

# **Design and Optimization of Regenerators Required for a Cryocooler Based on Pulse-Tube Concept**

## **Abstract**

Project Definition and Objective: The pulse-tube-based cryocoolers are used in many small-scale cryogenic experiments and it is reliable considering low maintenance and low vibration. These cryocoolers can go down to liquid helium temperature also. The process fluid used in these cryocoolers is helium. This type of cryocoolers use regenerators which are the key components of a cryocooler. 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. Its targeted cooling power is ~40 W at ~80 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, thermal property, geometric configuration, fabrication difficulties, pressure drops through the regenerator, etc. During this project industry survey will be done to check 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. Study the functions of regenerator and effects of different parameters on the design and efficiency.
3. Design and optimization of the regenerator.
4. Study of different materials and configurations.
5. Industry survey for manufacturing and orienting the design to suit the Indian industry.
6. Redesign and optimization, if required, based on industry requirement.

Project duration: About 9 months

Project outcome: Optimization method, Optimized Parameters and a report for regenerators of a cryocooler.

## **Academic Project Requirements:**

**1) Required No. of student(s) for academic project: 1**

**2) Name of course with branch/discipline: M.E./M.Tech Mechanical Engineering**

**3) Academic Project duration:**

**(a) Total academic project duration: 38 Weeks**

**(b) Student's presence at IPR for academic project work: 3 Full working Days per week**

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