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(DESIGN AND DEVELOPMENT OF HEAT RECOVARY MODEL FOR HOTEL INDUSTRIES)

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Abstract:

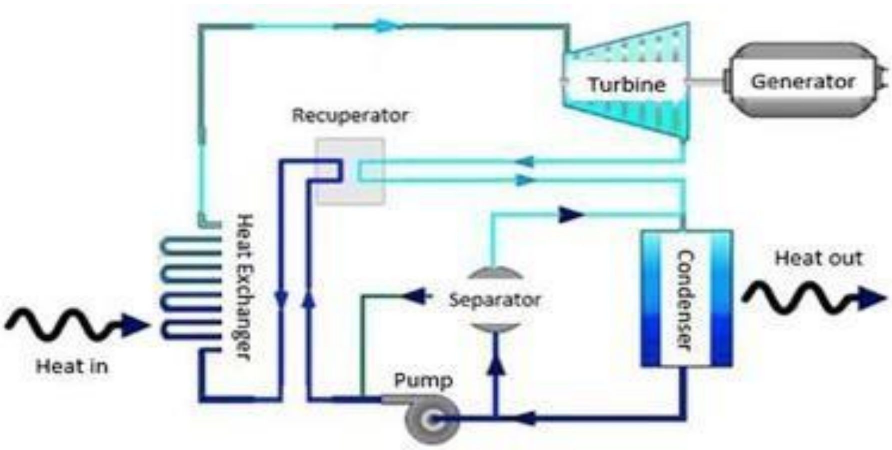
The main aim of our project is to utilize the heat which is wasted from the gas burnerin kitchen to clean the dishes from hot water. The copper tubes are mounted below thegas burner. The water will be passed through these tubes. Then the water coming out from the copper tubes will be hot as the heat will be transferred from the gas burner andthen through the copper tubes to the water. This hot water will be then passed through the PCM i.e. Phase change material. The heat will be transferred from the water to the PCM so that temperature of PCM gets increased and after some time it will change its phase. The water will be then collected in the tank. The flow control valve will be usedto control the flow rate of water. The pump will be placed after the tank and the nozzlewill be placed so that the water will be sprayed on the dishes to clean.

When the burner is in off condition then at that time the heat will be transferred from the PCM to the water so that temperature of PCM will be decreased. But the temperature of water will be increased so that we will get the required output temperature of water to clean the dishes. The 3D model will be drawn with the help of CATIA software. The analysis will be carried out on ANSYS software. The experimental testing will be carried out and then the result and conclusion will be drawn.

Keywords: Dish Washer Machine, Heat Household Gas,

Introduction

Due to the increase of energy costs, buildings energy consumption has tended to decrease in the past decades. This gives an opportunity for developing innovative renewable technologies that are more adapted to recent buildings with low energy demand. So, the main challenge is to manage non-simultaneous availability of heat source or sink and the energy demand of buildings. Hence, different technologies dedicated to energy storage have been developed recently; one of them is the use of Phase Change Materials (PCM). These materials are considered because they exhibit a higher heat storage capacity than sensible storages and a tunable phase change temperature according to their composition. PCM are used in many applications, for instance, Campos-Chelator et al. designed a finned plate PCM energy storage for domestic application using RT60 and water. They developed and validated a mathematical model to cover the simulations of the system.



OBJECTIVE:

1. To harness the untapped heat energy liberated from the gas.
2. To study the radiative, hear transfer and design the system accordingly.
3. To design the dish washer where heated water is coming for the washing purpose of utensils.
4. to supply conditioned air to the occupied space to maintain a certain temperature
5. the recovery of the energy by transferring the heat of the air that is extracted from the inside of a premise to the air that is driven outside.
6. minimize the amount of heat wasted in this way by reusing it in either the same or a different process.

PROBLEM STATEMENT:

Now a day's energy security is the most vital question being faced by humanity. To tackle it we are going to increase the efficiency and effectiveness of the system. LPG gas is the form of nonrenewable energy source, it is used for household cooking purposes. A large amount of untapped energy is being lost by the system in the form of radiation. This radiated energy can be used for heating of hospitality drinking water ,for shower ,cooking.

