26th National Symposium on Cryogenics and Superconductivity

Contribution ID : 131

CFD analysis of high speed cryogenic helium turboexpander with splitter blades

Content :

Helium turbo expander is an inseparable part of cryogenic liquefaction / refrigeration cycles that cool complex devices like superconducting magnets for fusion reactors, particle accelerators etc. There is a need to improve the efficiency of turbo expander for proper functioning of these major devices. This can be made possible only by identifying the losses through flow-analysis and minimizing the same. Due to low molecular weight and density of helium and also low mass-flow rates, these turbines rotating at cryogenic temperature possess very high rpm and very small diameter. The possibility of any experimental investigation is both expensive and complex. But analysis can be made possible by using CFD. The flow characteristics within the turboexpander is highly complex and unsteady. In the design of radial inflow turbines, splitter blades have been used to improve the performance of the machine. Whether the performance gets enhanced in the case of a microturbine used in helium liquefaction needs to be studied and is the objective of the present analysis. So in the current effort, a three dimensional steady state analysis of a cryogenic helium turboexpander was carried out to analyze the influence of splitter blades on the turbine performance. The adopted blade profile design is based on the methodologies proposed by Hasselgruber and Kun and Sentz. The analysis was performed for cases with and without splitter blades. Simultaneously, efforts have also been made to optimize the splitter blade geometry from detailed flow-field comparisons.

Primary authors : Dr. SAM, Ashish Alex (Cryogenic Engineering Centre, Indian Institute of Technology Kharagpur, India – 721302)

Co-authors : Prof. GHOSH, P S (Cryogenic Engineering Centre, Indian Institute of Technology Kharagpur, India – 721302)

Presenter : Dr. SAM, Ashish Alex (Cryogenic Engineering Centre, Indian Institute of Technology Kharagpur, India – 721302)

Session classification : Poster Session 2: Abstract ID 11,33,34,35,36,38,39,40,43,48,52,54,59,66, 67,70,71,78,88,89,90,92,94,100,102,105,107,108, 109,111,112,115,116, 120,121,124,125,127,128,129,131,190

Track classification : Heat Transfer / Thermal Insulation / Thermal Analysis

Type : --not specified--