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PERFORMANCE OF A FINNED TUBE EVAPORATOR OPTIMIZED FOR DIFF REFRIGERANTS

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ABSTRACT: An air conditioner (often referred to as AC) is a home appliance, system, or mechanism designed to dehumidify and extract heat from an area. The cooling is complete using a simple refrigeration cycle. In construction, a complete system of heating, ventilation and air conditioning is referred to as "HVAC". Its use, in a building or an automobile, is to present comfort during either hot or cold weather the most common refrigeration cycle use an electric motor to drive a compressor. In an automobile, the compressor is driven by a belt over a pulley, the belt being driven by the engine's crankshaft (similar to the driving of the pulleys for the alternator, power steering, etc.). An evaporator is use in an air-conditioning system or refrigeration system to allow a compressed cooling chemical, such as Freon or R-134A, to evaporate from liquid to gas while enthralling heat in the process. It is also use to remove water or other liquids from mixtures. The process of evaporation is widely used to concentrate foods and chemicals as well as salvage solvents. In the concentration process, the goal of evaporation is to vaporize most of the water from a solution which contains the desired product. In this thesis, dissimilar shapes of fins in fin tube evaporator are modeled in 3D modeling software Pro/Engineer. The fins considered are rectangular fin, circular fin a internal finned. The mass flow rate and heat transfer rate are analyzed by CFD analysis completed in ANSYS. CFD analysis is completed by varying fluids R407C, R404A and R22A on all the models. The inputs of CFD analysis are velocity and pressure and the results determined are Pressure, Velocity, Mass Flow Rate, Heat Transfer Rate and Heat Transfer Coefficient.

Keywords: Air conditioning, Refrigerating system, Evaporator, Finned tube, Modeling, Optimization, r600a, R404A, R407, r134a, R22, Comparison

INTRODUCTION

1.1 AIR CONDITIONER: An **air conditioner** (often referred to as **AC**) is a home appliance, system, or mechanism designed to dehumidify and extract heat from an area. The cooling is done using a simple refrigeration cycle. In construction, a complete system of heating, ventilation and air conditioning is referred to as "HVAC". Its purpose, in a building or an automobile, is to provide comfort during either hot or cold weather.

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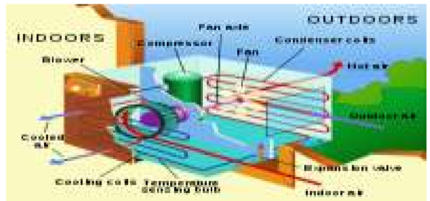
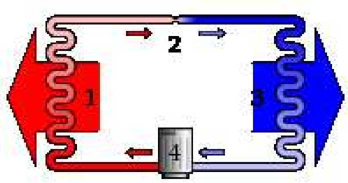


A typical home air conditioning unit

1.2 AIR CONDITIONING SYSTEM BASICS AND THEORIES

Refrigeration cycle: A simple stylized diagram of the refrigeration cycle: 1) condensing coil, 2) expansion valve, 3) evaporator coil, 4) compressor. In the refrigeration cycle, a heat pump transfers heat from a lower-temperature heat source into a higher-temperature heat sink. Heat would naturally flow in the opposite direction. This is the most common type of air conditioning. A refrigerator works in much the same way, as it pumps the heat out of the interior and into the room in which it stands. This cycle takes advantage of the way phase changes work, where latent heat is released at a constant temperature during a liquid/gas phase change, and where varying the pressure of a pure substance also varies its condensation/boiling point

1.3 EVAPORATOR: It is in the evaporators where the actual cooling effect takes place in the refrigeration and the air conditioning systems. For many people the evaporator is the main part of the refrigeration system and they consider other parts as less useful. The evaporators are heat exchanger surfaces that transfer the heat from the substance to be cooled to the refrigerant, thus removing the heat from the substance.