SCOPE

1. A Recovery of light density oil e.g. (Crude oil, Endicott oil) will be done efficiently.
2. Highest efficiency of 80-90% in still water at ambient temperature for low viscosity index oil can be achieved by use of double disc.
3. oil recovered will be 60-70% efficient to be reused as compared to original properties.
4. The use of solar panel in the system to drive the motor will make the system eco- friendly.
5. The propellers will help in movement of system.
6. By taking advantages of this otherwise wasted energy source, companies will reduced their overall energy consumptions.
7. improve efficiency and reduced energy bills.
8. The main advantage of waste heat recovery is its value as an energy source
9. This energy is then repurposed to heat other media and materials, including asphalt and oil.

Alert system will further increase the output by timely alerting for emptying the collection tank.

METHODOLOGY:

No methodology is available for material and method selection except decision making in multi attribute environment. Material selection is vital and crucial activity in any industry nowadays. This substantially reduces the risk of wrong material or method selection.

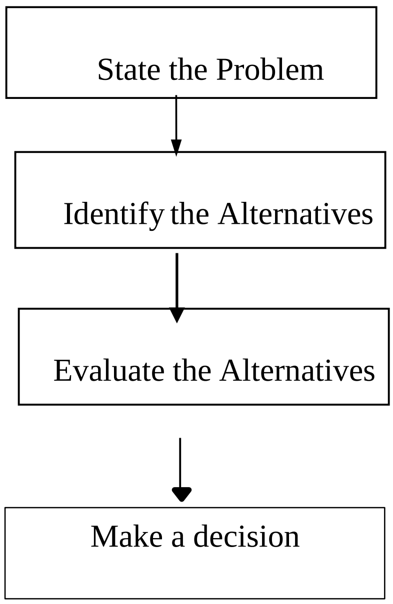


Figure 3.1 - Decision Making Processes

Working

1. Water Storage in Upper Tank:

Water is initially stored in an upper tank area.

2. Heat Exchange in Copper Coil:

The water flows from a copper coil at a moderate rate. The copper coil is wound around a gas flame where thermal heat exchange takes place The heat from the gas flame is transferred to the water through the copper coil.

3. Transfer of Heated Water to Paraffin Wax Chamber:

The heated water then transfers this energy to the next chamber, which is filled with paraffin wax. Paraffin wax has the ability to store heat effectively.

4. Heat Storage and Energy Transfer:

The paraffin wax stores the heat energy received from the water. This stored heat energy can be released back when the gas flame is turned off. The wax acts as a thermal energy storage medium, retaining heat for later use.

5. Melting Process and Water Flow to Storing Tank:

As the wax begins to melt due to the stored heat, the heated water simultaneously flows to the next storing tank. In the storing tank, the hot water is stored for later use.

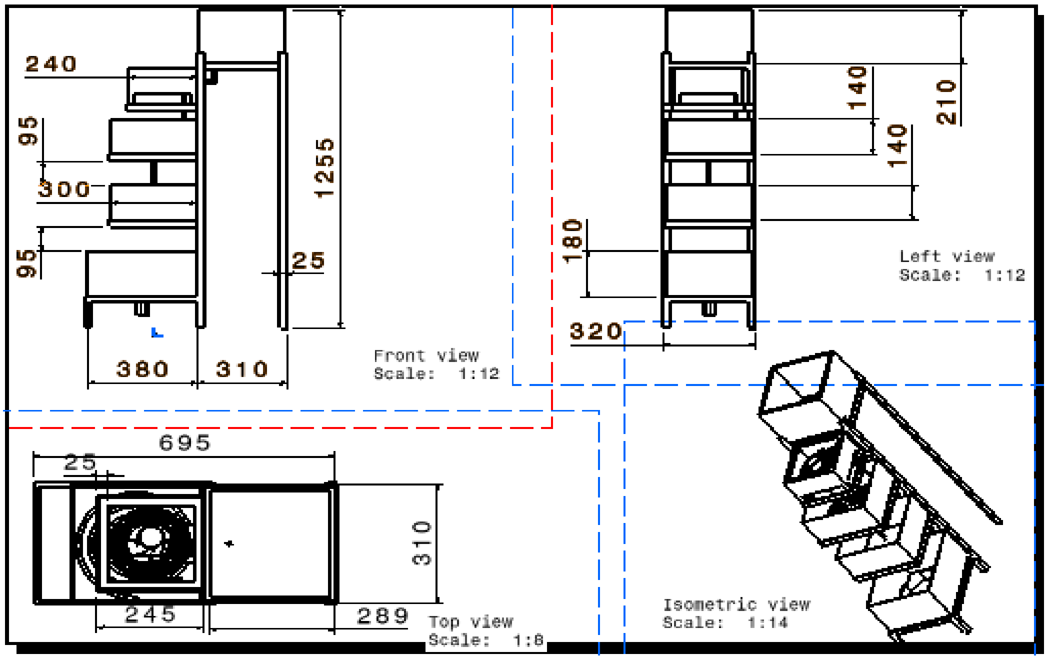
6. Energy Efficiency and Heat Retention:

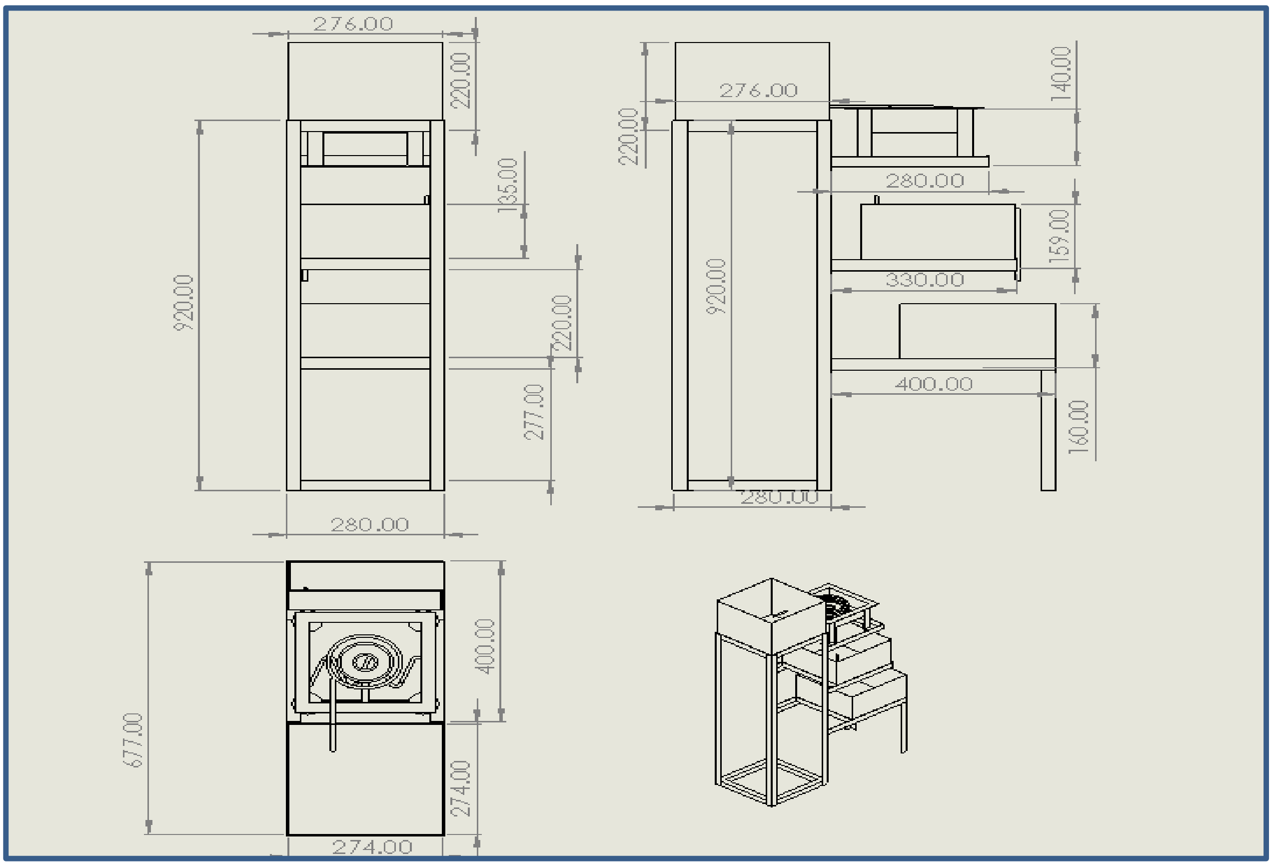
This system allows for efficient utilization of heat energy from the gas flame. The paraffin wax enhances heat retention and provides a continuous supply of hot water even when the gas flame is not active.

