Performance of a clothes drying cabinet by utilizing waste heat from a split-type residential air conditioner

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ABSTRACT

In the present paper a study on the performance of clothes drying cabinet by utilizing waste heat from a split-type residential air-conditioner (RAC) has been carried out. A drying cabinet with a volume of 1 m³ has been designed and fabricated. The waste heat from the condenser of the RAC with power of 800 W was utilized as a heat source. In the experiments, the RAC was operated to keep a conditioned space at 20 °C. The clothes dried made of pure cotton with initial weight varied 3.05 kg, 5.25 kg, 6.21 kg, 8.22 kg, and 10.22 kg. Two different inlets, single inlet and multi-inlets, has been tested. The results show that the drying time varies from 80 to 410 min. For single inlet the averaged drying time, optimum initial weight, optimum drying rate and optimum SMER was 242 min, 6.21 kg, 0.868 kg/h, and 2.345 kg/kW h. On the other hand, the drying chamber with multi-inlets the averaged drying time, optimum initial weight, optimum drying rate and optimum SMER was 222 min, 8.22 kg, 0.922 kg/h, and 2.492 kg/kW h. Thus, the present drying cabinet should be operated with multi-inlets and the initial weight varies from 6 to 8 kg.

1. Introduction

Drying clothes is one of the biggest sectors that consume huge amount energy. Based on a study in USA, electricity consumption for drying clothes is estimated as 71 Terawatt hours (TWh) per year it is up to 9% of electricity consumption in the USA [1,2]. For Indonesian case, to the best knowledge of the authors, there is no report on energy consumption for drying clothes. Typical method of drying clothes in Indonesia is natural drying using solar energy. Several commercial sectors, such as hotels and hospitals, use commercial drying machines for drying clothes. The typical method of commercial clothes dryer is tumbler rotating drum and flowed by hot air of 40–60 °C [3]. Recently, housing in densely populated cities in Indonesia, do not provide sufficient spaces for drying clothes naturally. Thus, several places around the house such as windows, balcony, garage, front gate, etc are used for drying clothes naturally. This method of drying disturbs esthetics of housing. Thus, laundry business is now growing significantly in Indonesia. The commercial drying and laundries in Indonesia use electricity, kerosene, and natural gas as energy source. This sector is predicted will consume fossil fuel

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significantly. On the other hand, due to increase in economic growth and humid climate of Indonesia, the use of split-type residential air conditioner (RAC) is growing significantly, in particular for dense populated cities. As a note, condenser of RAC releases a significant waste heat to the ambient for free. This waste heat can be utilized as heat source for clothes drying. This is the background of the present study.

The method of using the heat from a condenser of vapor compression cycle is known as heat pump drying. Several researchers have published their work related to heat pump drying [4]. The heat pump drying has been used to dry several objects such as clothes, agricultural products, food, medicines, etc. In particular for clothes dryer, several works were found in literature. Braun et al. [5] reported a study on energy efficiency analysis of air cycle heat pump dryers. Two types of cloth dryers were compared the first one is conventional tumbler dryer using electric heater and the second one is using reversed Brayton cycle. The results showed dryer with heat pump cycle offers up to 40% improvement in energy efficiency over the electric heater dryer. Ameen and Bari [6] investigated the feasibility of drying clothes using waste heat from a condenser of a typical split-type RAC used in high rise urban apartments. A drying cabinet made of wood was designed and a box cover of condenser was made. In order to drawn the hot air from the box cover of the condenser an auxiliary fan was installed. Three methods drying clothes were compared, they are drying with commercial dryer using 1 kW electric heater, natural drying of the clothes indoors, and drying clothes using condenser heat (heat pump dryer). The initial weights of the clothes dried were 1792–1888 g. The results showed that the drying rate for commercial dryer, natural drying, and heat pump dryer was 0.319 kg/h, 0.139 kg/h, and 0.424 kg/h, respectively. The drying time varied from 120 min to 390 min. In order to compare the performance of the dryer, specific energy consumption (SEC) rate in kW h/kg and specific moisture extraction rate (SMER) in kg/kW h were proposed. Here the mass of the clothes dried were not varied and the characteristics of the drying cabinet were not discussed. Deng and Han [7] performed experimental study on clothes dryer using rejected heat from split-type RAC. A laboratory experimental rig has been purposely set up. The RAC with specification of 6.4 kW of cooling capacity a typical RAC size applicable to a room of up to 30 m^2 in Hong Kong was used. A drying rack made of 8 moveable hanging bars with a dimension of 760 mm $\times$ 450 mm base and 460 mm height was inserted in a 2.5 m long air duct made of polymethyl methacrylate. This rack can be viewed as a drying cabinet with a volume of 0.157 m^3. In the experiments, no auxiliary fan was used. The initial weight of clothes dried was about 3 kg. Two methods of drying were compared, electricity clothes dryer and the method proposed. The electricity consumption and drying time were compared. Temperatures of condenser and in the drying cabinet, and change of weight were plotted. The results showed that the additional electric use of RAC was only 1.2%. A further study on a new termination control method for clothes drying process in their previous clothes dryer has also been reported [8]. In these two studies, the drying chamber is not practical. It is a drying rack inside a 2.5 m long of wind tunnel.

