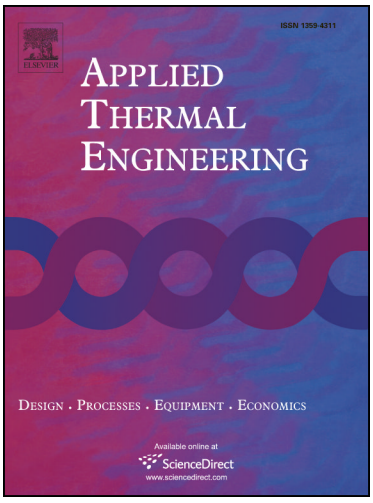

Research Paper

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Investigation of convectional heat transfer coefficient of circular cross-section short pipes in hot stamping dies

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Abstract: Since the cooling system design in hot stamping die is an important issue in hot stamping technology, the heat transfer characteristics between water flow and the inner wall of pipes becomes particularly important for its remarkable effect on hot stamping process. In order to investigate the heat transfer characteristics between H13 tool steel and the water flow in hot stamping dies, a self-developed convectional heat transfer coefficient (CHTC) measuring equipment was established based on a circular cross-section short pipe model. To calculate the CHTC, an analytical calculating method named Fourier equation method based on experimental data and a numerical simulation method were introduced. To further investigate the influence of different factors including inlet mass flow rate, inlet fluid temperature, inlet fluid turbulence intensity, pipe diameter, surface roughness and the furnace temperature on the CHTC, more numerical simulations were implemented, together with the ANOVA analysis. And results showed that the obtained simulation temperature field was in good agreement with the experiment, and the calculated CHTC values distilled from the simulation result were matched well with that of experiment, too. Moreover, all the investigated factors were found to have significant influence on the CHTC value, and the top three factors are inlet fluid flow rate, inlet fluid temperature and pipe surface roughness. Finally, a novel threaded pipe applied in hot stamping die was introduced derived from the ideal of improving inner pipe surface roughness, which is found to have much higher CHTC, the turbulence intensity along the cooling pipe can be promoted, which can help increase the heat transfer intensity as well.

Key words: Hot stamping; Short pipe flow model; CHTC; Calculating methods; Influencing factors; Threaded pipe