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Water Saving AC Cooler

Rushikesh P. Dhawale[1], Rushikesh N. Bharde[2], Rushikesh N. Dharmale[3], Kashif Khan. S. Khan[4], Ankita S. Gulhane[5], Dr. S. C Jirapure[6]

Department of Mechanical Engineering[1,2,3,4,5]

Head, Department of Mechanical Engineering[6]

Dr. Rajendra Gode Institute of Technology and Research, Ghatkheda, Amravati, Maharashtra, India

srdhawale2017@gmail.com, rushikeshbharde2000@gmail.com, rushikeshdharmale9@gmail.com

kashifpathan9175@gmail.com, ankita.gulhane111@gmail.com

Abstract: *Necessity can make people create the most amazing things. For example, some people will do almost anything to keep cool in the summer heat. Those of you living in the warmer regions of the world can relate to how frustrating it can be to spend time in a place without proper air conditioning. Well one creative Flickr user created a homemade air conditioner to cool his apartment. Here's how he did it.*

Keywords: Copper Coil, vinyl tubing, tubing, Pump

I. Introduction

The summer of 2015 was a particularly hot one for Amravati region. The mean average temperature in Amravati for the month of May was a staggering 42.5 °C. Environment India. It smashed the normal temperature by almost five degrees. It's a significant record (...) the previous record was 48.7 C in 2015." It was a deadly difference, as three heat related deaths were identified by Amravati during May.

The summer of 2015 was an extremely hot one for Ontario. We was living in a cramped student house at the time, with no air conditioning. Eventually it ended up constructing a homemade air conditioner which happened to work quite well, allowing me to get to sleep easily during one of the hottest summers on record

1.1 Description

The unit functioned as a basic heat pump, using water as the transport medium. Cold water chilled a copper coil, and a fan was then used to push the warm air in the room over the coil. The warm air heated the coil, removing heat from the air and warming the water inside the coil. The waste warm water was then removed. A front view of the fan with the attached copper coil may be seen.

II. Design And Specification

Edmonton is currently in the midst of its 2 weeks of actual summer weather. That means that temperatures are hovering in the high-20s most days. Today the mercury hit 30 degrees for the first time this year. I needed to find a way to stay cool through this heat wave.

Rather than dropping the cash on central air conditioning or a portable air conditioning unit, it decided to make an air conditioner based on designs seen here and here and here. The basic idea is that you have a cooler of icy cold water. You use a pump to circulate the cold water through copper pipe that runs in front of and behind your fan, thus cooling the air circulated by your fan. It picked up all the supplies I needed with one stop at Canadian Tire:

- One desktop fan (I used a 16″ fan)
- A cooler with capacity of approximately 10 L (I went with a real coolerinstead of Styrofoam)
- 28 feet of 1/4″ copper tubing
- 10 feet of 3/8″ clear vinyl tubing (1/4″ interior diameter)
- A small fountain pump
- Zip ties
- Small hose clamps

- Cardboard
- Various hand tools already on hand – screwdriver, hacksaw or copper pipe cutter, scissors, utility knife, etc.

It spent just over 100 on supplies. It could definitely do this with less expense if you used a fan on hand and a cheaper cooler option. It went with something a little more durable, as we'll be moving this around the house and we're hoping to use it for more than one summer

III. Components

3.1 Copper Tube

Spiral coil designs can be an effective use of space in heat transfer applications. Convection can be improved by switching from an inferior material such as aluminum or stainless steel. Thermal conductivity of copper is 385 w/m-k it is higher thermal conductivity as compair to all other materials

3.2 Copper Tube

Helical coils may experience slightly better performance. Forming spiral coils is yet another specialty of the Copper Tube Coils Group. One positive feature of a spiral coil is that it approaches the maximum space available on a 2D plane while also allowing some air flow. If your space is limited, a spiral coil may be your best bet.

3.3 Metal Sheet Ducting

Galvanized Sheet Metal Ducts from The Duct Shop's HVAC ductwork is manufactured from high quality galvanized steel in 3 foot lengths for easy handling. One end of each piece is crimped for easy fitting of consecutive joints or to sheet metal fittings and flexible duct. The seam on our galvanized sheet metal duct is formed on a snap-lock machine which allows ease of assembly on your job site. Just snap the seam together and install to your adjoining items. Of course, we have your sheet metal ductwork tools.

Figure: Metal Sheet Ducting

3.4 Water Tub

Water Tub 10 Liters and 25 Liter will redefine your water carrying experience. This is a durable and a sturdy water dispenser that adds comfort and style to your water carrying. This versatile durable water dispenser can store enough water for a family's consumption when you step out for a picnic or any other outdoor activity. Water stays safe with its airtight and liquid tight features, keeping it free from contamination

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Figure: Water Tub

3.5 Rubber Tube

EK ZMT (Zero Maintenance Tubing) is a high quality industrial grade EPDM rubber tubing in stylish matte black. This tubing is designed to withstand harsh conditions for a very long period of time, offering a truly exceptional lifespan even under UV, ozone and heat exposure for many years. EK ZMT tubing ensures long lasting operation and does not suffer from plasticiser leaching effects. The 12.5mm/19.4mm (ID/OD) dimensions also allow for a relatively small bend radius. 3m in length.