Mahlia et al. [9] reported an experimental study on using heat wasted from split-type RAC for drying clothes. The system proposed consists of a drying chamber and a moveable unit of RAC. Dimensions of the drying chamber were not reported. The initial weight of the clothes dried was varied from 2.5 kg to 2.8 kg and the moisture removed was from 720 g to 925 g. The study compared the effectiveness of the drying system proposed to a conventional one in terms of drying time and energy consumption. The results showed that drying time was from 70 min to 420 min. The drying rate for the test ranged from 0.56 kg/h to 0.75 kg/h with RACD compared to 0.13 kg/h for indoor drying and 0.18 kg/h for out door drying. The analysis showed that SMER varied from 0.1809 kg/kW h to 0.2205 kg/kW h. The RAC clothes dryer is claimed more efficient way to dry clothes and in term of time it is also more effective. However, the increase of fan capacity due to air resistance was not taken into account. Suntivarakorn et al. [10] reported a study on clothes dryer using waste heat from split-type RAC. A drying chamber with dimensions of 0.5 m $\times$ 0.5 m $\times$ 1.0 m was designed and fabricated. An auxiliary fan with power of 180 W was installed to draw hot air from the condenser. Load of the drying chamber was varied. The results showed that the drying rate of clothes using waste heat from air conditioner is between 1.1 kg/h and 2.26 kg/h. This was claimed better than commercial dryer and natural drying. The effects of auxiliary fan were evaluated using decreasing COP of the system. However drying characteristics and SMER were not discussed. Recently, Bansal et al. [11] reported a study on the method to determine air leakage in heat pump clothes dryer. In the system, heat pump was employed to produce hot drying air to tumbler dryer instead of using conventional electric heater. It was reported that although heat pump clothes dryers offer higher energy efficiency through air recirculation, it is likely that various components are prone to air leakage and resulting in a loss of efficiency. They suggested and tested a procedure to determine air leakage in heat pump clothes dryers. Mainly the studies related to clothes dryer found in literature dealt with tumble dryer [11–15] and only very limited studies related to cabinet heat pump clothes dryer.

The above reported studies showed that waste heat from split-type RAC can be used as heat source for clothes dryer. The performances of the clothes dryer using waste heat from split-type of RAC, in term of SMER and drying time, were discussed and showed a better performance compared with commercial electric clothes dryer. The focus of the previous studies was mainly on the performance of the system. Only limited study reported the performance of the drying chamber. The present paper focuses on the performance of a drying chamber of clothes dryer using waste heat from a split-type RAC. The effects of drying load and inlet configuration will be analyzed in term of SMER, drying time, and drying characteristics. The results are expected to supply necessary information on development and optimization of RAC clothes dryer.

Table 1
Specification of split-type RAC utilized for experiments.

Parameter	Value
Power (averaged)	800 W
COP	3.3
Voltage/frequency	220–240 V/50 Hz
Current (maximum)	4.7 A
Dimension of outdoor unit	660 mm × 470 mm × 240 mm
Dimension of indoor unit	820 mm × 283 mm × 210 mm

2. Methods

2.1. Experimental apparatus

In order to perform the experiments, a drying cabinet with a volume of 1 m³ was designed and fabricated. The drying cabinet utilized waste heat from condenser of a split-type RAC. The RAC used in this study is a typical residential air conditioner size applicable to a room of 5 m × 6 m × 3 m in Medan or Jakarta city of Indonesia. The specifications of the RAC used in this study are shown in Table 1. The commercial name of the RAC was Samsung with model AS09TUUQX. The conditioned space was an office with dimensions of 5 m × 6 m × 3 m. The space is located inside the main building of engineering faculty of University of Sumatera Utara with geographic coordinate 3°34′ North and 98°40′ East. The adjoining rooms on the south, west, and north walls of the conditioned space were not conditioned. The east wall was open for sun radiation. The cooling loads inside the room come from two lights of 100 W fluorescent, two computers, and two students.

