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"TO ESTIMATE PLATE TYPE HEAT EXCHANGER REFRIGERATION TUBE DAMAGE CAUSE BY USING CFD APPROACH"

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ABSTRACT

A failed heat exchanger was sent to CMRDI to investigate the possible causes of leaks occurred in the tubes of the heat exchanger. The heat exchanger tubes were made of stainless steel 316 straight type. The air with moisture, its pressure is high and when it acts on the refrigerant tube, the erosion and stress will be high and if this happens continuously, the tube will puncture. Whereas if the air turbulence is high, the heat transfer will be high and the efficiency of the heat exchanger will increase and the high velocity is also not good for the tube.

Keyword: *Heat exchanger, corrosion, ph, stainless steel*

I. INTRODUCTION

A plate heat exchanger is a sort of intensity exchanger that utilizes metal plates to move heat between two liquids. This enjoys a significant upper hand over an ordinary intensity exchanger in that the liquids are presented to a lot bigger surface region on the grounds that the liquids spread out over the plates. This works with the exchange of intensity, and significantly speeds up the temperature change. Plate heat exchangers are currently normal and tiny brazed forms are utilized in the serious trouble segments of millions of blend boilers. The high intensity move proficiency for such a little actual size has expanded the homegrown heated water (DHW) stream pace of mix boilers. The little plate heat exchanger has had an extraordinary effect in homegrown warming and boiling water. Bigger business variants use gaskets between the plates, more modest form will quite often be brazed. The idea driving an intensity exchanger is the utilization of lines or other regulation vessels to intensity or cool one liquid by moving intensity among it and another liquid. Generally speaking, the exchanger comprises of a wound line containing one liquid that goes through a chamber containing another liquid. The walls of the line are typically made of metal or one more substance with a high warm conductivity, to work with the trade, though the external packaging of the bigger chamber is made of a plastic or covered with warm protection, to deter heat from getting away from the exchanger. The plate heat exchanger (PHE) was imagined by Dr Richard Seligman in 1923 and changed strategies for circuitous warming and cooling of liquids. Dr Richard Seligman established APV in 1910 as the Aluminum Plant and Vessel Organization Restricted, an expert creating firm providing welded vessels to the distillery and vegetable oil exchanges. Plate heat exchangers (PHEs) are not another idea or innovation. One of the principal licenses was given in 1890 to Langem and Hundhanssen, a German organization. Before, this sort of exchanger has been effectively utilized in ventures like dairy, process, paper/mash, and warming, ventilating, and cooling (central air). The principal motivation behind this article is to guide likely scientists to the subject of PHE, on the grounds that ongoing businesses miss the mark on data about them.

These kinds of evaporators are being utilized in the warming, ventilating, cooling, and refrigeration (HVAC&R) industry consistently, yet there is no direction at all. The goal here is to introduce the current

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TYPES OF PHE :

A few sorts of exchangers have been utilized in the refrigeration framework, i.e., customary gasketed plate and edge, all welded compabloc, minimized brazed, semi welded, and shell and plate. The last three sorts are most normal in the business today, and they all have comparative mathematical qualities. Gasketed Plate and Casing Each plate is fixed through an elastomer gasket, bringing about exchanging stream channels for every liquid, as displayed in Figure 4. The main modern refrigeration utilization of this sort of exchanger was accounted for in 1984 in Germany. Somewhere in the range of 1984 and 1991, when the primary semi-welded plates were presented, more than 150 units of different sizes and limits working with R-12, R-22, smelling salts, and propane were effectively introduced around the world (barring the US) in the dairy, food, drink, mining, meat/poultry, synthetic, plastics, wine, and general cooling ventures.

