



EVAPORATIVE COOLING OF WATER IN A NATURAL DRAFT CROSS-FLOW COOLING TOWER

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ABSTRACT

The new two-dimensional mathematical model of the performance of a natural draft cross-flow cooling tower is presented. It is worth to mention that the simulation of a cross-flow cooling tower is most difficult task in compare with natural draft cooling tower because we have to combine two-dimensional description of heat and mass transfer in air flow with falling water droplets. Our model includes a positive feedback between aerodynamics of cooling tower and a rate of evaporative cooling. It takes into account the values of heat and mass transfer coefficients, temperatures, flow rate and pressure of water and meteorological conditions. The self-consistent iterative algorithm of its solution is proposed and discussed. The simulation results, which included profiles of air temperature at the rain zone, are displayed. It is shown that the main parameter, affecting on the thermal efficiency of a natural draft cross-flow cooling tower, is the average droplet radius. Also, the thermal efficiency depends on water temperature difference between inlet and outlet of cooling tower, which by-term depends on several parameters, such as flow rate through the cooling tower, air temperature, relative humidity of air, inlet water temperature. The range of change of final droplet temperatures is calculated.

Keywords: cooling tower, evaporative cooling, natural draft, simulation