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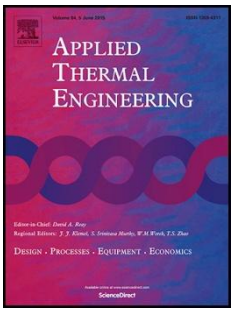

Title: Numerical simulation of water spray in natural draft dry cooling towers with a new nozzle representation approach

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NUMERICAL SIMULATION OF WATER SPRAY IN NATURAL DRAFT DRY COOLING TOWERS WITH A NEW NOZZLE REPRESENTATION APPROACH

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Highlights

- CFD investigation of real spray nozzles for inlet air pre cooling.
- Developments of a new adaptable hollow-cone spray representation method.
- Incorporation of experimentally measured spray characteristics into CFD.
- CFD model validation with wind tunnel measurements.

ABSTRACT

Pre-cooling of inlet air with water spray is proposed for performance enhancement of natural draft dry cooling towers (NDDCTs) during high ambient temperature periods. Previous experiments showed promising results on cooling enhancement using spray cooling. In this study, a numerical Eulerian-Lagrangian 3-D model is used to simulate evaporating water sprays produced by real nozzles. A new adaptable method of hollow-cone spray representation in Eulerian-Lagrangian numerical models was developed to reproduce the real nozzle behavior using experimentally measured initial spray characteristics and taking into account radial evolution of droplet size distribution and air/droplets momentum exchange. Experimental measurements from a wind tunnel test rig simulating NDDCTs inlet flow conditions have been performed for validation. Overall, a good agreement was obtained between numerical predictions and experimental measurements for the streamwise development of droplet size and velocity, and outlet air dry bulb temperature. An average deviation below 5.3% was achieved for all compared parameters. Moreover, the validated CFD model has provided insight into the experimental observations of local droplet velocity increase and higher air cooling in the lower region.

Keywords: Spray cooling, Air pre-cooling, Natural draft, Spray representation, Rosin-Rammler