

Quantitative analysis of silica aerogel-based thermal insulation coatings - DTU Orbit (08/11/2017)

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A mathematical heat transfer model for a silica aerogel-based thermal insulation coating was developed. The model can estimate the thermal conductivity of a two-component (binder-aerogel) coating with potential binder intrusion into the nanoporous aerogel structure. The latter is modelled using a so-called core-shell structure representation. Data from several previous experimental investigations with silica aerogels in various binder matrices were used for model validation. For some relevant cases with binder intrusion, it was possible to obtain a very good agreement between simulations and experimental data with shell thickness and/or thermal conductivity of the shell as adjustable parameters. However, the experimental data was not sufficiently detailed to allow a separation of the effects of the two parameters. In the ideal case of no aerogel binder intrusion, a comparison with a coating containing intact hollow glass or polymer spheres showed that silica aerogel particles are more efficient in an insulation coating than hollow spheres. In a practical (non-ideal) comparison, the ranking most likely cannot be generalized. A parameter study demonstrates how the model can be used, qualitatively, to get an indication of the effect of important model parameters on the thermal conductivity of an insulation coating. With relevant data available for service life exposure conditions and raw material costs, the model can also be used as an optimization algorithm.

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