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Cooling effect caused by magneto-caloric materials

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In this study, a test bench was designed and fabricated which allowed to experiment with different materials that exhibit Magneto–Caloric Effect (MCE) to achieve desirable temperature depressions as a result of alternate application of magnetization and demagnetization processes. The Magneto-Caloric Effect (MCE) is the heating or cooling of magnetic materials when subjected to magnetic field variation. It is characterized by a temperature change in an adiabatic process and by an entropy change in an isothermal process. A change in entropy produced during magnetization or demagnetization of the material under isothermal conditions is dependent on the temperature of the material and the magnitude of the magnetic field. The test bench consisted of an electromagnet system, water circulation system and an electronic control unit. An electromagnet was designed to produce a maximum of 1.3T and electronic control unit was used to control the hot and cold water circulation during the magnetization and demagnetization processes. The temperature of inlet water, outlet water and the metal were measured using a LM35 temperature sensor and displayed in a 16 x 4 LCD displayer. Initially, four MCMs, namely, perm alloy, zinc coated iron, brass and stainless steel were tested with a magnetic field strength of 1T. A maximum temperature depression of 3 ^{o}C was obtained for stainless steel and brass. For perm alloy and zinc coated iron the temperature depressions were recorded as 1.8 ^{o}C and 2.5 ^{o}C respectively. The experimental trails with different MCMs and at different magnetic field strengths are recommended to be carried out and the cooling effect thus obtained is to be transferred to a working fluid for useful applications.

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