Experimental Study of Heat Transfer Characteristics in the Porous Heat Absorber of Thermoelectric Generator System for Waste Heat Recovery

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Abstract

This study will develop a porous heat absorber used in the thermoelectric generator for the vehicle engine waste heat recovery. The high performance of the porous heat absorber may enhance the generating electricity of the thermoelectric generator. Hence, the heat transfer characteristics in the asymmetrically heated rectangular channels fully filled with porous materials will be investigated experimentally. Air was used as the coolant. The porous materials were packed by brass beads with average diameters (d) of 2, 4 and 6 mm. The channel width (W) was fixed to be 60 mm. Variable parameters were the relative length of packed channel (L/d=5~60), the relative height of packed channel (H/d=1.67~15) and the Reynolds number (Re_D=755~7921 and Re_{dp}=38~2703). The results indicated that the bead diameter (d), rather than the hydraulic diameter (D_h), may be a proper parameter to generalize the data for heat transfer in a packed channel. Besides, the particle Nusselt number ($\overline{Nu}_{dp}$) increased with decreasing L/d, while the H/d was not sensitive to $\overline{Nu}_{dp}$. Finally, the correlations of average and local particle Nusselt numbers ($\overline{Nu}_{dp}$ and $Nu_{dp,x}$) for various L/d, H/d and Re_{dp} were provided.

Keywords: Heat transfer, porous materials, packed channel, brass beads.