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# SIMULATION OF CRYOGENIC REGENERATORS

**B. JAYARAMAN AND P. SENTHIL KUMAR**

**Abstract**

Regenerator is a microporous structure that is subjected to periodic flow of a cryogenic fluid. To achieve optimum performance, the regenerator should have a maximum heat transfer area, minimum pressure drop loss, high heat capacity and minimum dead volume. Wire mesh screen type regenerator with varying hydraulic radius along the stack length, also called hybrid regenerators have been used based on empirical understanding for optimum performance. Theoretical studies on Hybrid Regenerators are carried out in this paper to prove its superior performance compared to the single mesh size regenerator.

A mathematical model of the physical phenomena occurring in a wire screen single mesh size regenerator is developed. A numerical solution of the open form using finite difference technique for the model is coded in a computer program and the performance of the regenerator analysed. The need to reduce losses and improve effectiveness of the regenerator using combinations of sizes is established and a methodology is devised and incorporated in the simulation program to generate combinations confirming to the physical and geometrical constraints. The hybrid regenerator geometry is calculated for specified operating conditions. Performances are predicted and the data analysed to select the mesh combination length having a minimum of losses. For a Pulse Tube Refrigerator system (PTR) developed by Kral et al, an effectiveness of 0.9907 is predicted for the 400 mesh regenerator with pressure drop during compression of 12.68 kPa under specific operating conditions. Inserting a hybrid regenerator in the same system with a 250-300-400 mesh size combination of 20-78.086-4.913 mm length respectively increases the effectiveness by 0.16 % and decreases the pressure drop by 29.2 % when compared to the 400 mesh regenerator.

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**Keywords**: Simulation, Cryogenics, Pulse Tube Refrigerator, Regenerator