Investigation of Graphene Oxide-Distilled Water Nanofluids with Consideration of Heat Transfer and Flow Structure for Backward-Facing Step Flow

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Abstract

The backward-facing step flow is seen in applications in our daily life: the high attack angle at airfoil, the separation flow behind a vehicle, the flow in a gas turbine, and the flow around a boat or building. In view of increasing the heat and mass transfer, control of the backward step region is important. In this study, the heat transfer and flow structures with turbulence of step corner structures with a chamfer h/2 and h long and without chamfer were numerically examined with GO (Graphene Oxide)-distilled water (DW) solutions of volumetric concentrations of 0.01% and 0.02% in comparison with distilled water in a vertically positioned backward-facing step flow geometry. The results of the study were obtained via solving conservation equations of a three dimensional and steady k-epsilon turbulence model with the Boussinesq approach using the ANSYS-FLUENT-18.0 computer program. The nanofluids used in the study were considered as single-phase ones, and experimentally obtained thermophysical values were used. The study was carried out for Reynolds numbers of 5000 and 7500. The findings of present study were compared with the numerical results of a work found in the literature. The outcomes were found to be compatible and acceptable. The results were presented as variations of the Nu number, fluid temperature, turbulence kinetic energy, and pressure. In addition, the contours of the temperature and velocity and streamline distributions were visualized for a backward-facing step flow geometry. For Re = 7500 and the step geometry with an h-long chamfer, the average Nu number values for the 0.01% and 0.02% GO-DW nanofluids were determined to be higher by 11.7% and 14.33%, respectively, than those for distilled water.

Keywords

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