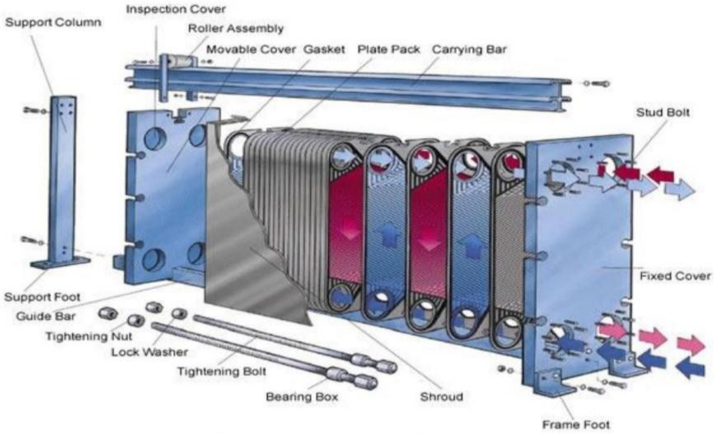

Figure 1 plate type heat exchanger

Brazed Plate Exchangers Figure 1 shows a regular minimal brazed exchanger, usually known as CBE. These units were at first intended for cooling oil and other fluid to- fluid applications. Notwithstanding, the cooling and intensity siphon ventures were promptly drawn to its superior exhibition qualities and conservativeness. The producers of chillers began involving them as evaporators and condensers. More often than not these units worked; in any case, disappointments happened while they were utilized as evaporators for low temperature applications. They additionally showed terrible showing at high burden limits, principally on the grounds that the exchangers that were intended for single stage application were utilized as ―drop-in‖ substitutes for evaporators, with no thought to the issues related with two-stage stream conveyance. During the beyond five years, this issue has been offered due consideration, and a few makers have consolidated arrangements for worked on refrigerant dispersion. The most well-known procedure utilized is the work of a more modest size gulf port versus the power source port and a punctured line embedded at the delta. A few makers use opening rings at the entry of every refrigerant channel or a two-chamber entrance that outcomes in a uniform backpressure. The two strategies bring about superior dissemination except if the openings in the previous case are stopped up during the brazing system. There have been situations where the fine holes were stopped up and the exchangers must be supplanted. Ayub [2] proposed a drop-in embed that utilizes an idea of twirl stream in a continually decreasing stream region
along the stream way in the bay port chamber. Brazed exchangers can't be precisely cleaned and hence are restricted to non-fouling applications as it were.

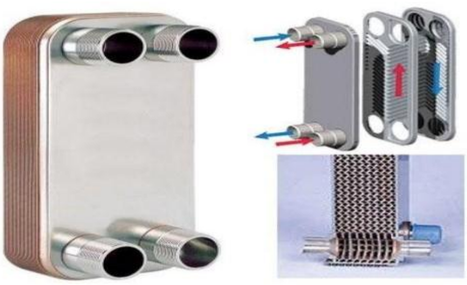

Figure 2: Compact brazed exchanger

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Semi-Welded Plate and Edge

The semi-welded PHE is like a gasketed plate and edge with the exception of the two neighboring plates are welded. The welded pair is typically called a plate tape, as displayed in Figure 3. Two inverse chevron plates are accuracy laser welded, subsequently, dispensing with the stream gasket on the refrigerant side. The refrigerant is limited to the pit made by the welding of two adjoining plates. In any case, it's anything but a without gasket unit. The ports must be fixed with ring gaskets to try not to blend the refrigerant and interaction liquid. Just the cycle liquid side can be cleaned once the refrigerant is completely siphoned down. Intense consideration must be seen during the cleaning system, as caught refrigerant could cause wounds or fatalities. There is a slight confusion in the business with respect to welded plates. Numerous clients accept that the plate matches are 100 percent welded together. Sadly, that isn't true. To keep up with the refrigerant stream, just Oaring gaskets keep

the temperature perspective, and end plate thickness restricts the tension angle. As far as possible is −40◦F to 300◦F, and as far as possible is 300 psig.

Shell and Plate

Shell and plate is the most up to date plan in the plate exchanger innovation and has exceptional elements. It consolidates the upsides of shell and cylinder and plate and casing advancements, with high mechanical trustworthiness inborn to shell and cylinder and the prevalent warm qualities of plate and edge. A plate pack is welded together so that the shell side is separated from the plate side, and there is no gasket for the end goal of fixing with the exception of an O-ring for a body spine on account of a removable plate pack. Figure 4 shows a shell and plate exchanger.