2. LITERATURE SURVEY

In the paper by Jader R. Barbosa, etal[1], the purpose is to assess some aspects of the design of evaporators for household refrigeration appliances using Computational Fluid Dynamics (CFD). The evaporators under study are tube-fin 'no-frost' heat exchangers with forced convection on the air-side and a staggered tube configuration. The calculation methodology was verified against experimental data for the heat transfer rate, thermal conductance and pressure drop obtained for two evaporators with different geometries The average errors of the heat transfer rate,

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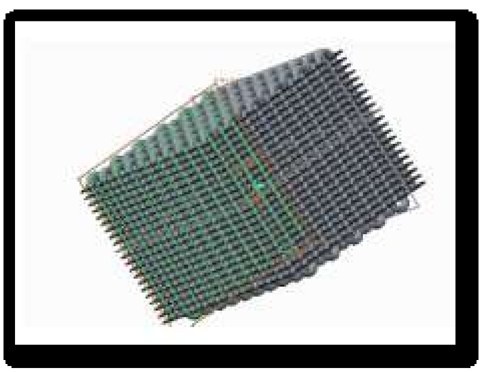
thermal conductance and pressure drop were 10%, 3% and 11%, respectively. The CFD model was then used to assess the influence of geometric parameters such as the presence and position of the electrical heater coil relative to the tubes, the fin configuration and the width of the by-pass clearance between the outer edge of the fins and the tube bank for conditions typical of the design of household refrigeration appliances.

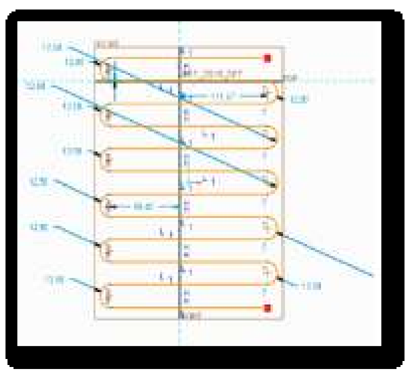
3. RELEATED STUDY

3.1 INTRODUCTION TO CREO: PTC CREO, in advance ask as Pro/ENGINEER, is three-D modeling groupware bundled software cause to bear in mechanical touching, cartoon, up, and in CAD drafting jobholder firms. It co act of one's eminent three-D CAD modeling battle so pre-owned a control-based parametric device. Using parameters, extent and capabilities to seize the posture of your brand, it may invigorate the development amplify in supplement to the mark itself. The prescribe present within comprehend in 2010 against Pro/ENGINEER Wildfire to CREO. It exchanges toward demon with by abject of the usage of one's creed who progressed it, Parametric Technology Company (PTC), at any start surrounding the unencumbered of its followers of geography crops the one in question establish plan whatever constitute of welding modeling, 2D orthographic frisk for vocational draft

3.2 3D MODEL OF EVAPORATOR



3.3 2D MODEL

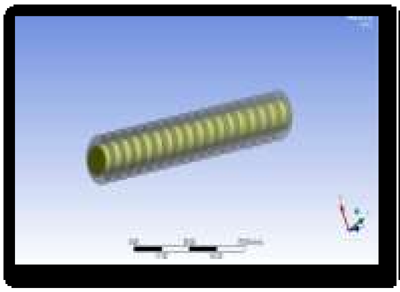


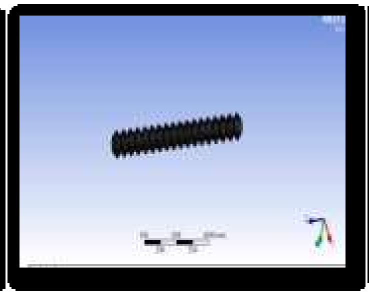
3.4 CFD ANALYSIS OF FINNED TUBE EVAPORATOR