The heat from the condenser of RAC will be injected into a drying cabinet. The dimension of the drying cabinet was 860 mm × 860 mm × 1550 mm. It was made of aluminum plate of 2 mm. In order to decrease the heat loss from the drying cabinet, the wall was insulated by using rock wool with a thickness of 20 mm. The rock wool was placed between inside and out side aluminum plates. The door of the drying cabinet was made of acrylic, with a 2 mm thickness. An analysis has been carried out to calculate the total thermal resistance of the drying cabinet it was 0.746 W/m K. The schematic diagram of the drying cabinet and outdoor unit of the RAC is shown in Fig. 1. The drying cabinet was located inside a room which was not conditioned. The maximum and minimum mean dry bulb temperatures of ambient in the location of the experiments are 33.9 °C and 18.9 °C, respectively.

The ambient air was used to cool condenser and results in hot drying air. In conventional split-type RAC, the condenser is placed outside and it is cooled by ambient air. Here, the condenser was covered with a box in order to collect the hot air. The hot air was flowed into drying cabinet using an auxiliary fan. By using the fan, the vapor compression cycle will be operated normally. The operation mode of the vapor compression cycle will be divided into two modes. The first mode was normal operation. Here, vapor compression cycle (VCC) was operated as a cooling unit and the drying cabinet was not operated and
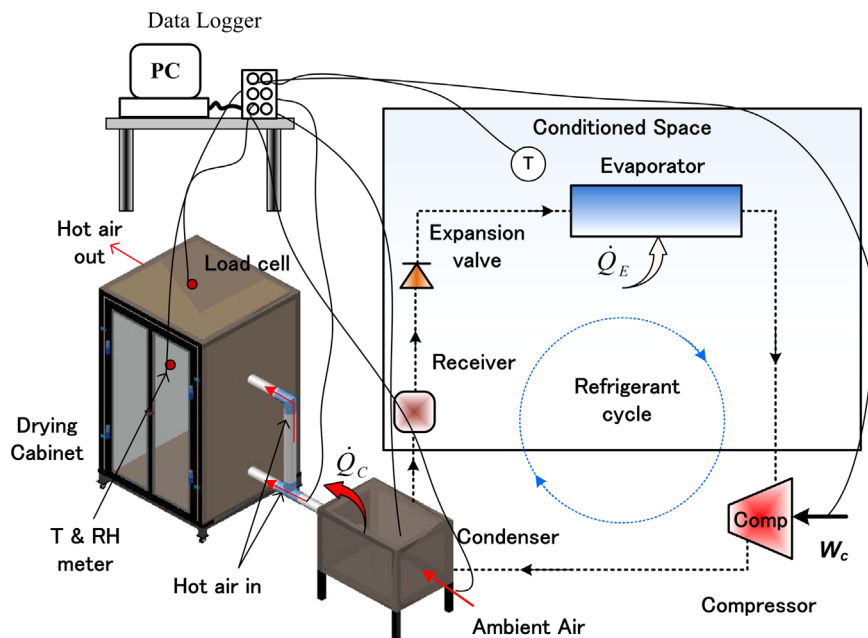

Fig. 1. RAC, experimental apparatus, and data acquisition unit.

the condenser was opened to the ambient air. The second mode was hybrid mode. Here, the VCC was operated to cool the air in the conditioned space and the condenser was covered to result the hot air. The drying cabinet was operated using the hot drying air from the condenser.

In the first mode, temperature of the conditioned space, temperature and the pressure of the condenser, electric power to the VCC will be measured using data logger. In the second mode, additional measurements were carried out. They were temperature and velocity of the hot air when it was entering the drying cabinet, and mass of the clothes dried. Temperatures will be measured using J-type thermocouples with uncertainly equal to 0.1 °C. RH meter EL-USB-2-LCD was used to measure RH and temperature in the drying cabinet. The accuracy of the RH meter was ±0.1. The velocity of the hot air was measured using a DT-8880 Hot wire anemometer with speed measuring range and accuracy of 0.3–30 m/s and ±3%, respectively. Pressure in the condenser was measured using pressure gauge.

2.2. Clothes dried and drying method

The clothes dried in the present experiments were several shirts made of cotton. The experiments were carried out for five different initial weights as load for drying cabinet. The weights of the clothes when dry are 1.9 kg, 2.5 kg, 2.9 kg, 3.6 kg, and 4.9 kg. The clothes were soaked and span to reduce the water content. Here the initial weights of the wet clothes are 3.05 kg, 5.25 kg, 6.21 kg, 8.22 kg, and 10.22 kg, respectively. These will be known as initial weights to be dried. Thus there were five samples will be dried in the drying cabinet.

