
**SESSION 15: Regenerator / Recuperator
Investigations****Paper 15.3****Thursday ORAL Session****11:15 AM**

***Analysis of No-Load Cooling Temperature
of a Regenerative Cryocooler
Based on Thermal Non-Equilibrium
Energy Equations***

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The no-load cooling temperature plays an important role in the design and performance optimization of the regenerative cryocooler. Previous theoretical studies have analyzed the minimum temperature based on the physical properties of the working gas in the critical state, but they are not able to answer the no-load cooling temperature of a regenerative cryocooler under different operating conditions. In this study, the dimensionless analytical solution of gas and regenerator material temperatures was obtained based on thermal non-equilibrium energy equations. The expression of the ratio of enthalpy flow to acoustic work RH inside the regenerator was derived, and it was pointed out that the ratio of gas and solid specific heat capacity inside the regenerator as well as the temperature gradient of the regenerator are the key parameters influencing the no-load cooling temperature of the regenerative cryocooler. The variation of RH with different regenerator materials and cold end temperature was further analyzed based on a single-stage pulse tube cryocooler. And the effect of pre-cooling temperature on the efficiency of low-temperature regenerators was also discussed. This study quantitatively analyzes the relationship between the no-load cooling temperature of the regenerative cryocooler and its geometrical parameters as well as the operating conditions, which is of some significance for optimizing the efficiency of the regenerative cryocooler.