Seminar

Institute for Plasma Research

Title : CFD analysis of Cryogenic Twin-Screw Hydrogen Extruder System

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Date : 11th March 2021 (Thursday)

Time : 10:00 AM

Venue : Online- Join the talk:

https://meet.ipr.res.in/PDFextensiontalk

Abstract:

Cryogenic twin-screw extruder is a most stable and promising process due to continuous production of hydrogen pellet for futuristic fusion reactor. The counter-rotating twin-screw extruder system for the fuelling of reactors is under development at the Institute for Plasma Research (IPR) India. The rheological and non-isothermal behaviour of solid hydrogen in addition with the rotation of the two intermeshing screws demands an appropriate tool for the analysis. Hence, setup in CFD POLYFLOW has been developed for a non-Newtonian and non-isothermal fluid like solid hydrogen. Shear stress model of solid hydrogen have temperature dependent viscosity and its stress follows Herschel Bulkley model. Due to the more number of moving surfaces at intermeshing zone inside the extruder system, the temperature of solid hydrogen is higher and increases above the melting point temperature (T_m = 13.8 K). Prediction of hydrogen temperature at the intermeshing zone inside the extruder system plays a vital role to decide the barrel temperature. Solid hydrogen temperature is observed to be different at flight gap and intermeshing zone with different barrel temperatures and screw rotation speed (5 – 15 rpm). Brinkman number (Br) varies from 0.15 to 0.46 at 5 and 15 rpm respectively. The effect of barrel wall temperature with screw rotation speeds (5–15 rpm) on the viscous dissipation rate and pressure development at required throughput was examined for an extruder system. Viscous dissipation rate determines the cooling load requirement for the extruder. The results of analysis revealed that as the barrel temperature decreases, the extrudate got stronger creating more pressure drop in the die.

Keywords: Twin-screw extruder, Viscous dissipation Rate, Brinkman number, Shear Stress, Cryogenic, Non-Newtonian fluid, Barrel Temperature.