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ANALYSIS OF A COMPARED TEMPERATURE USING CAPILLARY TUBE DIFFERENT MEASUREMENT LENGTH AT ROOM 3 X 4 M^2 HELPING AC PORTABLE

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ABSTRACT

At this time along with the times a lot of problems that occur in this world like the Earth's warming temperatures globally. Human needs of the air conditioning apparatus has become a staple in our daily lives. There is also a saying that the Air Conditioner (AC) has become a mandatory item installed in homes without air conditioning because of the environment around the home became more sultry and hot when we were in the neighborhood. In developments at this time have many types of AC marketed like Split AC, AC Windows, Central air conditioning and so on. A capillary tube expansion device or lowering pressure so cheap that researchers sought to examine the ratio of capillary-sized 33, 54, and 76 cm to the temperature of an air conditioner Portable. Results comparative study of the capillary tube length obtained the lowest total heat value is 9086, 6925 Btu / Hr and the highest is 15144.4875 Btu/Hr.

Keywords: Total Heat, Capillary Tube, Psikrometri, Air Conditioning

1. INTRODUCTION

In general, most people today need something easy and also simply. Then also by means of air conditioning air conditioning communities need tools that can be taken whenever they want to use the air conditioner. Portable air conditioner air conditioning is a small tool that can be used easily and can be taken anywhere. Therefore, the community at this time along with the time and the times are very want to buy something that is easy and practical.

According to Anwar (2010) , capillary tube has advantages and disadvantages. advantages of AC Portable because of its simple , has no moving parts and is relatively inexpensive .
Portable Air Conditioning is a tool air conditioning very practical so it can be moved across the room to a room that one of the main lain. The component of AC Portable air conditioning apparatus is as follows: compressor , condenser , capillary tube , evaporator . cycle of air conditioner Portable at using the vapor compression cycle where the compressor works to raise and lower the pressure .

At Portable AC contained component that serves to reduce the pressure of the condenser pressure is high. The component of capillary tube which serves to reduce the pressure due to the capillary diameter is smaller than the size of the condenser pipe toward the capillary tube (Sanaye , 2004) . While the temperature the exit of the capillary tube to be down due to the diameter and length of the capillary tube influences (Sanaye , 2004) . therefore I as the author would like to examine the effect of a decrease in air temperature in the surrounding area air conditioned by comparing the length of the capillary tube size .

Air Conditioner is a device used to regulate air quality or condition which include air circulation, regulate humidity , air cleanliness and arrange for air purifying (Sanaye, 2004). And AC Portable is one of the components of air conditioning units made in a single unit and can be easily carried or moved .

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The main component is a basic component that must be present on components such as the air conditioning unit Portable air conditioning . If one of the main components of the damage occurs in the vapor compression cycle air conditioning unit will not run.

Compressor
The compressor is a tool that is used to circulate the air conditioning system in which the compressor has a suction side and a press that can circulate refrigerant in air conditioning systems. Just as the human heart compressor is one major component that is very important in air conditioning systems (Langley, 2008) .

Figure 1. Compressor (Handoko, 2007)

Condenser
The condenser is a device that has a function as a heat exchanger where the temperature drops and the refrigerant becomes a form of change from the previous refrigerant gas into a liquid form (Liang, 2010).

Deepak (2006) argues that the condenser pipes must be fitted with fins so that the process becomes more rapid heat release in which the heat transfer takes place by convection .

According to Bansal (2005) , a condenser has a very important meaning in which the air conditioning refrigerant is condensed by convection forced to change the refrigerant into a liquid form .

Figure 2. Condenser (Handoko, 2007)

Capillary Tube
The capillary tube is the main component in the air conditioning system in particular that serves as a portable air conditioner refrigerant pressure lowering and turn it into a mixed phase (Bansal , 2005) . The capillary tube has a very important meaning in the AC Portable because it connects two parts of different pressures, namely high pressure and low pressure. High-pressure refrigerant pressure be lowered after passing through the capillary tube so that the temperature of the refrigerant will decrease and the phase of the refrigerant will be a mixture of liquid and gas (Ekadewi , 2002).

