ABSTRAK

ANALISIS PENGARUH SIMULASI *FOULING* RADIATOR DAN VARIASI KECEPATAN POMPA TERHADAP DISTRIBUSI TEMPERATUR SIMULATOR *COOLING SYSTEM*

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Sistem pendingin pada mesin diesel alat berat berperan penting dalam menjaga temperatur kerja mesin agar tetap stabil dan mencegah terjadinya overheating. Pada kondisi operasional di lapangan, radiator sering terpapar debu, lumpur, dan partikel lingkungan yang dapat menyebabkan fouling pada sirip radiator. Fouling mengurangi luas permukaan efektif, meningkatkan hambatan termal, dan menurunkan kemampuan radiator dalam melepas panas. Penelitian ini bertujuan untuk menganalisis pengaruh simulasi fouling radiator dan variasi kecepatan pompa terhadap distribusi temperatur pada simulator cooling system. Penelitian dilakukan secara eksperimental dengan mengukur temperatur masuk dan keluar radiator, kemudian data diolah menggunakan parameter perpindahan panas dan karakteristik aliran fluida. Simulasi fouling dilakukan dengan variasi penutupan permukaan radiator sebesar 0%, 25%, 50%, dan 75%, sedangkan kecepatan pompa divariasikan pada 800 rpm, 1800 rpm, dan 2800 rpm. Parameter yang dianalisis meliputi selisih temperatur, laju perpindahan panas fluida, laju perpindahan panas udara, hambatan termal, hambatan fouling, koefisien perpindahan panas menyeluruh, efektivitas radiator, dan NTU. Hasil penelitian menunjukkan bahwa peningkatan fouling menyebabkan penurunan performa pendinginan radiator. Kondisi terbaik diperoleh pada fouling 0% dan kecepatan pompa 1800 rpm dengan selisih temperatur 23,46 °C, laju perpindahan panas fluida 23282,80 W, laju perpindahan panas udara 2201,52 W, dan efektivitas radiator 0,6580. Kondisi fouling 75% menghasilkan penurunan performa terbesar dengan efektivitas 0,1737–0,2256 dan hambatan total fouling sekitar 0,013778–0,013844 m²°C/W. Berdasarkan hasil tersebut, fouling menjadi faktor dominan yang menurunkan kemampuan pendinginan radiator, sedangkan 1800 rpm menjadi kecepatan pompa paling efektif. Hasil penelitian ini dapat menjadi referensi dan media pembelajaran perpindahan panas serta sistem pendingin pada bidang alat berat di Politeknik Negeri Sriwijaya.

Kata kunci: Sistem Pendingin, Fouling, Radiator, Laju Aliran Fluida, Perpindahan Panas

ABSTRACT

ANALYSIS OF THE EFFECT OF RADIATOR FOULING SIMULATION AND PUMP SPEED VARIATION ON THE TEMPERATURE DISTRIBUTION OF A COOLING SYSTEM SIMULATOR

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The cooling system in heavy equipment diesel engines plays an important role in maintaining stable engine operating temperature and preventing overheating. Under field operating conditions, radiators are often exposed to dust, mud, and environmental particles that can cause fouling on the radiator fins. Fouling reduces the effective surface area, increases thermal resistance, and decreases the radiator's ability to dissipate heat. This study aims to analyze the effect of radiator fouling simulation and pump speed variation on the temperature distribution of a cooling system simulator. The research was conducted experimentally by measuring the radiator inlet and outlet temperatures, after which the data were processed using heat transfer parameters and fluid flow characteristics. The fouling simulation was carried out by varying the radiator surface blockage at 0%, 25%, 50%, and 75%, while the pump speed was varied at 800 rpm, 1800 rpm, and 2800 rpm. The analyzed parameters include temperature difference, fluid heat transfer rate, air-side heat transfer rate, thermal resistance, fouling resistance, overall heat transfer coefficient, radiator effectiveness, and NTU. The results show that increasing fouling causes a decrease in radiator cooling performance. The best condition was obtained at 0% fouling and 1800 rpm pump speed, with a temperature difference of 23.46 °C, fluid heat transfer rate of 23282.80 W, air-side heat transfer rate of 2201.52 W, and radiator effectiveness of 0.6580. The 75% fouling condition produced the greatest performance reduction, with effectiveness ranging from 0.1737 to 0.2256 and total fouling resistance of approximately 0.013778–0.013844 m²°C/W. Based on these results, fouling is the dominant factor that reduces radiator cooling capability, while 1800 rpm is the most effective pump speed. The results of this study can serve as a reference and learning medium for heat transfer and cooling system topics in the heavy equipment field at Politeknik Negeri Sriwijaya.

***Keywords**: Cooling System, Fouling, Radiator, Fluid Flow Rate, Heat Transfer*