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Thermal Analysis of Adsorption Refrigeration System Using Silicagel–Methanol Pair

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Abstract : Refrigeration technology is a fast developing field at the present era since it has very wide application in both domestic and industrial areas. It started from the usage of simple ice coolers to store food stuffs to the present sophisticated cold storages along with other air conditioning system. A variety of techniques are used to bring down the temperature below the ambient. Adsorption refrigeration technology is a novel, advanced and promising technique developed in the past few decades. It gained attention due to its attractive property of exploiting unlimited natural sources like solar energy, geothermal energy or even waste heat recovery from plants or from the exhaust of locomotives to fulfill its energy need. This will reduce the exploitation of non-renewable resources and hence reduce pollution too. This work is aimed to develop a model for a solar adsorption refrigeration system and to simulate the same for different operating conditions. In this system, the mechanical compressor is replaced by a thermal compressor. The thermal compressor uses renewable energy such as solar energy and geothermal energy which makes it useful for those areas where electricity is not available. Refrigerants normally in use like chlorofluorocarbon/perfluorocarbon have harmful effects like ozone depletion and greenhouse warming. It is another advantage of adsorption systems that it can replace these refrigerants with less harmful natural refrigerants like water, methanol, ammonia, etc. Thus the double benefit of reduction in energy consumption and pollution can be achieved. A thermodynamic model was developed for the proposed adsorber, and a universal MATLAB code was used to simulate the model. Simulations were carried out for a different operating condition for the silicagel-methanol working pair. Various graphs are plotted between regeneration temperature, adsorption capacities, the coefficient of performance, desorption rate, specific cooling power, adsorption/desorption times and mass. The results proved that adsorption system could be installed successfully for refrigeration purpose as it has saving in terms of power and reduction in carbon emission even though the efficiency is comparatively less as compared to conventional systems. The model was tested for its compliance in a cold storage refrigeration with a cooling load of 12 TR.

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