

Summary

A technology that has the potential to create more efficient and compact refrigeration devices is an Active Magnetic Regenerative Refrigerator (AMRR). An AMRR can operate over a broad range of temperatures, as long as the appropriate refrigerant is implemented. Thus this flexible technology can be used for small, efficient, and simple room temperature refrigerators, as well as efficient gas liquefaction plants (AMRLs). Active Magnetic Regenerator Refrigeration exploits the magnetocaloric effect displayed by magnetic materials whereby a reversible temperature change is induced when the material is exposed to a magnetic field. By using the magnetic materials in a regenerator as the heat storage medium and as the means of work input, one creates an Active Magnetic Regenerator (AMR).

Active Magnetic Regenerator refrigeration systems still rely on correlations between fluid and matrix material to determine the heat transfer coefficient. Typical configurations operate in low Reynolds number and high Prandtl number ranges. For the oscillating fluid flow through these regenerators correlations are used based on single blow experiments. There are large discrepancies for low Reynolds numbers and high Prandtl numbers between the commonly used correlations, even for typically used packed beds, such as packed stainless steel spheres with uniform diameter of 1 mm. Therefore, this thesis addresses the determination of the heat transfer coefficients for oscillating fluid flow with a new approach which combines an analytical model with experimental data. In this work findings for a passive regenerator test apparatus (PRTA) are determined based on thermal and hydraulic effects. Experiments are performed for different operational parameters in respect of the low Reynolds number range, for varying fluid flow frequencies, mass flow rates and heat loads. The generated experimental data are the input for the analytical model for the heat transfer coefficient determination. The results are compared to a commonly used correlation for regenerators like Wakao and Engelbrechts correlations.