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A Review of Experimental study of Solar Air Heater with different Parameter

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Abstract

Solar energy is an inexhaustible resource. The sun produces vast amounts of renewable solar energy that can be collected and converted into heat and electricity. In the application of solar energy to the heating of dwellings and other uses, the primary element in the heating system is the ''Collector''. Most collectors employed a black-painted, flat absorber plate with heat-transfer passages built within, above or below it and with one or more glass covers on the top. The heat transfer in solar collector takes place by simultaneous radiation, convection, and conduction.

Keyword: speed regulator, Air outlet, Aluminum Pipe ,Temperature.

Introduction

Solar air heating collectors are one of the better solar projects. They are easy to build, cheap to build, and offer a very quick payback on the cost of the materials to build them. They also offer a huge saving over equivalent commercially made collectors.
Two of the more popular designs are the pop can collector and screen absorber collector. The pop can collector uses columns of ordinary aluminum soda pop cans with the ends cut out. The sun shines on the black painted pop cans heating them, and air flowing through the inside of the can columns picks up the heat and delivers it to the room. The screen collector uses 2 or 3 layers of ordinary black window insect screen as the absorber. The sun shines on the screen and heats it, and the air flowing through the screen picks up the heat and delivers it to the room.

Literature review

By research paper, Solar energy is an inexhaustible resource. The sun produces vast amounts of renewable solar energy that can be collected and converted into heat and electricity. In the application of solar energy to the heating of dwellings and other uses, the primary element in the heating system is the ''Collector''. The solar collector converts the solar radiation to energy in the form of sensible or latent heat in a fluid (air or water) which is-passed through the collecting unit.
Most collectors employed a black-painted, flat absorber plate with heat-transfer passages built within, above or below it and with one or more glass covers on the top. The heat transfer in solar Collector takes place by simultaneous radiation, convection, and conduction. Solar air collector is a specific type of heat exchanger that transfers heat to air, which is obtained from absorbing solar radiation by absorber. In solar air collector heat transfer occurs from an energy source which spreads radiation to the air. It consists of an absorber plate, supportive walls, ducts or channels of fluid flow, glazing, air blower or fans (if forced convection), and insulation to minimize heat losses. Almost parts of solar air collector or heaters are thermally well insulated to reduce thermal heat losses.

Collector basics

Solar air collector is a specific type of heat exchanger that transfers heat to air, which is obtained from absorbing solar radiation by absorber. In solar air collector heat transfer occurs from an energy source which spreads radiation to the air. It consists of an absorber plate, supportive walls, ducts or channels of fluid flow, glazing, air blower or fans (if forced convection), and insulation to minimize heat losses. Almost parts of solar air collector or heaters are thermally well insulated to reduce thermal heat losses. Glazing minimizes convective and radiative losses to the atmosphere and obtains solar radiation to stay between absorber and glazing, and to be absorbed by blackened absorber. Heat transferred to air by an air duct between glazing and absorber plate. SAHS are generally used to dry agricultural products, to dry fabrics and space heating.

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Since solar radiation is an inherently timely dependent energy resource, storage of energy is essential if solar is to meet energy needs at night or during daytime periods of cloud cover and make a significant contribution to total energy needs. Since radiant energy can be converted into a variety of forms of energy storage as thermal, chemical, kinetic or potential energy. Generally, the choice of the storage media is related to the end use of the energy and the process employed to meet that application. In the thermal conversion process, stored as thermal energy, it is often most cost effective.

The heat output the collector can be calculated as

Heat Output = (Temperature Rise)(Airflow)(air density)(specific heat of air)

Temperature rise is the increase in air temperature from the inlet to the outlet of the collector -- often around 50 to 60F for well designed collectors. For example, air might enter at 65F and exit at 120F.

Airflow is the volume of air flowing through the collector expressed in cubic ft per minute (cfm) -- often around 3 cfm/sqft of collector area for well designed collectors.

Air density and Specific Heat are physical properties of air that you don't really have any control over -- air density is 0.075 lbs per cubic foot under standard conditions, and the Specific Heat of air is about 0.24 BTU per lb per degree F.

Its very important to note that the heat output depends on BOTH the Temperature Rise and the Airflow. Many of the videos out there talk only about temperature rise as though that is all that mattered, when it fact its only half the story. It is quite common for a collector to have a very high temperature rise and have a low heat output because the airflow is much to low.

There is a tendency to think that things that increase the collector temperature rise will improve the efficiency of the collector, but, in general, the most efficient collectors will have a temperature rise that is just enough to be used for space heating and an airflow that is relatively large. The reason for this goes back to that portion of the heat that the absorber takes in that ends of being lost out the collector glazing. You want to minimize those glazing losses, and an important way to do that is to keep the absorber temperature as low as possible -- the cooler the absorber runs, the less heat will be lost out the glazing. A way to keep the absorber cooler while extracting the same amount of energy from it is more airflow.

On solar air heating collectors, it is relatively easy to get most of the suns energy into the collector absorber. The difficult part of air collector design is getting the heat transferred from the absorber into the air. Air is a low density material with a low specific heat, and that makes the heat transfer from absorber to air difficult. The things that tend to help in the transfer of heat from the absorber to the air stream are a high volume of airflow, a lot of absorber area, and good and even airflow of high velocity air over the full surface of the absorber. All of these things help to efficiently pick up heat from the absorber, and to keep the absorber at a cooler temperature so that losses out the glazing are minimized.

The good characteristics of the pop can collector from an efficiency point of view are that it has a lot of absorber area (about Pi times what a flat plate would have), and it has a mixed flow of relatively high velocity air through he can columns. The good characteristics of the screen collector are that the thousands of strands of screen wire provide a lot of screen to air heat transfer area, and that the inlet and exit vents are arranged such that the airflow is required to pass through the screen to get from the inlet to the outlet.

While there are no hard and fast rules, a temperature rise through the collector of about 50 to 60F works well in that is is warm enough to feel warm coming out of a heater vent. If the room temperature is 65F, than the collector outlet temperature will be about 120F. Moving air that is much cooler than this will not feel warm. Going for a temperature rise greater than 60F usually means a hotter collector absorber and increased heat loss out the glazing.

Airflow through the collector of around 3 cfm per sqft of collector area for a collector with a well designed absorber is about right. More airflow would make the collector more efficient, but it also increases noise and fan power, and may lower the temperature rise to the point where the air does not feel warm to people for space heating. The about 3 cfm per sqft of absorbers seems to be a good compromise between efficiency and the other factors.

Materials

There are two common methods used to create a solar air heater. The first is a pop can design and the other directs the air through a channel in a "snake" pattern. Both methods use similar materials and tools with only a few exceptions.

Both designs require the following materials:

- Plywood
- Wood - 2"x4"
- Glass or plexiglass
- Sealant
- Insulation

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- Black paint

Performance

Measuring the absolute performance of a collector is difficult. A collectors performance depends on its design, but is also influenced by solar intensity, ambient temperature, wind and collector orientation -- all things that vary quite a bit from day to day and even minute to minute. One way to get around most of the variations is to test a baseline or reference collector side by side with the collector you are making changes to. If the two collectors are side by side, then they see the same ambient temperature, the same solar intensity and the same wind. If you make a change to your test collector and it performs better relative to the reference collector, than you can be sure the change you made was a good one.

Conclusion

Heat transfer between the absorber plate and the air stream reduces sensibly the temperature of the absorber and in same time the heat losses are reduced. collector the double glazing gives lower thermal performance than the triple glazing this is due to the heat losses towards the surroundings.

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