Two method of drying experiments were carried out. The first case when the hot air was flowed only from the bottom of the drying cabinet, named as a single inlet. The second case, when the hot air was flowed from the top and the bottom of the drying cabinet, named as multi-inlets. For each case, the load of the drying cabinet was varied from 3.05 kg, 5.25 kg, 6.21 kg, 8.22 kg, and 10.22 kg, respectively. Thus a total of 10 experiments were carried out.

In all experiments, the RAC will be operated at a room temperature fixed at 20 °C, typical conditioned room temperature for cities in Indonesia. Every experiment starts at 9.00 am. In the beginning the RAC will be operated with empty drying chamber for 30 min, named as idle time. After the idle time, the wet clothes placed by hanging inside the drying chamber. The experiment begins and all of the temperatures, weight, electric current, and hot air velocity were measured and recorded using the data acquisition unit.

2.3. Performance parameters

As mentioned above, in the experiments the temperatures, weights, and air velocity in the drying cabinet will be read and recorded by a data acquisition unit. The voltage, electric current, and pressure of the air conditioner will be measured. These measured parameters will be used to analyze performance parameters. The performance parameters used in this study are explained as follows.

Non-dimensional moisture ratio (MR) will be used to compare the drying characteristics. It is calculated using the following equation.

$$MR = \frac{m_t - m_e}{m_i - m_e} \tag{1}$$

where m_t, m_i, and m_e is the mass of the clothes dried at measured time, at initial time, and at equilibrium, respectively. The moisture content X [kg/kg db] of the clothes dried is calculated by

$$X = \frac{m_t}{m_e} \tag{2}$$

The drying rate $\dot{m}$ [kg/h or g/min] of the clothes dried is calculated by the following equation:

$$\dot{m} = \frac{m_t - m_{t-1}}{\Delta t} \tag{3}$$

where Δt is interval measurement in h or min. In the present air-conditioner unit, a vapor compression cycle is utilized as refrigeration cycle. In the cycle, the heat in evaporator ($\dot{Q}_e$) is drawn from the conditioned space by using compressor power ($\dot{W}_c$). The total energy from the cycle will be rejected in condenser ($\dot{Q}_{cond}$) and calculated by

$$\dot{Q}_{ccnd} = \dot{Q}_e + \dot{W}_c \tag{4}$$

The heat released in condenser is a waste heat.

In this study, parameter of performance of specific moisture extraction rate (SMER) will be used. This parameter is defined as number of moisture removed from the clothes divided by energy consumed. Here, the energy used for removing the moist from clothes consists of heat release from condenser and energy to power the auxiliary fan. Since the heat released from condenser is the waste heat, it is considered as free energy. Thus, SMER [kg/kW h] will be calculated using the following equation:
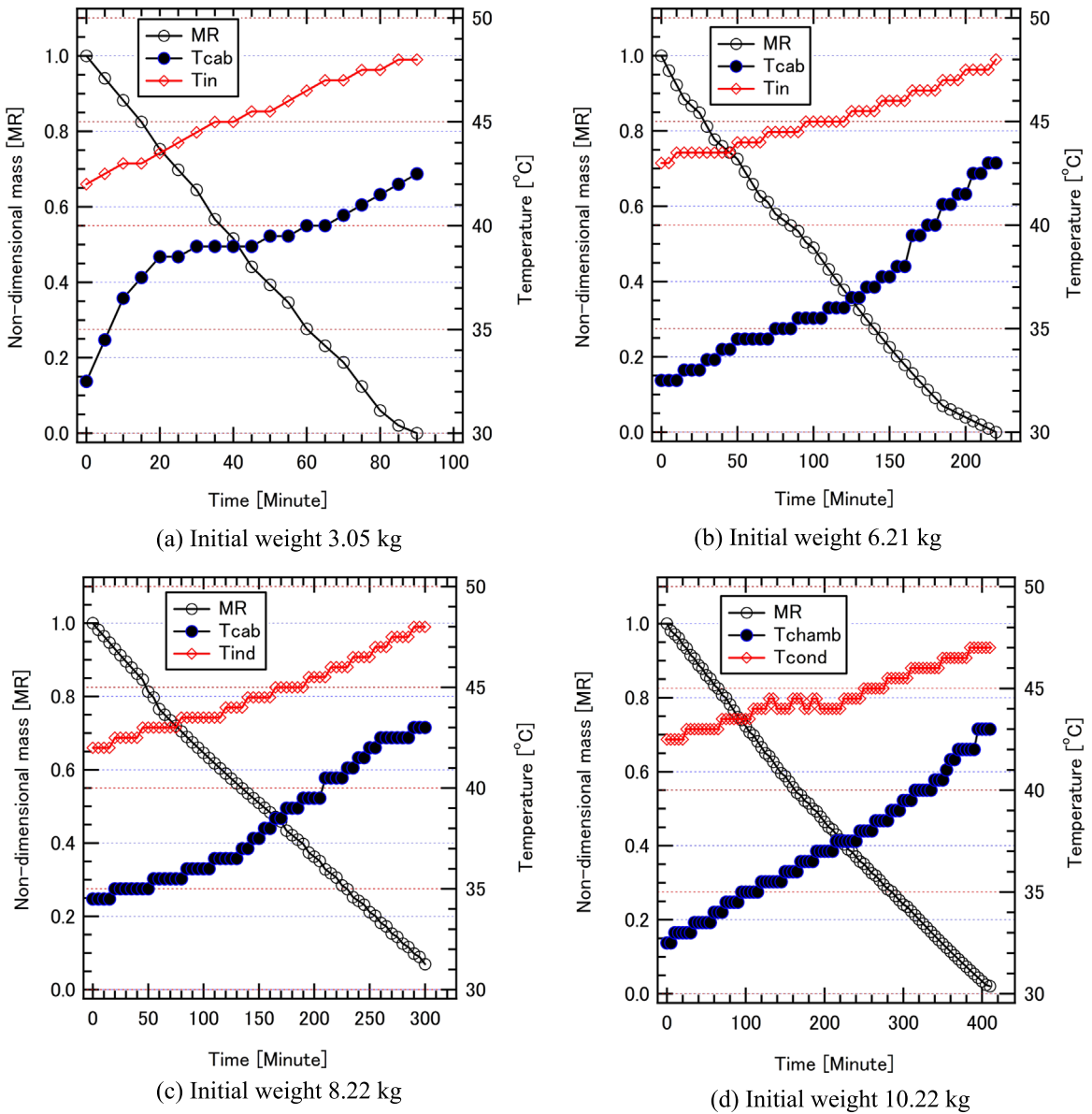
(a) Initial weight 3.05 kg

