<u>*Секція «Фізика»*</u>

POLYNOMIAL GENERALIZATION OF THERMAL CONDUCTIVITY MODELS FOR PARTICULATE COMPOSITES

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Studies carried out on composite media proved that effective properties of heat transfer in heterogeneous materials greatly depend on their microstructure. A large number of theoretical and numerical studies are devoted to obtaining a generalized formula for the thermal conductivity of particulate composites. Four basic models of heat transfer in composite are considered in the work. Maxwell model (model *m1*) considered the problem of spherical particles embedded in a continuous matrix. Rayleigh (model *m2*) considered material in the form of spherical inclusions arranged in a simple cubic array, embedded in a continuous matrix. Hasselman and Johnson (model *m3*) emphasized that for a composite with a given shape of inclusion, the effective thermal conductivity depends on not only the filler volume fraction, but particle size as well. Lewis-Nielsen (model *m4*) assumed that a composite material might be constructed incrementally by introducing infinitesimal changes to an already existing material. The advantage of all four presented models is quite simple expressions for the thermal conductivity of composites [1]. However, these analytical formulas are still different. This paper presents the result of a generalization of these formulas using the matrix-polynomial paradigm. The effective thermal conductivity of composites can be represented as follows

$$\kappa_{e,mi} = \alpha_{p,mi}\varphi^{p}, \quad p = 0, \ldots, 6,$$

where

$$\alpha_{p,mi} = \begin{pmatrix} 0.917 & 5.82 & -29.08 & 126.04 & -228 & 215 & -80.1 \\ 1.11 & 3.79 & 110.7 & -610 & 1624 & -1980 & 903.7 \\ 0.95 & 2.8 & -21 & 114 & -343.7 & 515.9 & -291.9 \\ 0.905 & 6.16 & -78.2 & 496 & -1469 & 2044 & -1078 \end{pmatrix},$$

φ is the volume fraction of the filler, mi is the number of model.

References

1. K. Pietrak, and T. S. Wisniewśki. A review of models for effective thermal conductivity of composite materials. *Journal of Power Technologies*, 95(1), 2015. P. 14–24.