EXPERIMENTAL ANAYLISIS ON HEAT TRANSFER RATE OF SHELL AND TUBE HEAT EXCHANGER BY EXTRACT OF CIRTULLUS LANATUS AS A COOLANT.

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ABSTRACT **-** Heat transfer is one of the most important processes inside the industry so increasing heat exchanger efficiency has a great use and major beneficial effect to the heat transfer. The thermal fluids like distilled water and ionized water are used as their application in diverse industries, to improve heat transfer and to save energy, has increased. One important aspect of applying these waters, thermal processing is shortening the process time which could have high potentials in the food industry since nutritional and bioactive components would be maintained much higher than common thermal processes. In this project, distilled water in 200liters, ionized water in 100ml, during high temperature short time processing (75, 80 and 85°C for 15, 30 and 45 sec) of watermelon juice with 40ml in a shell and tube exchanger regarding its qualitative properties was investigated. Reduction in process time when applying 200 litres and 100ml thermal fluids, had considerable effects on maintaining qualitative properties for watermelon juices. The project objective is to design an experimental system of shell and tube heat exchanger using thermal fluids in the shell side. Comparison with pure fluid, the experiment is to be characterized of two types of water, which are distilled and ionized water, both types of thermal fluids are mixed with water melon separately as a heat transfer medium through the shell and tube heat exchanger. We examined the discrepancy in performance and efficiency of the heat exchanger when thermal fluids are utilized instead of the normal process fluids. The result is shown improvement in efficiency when using distilled and ionized water as a heat transfer medium since these possess more advantageous to the conventional

KEY WORDS: Modern Heat exchanger, Shell and Tube heat exchanger, Thermal Design, Mechanical Design.

INTRODUCTION

The intensity exchanger is a system used to move nuclear power between at least two liquids, between the strong surface and the air, or between the strong particles and the liquid, at different temperatures and in warm contact [1]. There are regularly no outside intensity and capability encounters in heat exchangers. Run of the mill applications require warming or cooling of the connected liquid stream and vanishing or build-up of single or multipart liquid streams. In different applications, the objective might be to recuperate or reject heat or to disinfect, sanitize, fractionate, distil, concentrate, take shape or screen process liquids. In a couple of intensity exchangers, heat trade liquids are in direct co-activity. In

most intensity exchangers, the intensity move between liquids happens in a brief way through an isolating wall or all through a wall. In a great deal of intensity exchangers, the liquids are disconnected by an intensity move surface and, ideally, don't mix or spill. Such an exchanger is alluded to as an immediate exchange structure, or essentially a recuperator. On the opposite side, the exchangers of which there is discontinuous intensity trade among hot and cold liquids — through the amassing of nuclear power and through the exchanger surface or lattice — are alluded to as backhanded 5 exchange type, or basically regenerators [2]. These exchangers ordinarily give liquid spillage from a solitary progression of liquid to a solitary progression of liquid. Famous instances of intensity exchangers are shell and cylinder heat exchangers, auto radiators, condensers, evaporators, pre-warmers and coolers. Towers, man. On the off chance that a stage shift occurs between any of the liquids in the intensity exchanger, it is frequently alluded to as a reasonable intensity exchanger. Interior nuclear power sources could be found in heat exchangers, for example, electrical warmers and atomic fuel components [3].

Ignition and compound responses can happen inside the intensity exchanger, e.g., in boilers, radiators and liquid bed heat exchangers. Mechanical frameworks can be utilized in specific exchangers, like scratched surface exchangers, fomented vessels and blended tank reactors. The intensity exchanger is a piece of hardware intended for compelling intensity move starting with one medium then onto the next [4]. The media can be disconnected by a substantial wall so they might in all likelihood never cross-over or be in close contact with one another. They're normally utilized in Room warming, refrigeration, cooling, electric stations, compound plants, petrochemical plants, fuel treatment facilities and gaseous petrol refining and sewage removal. The exemplary illustration of an intensity exchanger can be found in the gas-powered motor, in which the coursing liquid known as the motor coolant moves through the radiator loops and the wind currents past the curls, cools the coolant and warms the approaching air.

Materials And Methods used

The metals identified for the present study are GA-iron sheet, copper pipe 6.34mm, Digital Thermometer, Water heater (240 volts), Pump, Motor.

Galvanized steel with higher silicon content will appear dark Gray in colour, matted and as result the coating will become brittle. The ideal composition of steel should consist of less than 0.25% carbon, 0.05% phosphorous and manganese of less than 1.3%. As mentioned above the ideal silicon content should range between 0-0.04% or 0.15-0.25%. Materials galvanized properly should appear shiny with a spangled pattern covering their surface. The density of galvanized steel is the weighted average of the mild steel density (7.87 gr/cc) and the density of the zinc coating (7.13 gr/cc).