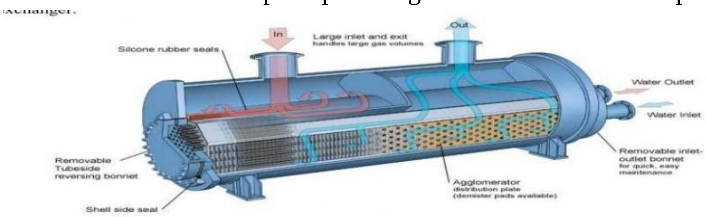

Figure 3: Shell and Plate Heat Exchanger

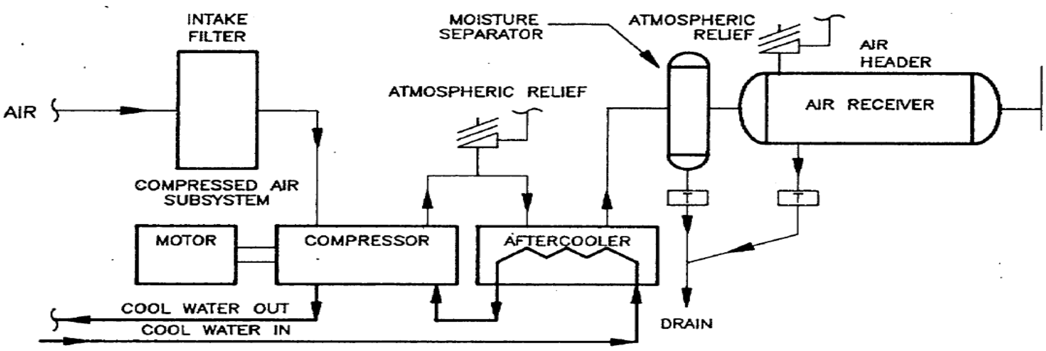

Figure .4 Flow diagram of air compression unit

Each plant may not contain the above parts as a whole and some might have extra parts.
Air admissions, similar to blowers and dryers, differ incredibly from one plant to another. They depend on the many plan boundaries expected for the kind of plant and its area.
Preferably, the blower pull ought to be situated in a perfect region, as near the blower as could really be expected.

Packed air is a fundamental type of driving and cycle energy in all fields of modern and creation producing. Compacted air should be dry, liberated from oil and clean to stay away from costly creation breakdowns. Packed air is created by compacting air which is sucked into the blower. This normally contains poisons, soil particles and consistently dampness as water fume, which gathers unexpectedly in the compacted air and can then prompt disturbances in activities and accordingly to significant yet avoidable expenses.

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II. DESIGN & SIMULATION

We made a model by measuring the entire air passage and applying the boundary condition on it, the result came out because we wanted to see what kind of difference is found in the results of both the designs.

The simulation and analysis done by the software is shown in the figures given below.

Boundary Condition- Working Fluid: Air **Pipe Material**: Steel
Table 3.1: Boundary Condition

Sr. No	Hot Air Temp Inlet	Cold Air Temp Inlet
1	311 K (38 C)	304 K (31 C)

Sr. No	Hot Air Pressure Inlet	Cold Air Pressure Inlet
1	661897 Pa (96 PSI)	675686 Pa(98 PSI)

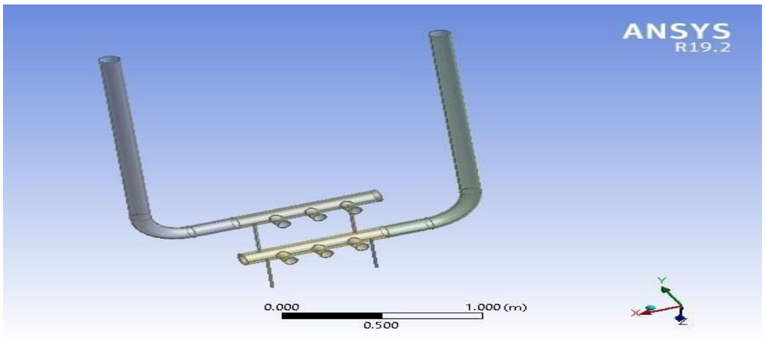

Figure 5 Model of Entry & Exit Section of Three Plate Heat Exchanger

Three PHE Unit pipe CAD model import in ANSYS workbench for finding CFD results by fluent platform of simulation

