Improved Efficiency of a Rotary Active Magnetic Regenerator

K. Engelbrecht, D. Eriksen, C. R. H. Bahl, R. Bjørk, K. K. Nielsen, N. Pryds

[1]*Technical University of Denmark, Department of Energy Conversion and Storage*

kuen@dtu.dk

Research on room-temperature magnetic refrigeration devices has taken place since a room-temperature regenerative device was reported by Brown in 1976 [1]. Recent work in our group has focused on improving the performance and, more importantly, the efficiency of active magnetic refrigeration (AMR) devices. Using the most recently reported AMR developed in our group [2], it is demonstrated experimentally that additional efficiency improvements over our previous laboratory devices can be achieved by implementing thermal insulation in the initial system design, by insuring that a uniform fluid flow is delivered to all regenerator beds and by improving overall transmission efficiency by balancing the required motor torque over the entire cycle.

In addition to experimental results, detailed numerical modeling of AMR performance will be presented for a range of parameters such as magnetic field, regenerator effectiveness and fluid flow rate. Critical design aspects can be extracted from the modeling results and ways to improve AMR efficiency will be suggested. Effects of flow distribution in a multi-regenerator AMR will be discussed. We have demonstrated experimentally and theoretically that having a fluid flow that is dependent on flow direction can drastically degrade AMR performance. This is not an issue for single regenerator devices or those that use a displacer for fluid flow, but machines that have multiple regenerators arranged in parallel from a flow perspective can have slightly different flow profiles in the cold-to-hot direction than the hot-to-cold direction. The reasons for the performance degradation and impacts are discussed.

Key Words: Regenerator, thermal modeling, magnetic refrigeration

References

[1] Brown, G. V., 1976, *Journal of Applied Physics* 47:3673-3680.

[2] D. Eriksen, K. Engelbrecht, C. R. H. Bahl, R. Bjørk, K. K. Nielsen, A. R. Insinga and N. Pryds, Design and experimental tests of a rotary active magnetic regenerator prototype, *Int. J. Ref.* accepted for publication.