(b) Initial weight 6.21 kg

(c) Initial weight 8.22 kg

(d) Initial weight 10.22 kg

Fig. 2. Typical temperatures and non-dimensional mass of the clothes dried.

$$SMER = \frac{\Delta m_d}{P_{fan} \times \Delta t}$$

(5)

where Δm_d [kg] total of moisture removed from the clothes during the drying time, P_{fan} [W] the electric power of fan, and Δt [h] is drying time.

The above parameters will be used as performance parameters in order to compare the performance of the drying chamber.

3. Results and discussions

Five different initial weights of wet clothes and two different inlets of the drying cabinet were studied experimentally. Thus a total of 10 cases of experiments were carried out. The results will be analyzed in terms of drying characteristics, drying kinetics, and SMER.

3.1. Drying characteristics

The drying characteristics of the drying cabinet with single inlet are presented in Fig. 2(a)–(d). The figure shows the non-dimensional moisture ratio, temperature of drying air at inlet, and temperature inside the drying cabinet. It can be seen that the temperature of the hot air at the inlet was not constant but increase gradually. Temperature inside the drying cabinet also increases gradually. The non-dimensional moisture ratio decreases almost linearly. In the beginning of the experiments temperature of drying air at inlet is the same for all initial weights, it is about 42 °C. However, at the end of the drying process the temperature at inlet was from 46 °C to 48 °C, it depends on the initial weights. As a note, temperature in the conditioned space is kept constant at 20 °C. Since every experiment starts at 9.00 am of local time, temperature of the ambient increases as time increases. The increase of ambient temperature results in increase cooling load in the conditioned space and it leads to more waste heat released in the condenser. In addition, the condenser of the RAC is cooled by ambient air. The increasing of heat released in the condenser and increasing ambient temperature make the temperature of the hot air resulted by the condenser increases as time increases.

The hot drying air will provide energy for the moist in the clothes dried to evaporate into vapor. This heat is known as latent heat and will make the temperature in the drying cabinet lower than temperature of the hot air entering the drying cabinet. This fact is shown in the figure. It can be seen that, the temperature difference of the drying air at inlet and temperature in the drying cabinet at the beginning is bigger than at the end of drying time. For instance, for initial weight of 6.21 kg, the temperature difference at the beginning and at the end of the drying period is 10.5–5 °C, respectively. This is because, at the beginning many water present in the surface and it needs heat for evaporating. Thus, it makes temperature in the drying cabinet decrease significantly. At the end of the drying period, limited water left in the clothes to be evaporated. Thus, temperature difference will be lower. The temperature difference at the end of drying period is dominated by heat loss from the drying cabinet. It is mainly from the door of the drying cabinet.

