, the proposed method is applied to example distribution transformer and the results from CFD calculations indicate about 20% improvement of the heat transfer rate.

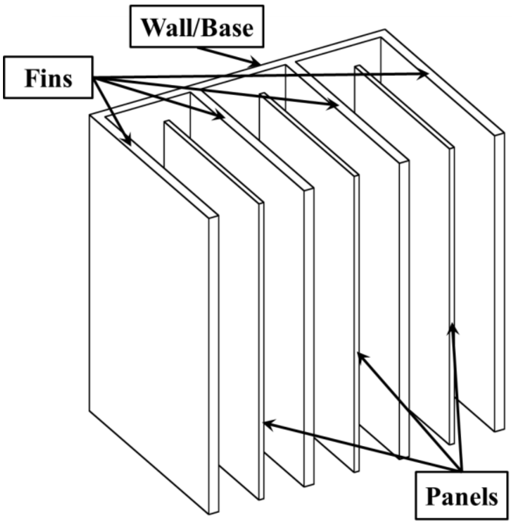

Figure 1: The schematic view of the concept of panels for increasing radiative heat transfer from fins.

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