INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

The present thesis work investigated the effect of various shapes of winglets, such as delta winglet pairs (DWP), rectangular winglet pairs (RWP), and curved rectangular winglet pairs (CRWP), on the flow behavior of an aqueous solution of carboxymethylcellulose (CMC) through a rectangular channel with and without the inbuilt cylinders. Three-dimensional numerical simulations were carried out for a range of Reynolds numbers (50-200) using aqueous carboxymethylcellulose, commonly known as non-Newtonian shear-thinning fluid as a working fluid. Nusselt number (Nu), friction factor (f), and the combined effect of Nu and f, commonly known as quality factor (Q_f), were calculated and compared for each case. Additionally, the comparison is also made with the base channel considering a dimensionless number (η) defined as $(Nu_m/Nu_o)*(f_o/f)^{0.33}$. As well, an investigation was conducted into the impact of attack angle, winglet placement, and tube placement on the thermohydraulic performance of the channel. The fin-tube heat exchanger (FTHE) performance parameters were effectively compared and evaluated using an aqueous solution of CMC and water. It was discovered that incorporating DWP in FTHE improves overall performance compared to RWP. Still, when only heat transfer applications are considered, RWP outperforms DWP. When comparing the thermohydraulic performance, the use of CRWP is unequivocally superior to RWP. The former option provides a more efficient and effective means of achieving the desired outcomes. Reducing the attack angle improves performance up to a limit, but further decrease reduces performance. Utilizing an aqueous solution of CMC as a working fluid has been established as a practical approach to augment heat transfer while simultaneously reducing pressure drop. Based on the thorough evaluation of the overall performance, it is evident that FTHE with winglets significantly outperforms the base channel. Staggered tube configurations of FTHE show better thermal performance than inline tube configurations. They generate higher values of critical parameters such as Nu, f, and Q_f, which enhances the efficiency and effectiveness of relevant applications.