3.2. Drying kinetics

The drying kinetics will be discussed using the non-dimensional mass ratio versus time, the drying rate versus time, and the drying rate versus water content. Non-dimensional mass versus time for all initial weights with single inlet in the drying cabinet are shown in Fig. 3. The figure shows that for all initial weights the non-dimensional mass decreases as time increases. All curves almost linier with negative value of gradient. The highest value of gradient is shown by initial weight of 3.05 kg and its drying time is 90 min. The drying time for initial weight of 5.25 kg, 6.21 kg, 8.22 kg, and 10.22 kg is 190 min, 220 min, 300 min, and 410 min, respectively. Typical drying curve for common material with constant hot drying air found in literature showed that the non-dimensional mass will fall at moderate gradient in the beginning and almost horizontal in the end of drying period. However, the curves in the present study do not show the same trend. This is because temperature of the drying air was not constant but increase gradually. This will keep the drying rate in the end of drying time is relatively high. As a note, the volume of the present drying cabinet is fixed at 1 m^3. More clothes in the drying cabinet results in more water to be evaporated. This results in increasing drying rate. However, too many clothes in the drying cabinet results in decreasing space for drying air to flow. This will make drying rate lower. An optimum initial weight for the drying cabinet must exist.

Typical drying curve for common material can be divided into initial transient period, constant rate period, the first and second falling rate periods. The constant rate period is fully governed by the rate of external heat and mass transfer since the film of free water is always available at the evaporating surface. This drying period is nearly independent of the material being dried. In the present study, the figure shows that for all cases, only falling rate period was captured. The curves do not display the initial transient and constant rate periods. This is mainly because the hot drying air temperature was not
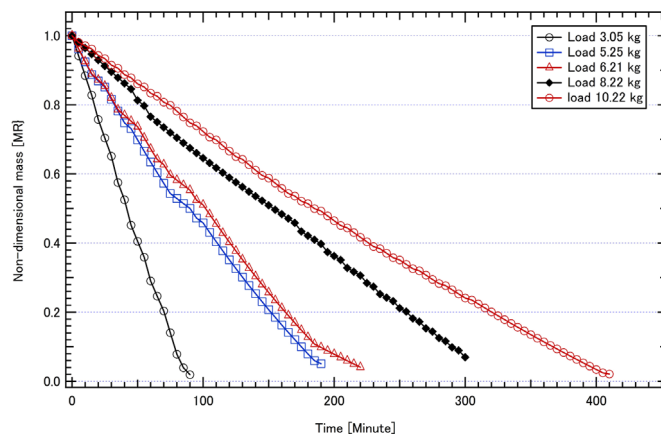

Fig. 3. Non-dimensional mass versus time for all initial weights.
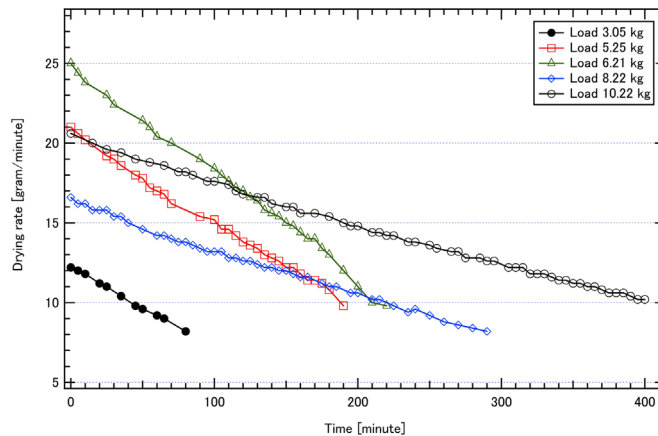
Fig. 4. Drying rate versus time for all initial weights.

constant but increases gradually. The other reason is the characteristics of the clothes dried.

The drying rate as a function of time for all initial loads is shown in Fig. 4. The drying rate in every measurement was calculated using Eq. (3). The figure shows drying rate decreases as time increase. In the beginning of the drying time, the drying rate is relatively big, since many water present in the clothes dried. On the other hand, in the end of the drying period, the drying rate is very low, even though temperature of drying air increases as time increase. This is because in the end of drying time the moist is less in the clothes dried. This fact agrees well with the graph shown in Fig. 3. The lowest drying rate is shown by the experiment with initial weight of 3.05 kg. On the other hand, the highest drying rate is shown by initial weight of 6.21 kg. When the drying load is being added, from initial weight of 3.05 kg–6.21 kg, the drying rate is increasing. However, when drying load is being added from 6.21 kg–10.22 kg, the drying rate is decreasing. This fact suggests that too many clothes inside the drying chamber will decrease the drying rate. The dense drying cabinet will make many blocking of drying air flow and results in a low drying rate.