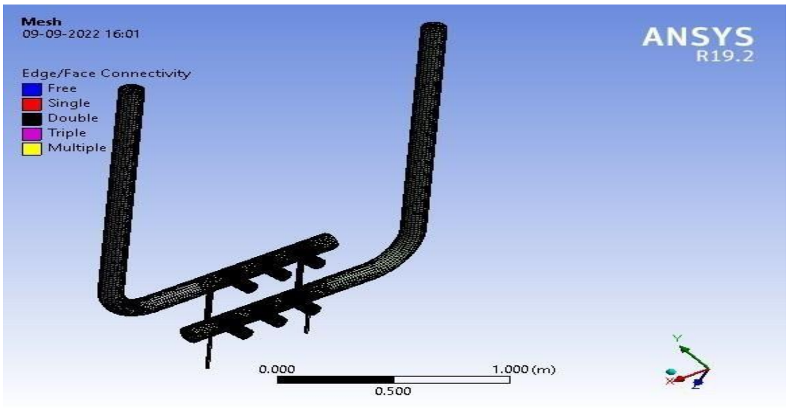

Figure 6 Meshing Model of Entry & Exit Section of Plate Heat Exchanger

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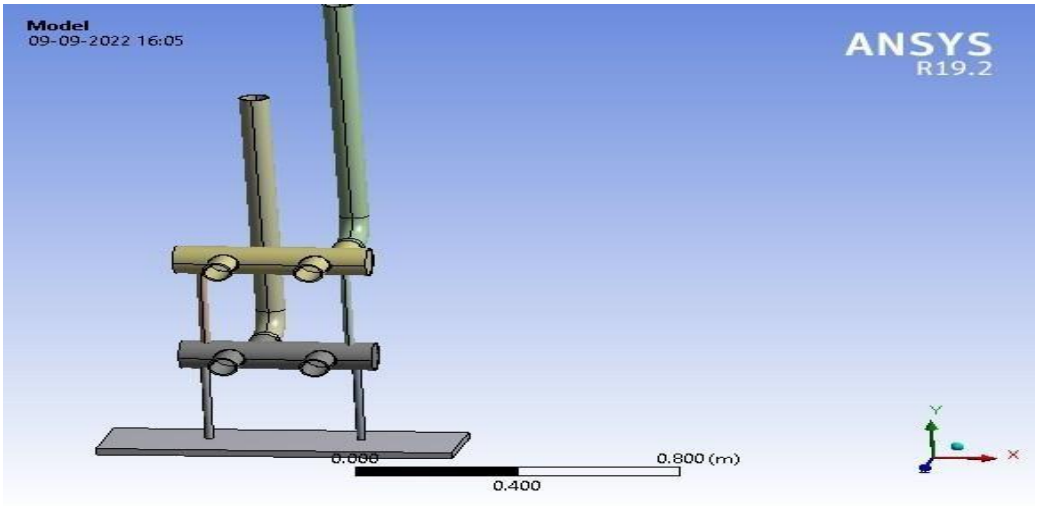

