ABSTRAK

Tujuan penelitian ini adalah (a) merancang dan merakit mesin pengering dengan mempergunakan mesin siklus kompresi uap untuk proses pengeringan handuk yang bersifat ramah lingkungan, aman (tidak berbahaya), praktis, dan dapat dipergunakan kapan saja (b) mengetahui waktu tercepat yang dibutuhkan untuk mengeringkan handuk dengan mempergunakan mesin pengering hasil rakitan dengan berbagai variasi sistem udara dalam proses pengeringan, yaitu (1) sistem udara tertutup, dan (2) sistem udara terbuka untuk kondisi awal handuk yang berbeda, yaitu dengan kondisi awal hasil perasan tangan, dan kondisi awal hasil perasan mesin cuci (c) mengetahui karakteristik mesin siklus kompresi uap yang dipergunakan pada mesin pengering handuk yang memberikan waktu pengeringan tercepat, meliputi: kondisi udara pada ruang pengering, Q_{in}, Q_{out}, W_{in}. Penelitian dilakukan di laboratorium Perpindahan Kalor, Teknik Mesin, Fakultas Sains dan Teknologi, Universitas Sanata Dharma. Mesin pengering handuk yang dirancang dan dirakit merupakan mesin pengering handuk yang menggunakan dua sistem udara dalam proses pengeringan. Komponen utama mesin siklus kompresi uap diantaranya: 2 kompresor, 2 evaporator, 2 kondensor, 2 pipa kapiler. Mesin pengering handuk mempergunakan 2 kompresor masing-masing berdaya 1 HP. Kapasitas setiap komponen utama dari mesin siklus kompresi uap menyesuaikan besarnya kapasitas kompresor dari mesin yang dipergunakan. Lemari pengering handuk memiliki dimensi p x l x t : 250 cm x 160 cm x 120 cm. Handuk memiliki ukuran p x l : 100 cm x 50 cm, dan tebal 0,2 cm berjumlah 18 buah. Variasi dalam penelitian dilakukan terhadap sistem udara mesin pengering handuk, yaitu sistem udara tertutup dan terbuka dengan berbagai kondisi awal handuk basah di setiap variasi, yaitu kondisi awal peras tangan dan peras mesin cuci.

Mesin pengering handuk dapat mengeringkan handuk dengan ramah lingkungan, aman (tidak berbahaya), praktis, dan dapat dipergunakan kapan saja baik pada variasi sistem udara tertutup maupun terbuka. Waktu pengeringan handuk tercepat terjadi pada proses pengeringan handuk dengan sistem udara tertutup kondisi awal peras mesin cuci, yaitu membutuhkan waktu 32 menit untuk mencapai berat handuk kering sebesar 3,6 kg dari berat mula-mula sebesar 5,42 kg. Mesin pengering handuk yang memberikan waktu pengeringan tercepat pada mesin pertama dengan refrigeran R410A memiliki kondisi udara yang memasuki ruang pengering handuk rata-rata bersuhu 46,11 ^{o}C dengan nilai (RH) sebesar 28,7 %, (Q_{in}) sebesar 140,80 kJ/kg, (Q_{out}) sebesar 172,284 kJ/kg, (W_{in}) sebesar 31,484 kJ/kg, (COP_{actual}) sebesar 4,472, (COPideal) sebesar 6,313, dan efisiensi sebesar 70 %. Sementara itu pada mesin kedua dengan refrigeran R22 memiliki kondisi udara yang memasuki ruang pengering handuk rata-rata bersuhu 45,55 ^{o}C dengan nilai (RH) sebesar 25,6 %, (Q_{in}) sebesar 139,435 kJ/kg, (Q_{out}) sebesar 182,350 kJ/kg, (W_{in}) sebesar 42,915 kJ/kg, (COP_{actual}) sebesar 3,249, (COP_{ideal}) sebesar 4,440, dan efisiensi sebesar 73,1 %.

Kata Kunci : Mesin pengering handuk, siklus kompresi uap, sistem udara tertutup, sistem udara terbuka

ABSTRACT

The aims of the research are (a) to design and assemble dryer machine using vapor compression cycle machine for towel drying process which is eco friendly, safe, practical, and can be used anytime (b) to know the fastest time that is needed to dry the towel by using assembled dryer machine with the varieties of air system in drying process, which are (1) closed air system, and (2) open air system for the different initial conditions of towel which are hand-squeezed and washing machine-drained result (c) to know the characteristics of vapor compression cycle machine which is used in towel dryer machine that gave fastest drying time, which were the air condition in dryer room, Q_{in}, Q_{out}, W_{in}. The research was done in Heat Transfer Laboratorium, Mechanical Engineering, Science and Technology Faculty of Sanata Dharma University. The towel dryer machine which was designed and assembled was a towel dryer machine that used two air systems in the process of drying. The main components of steam compression cycle machine are: 2 compressors, 2 evaporators, 2 condensor, 2 capillary pipe. Towel dryer machine used 2 compressors which each of it had power 1 HP. The capacity of each main component of steam compression cycle machine adjusted the amount of capacity/ compressor's power of used-machine. The box/ towel dryer place had l x w x h dimension: 250 cm x 160 cm x 120 cm. The size of towels was l x w: 100 cm x 50 cm, and the thickness was 0,2 cm with the total amount of towels were 18 towels. The variety in the research was conducted toward air systems of towel dryer machine; closed air system and open air system with various initial wet towel condition; hand-squeezed and washing-machine-drained result.

Towel dryer machine could be used to dry towel which was eco friendly, safe, practical and could be used anytime whether in closed air system or open air system. The fastest drying time occured in the process of drying towel using closed air system and the towel condition of washing machine-drained result was 32 minutes to reach the weight of dried towel which was 3,6 kg of its initial weight (wet) was 5,42 kg. The fastest towel dryer machine with refrigerant R410A had air condition that entered towel dryer room with average temperature 46, 11 ^{o}C , relative moisture was 28,7 %, (Q_{in}) was 140,80 kJ/kg, (Q_{out}) was 172,284 kJ/kg, (W_{in}) was 31,484 kJ/kg, (COP_{actual}) was 4,472, (COP_{ideal}) was 6,313, and efficiency was 70 %. Whereas, the second machine with refrigerant R22 had air condition that entered the dryer room with average temperature was 45,55 ^{o}C , relative moisture was 25,6 %, and (Q_{in}) was 139,435 kJ/kg, (Q_{out}) was 182,350 kJ/kg, and (W_{in}) was 42,915 kJ/kg, (COP_{actual}) was 3,249, (COP_{ideal}) was 4,440, and efficiency was 73,1 %.

Key words: towel dryer machine, vapor compression cycle, closed air system, open air system.