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Design and Optimization of a regenerator for the prototype cryocooler based on pulse-tube concept

Abstract: The pulse-tube-based cryocoolers are used in many small-scale cryogenic experiments and it is reliable considering low maintenance. These cryocoolers can go down to liquid helium temperature also. The process fluid used in these cryocoolers is helium. This type of cryocooler has regenerator which is one of the key components. As the name says, it holds heat energy of the fluid in forward flow and returns back or regenerates heat energy back to helium fluid. Its efficiency plays a major role to decide the efficiency of the cryocooler. A cryocooler based on pulse-tube concept is being developed at IPR in the LCPC Division. It's targeted cooling power is 100 W at ~50 K. A prototype (as a full-scale) will be designed and manufactured to check the operational feasibility and its performance. The regenerator required for this prototype cryocooler need to be designed and optimized in this project. This will look into different aspects, like type of material, geometric configuration, fabrication easiness, pressure drops through the regenerator, etc. During this project industry survey will also be made considering material availability and manufacturing feasibility in the Indian industry.

Following works will be involved in this project.

1. Study the cryocooler existing in IPR
2. Learning of functions of regenerator and effects of different parameters on the design and efficiency.
3. Design and optimization of the regenerator.
4. Consider different material and configurations in the design.
5. Industry survey for manufacturing and orienting the design to suit the Indian industry.
6. Redesign and optimization, if required, based on industry requirement.

Required Period of work: About 10 months

Project Guide: A. K. Sahu

Division: Large Cryogenic Plant and Cryosystem (LCPC)

Stream/ Branch: Mech. Engg

Eligibility: Only students of ME/M.Tech in thermal/cryogenic/turbo-machinery or similar branch can submit their application at following email addresses

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