

ABSTRAK

Pencucian sepatu secara manual membutuhkan waktu dan tenaga yang relatif besar serta hasilnya bergantung pada metode pencucian yang digunakan. Penelitian ini bertujuan untuk merancang dan menganalisis mesin cuci sepatu menggunakan sistem boiler sebagai sumber energi panas dan uap. Metode penelitian yang digunakan adalah metode perancangan (*engineering design*) dengan pendekatan analisis teoritis. Analisis dilakukan terhadap kapasitas boiler, kebutuhan energi pemanasan, laju produksi uap, perpindahan panas, kecepatan putaran drum, sistem penggerak, dan kekuatan poros. Parameter perancangan meliputi kapasitas boiler 5 liter, daya elemen pemanas 1500 W, daya motor listrik 250 W, temperatur uap sekitar 120 °C, diameter drum 350 mm, diameter poros 20 mm, dan kecepatan putaran drum 120 rpm. Hasil analisis menunjukkan bahwa massa air dalam boiler sebesar 5 kg dengan kebutuhan energi pemanasan sebesar 1883,7 kJ dan waktu pemanasan teoritis sekitar 20,9 menit. Laju produksi uap teoritis diperoleh sebesar 2,45 kg/jam atau 0,681 g/s. Kecepatan putaran drum 120 rpm menghasilkan kecepatan sudut sebesar 12,57 rad/s dan kecepatan linear sebesar 2,20 m/s. Analisis perpindahan panas dilakukan melalui mekanisme konduksi, konveksi, dan radiasi untuk mengevaluasi distribusi energi panas dalam sistem. Berdasarkan hasil perancangan dan analisis teoritis, rancangan mesin cuci sepatu menggunakan sistem boiler secara konseptual dapat mendukung proses pencucian melalui kombinasi energi panas dan gerakan mekanis. Penelitian selanjutnya diperlukan untuk melakukan pembuatan prototipe dan pengujian kinerja secara langsung.

Kata kunci: mesin cuci sepatu, sistem boiler, perancangan mesin, perpindahan panas, produksi uap.

ABSTRACT

Manual shoe washing requires significant time and effort, and the results depend heavily on the washing method employed. This study aims to design and analyze a shoe washing machine that utilizes a boiler system as the source of thermal energy and steam. The research employs an engineering design methodology combined with a theoretical analysis approach. Analyses were conducted regarding boiler capacity, heating energy requirements, steam production rate, heat transfer, drum rotational speed, the drive system, and shaft strength. Design parameters included a boiler capacity of 5 liters, a heating element power of 1500 W, an electric motor power of 250 W, a steam temperature of approximately 120°C, a drum diameter of 350 mm, a shaft diameter of 20 mm, and a drum rotational speed of 120 rpm. The analysis results indicate a boiler water mass of 5 kg, a heating energy requirement of 1883.7 kJ, and a theoretical heating time of approximately 20.9 minutes. The theoretical steam production rate was calculated at 2.45 kg/h (or 0.681 g/s). A drum rotational speed of 120 rpm yields an angular velocity of 12.57 rad/s and a linear velocity of 2.20 m/s. Heat transfer analysis was performed considering conduction, convection, and radiation mechanisms to evaluate thermal energy distribution within the system. Based on the design and theoretical analysis, the proposed shoe washing machine concept supports the washing process through a combination of thermal energy and mechanical action. Further research is required to fabricate a prototype and conduct direct performance testing.

Keywords: shoe washing machine, boiler system, machine design, heat transfer, steam production.