Copper is a malleable ductile metal that has high thermal and electrical conductivity. Copper is an element, hence it doesn't have any chemical formula, although it is represented by the symbol Cu. composition of a minimum of 99.9% Copper (Cu) and Silver (Ag) combined and a maximum allowable range of Phosphorous (P) of 0.015 % - 0.040 %.

1) Process:

1. Process fluid assignments to shell side or tube side.
2. Selection of stream temperature specifications.
3. Setting shell side and tube side pressure drop design limits.
4. Setting shell side and tube side velocity limits. 5.Selection of heat transfer models and fouling coefficients for shell side and tube side.

2) Mechanism:

1.Selection of heat exchanger TEMA layout and number of passes.

2.Specification of tube parameters - size, layout, pitch and material.

3.Setting upper and lower design limits on tube length.

4.Specification of shell side parameters – materials, baffles cut, baffle spacing and clearances.

5.Setting upper and lower design limits on shell diameter, baffle cut and baffle spacing.

Measurements of heat exchanger

Shell outer dia-4. 5inch
Inner dia -4inch
Pipe dia- 0.5 in (Hot water in let and out let, Coolant inlet and outlet)
Hot water chamber -5.5x4 inch
Depth 4.5 inch
Coolant chamber -6.1x4.75 inch
Depth -4.5inch
Power adapter 240volts
Shell length-26inch
Copper tube dia 6.34mm
Basement - 21x14. 5 inches

Figure-1: extracted liquid from Circtullus lanatus

Fabrication Techniques and Discussion.

MAKING OF COOLANT USING CIRTULLUS LANATUS:

Taking water melon squander and eliminating the white shaded part from the wastage and drudgery it and concentrate the fluid from it and channel it most extreme multiple times by utilizing a white materialAlso, eliminate the residue and unessary squander from it.

MIXING OF EXTRACTED MATERIAL IN WATER:

15% of extracted liquid (blended in the water by required quantity)
25% of extracted liquid (blended in the water by required quantity)
50% of extracted liquid (blended in the water by required quantity)

Disadvantages

i. Oxidative stability
ii. Poor corrosion protection

SHELL AND TUBE HEAT EXCHANGER:

Shell Tube Heat Exchanger is generally utilized in assortment of utilization as a cooling arrangement. Normal amount them is for cooling of Hydraulic Fluid and oil in motors, transmissions and pressure driven power packs. With right combination of materials they can likewise be utilized to cool or intensity different mediums, such pool water or charge air. One of the huge benefits of utilizing a shell and cylinder heat exchanger is that they are frequently simple to support, especially with models where a drifting cylinder pack (where the cylinder plates are not welded to the external shell) is accessible. Can likewise be utilized on fixed tube sheet heat exchangers.

Figure-1: extracted liquid from Circtullus lanatus

Figure-2 : Heat exchanger

Materials and equipment used:

1. **2. digital thermometer**

GA.sheet

3. Pump **4. Water heater**

5. Adapter **6. Hot water pump**

Result:

S.no	HOT WATER		COOLANT	
	INLET °C	OUTLET°C	INLET°C	OUTLET°C
1	50	49.7	30.3	48.6
2	55	54.8	30.3	54.3
3	60	59.9	30.3	59.5
4	65	64.9	30.3	64.7
5	70	69.5	30.3	69.8

Table-1: Distilled Water is used as coolant.

S.no	HOT WATER		COOLANT	
	INLET °C	OUTLET°C	INLET°C	OUTLET°C
1	50	47.2	29.5	45.1
2	55	52.2	29.5	49.2
3	60	57.8	29.5	55.7
4	65	63.1	29.5	60.3
5	70	68.6	29.5	65.9

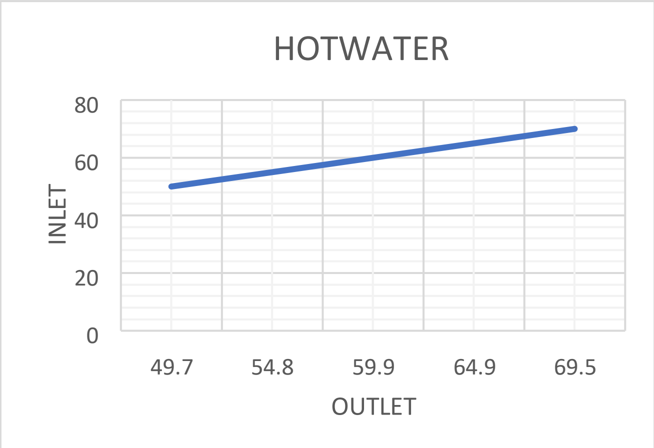
Table-2: 15% extracted watermelon is mixed with distilled water as coolant.

