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# Effective Thermal Conductivity Of Porous Media: A New Semi-Empirical Correlation

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## Extended Abstract

The randomness of the microstructure of the solid phase and the complication of evaluating the thermal resistance in two-phase porous media make it challenging to come up with general formulas that accurately predict the effective thermal conductivity. The parallel, series, and a combination of parallel and series heat flow are usually utilized to develop models that predict the effective thermal conductivity of porous media. All these models end up with equations where porosity is used as an average weighting factor. In some cases, additional weighting factors are used to fit specific experimental data and to improve accuracy.

A new correlation has recently been developed [1] based on a combination of re-examined parallel and series heat transfer models using the Langmuir shape factor, which is expressed as

$$\bar{k}_e = \bar{S}_s^p + \bar{k}_f \bar{S}_f^p + \frac{\bar{k}_f \bar{S}_s^s \bar{S}_f^s}{(\bar{S}_s^s + \bar{k}_f \bar{S}_f^s)}$$

where $\bar{k}$ and $\bar{S}$ are the normalized thermal conductivity and Langmuir shape factor, superscripts *p* and *s* are referred to the re-examined parallel and series heat transfer models, subscript e is referred to the effective thermal conductivity, and subscripts *f* and *s* are referred to the solid and fluid phases.

The new correlation was used to analyze experimental data that investigated the microstructure characteristics of the solid and fluid phases on the effective thermal conductivity of sintered copper powder [2]. The analyses result in semi-empirical correlations for the average heat transfer areas, lengths of heat transfer pathway, Langmuir shape factors, and the effective thermal conductivity as functions of porosity. Furthermore, the predictions of the effective thermal conductivity of the new correlation are accurate within the uncertainty of the measurements.

## References

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