

ABSTRAK

ANALISIS KINERJA SISTEM MESIN 3R (*RECOVERY, RECYCLE, AND REUSE*) DENGAN VARIASI BEBAN OPERASI DAN JENIS REFRIGERAN HCFC (R22) DAN HFC (R134A)

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(2026: xv + 84 Halaman + 17 Gambar + 8 Tabel + 7 Lampiran)

Penelitian ini bertujuan untuk menganalisis kinerja sistem mesin 3R (Recovery, Recycle, and Reuse) berdasarkan variasi beban operasi dan jenis refrigeran, yaitu HCFC (R-22) dan HFC (R-134a). Pengujian dilakukan menggunakan mesin 3R hasil rancang bangun di CV Central Indo HVAC, Palembang, dengan variasi massa refrigeran sebagai beban operasi. Parameter yang dianalisis meliputi tekanan sisi hisap dan sisi tekan, rasio tekanan (Pr), temperatur operasi, daya kompresor, waktu proses recovery, konsumsi energi listrik, serta Specific Energy Consumption (SEC). Hasil pengujian menunjukkan bahwa refrigeran R-134a memiliki tekanan suction 10 psi dan tekanan discharge 150 psi dengan Pr sebesar 15, jauh lebih tinggi dibandingkan R-22 yang memiliki tekanan hisap 40 psi, tekanan buang 110 psi, dan Pr sebesar 2,75, yang menunjukkan beban kerja kompresor pada R-134a lebih besar. Dari segi energi, daya kompresor R-22 sebesar 0,2899 kW sedikit lebih tinggi dibandingkan R-134a sebesar 0,2832 kW, dan karena waktu operasi R-22 lebih lama (0,058 jam berbanding 0,05 jam), konsumsi energi listriknya mencapai 0,0168 kWh dibandingkan 0,01426 kWh pada R-134a. Meskipun demikian, nilai SEC R-22 sebesar 0,0373 kWh/kg justru lebih rendah dibandingkan R-134a sebesar 0,0407 kWh/kg, yang menunjukkan bahwa proses recovery menggunakan R-22 lebih efisien dalam penggunaan energi per satuan massa refrigeran yang berhasil dipulihkan. Berdasarkan hasil tersebut, refrigeran R-22 menunjukkan kinerja yang lebih baik dibandingkan R-134a pada mesin 3R ditinjau dari efisiensi energi dan kestabilan tekanan operasi selama proses recovery, sehingga mesin 3R hasil rancang bangun ini berpotensi menjadi sistem manajemen refrigeran yang efektif, efisien, dan ramah lingkungan.

Kata Kunci: mesin 3R, recovery, recycle, reuse, refrigeran R22, refrigeran R134A, Specific Energy Consumption (SEC).

ABSTRACT

PERFORMANCE ANALYSIS OF THE 3R (RECOVERY, RECYCLE, AND REUSE) REFRIGERANT MACHINE SYSTEM UNDER VARIOUS OPERATING LOADS AND HCFC (R22) AND HFC (R134A) REFRIGERANTS

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This study aims to analyze the performance of a 3R (*Recovery, Recycle, and Reuse*) refrigerant machine under various operating loads using HCFC (R-22) and HFC (R-134a) refrigerants. The experiments were carried out using a self-designed 3R machine at CV Central Indo HVAC, Palembang, with different refrigerant masses as operating loads. The observed parameters included suction pressure, discharge pressure, pressure ratio (Pr), operating temperature, compressor power, recovery time, electrical energy consumption, and *Specific Energy Consumption* (SEC). The results showed that R-134a had a suction pressure of 10 psi and a discharge pressure of 150 psi, with a pressure ratio of 15, considerably higher than R-22's 40 psi suction pressure, 110 psi discharge pressure, and pressure ratio of 2.75, indicating a heavier compressor workload for R-134a. Regarding energy consumption, R-22's compressor power (0.2899 kW) was slightly higher than R-134a's (0.2832 kW); however, since R-22's operating time was longer (0.058 hours versus 0.05 hours), its electrical energy consumption reached 0.0168 kWh compared to 0.01426 kWh for R-134a. Despite this, R-22's SEC value of 0.0373 kWh/kg was lower than R-134a's 0.0407 kWh/kg, indicating that the recovery process using R-22 was more energy-efficient per unit mass of refrigerant recovered. These results show that R-22 outperformed R-134a in terms of energy efficiency and pressure stability throughout the recovery process. Therefore, the developed 3R machine is capable of performing refrigerant recovery effectively and has the potential to become an efficient and environmentally friendly refrigerant management system.

Keyword : 3R machine, recovery, recycle, reuse, R22 refrigerant, R134A refrigerant, Specific Energy Consumption (SEC).