S.no	HOT WATER		COOLANT	
	INLET °C	OUTLET°C	INLET°C	OUTLET°C
1	50	46.5	29.3	44.1
2	55	51.8	29.3	49.5
3	60	57.1	29.3	53.7
4	65	62.5	29.3	58.8
5	70	67.9	29.3	64.2

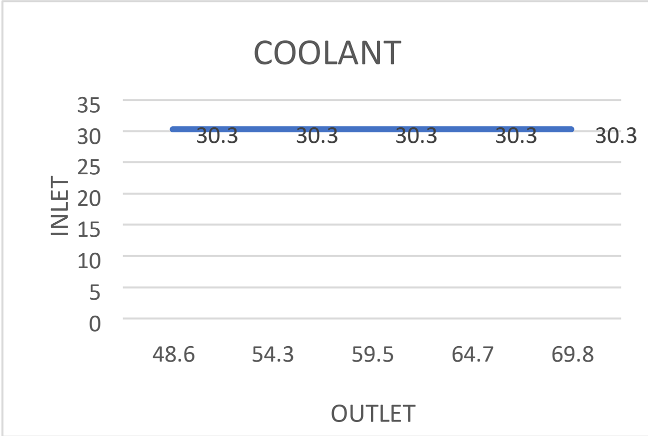
Table-3: 25% extracted watermelon is mixed with distilled water as coolant.

S.no	HOT WATER		COOLANT	
	INLET °C	OUTLET°C	INLET°C	OUTLET°C
1	50	43.9	28.5	43.3
2	55	49.2	28.5	48.1
3	60	54.6	28.5	52.8
4	65	59.9	28.5	57.7
5	70	65.1	28.5	64.5

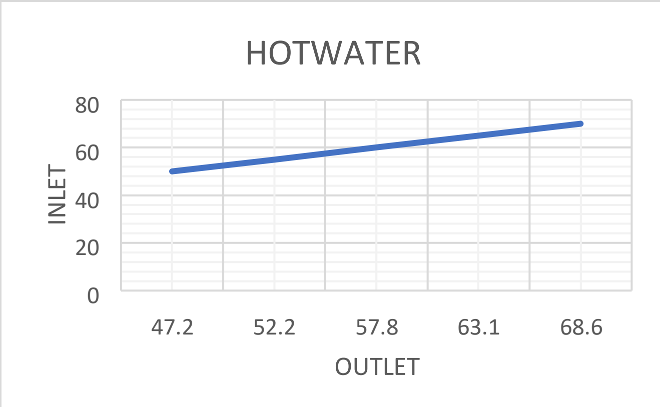
Table-4: 50% extracted watermelon is mixed with distilled water as coolant.



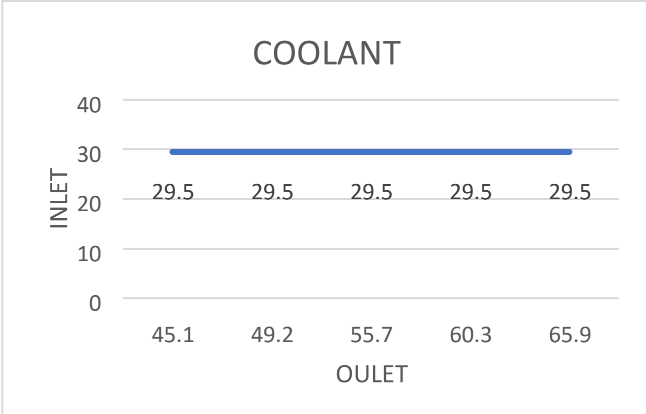
GRAPH.1.1: In let and Out let Temperature of Hot Water



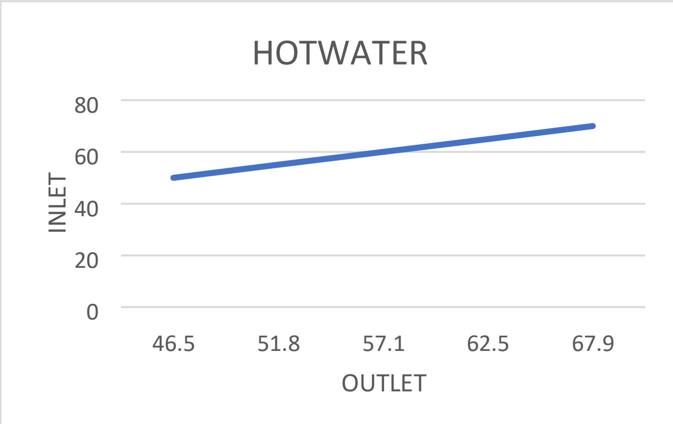
GRAPH.1.2: In let and Out let Temperature of Coolant