In order to examine the optimum initial weight for the drying cabinet, the drying rate versus water content for all initial weights are calculated and presented in Fig. 5. It can be seen that all experiments fall in the falling rate period of drying or no constant drying rate period was captured. As expected, the drying rate decreases as moisture content decreases. The initial weights of 3.05 kg and 8.02 kg show the same characteristics. The same characteristics are also shown by initial weight of 5.25 kg and initial weight of 10.22 kg. The highest drying rate is shown by initial load of 6.21 kg. This figure suggests that the optimum drying rate for these experiments is the initial weight of 6.21 kg. As a note, this optimum initial weight is for drying cabinet with single inlet.

3.3. Effect of multi-inlets

In order to examine the effects the inlet of drying air, experiments with multi-inlets for all initial weights were also carried out. In the single inlet the drying air was injected from the bottom channel only. While, in the multi-inlets two drying air channels were used, the first is the bottom channel and the second channel is placed 50 cm below the top. The volume rate of drying air is the same for single and multi-inlets. The non-dimensional mass relative versus time for initial
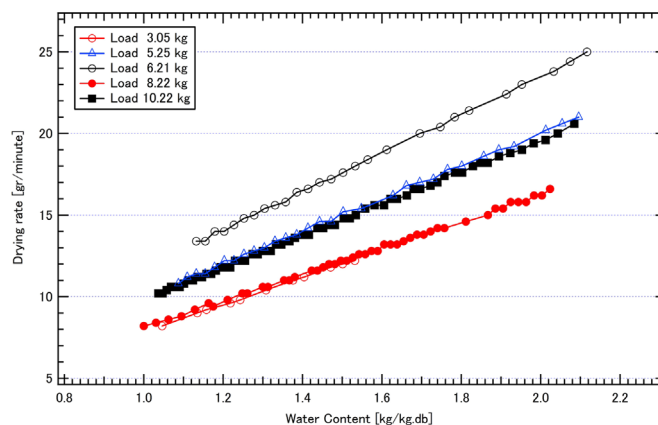

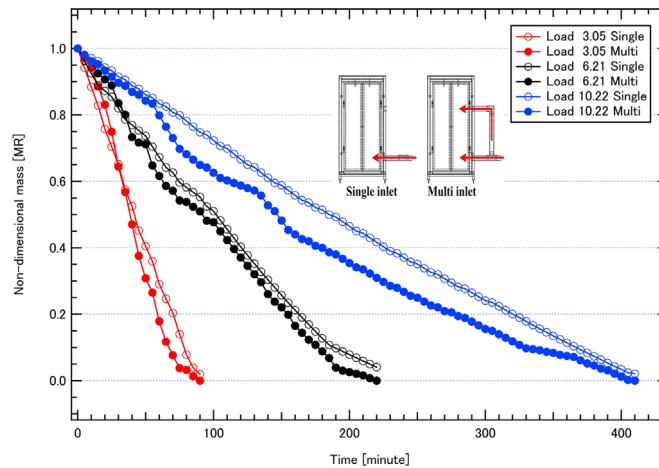**Fig. 5.** Drying rate versus water content for all initial weights.

Fig. 6. Effect of multi-inlets to the performance of the drying cabinet.

weights of 3.05 kg, 6.21 kg, and 10.22 kg with single and multi-inlets are shown in Fig. 6. It can be seen that for all cases the characteristic of multi-inlets is better than single inlet. This is because multi-inlets make the drying air disperse widely in the drying chamber in comparison with single inlet. In other words, the drying air will have wider effective drying surfaces. Wider effective drying surface results in bigger drying rate. For bigger initial weights wider drying surface will be more effective in increasing the drying rate. This fact suggests that performance of the drying chamber with multi-inlets is better than single inlet, especially for big initial weights. This fact is shown clearly in the figure.

Effects of initial weight to drying time for both single and multi-inlets of the drying cabinet are presented in Fig. 7. The drying time for single inlet is shown by black circle marker and for multi-inlets shown by red rhombus marker. The figure shows that drying time increases as initial weight increases. The increasing of the drying time is linear. The drying time for multi-inlets is higher than single inlet. The averaged drying time for multi-inlets is 222 min and for single inlet is 242 min. In other words, drying time for multi-inlets is 20 min faster than single inlet. Here the equations to calculate the drying time for each case are proposed. The drying time t_d in min as a function of initial weight of clothes dried for single inlet can be calculated by using the equation

$$t_d = 43.525m_i - 44.871 \tag{6}$$

and for multi-inlets is calculated by

$$t_d = 43.481m_i - 57.992 \tag{7}$$

The value of R-squared for single and multi-inlets is 0.99 and 0.98, respectively.