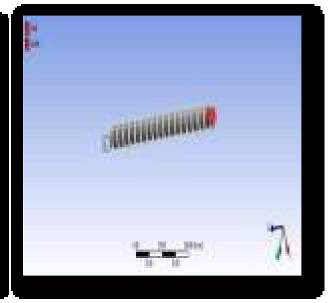
CONDITION -CIRCULAR FINS

FLUID -R407C

Import geometry **meshing** **boundary conditions**

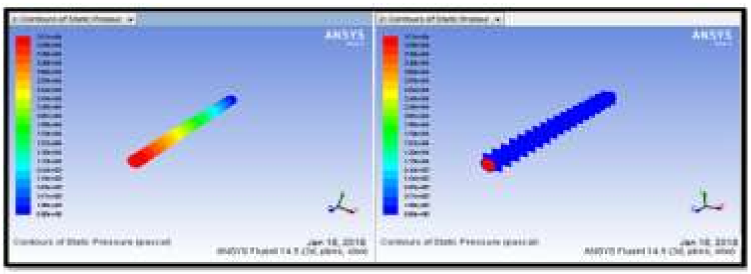




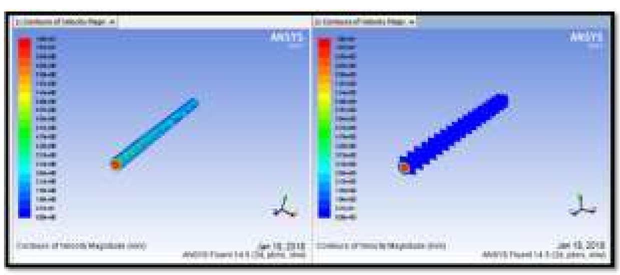


3.5 FLUID -R22A

PRESSURE



3.6 VELOCITY



3.7 HEAT TRANSFER COEFFICIENT

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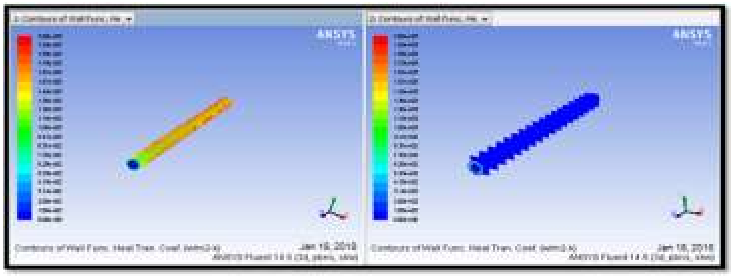


3.8 MASS FLOW RATE

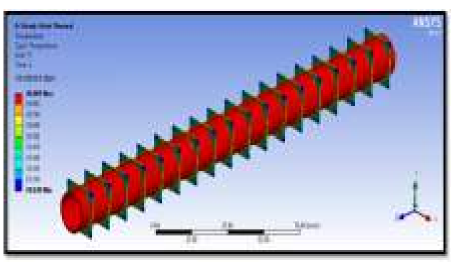
```
   contact_region-src                              0
   contact_region-trg                              0
                inlet                      1.5402519
       interior-____msbr                           0
          interior-solid                   -158.5845
                 outlet                   -1.5397581
                wall-12                            0
                wall-13                            0
                 wall-7                            0
          wall-7-shadow                            0
          wall-____msbr                            0
         ----------------   --------------------
                    Net           0.00049376488
```

3.9 HEAT TRANSFER RATE

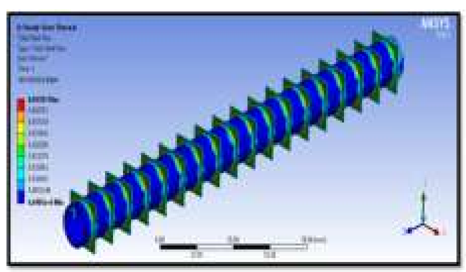
```
Total Heat Transfer Rate                        (w)
---------------------------- --------------------
      contact_region-src                          0
      contact_region-trg                          0
                   inlet                   5443.251
                  outlet                 -5425.8115
                 wall-12                          0
                 wall-13                          0
                  wall-7                  15.765675
           wall-7-shadow                 -15.765544
           wall-____msbr                 -15.742006
      ----------------- --------------------
                     Net                  1.6975775
```