Technical specifications:

- Material: EPDM
- Colour: Black, not UV-reactive
- Inner diameter: 12.5mm (1/2in)
- Outer diameter: 19.4mm (3/4in)
- Operating temperature range: -30C to 110C
- Compatible with all known widely used coolants

Figure: Rubber Tube

3.6 Pump

New Air Desert cooler Submersible Water Pump Cooler Pump Copper Winding DDC-2/MCP355 DDC-1/MCP350- Any incredibly popular pump all over the world for its small size and excellent performance, the DDC-2 provides performance exceeding the AQX50Z and MCP655, while having a smaller footprint and consuming the same power as the MCP655 (the AQX50Z consumes less than half).

- 9W Motor, Can lift water upto 0.8 meters
- Rust Proof
- Easy to install & handle
- Low electricity consumption
- Compact size

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Figure: Pump

3.7 Plastic Blower

We are reckoned amongst the trusted manufacturers and exporters of a wide range of Tanqential Plastic Blowers that can run at high speed. These are offered in diameter of 96 mm 102 mm, 108 mm, 110 mm, 156 mm and 180 mm in lengths varying from 250mm to 1000mm. These fans are ultrasonically welded, dynamically balanced and are moulded and Designed for low noise level, our range finds applications in split air conditioning, air coolers, tower fans, air curtains & coolers. We offer Plastic Blower (Diameter 110 Mm), Tangential Blower (Diameter 180 Mm), Plastic Blower (Diameter 156 Mm), Plastic Blower (Diameter 108 Mm), Tangential Blower (Diameter 102 Mm) etc.

Figure: Plastic Blower

3.8 Blower Motor

At the heart of most automotive HVAC systems is a component called a blower motor. This descriptive term refers to the fact that these components are electric motors that are attached to fans and used to move air through the HVAC system. In most cases, a single blower motor is responsible for delivering both hot and cool air, on demand, depending on how the climate controls are set. he components of a blower motor can vary from one application to another, but they typically consist of:

- a DC motor
- a housing that can be bolted down
- a fan (also known as a wheel or cage)

Figure: Blower Motor

- KU : R76700542
- Minimum Purchase: 1 unit
- Manufacturer Part Number : R76700542

- Manufacturer : Ducane
- Category: Furnace
- Parts Horsepower: 1/4 HP
- Application : Blower Motor
- Volt : 240 V

3.9 Water Float Level Sensor

Float Sensor is an electrical ON/OFF Switch, which operates automatically when liquid level goes up or down with respect to specified level. The Signal thus available from the Float Sensor can be utilized for control of a Motor Pump or an allied electrical element like Solenoid, Lamps, and Relays etc.

Figure: Water Float Level Sensor

IV. Advantages & Disadvantages, Application

4.1 Advantages

- It has compact size.
- It required less quantity of water than window A/C
- It required less electricity than window or split A/C.
- Manufacturing and installation cost is comparatively less.
- It can be easily move from one place to another place
- Maintenance cost is less.
- Dry and cold air.
- Eco-friendly
- Long operating life Disadvantages
- It required more ice.
- Air cannot be filter.
- Ice and salt replacement after periodic time involves extra cost.
- Temperature cannot easily control Applications
- It can be use as summer & winter air conditioning at home.
- It can be use in agriculture for controlling the temperature.
- It can be use industrial application for cold storage at low cost.
- Area with less amount of water availability.
- Agricultural field and lands

V. Comparison Between Home Made And Split Air Conditioning

Home Made Air Conditioning

1. Initial cost is less
2. Installation is simple
3. Installation cost is less
4. Home made AC required less electricity

Split Air Conditioning

1. Initial cost is more
2. Installation is complicated
3. Installation cost is more
4. Split AC required more electricity

VI. Conclusion

It was found that the heat removal capacity of the homemade air conditioning system ranged from approximately 500 BTU/h to 1750 BTU/h as flow rate through the system ranged from 0.25 L/min to 2.00 L/min. A model was proposed to describe the response of heat removal capacity to changing flow rate, seen below

In this case, H represents heat removal, the heat removal at a unit flow rate, f the flow rate, and u a constant which adjusts for units. The constant u had the value of 1 (min/L) 0 ' 5 in this case, and 1 (time/volume) 0.5 in the general case. It was suspected that u may vary from unity, but insufficient data was present to quantify this to any degree of accuracy.

The efficiency of the system was measured in terms of BTUs removed per litre of water used. Efficiency varied from approximately 35 BTU/L to 15 BTU/L as flow rate through the system ranged from 0.25 L/min to 2.00 L/min. Based on the model for variation of heat removal capacity with flow rate, a model was constructed to describe the variation of efficiency with flow rate, seen below.

For the above, E represents heat removal efficiency, E} the heat removal efficiency at a unit flow rate, f the flow through the system, and u a constant adjusting for units identical to that described above. The equation was derived from the fact that efficiency in this case is simply defined as heat removal capacity divided by flow rate

Economic analysis of the system was conducted to determine the long term feasibility of operating the unit. Net present worth calculations were undertaken based on typical usage patterns at flow rates ranging from 0.25 L/min to 2.00 L/min. It was found that the total cost of operation (measured by net present worth) varied from approximately 35 to 130, below the cost of purchasing and operating a commercial air conditioning unit.

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