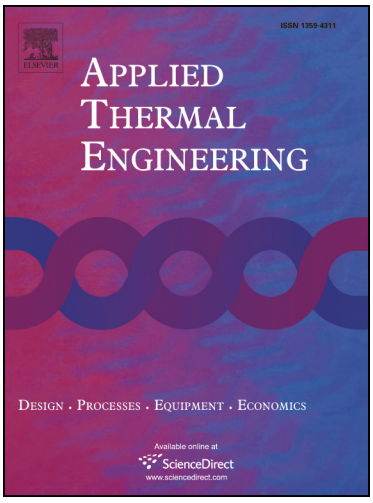

Research Paper

Influence of material properties and structural parameters on the performance of near-space use lightweight insulation structure

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Influence of material properties and structural parameters on the performance of near-space use lightweight insulation structure

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Abstract

We recently developed a lightweight insulation structure (*LIS*) which had a high request in thermal insulation performance and structural weight and was promising to be used as the thermal control element for a near-space aircraft. In the present paper, the effects of the material properties and structural parameters on the thermal insulation performance of near-space use *LIS* were numerically investigated in detail. In the proposed theoretical model, the equivalent thermal conductivities and specific temperature differences of *LIS* were studied to make detailed thermal features clear. Compared with the experimental and previous simulation data, the theoretical model has been validated, showing a good consistency. The results showed that the thermal conductivity of insulating material had a great influence on the specific temperature difference due to its strong effect on the equivalent thermal conductivity of *LIS*. In addition, it can be seen that the structural parameters mainly influenced the insulation performance of *LIS* by changing the areal density of *LIS*. The results demonstrated that the theoretical model suggested a pathway towards designing the structure parameters of near-space use *LIS* and selecting suitable insulating materials quickly.

Keywords: Equivalent thermal conductivity, lightweight structure, specific temperature difference, structural parameter, theoretical model, thermal insulation performance

Nomenclature

A	area, m^2
b	fin width, mm
c_P	thermal capacity of the air in the channel, J/(Kg.K)

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