Figure 3. Capillary Tube (Handoko, 2007)

Evaporator
The evaporator is the component that serves to absorb heat from the refrigerant to the environment so that the liquid form of saturated refrigerant through a capillary tube after going to turn into a gas. Evaporator is often referred to as a heat exchanger. Hot air surrounding environment will be absorbed by the evaporator and then go through the fins on the evaporator pipe so that the air temperature coming out of the evaporator is lower than the conditions before entering the evaporator (Dabas , 2011) .

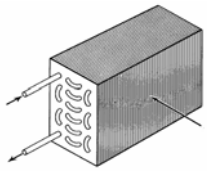

Figure 4. Evaporator (handoko, 2007)

2. METHODOLOGY/ EXPERIMENTAL

Making this portable air conditioner uses main components such as the compressor , condenser , capillary tube and evaporator as a very important component in refrigeration systems and air conditioning systems. In this case the researchers will try to make a portable air conditioner in order to conduct a study of the length of the capillary tube at room temperature laboratory equipment.

As we all know that the function of the capillary tube is to reduce the pressure of the condenser in the vapor compression cycle so that the temperature after the exit of the capillary tube is low but still a form of liquid refrigerant.

Evaporator is the site of absorption of heat in the refrigerant heat temperature. Heat transfer of

conditioned room by the evaporator boiling refrigerant has the effect of causing a change of state from liquid to vapor (latent heat). While the temperature of refrigerant to the evaporator of a capillary tube at temperatures generally reach saturated evaporation (evaporator saturation temperature). Having vaporized refrigerant in the evaporator, the steam temperature after the evaporator must be raised in order to gain further steam conditions (superheated vapor) .

Equipment

Equipment used in the manufacture of Portable Air Conditioners are as follows:

Table 1 Equipment Used

No	Equip.	Total
1	Capillary Tube (33 cm)	1 Piece
2	Capillary Tube (54 cm)	1 Piece
3	Capillary Tube (76 cm)	1 Piece
4	Compressor	1 Piece
5	Condenser	1 Unit
6	Evaporator	1 Unit
7	Brush dan Stingy	1 Piece
8	Sandpaper	1 Piece
9	Vernier Calliper	1 Piece
10	Ruler	1 Piece
11	Sling Psychometrics	1 Piece
12	Manifold gauge	1 Piece
13	Pressure gauge high	1 Piece
14	Pressure gauge Low	2 Pieces
15	Copper Pipe	2 Pieces
16	Flaring and swaging tools	2 Roll
17	Bending tool	1 Set
18	Las Gas	1 Piece
19	Hand Drill Machine	1 Set
20	Spanner	1 Piece
21	Adjustable Wrench	1 Set
22	Screwdriver	1 Piece
23	Key L	1 Piece
24	Tang	1 Set
25	Iron Hammer	1 Piece
26	Presets Iron	1 Piece
27	Refrigerant R-22	1 Piece
28	Temperature digital	4 Pieces
29	Las Listrik	Set

Material

Materials used in the construction of Mini Portable Air Conditioners are as follows :

a. Channel iron and iron elbow
b. plate Plywood
c. Electric welding electrodes
d. Nuts, bolts , and ring
e. Paints and thinners

Data Collection Procedures

For the measurement procedure this data is the first step that starts the preparation of the initial size of the measuring instrument which is a measure of comparison for the results obtained. Before the authors to the conclusion of the final results of the data processing, the authors first conducted an experiment to obtain data obtained in this experiment . The measures undertaken by the authors are as follows:

Calibration Measurement

Calibration of measuring instruments are useful for comparison of standard gauge. In this case a calibrated digital thermometer. Given the value obtained from the measuring instrument is the amount to be processed, so the statutes and use measuring devices must be considered.

Determining the measurement points

Calibrated measuring instrument is then ready to be installed at the points of measurement. Determination of measurement points should really be considered lying because if the measuring instrument is not placed in the right position, it will concern the data generated from inaccurate measurement tools can even lead to errors in the data generated.

