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Mathematical Modelling and Numerical Simulation of Maisotsenko Cycle

Authors : Rasikh Tariq, Fatima Z. Benarab

Abstract : Evaporative coolers has a minimum potential to reach the wet-bulb temperature of intake air which is not enough to handle a large cooling load; therefore, it is not a feasible option to overcome cooling requirement of a building. The invention of Maisotsenko (M) cycle has led evaporative cooling technology to reach the sub-wet-bulb temperature of the intake air; therefore, it brings an innovation in evaporative cooling techniques. In this work, we developed a mathematical model of the Maisotsenko based air cooler by applying energy and mass balance laws on different air channels. The governing ordinary differential equations are discretized and simulated on MATLAB. The temperature and the humidity plots are shown in the simulation results. A parametric study is conducted by varying working air inlet conditions (temperature and humidity), inlet air velocity, geometric parameters and water temperature. The influence of these aforementioned parameters on the cooling effectiveness of the HMX is reported. Results have shown that the effectiveness of the M-Cycle is increased by increasing the ambient temperature and decreasing absolute humidity. An air velocity of 0.5 m/sec and a channel height of 6-8mm is recommended.

Keywords : HMX, maisotsenko cycle, mathematical modeling, numerical simulation, parametric study
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