3.4. Specific moisture extraction rate

In term of energy used, the performance of the drying cabinet will be analyzed using specific moisture extraction rate
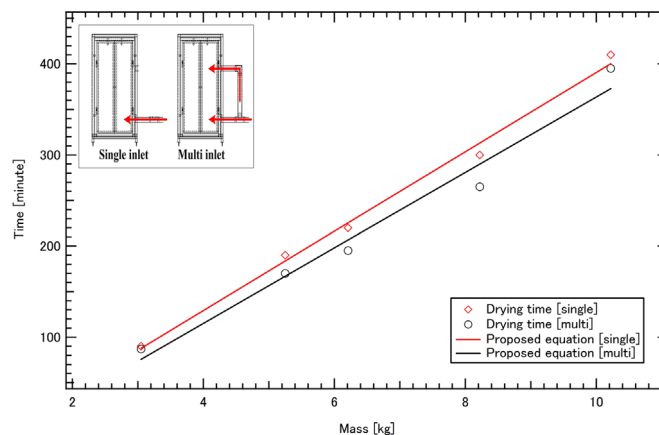

Fig. 7. Comparison of drying time for all initial loads. (For interpretation of the references to color in this figure, the reader is referred to the web version of this article.)

Table 2
Performance of the clothes drying cabinet.

No	Initial mass (g)	Type of inlet	Drying time (min)	Averaged drying rate (kg/h)	SMER (kg/kW h)
1	3045	Single	90	0.684	1.849
		Multi	80	0.704	1.903
2	5250	Single	190	0.822	2.222
		Multi	170	0.868	2.346
3	6215	Single	220	0.868	2.345
		Multi	195	0.895	2.418
4	8220	Single	300	0.858	2.319
		Multi	270	0.922	2.492
5	10,255	Single	410	0.763	2.061
		Multi	395	0.778	2.104

(SMER). This parameter was defined with Eq. (5), in the above section. It can be viewed as how efficient the energy consumed to remove the moist from the clothes dried. SMER for all experiments were calculated and presented in Table 2. In the table, the other performance parameters such as drying time and averaged drying rates are also presented. The table shows that SMER for drying cabinet with single inlet varies from 1.849 kg/kW h to 2.343 kg/kW h with an averaged value of 2.159 kg/kW h. On the other hand, for multi-inlets drying cabinet the SMER varies from 1.903 kg/kW h to 2.492 kg/kW h with an averaged value of 2.252 kg/kW h. Mahlia et al. [9] reported that the SMER varied from 0.1809 kg/kW h to 0.2205 kg/kW h. This fact suggests that SMER in the present study is higher than the results of Mahlia et al. [9]. However, there was a different interpretation of definition of the SMER. It was clearly stated that SMER will be the comparison of moisture removed to energy consumed. In this system the energy consumed in the drying chamber is only energy for auxiliary fan. Mahlia et al. [9] defined the energy consumed in the drying cabinet is the sum of energy used by auxiliary fan and heat released by condenser. However, the heat released by condenser is a waste heat or free energy. This is should not be treated as energy consumed. This fact made the SMER of the present study is lower than the work reported by Mahlia et al. [9].

The table suggests that the optimum values of averaged drying rate and SMER. For the drying chamber with single inlet, the optimum averaged drying rate and SMER is 0.868 kg/h and 2.345 kg/kW h. These values reveal that, in term of efficiency, the drying cabinet with single inlet should be operated at the initial load about 6 kg. If it is operated at lower or higher of this initial load, the drying rate and SMER will be decrease. For drying chamber with multi-inlets, the optimum initial weight is about 8 kg. This load will give drying rate value of 0.922 kg/h and SMER of 2.492 kg/kW h.

4. Conclusion

A drying cabinet with a total volume of 1 m^3 has been designed and fabricated. The drying chamber utilizes waste heat from residential split-type AC with compressor power of 800 W. The drying chamber was tested to dry the clothes made of pure cottons with several initial weights and the conditioned space was kept constant at 20 °C. The effects of different initial weights of the clothes and modification of drying air inlet were examined. The main conclusion of this study is that the drying chamber for drying clothes by utilizing rejected heat from residential AC is viable in term of time and energy utilization. The experiments showed that the drying time varies from 80 min to 410 min. The modification of drying air inlets improves the performance of the drying chamber. For single inlet the averaged drying time, optimum initial weight, optimum drying rate and optimum SMER was 242 min, 6.21 kg, 0.868 kg/h, and 2.345 kg/kW h. On the other hand, the drying chamber with multi-inlets the averaged drying time, optimum initial weight, optimum drying rate and optimum SMER was 222 min, 8.22 kg, 0.922 kg/h, and 2.492 kg/kW h. Thus, the present drying cabinet should be operated with multi-inlets and the initial weight varies from 6 to 8 kg.

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