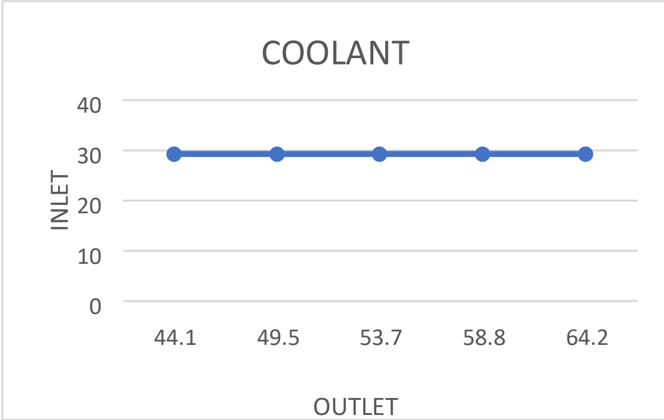
GRAPH.2.1: In let and Out let Temperature of Hot Water



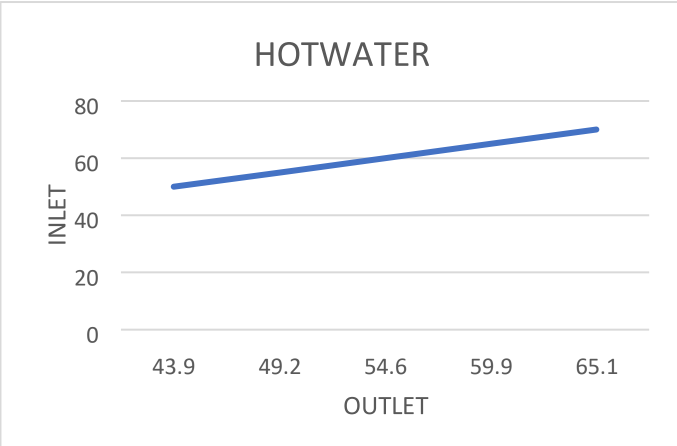
GRAPH.2.2: In let and Out let Temperature of Coolant



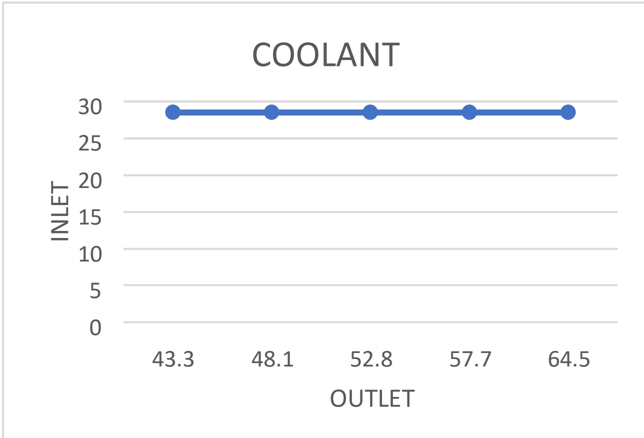
GRAPH.3.1: In let and Out let Temperature of Hot Water



GRAPH.3.2: In let and Out let Temperature of Coolant



GRAPH.4.1: In let and Out let Temperature of Hot Water



GRAPH.4.2: In let and Out let Temperature of Coolant

Calculation for complet distlled water used as coolant.

$Q = m^{o}_{h}\, c_h\, \Delta T_h$ -----(eq-1)

Q= Rate of Heat Transfer m^{o}_{h}= Mass Flow Rate c_h= Specific heat of hot water ΔT= Temperature difference

$m_{h^o} = \int * v * A \int$ = density V= velocity

A = Area of shell

= 1000X 2050 X Rπr (h+r)

= 2,2704 kg/s substituting equation -1

$Q = m^{o}_{h}\, c_h\, \Delta T_h$ =2270.4 * 4.187 * 0.3 = 2851.84 J/s & watt.

$\Delta T_{mean} = (T_{ho} - T_{co}) - (T_{hi} - T_{ci})$

$\ln \dfrac{T_{Ho} - T_{co}}{T_{Hi} - T_{ci}}$

= (1.1 – 19.7)/- 2.88 = 6.458

T_{ho} = temperature of hot water outlet.

