ABSTRAK

ANALISIS LAJU ALIRAN UDARA TERHADAP PERFORMA *COOLING TOWER* PADA MESIN SIMULATOR HIDROLIK DI LABORATORIUM MEKANIK POLITEKNIK NEGERI SRIWIJAYA

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Sistem pendingin berperan penting dalam menjaga kestabilan temperatur operasi peralatan industri agar dapat bekerja secara optimal dan terhindar dari penurunan kinerja akibat akumulasi panas. Salah satu perangkat yang banyak digunakan dalam sistem pendingin sirkulasi adalah *cooling tower* yang bekerja dengan memanfaatkan kontak antara air dan udara untuk melepaskan panas ke lingkungan. Penelitian ini bertujuan untuk menganalisis pengaruh laju aliran udara terhadap performa *cooling tower* pada mesin simulator hidrolik di Laboratorium Mekanik Politeknik Negeri Sriwijaya. Metode penelitian yang digunakan adalah metode kuantitatif dengan pendekatan eksperimental melalui variasi putaran *fan* sebesar 40%, 60%, 80%, dan 100% yang menghasilkan putaran masing-masing 370 RPM, 555 RPM, 740 RPM, dan 925 RPM. Parameter yang diukur meliputi temperatur air masuk (T_{in}), temperatur air keluar (T_{out}), temperatur *wet bulb* (T_{wb}), dan laju aliran udara dengan debit air konstan sebesar 8,22 L/menit. Data hasil pengukuran digunakan untuk menghitung nilai *range, approach*, efektivitas, *Number of Transfer Unit (NTU)*, laju perpindahan panas, dan *evaporation loss*. Hasil penelitian menunjukkan bahwa peningkatan laju aliran udara memberikan pengaruh positif terhadap performa *cooling tower*. Laju aliran udara meningkat dari 1,57 m/s menjadi 3,67 m/s yang diikuti oleh peningkatan nilai *range* dari 0,5°C menjadi 3,7°C, efektivitas dari 11,9% menjadi 78,7%, *NTU* dari 0,1 menjadi 1,5, serta laju perpindahan panas dari 0,287 kW menjadi 2,122 kW. Sementara itu, nilai *approach* menurun dari 3,7°C menjadi 1,0°C dan *evaporation loss* meningkat dari 0,2 L/jam menjadi 1,8 L/jam. Berdasarkan rekapitulasi seluruh parameter performa, kondisi operasi optimum diperoleh pada variasi fan 100% dengan putaran 925 RPM dan laju aliran udara rata-rata 3,67 m/s karena menghasilkan performa pendinginan terbaik. Hasil penelitian menunjukkan bahwa peningkatan laju aliran udara berpengaruh signifikan terhadap kemampuan *cooling tower* dalam membuang panas dan meningkatkan efektivitas sistem pendingin.

Kata Kunci: *Cooling Tower*, Laju Aliran Udara, Efektivitas, Perpindahan Panas.

ABSTRACT

ANALYSIS OF AIR FLOW RATE ON THE COOLING TOWER PERFORMANCE OF A HYDRAULIC SIMULATOR MACHINE IN THE MECHANICAL LABORATORY OF POLITEKNIK NEGERI SRIWIJAYA

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Cooling systems play a vital role in maintaining the thermal stability of industrial equipment, ensuring reliable operation and preventing performance degradation caused by excessive heat accumulation. Among the various components employed in recirculating cooling systems, cooling towers are widely used to dissipate heat from circulating water to the surrounding atmosphere through combined heat and mass transfer processes. This study aims to investigate the effect of air flow rate on the performance of a cooling tower installed in a hydraulic simulator system at the Mechanical Engineering Laboratory of Politeknik Negeri Sriwijaya. An experimental quantitative approach was employed by varying the fan speed at four operating conditions, namely 40%, 60%, 80%, and 100%, corresponding to rotational speeds of 370 RPM, 555 RPM, 740 RPM, and 925 RPM, respectively. The measured parameters included inlet water temperature (T_{in}), outlet water temperature (T_{out}), wet-bulb temperature (T_{wb}), and air flow rate, while the water flow rate was maintained constant at 8.22 L/min. The collected data were used to evaluate key cooling tower performance indicators, including range, approach, effectiveness, Number of Transfer Units (NTU), heat transfer rate, and evaporation loss. The results demonstrated that increasing the air flow rate significantly enhanced the cooling tower performance. As the air flow rate increased from 1.57 m/s to 3.67 m/s, the range increased from 0.5°C to 3.7°C, the effectiveness improved from 11.9% to 78.7%, the NTU increased from 0.1 to 1.5, and the heat transfer rate rose from 0.287 kW to 2.122 kW. In contrast, the approach value decreased from 3.7°C to 1.0°C, indicating that the outlet water temperature approached the wet-bulb temperature more closely. Evaporation loss also increased from 0.2 L/h to 1.8 L/h as a consequence of the intensified evaporative cooling process. Based on the overall performance evaluation, the optimum operating condition was achieved at 100% fan speed, corresponding to 925 RPM and an average air flow rate of 3.67 m/s, which provided the highest cooling performance. These findings confirm that air flow rate is a significant factor influencing cooling tower performance and overall cooling system efficiency.

Keywords : Cooling Tower, Air Flow Rate, Effectiveness, Heat Transfer.