To measure the per 10 minute period

Retrieval of data using psychometric slink - air conditioned room

1 . Preparation
Turn on the portable air conditioner, then adjust the temperature with a temperature of 23 ° C and put a digital thermometer in the room .

2 . Process of data collection
Dampen the cloth covering slink - psychometric with water to parts of the wet bulb temperature . Then turn the slink - psychometric for 2 minutes to get the temperature of the dry bulb and wet bulb temperature .

3. Writing the measured data
The data has been obtained is then written in the form of tables , making it easier for authors to manage the data.

4. Data processing
Data processing is done by using existing psikrometri diagram . And also data processing is carried out in a 3 X 4 M2 using Portable AC

room which is cooled with different capillary tube so that it can be compared which reaches a comfortable temperature in the room more quickly .

3. RESULTS AND DISCUSSION

Heat Load Calculation Total Rooms Using Portable Air Conditioner.

Portable air -conditioned comfort temperature is set at 23 ° C with a capillary tube 33 , 54 and 76 cm at room 3 X 4 M2.
Rate of Air Volume AC 1 Pk = 380 m^3/hr
1 m^3 = 35.314667 ft^3
Therefore, Rate of Air Volume :

$$= \frac{380\ m^3}{hr} x \frac{35{,}314667\ ft^3}{m^3}$$
$$= \frac{13419{,}57346\ ft^3}{hr} x \frac{1\ hr}{60\ min}$$
$$= 223{,}659 \frac{ft^3}{min}$$

Where : 1 kJ/kg = 0,42992 Btu/lb

1. Steady temperature using a Capillary tube size 33 cm
Tdbin = 25,0 °C
Twbin = 24,0 °C
Tdbout = 30,0 °C
Twbout = 29,0 °C
then :

a. Enthalpy

Determination of the enthalpy values obtained using psychometrics chart, the result is as follows :

$h_{1\ sensible}$(room air)= 74,0 kJ/kg = 31,81408 Btu/lb
$h_{2sensible}$(room air) = 80,0 kJ/kg = 34,39360 Btu/lb
h_{1laten} (environment air) = 80,0 kJ/kg = 34,39360 Btu/lb
h_{2laten} (environment air) = 95,0 kJ/kg = 40,84240 Btu/lb

b. Sensible Heat

Qs = 4,5 CFM.Δhs
= 4,5. 223,659 ft³/min . (34,39360 Btu/lb – 31,81408 Btu/lb)
= 2596,1978 Btu/hr

c. Latent Heat

Q_l = 4,5 CFM.Δh_l
= 4,5 . 223,659 ft³/min . (40,84240 Btu/lb – 34,39360 Btu/lb)
= 6490,4947 Btu/hr

d. Total Heat

Q_T = Q_s + Q_l
= 2596,1978 Btu/hr + 6490,4947 Btu/hr = 9086,6925 Btu/hr

2. Steady temperature using a capillary tube size 54 cm
Tdbin = 23,5 °C
Twbin = 22,5 °C
Tdbout = 31,0 °C
Twbout = 30,0 °C
then :

a. Enthalpy

Determination of the enthalpy values obtained using psychometrics chart, the result is as follows :

$h_{1\ sensible}$(room air)= 67,5 kJ/kg = 29,01960 Btu/lb
$h_{2sensible}$(room air) = 77,0 kJ/kg = 33,10384 Btu/lb
h_{1laten} (environment air) = 77,0 kJ/kg = 33,10384 Btu/lb
h_{2laten} (environment air) = 100,0 kJ/kg = 42,99200 Btu/lb

b. Sensible Heat

Qs = 4,5 CFM.Δhs
= 4,5. 223,659 ft³/min . (33,10384 Btu/lb – 29,01960 Btu/lb)
= 4110,6466 Btu/hr

