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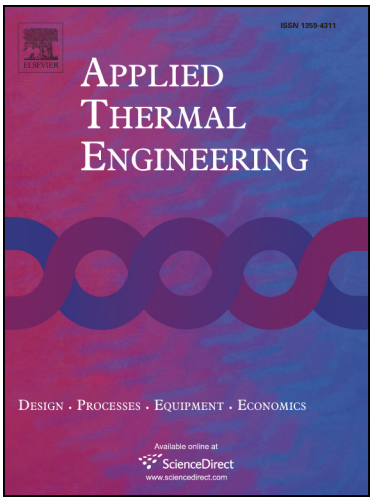

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A study on multi-nozzle arrangement for spray cooling system in natural draft dry cooling tower

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Abstract:

Natural draft dry cooling tower (NDDCT) technology is especially attractive to power plants built in arid regions with limited water resource. However, high ambient temperature in summer deteriorates the performance of built NDDCT. To address this problem, evaporative pre-cooling technology has been developed by using nozzles to disintegrate water into fine droplets to achieve quick evaporation. The pre-cooled air flowing through radiator, has an enhanced heat exchange with the hot working fluid in the tube side. This paper reports a spray cooling system for the experimental tower built in UQ by combining several nozzle LNN1.5 to cool the inlet air and consequently improve the cooling efficiency of the NDDCT. To minimize water usage, a careful arrangement of spray nozzles should be investigated to achieve the maximum cooling outcome. With five nozzles installment, the inlet air is cooled by 6.3 ºC, corresponding to 51.2% cooling efficiency. A dimensionless analysis is presented to correlate cooling efficiency with influencing factors. The advantage of this pre-cooling system lies in the efficient water usage: more than 96% of the injected water extracts substantial heat from hot air and evaporates into vapor, leading to a pre-cooled airflow.

Keywords:

Natural draft dry cooling tower; full evaporation; spray cooling; multi-nozzle arrangement

1 Introduction

For both thermal power plants and air conditioning industry, cooling towers are widely used to cool circulating water, which serve as a medium to transfer substantial waste heat to the surrounding environment. The cooling tower performance has a significant impact on the operation and efficiency of the whole power generation system. A defective cooling tower design, failing to provide adequate cooling for the power generation process, would lead to decreased electricity production and induce tremendous economic loss. In order to avoid such economic punishment, an effective cooling system is necessary for power plant normal operations.

In most power plants, mechanical and natural draft cooling towers are commonly used. However, the high running costs caused by the energy-consumptive motor-driven fans makes mechanical draught less attractive for many power plants, even though the capital costs are

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