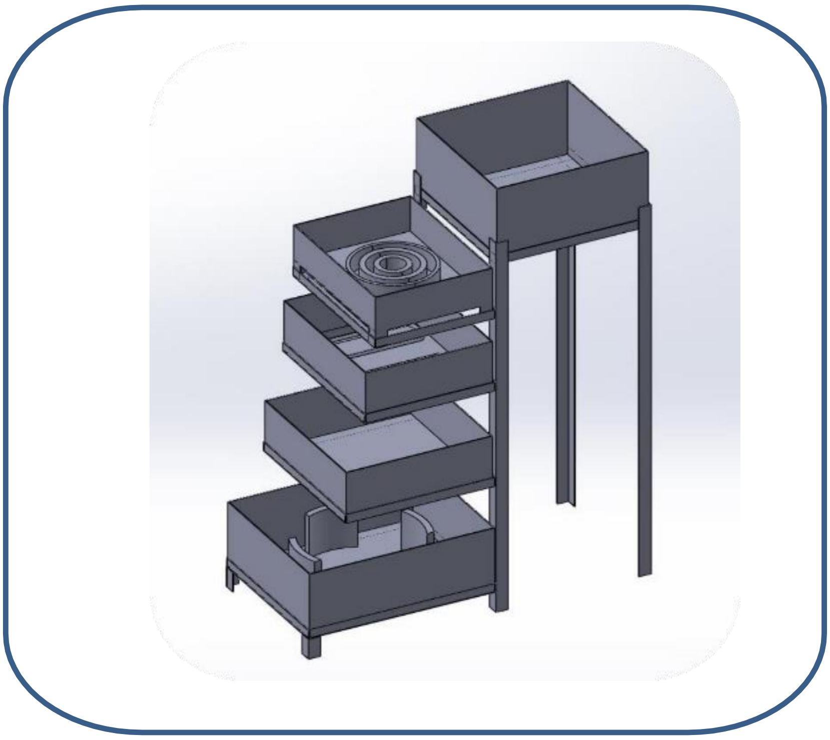
7. Benefits:

Energy-efficient design utilizing heat exchange and thermal storage. Continuous hot water supply even after the gas flame is turned off. Effective utilization of thermal energy for heating water

Model & Design







CALCULATION

According to our design we are going to tap the radiated heat liberated from the bottom of gas. Now as we know that for the household purposes LPG gas is used. LPG is consisting of butane or propane. The working temperature of butane and propane gas is very high.

The gas ring where the actual burning of gases is going on has outer diameter as 0.08m and inner diameter as 0.06m

Let the working temperature of the LPG gas=500 degree C =773 K

So, the working area, $(A)=3.14/4[(0.08)^2-(0.06)^2]$

$$A=2.19*10\text{^}-3\ m^2$$

1] Amount of heat radiated from the gas will be calculated from Stiffen-Boltzmann equation,

$$dQ/dT=e*\sigma*A*[T^4-T^4]$$

Here,

e= Let the Emissivity of the material = 0.5

σ= Stiffen-Boltzmann constant=$5.67*10^{-8}$ W/m2K.

A= Heat radiating area=$2.19*10^{-3}$ m2

T=Temperature of the hot surface from where heat is liberated=773 K

Now the gas also receives some amount of heat coming from surrounding, at Temperature=25-degree C=298 K

$$dQ/dT=e*\sigma*A*[T^4- T^0]$$

$$= (0.5) *(5.67*10^{-8}) *(2.19*10^{-3}) *[(773)^4-(298)^4]$$

$$dQ/dT= 21.751 \text{ Watts}$$

Now this much amount of heat is liberated from the source to all the directions, as we are putting PCM heat exchanger at the side so we have to consider ¼ th of the energy to be utilized to heat the PCM.

