Departmental Seminar

Seminar Title	: Conference Return Seminar on Non-Newtonian Fluid Flow around a Rotating Non-Circular Object (Presented at CHEMCON 2024)
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Venue	: New Seminar Hall
Date and Time	: 08 Jan 2025 (10.00 A.M.)

Abstract

: The study of fluid flow and heat-transfer characteristics around a circular cylinder has been one of the most researched topics in the sphere of bluff body flows and fluid mechanics, with studies dating back to the 15th century. Over the past few years, many researchers have been exploring various approaches to introduce modifications that can either speed up or slow down the rate of heat transfers and control the force coefficients for a circular cylinder. The flow and heat characteristics around a grooved cylinder are found in a wide range of engineering applications such as heat exchanger, aerodynamics, marine engineering and medical devices. In the present study, a numerical investigation is carried out in an unconfined domain to study the effect of surface topography, fluid behaviour, and rotation on fluid flow and heat transfer phenomena over a cylinder. The governing equations are solved numerically for a range of pattern frequency pattern amplitude, power-law index, Prandtl number, rotational speed, and Reynolds number. The streamlines and vorticity contours are drawn to visualize the flow field around the patterned cylinder. For a non-rotating patterned cylinder, small recirculation zones are observed over the trough, which are absent in circular cylinders. The size of these recirculation regions increases on increase in Reynolds number and power-law index. On adding rotation to the cylinder, these recirculation zones move away from the cylinder and appear over the crest. The size and shape of these vortices depend upon pattern frequency and amplitude, Reynolds number, rotating speed, and fluid behaviours. Compared to a circular cylinder, a significant reduction in drag can be achieved by choosing a suitable value of pattern frequency (ω) and amplitude (δ). The vortex shedding phenomena is observed for the unsteady flow regimes (Re=50-150) at a lower rotating speed (α=0.5) for all fluid behaviour. The time period during which the vortex is shed from the cylinder depends on α and fluid behaviour. It has been observed that the shedding of vortices stops whenever the rotating speed is increased.