Analysis of Natural Convective Flow of Casson Fluid around an Inclined Rectangular Cylinder

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Abstract

The current investigation uses the finite element method to analyze the natural convective flow of Casson fluid around a tilted hot rectangular cylinder placed in a square container. The influence of Casson fluid parameter (η), aspect ratio, (AR), angle of tilt (γ), and Rayleigh number (Ra) on isotherms and fluid flow pattern is enunciated. The walls of the enclosure and that of the cylinder are respectively fixed as T_c and T_h. Results from the findings reveal that for the range of Casson fluid parameter $(0.1 \le \eta \le 1.0)$, aspect ratio $(0.1 \le AR \le 0.7)$, and Rayleigh number $(10^3 \le Ra \le 10^6)$, investigated, the rate of heat transfer of the enclosure wall increases with increasing η, AR and Ra, while for the heated rectangular obstacle, the rate of heat transfer decreases with AR growth but improves with the growth of η and Ra. At $Ra = 10^6$, improvement in γ results in heat transfer enhancement for both the enclosure and cylinder walls. However, for Ra in the interval of $10^3 \le Ra \le 10^5$, the response of the thermal profiles of both the rectangular cylinder and enclosure walls to cylinder orientation depends on the values of Ra and γ considered.

Keywords: Casson fluid; Natural convection; rectangular cylinder; Aspect ratio; square enclosure.

Nomenclature