Seminar

Institute for Plasma Research

Title : Development of CFD model for the analysis of a Cryogenics Twin-Screw H_2 Extruder System

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Date : 20th March 2020 (Friday)

Time : 10.00 AM

Venue : Seminar Hall, IPR

Abstract :

A cryogenics twin-screw extruder for plasma fuelling is under development at Institute for Plasma Research (IPR), India. The fuel for Indian tokamaks SST-1 and Aditya-Upgrade is injected in the form of frozen hydrogen pellets; the current injector design includes a pipe gun based concept, cooled by a GMcryocooler. An advanced fuelling system will produce hydrogen pellets continuously using a twin-screw extruder, cooled by a GM-cryocooler. The viscous dissipation is one of the critical design parameters for the extruder system which determines the screw torque as well as the required cryocooler heat load. The performance of an extruder were accessed by measuring the pressure development for different throughput. In the current investigation, CFD model has been developed using ANSYS POLYFLOW under cryogenic temperature. A computational model for non-Newtonian isothermal solid hydrogen flow in the screw channel was developed and used to calculate extruder efficiency and viscous dissipation rate. The shear-rate-dependent viscosity laws was applied in the present analysis for shear stress modelling of solid hydrogen in the temperature interval from 10 to 13 K. The effect of screw rotation speeds (5-20 rpm) on the viscous dissipation rate and pressure development at requires throughput was also examined. As the screw rotation speed reduces, the viscous dissipation rate reduces. The results show that as temperature increases, the viscous dissipation rate and pressure development reduce. The analysis also revealed that the operating point of extruder-die system is highly sensitive to the screw rotation speed.

Keywords: Twin-screw extruder, Viscous dissipation Rate, Shear rate, Cryogenics, Non-Newtonian fluid, Frozen Hydrogen.