T_{hi} = temperature of hot water inlet.

T_{co} = temperature of coolant outlet.

T_{ci} = temperature of coolant inlet.

$Q^o = UA\Delta T_m$

$U = \dfrac{Q}{A\Delta T_m}$

= 2851.84

6.548 * (2270.4) U

= 0.194

co-efficient of heat Transfer.

Calculation for 15% of extracted liquid (blended in the water by required quantity).

$Q = m^{o}_{h} c_h \Delta T_h$ -----(eq-1)

Q= Rate of Heat Transfer m^{o}_{h}= Mass Flow Rate c_h= Specific heat of hot water ΔT= Temperature difference

m_{h^o}= ∫ * v * A ∫ = density V= velocity

A = Area of shell

= 1000X 2050 X Rπr (h+r) = 2,2704 kg/s

substituting equation -1

$Q = m^{o}_{h} \quad c_h \quad \Delta T_h$

=2270.4 * 4.187 * 2.8

= 26, 613.0409 J/s & watt.

$$\Delta T_{mean} = \frac{(T_{ho} - T_{co}) - (T_{hi} - T_{ci})}{\ln \frac{T_{Ho} - T_{co}}{T_{Hi} - T_{ci}}}$$

= (2.1 - 20.5)/- 2.27

= 8.105

T_{ho} = temperature of hot water outlet.

T_{hi} = temperature of hot water inlet.

T_{co} = temperature of coolant outlet.

T_{ci} = temperature of coolant inlet.

$Q^o = UA\Delta T_m$

$$U = \frac{Q}{A\Delta T_m}$$

= 26,613.0409

8.105 * (2270.4) U

= 1.44

co-efficient of heat Transfer.

Calculation for 25% of extracted liquid (blended in the water by required quantity).

$Q = m^{o}_{h} c_h \Delta T_h$ -----(eq-1)

Q= Rate of Heat Transfer m^{o}_{h}= Mass Flow Rate c_h= Specific heat of hot water ΔT= Temperature difference

m_{h^o}= ∫ * v * A ∫ = density

V= velocity

A = Area of shell

= 1000X 2050 X Rπr (h+r) = 2,2704 kg/s

substituting equation -1

$Q = m^{o}_{h} \quad c_h \quad \Delta T_h$

=2270.4 * 4.187 * 3.5

= 33271.576 J/s & watt.

$$\Delta T_{mean} = \frac{(T_{ho} - T_{co}) - (T_{hi} - T_{ci})}{\ln \frac{T_{Ho} - T_{co}}{T_{Hi} - T_{ci}}}$$

= (2.4 - 20.7)/- 2.154

= 8.496

T_{ho} = temperature of hot water outlet.

T_{hi} = temperature of hot water inlet.

T_{co} = temperature of coolant outlet.

T_{ci} = temperature of coolant inlet.

$Q^o = UA\Delta T_m$

U = Q

$$= \frac{33271.576}{8.496 * (2270.4)}$$

U = 1.725

→ co-efficient of heat Transfer.

Calculation for 50% of extracted liquid (blended in the water by required quantity).

Q=m°h c_h ΔT_h -----(eq-1) Q= Rate of Heat Transfer m°h= Mass Flow Rate c_h= Specific heat of hot water ΔT= Temperature difference

m°h= ʃ * v * A ʃ = density V= velocity

A = Area of shell

= 1000X 2050 X Rπr (h+r)

= 2,2704 kg/s substituting equation -1

Q=m°h C_h ΔT_h =2270.4 * 4.187 * 6.1

= 57987.605 J/s & watt.

$$\Delta T_{mean} = \frac{(T_{ho} - T_{co}) - (T_{hi} - T_{ci})}{\ln \frac{T_{Ho} - T_{co}}{T_{Hi} - T_{ci}}}$$

= (0.6 – 21.5)/- 3.57

= 5.85

T_{ho} = temperature of hot water outlet.

T_{hi} = temperature of hot water inlet.

T_{co} = temperature of coolant outlet.

T_{ci} = temperature of coolant inlet.

Q° =UAΔT_m

$$U = \frac{Q}{A\Delta T_m}$$

$$= \frac{57987.605}{5.85 * (2270.4)}$$

U = 4.365

→ co-efficient of heat Transfer.

CONCLUSION:

- Finally we concluded that the rate of heat transfer rate with Citrullus Lantau's is efficient than while using normal water.
- The extract of Citrullus Lantau's is abundant, and it is thrown as wastage.
- Therefore we mixed the extract of Citrullus Lantau's with distill water and we got 4.365 temperature difference than normal water.

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