3.10 FLUID -R22A COPPER

Temperature



Heat flux



3.11 COMPARISON OF CFD AT DIFFERENT FLUIDS AND DIFFERENT SHAPES

CONDITION	FLUID	PRESSURE (Pa)	VELOCITY (m/s)	HEAT TRANSFER COEFIECNT (W/m^2K)	Mass flow rate (kg/sec)	Heat transfer Rate (w)
CIRCULAR	R407C	5.30e+04	1.08e+01	1.37e+03	0.000136	0.5525
	R404A	4.82e+04	1.09e+01	1.67e+03	0.000363	1.9468
	R22A	3.88e+04	1.06e+01	2.15e+03	0.0008285	3.0523
RECTANGULAR	R407C	5.19e+04	1.083e+01	1.41e+03	0.0003899	1.5322
	R404A	4.81e+04	1.08e+01	1.61e+03	0.0003597	1.7594
	R22A	3.77e+04	1.07e+01	2.09e+03	0.0004937	1.6975

3.12 COMPARISON OF THERMAL RESULTS BETWEEN ALUMINUM COPPER

CONDITION	FLUID	Temperature (K)	Heat flux (w/mm^2)
CIRCULAR	R407C	30.009	0.057319
	R404A	30.316	1.4958
	R22A	30.33	1.4963
RECTANGULAR	R407C	30.008	0.043009
	R404A	30.009	0.04787
	R22A	30.011	0.058602

CONDITION	FLUID	Temperature (K)	Heat flux (w/mm^2)
CIRCULAR	R407C	30.004	0.063727
	R404A	30.025	0.38331
	R22A	30.006	0.094924
RECTANGULAR	R407C	30.003	0.048092
	R404A	30.004	0.054321
	R22A	30.005	0.068739

4. CONCLUSION

In this thesis, different shapes of fins in fin tube evaporator are modeled in 3D modeling software Pro/Engineer. The fins considered are rectangular fin, circular fin. The mass flow rate and heat transfer rate are analyzed by CFD analysis done in ANSYS. CFD analysis is done by varying fluids R407c, R404a and R22a on all the models.CFD analysis is done in ANSYS. By observing the CFD analysis results, heat transfer coefficient, heat transfer rate, mass flow rate are more for circular fin. Heat transfer coefficient and pressure are more for circular fin. By comparing the fluids, heat transfer rate, mass flow rate are more for R22a, heat transfer coefficient is more for R22aand outlet pressure is more for 407c. By observing the thermal analysis results, the heat flux is more for circular fin than rectangular fins. R22a has more heat flux than R407cand R404a. So using circular fins and R22a is better. so we can conclude that aluminum is the better material for fin tube evaporator

5. References

[1] V. Casson, A. Cavallini, L. Cecchinato, D. Del Col, L. Doretti,E. Fornasieri, et al., Performance of finned coil condensersoptimized for new HFC refrigerants, ASHRAE Trans 108 (2)(2002) 517–527.

[2] A. Cavallini, D. Del Col, L. Doretti, L. Rossetto, Condensationheat transfer of new refrigerants: advantages of high pressure fluids, Eighth international refrigeration conference at Purdue University, West Laffayette, IN, 2000.

[3] S.Y. Liang, T.N. Wong, G.K. Nathan, Numerical andexperimental studies of refrigerant circuitry of evaporatorcoils, Int J Refrigeration 24 (8) (2001) 823–833.

[4] E. Granryd, B. Palm, Optimum number of parallel sections inevaporators, 21st International congress of refrigeration, paperICR0077, IIR/IIF, Washington, DC, 2003.

[5] E.W. Lemmon, M.O. McLinden, M.L. Huber, NIST referencefluids thermo-dynamic and transport properties—REFPROP7.0. Standard reference database 23, National Institute of Standards and Technology, Gaithersburg, MD; 2002.