c. Latent Heat

Q_l = 4,5 CFM.Δh_l
= 4,5 . 223,659 ft³/min . (42,99200 Btu/lb – 33,10384 Btu/lb)
= 9952,0918 Btu/hr

d. Total Heat

Q_T = Q_s + Q_l
= 4110,6466 Btu/hr + 9952,0918 Btu/hr
= 14062,7384 Btu/hr

3. Steady temperature using a Capillary tube size 76 cm
Tdbin = 23,0 °C
Twbin = 22,0 °C
Tdbout = 31,0 °C
Twbout = 30,0 °C

then :

a. Enthalpy

Determination of the enthalpy values obtained using psychometrics chart, the result is as follows:

$h_{1\ sensible}$(room air)= 65,0 kJ/kg = 27,94480 Btu/lb
$h_{2sensible}$(room air) = 75,0 kJ/kg = 32,24400 Btu/lb
h_{1laten} (environment air) = 75,0 kJ/kg = 32,24400 Btu/lb
h_{2laten} (environment air) = 100,0 kJ/kg = 42,99200 Btu/lb

b. Sensible Heat

Q_s = 4,5 CFM.Δhs
= 4,5. 223,659 ft³/min . (32,24400 Btu/lb – 27,94480 Btu/lb)
= 4326,9964 Btu/hr

c. Latent Heat

Q_l = 4,5 CFM.Δh_l
= 4,5 . 223,659 ft³/min . (42,99200 Btu/lb – 32,24400 Btu/lb)
= 10817,4911 Btu/hr

d. Total Heat

Q_T = $Q_s + Q_l$
= 4326,9964 + 10817,4911 Btu/hr
= 15144,4875 Btu/hr

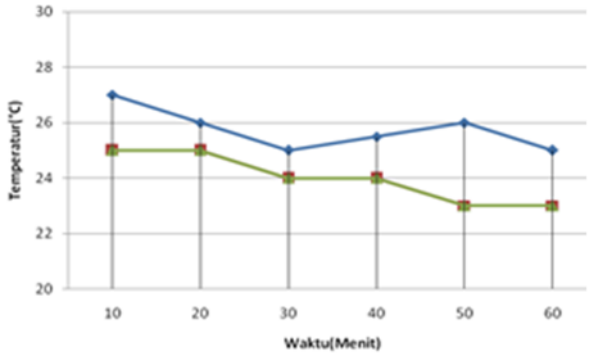

Figure 5. Comparison chart diagram of temperature on capillary

From the graph of temperature versus time comparison image above can be concluded that the length of the capillary tube length 76 cm faster cooling process compared to the size of the capillary tube 33 cm and 54 cm to reach the desired temperature in the room 3 X 4 M2 .

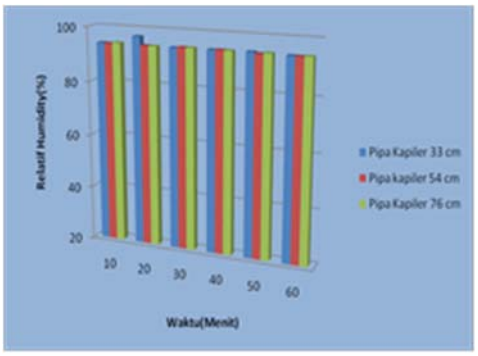

Figure 6. Relative Humidity comparison chart diagram on capillary

From the graph drawing comparisons relative humidity values with time can be seen that the relative humidity in the capillary tube 33 , 54 , and 76 cm is not much different because of the condition of Indonesian territory that has a high moisture content

4. CONCLUSION

After doing research on experiments that have been done then drawn conclusions :

1. Process of cooling of the length of the capillary tube size 76 cm more useful for accelerating the process of cooling the room 3 X 4 M2 compared with the size of the capillary tube 33 cm and 54 cm .

2. Expenses total cooling heat on a longer capillary tube that is 76 cm in size reaches 15144.4875 Btu / hr to make the process of achieving a comfortable temperature to conditions more rapidly than the size of the capillary tube 33 cm and 54 cm .

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