Hence heat received by the PCM heat exchanger will be,

$$dQ/dT= 5.437 \text{ Watts}= 5.437 \text{ Joules/sec.}$$

Now if the cooking be performed for 30 minutes, the total heat received by the PCM exchanger will be,

$$Q= (5.437) *(1800)$$

$$Q=9786.6 \text{ Joules.}$$

2] Now the water moving from the PCM heat exchanger will receive the heat by conduction,

Let the temperature of water moving inside the copper tube be=25 degree C

Let the temperature of water moving outside the copper tube be= 50 degree C

The heat transferred by convection will be,

$$Q=m*C_p*(T2-T1)$$

Here,

m=Mass flow rate of fluid.

C_p=Specific heat capacity of working fluid (Water)=4182 J/Kg C

Now we are using a copper pipe with diameter D=9mm=0.009m

Area of the pipe= $\frac{\pi}{4} * D^2$

$$A= 63.617 * 10^{-6} m^2$$

Assume that we are moving water with constant head by using the submersible water pump, Let the velocity of the moving water,

$$V=0.025 \text{ m/s}$$

Hence the discharge

$$Q_d = A*V$$

$$= (63.617*10^{-6})*(0.025)$$

$$Q_d =1.59*10^{-6} \text{ m}^3/\text{s}$$

Now we know that mass flow rate of fluid(m)=Density of fluid*Discharge

$$m= (997) *(1.59*10\text{^}-6)$$

$$m=1.585*10^{-3} \text{ kg/sec.}$$

Now the amount of heat transfer is calculated as,

$$Q=m*C_{p*}(T2-T1)$$

$$= (1.585*10^{-3}) *(4182) *(50-25)$$

$$Q_2= 165.71 \text{ Watts}$$

This much amount of heat will be transferred

3] When we turn off the gas the heat transferred will be from PCM to copper coil i.e. heat will be transferred from wax to copper.

Now melting point of wax=50 degree C

Heat transfer due to conduction will be calculated as,

$$Q_{conduction}=K*A*[(T2-T1)/L]$$

Here,

K=Thermal conductivity of copper=380W/mK

A=Surface area of the working coil inside the PCM heat exchanger=2*3.14*r*l=0.025m^2

T2=Temperature of wax when heated= 40 degree C

T1= Temperature of copper coil= 30 degree C

=Thickness of the copper coil= 0.002m

$$Q_{conduction}=K*A*[(T2-T1)/L]$$

$$= (380) *(0.025) [(40-30)/0.002]$$

$$Q_{conduction}=47.50*10^3 \text{ Watts.}$$

4] Now the heat transferred due to convection from copper to water when gas is turn off is calculated as,

$$Q=m*C_{p*}(T2-T1)$$

Here,

T2=Temperature of wax when heated= 40 degree C

T1= Temperature of copper coil= 30 degree C

$$Q=m*C_{p*}(T2-T1)$$

$$= (1.585*10^{-3}) *(4182) *(40-30)$$

$$Q=66.284 \text{ Watts.}$$

Conclusion:

The project successfully demonstrates an innovative approach to heating water efficiently using a combination of heat exchange, thermal storage, and energy transfer mechanisms. By storing water in an upper tank, facilitating heat exchange through a copper coil around a gas flame, and utilizing paraffin wax for heat storage, the system ensures a continuous supply of hot water even after the gas flame is turned off.

The utilization of paraffin wax as a thermal energy storage medium enhances heat retention and provides a sustainable solution for heating water. This design not only improves energy efficiency but also offers a practical and effective way to harness and

utilize thermal energy for heating purposes.

Overall, the project showcases the benefits of integrating heat exchange technologies with thermal storage solutions to create a reliable and energy-efficient system for hot water supply. The successful implementation of this project highlights the potential for utilizing innovative approaches to meet heating needs while promoting sustainability and resource efficiency.

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