Figure.7 Two Pipe Model of Plate Heat Exchanger

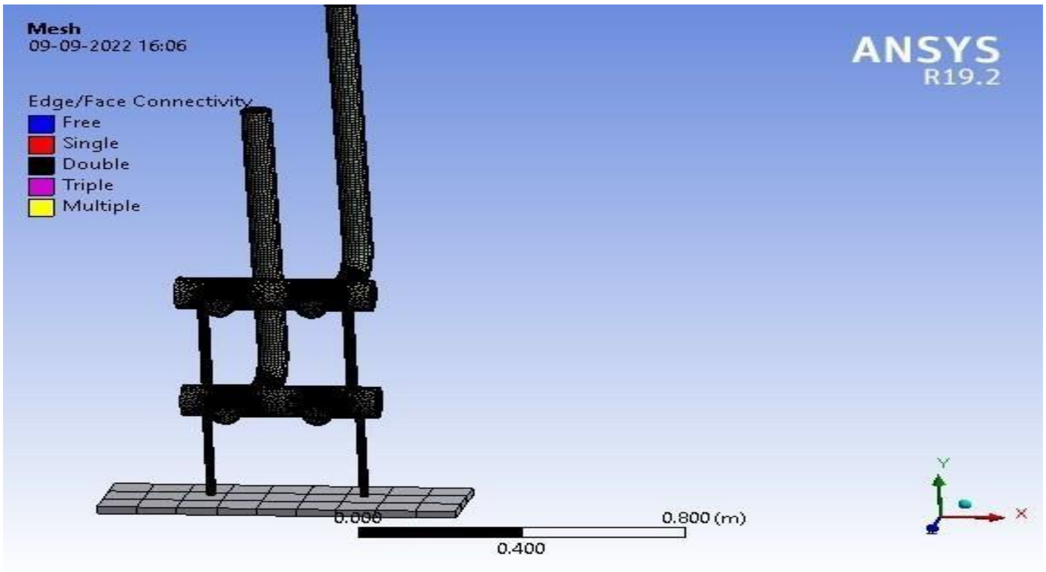

Figure 8 Meshing Model of Entry & Exit Section of Plate Heat Exchanger

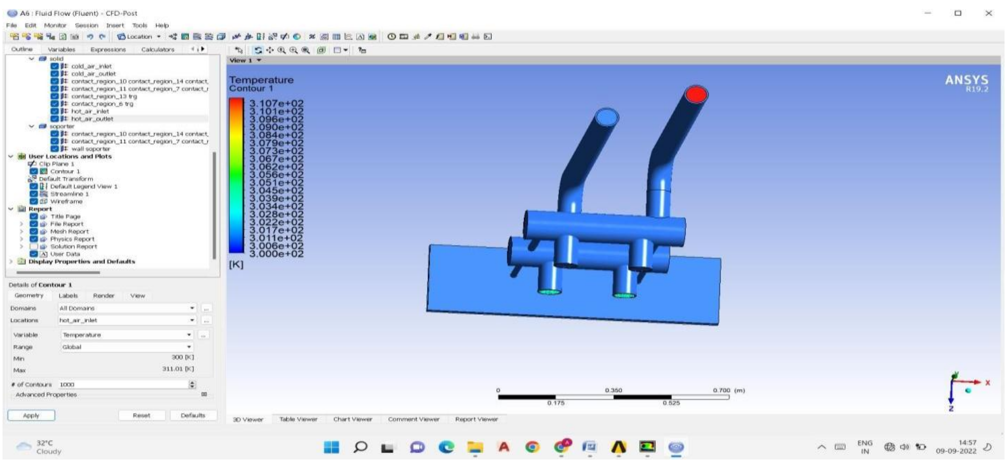

Figure 9 Temperature Contour on Two PHE System

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Impact Factor : 4.256

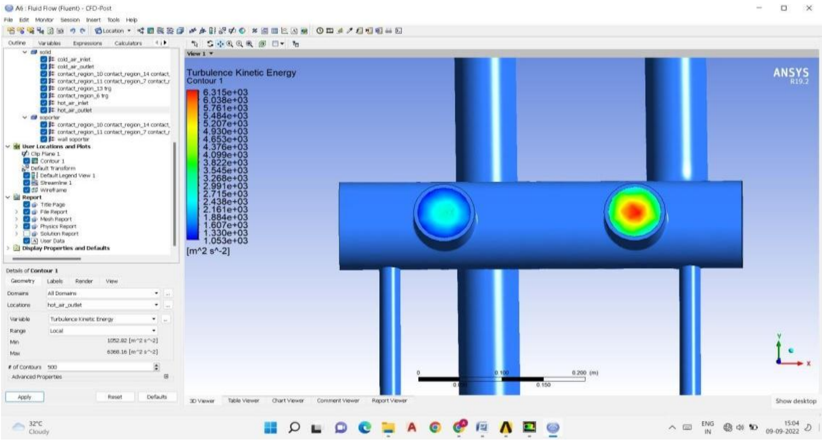

Figure 10 Turbulence Contour on Two PHE System

III. RESULT SUMMARY

Table 4.1 Results Summary

S. No.	Hot Air Outlet	Two PHE Design	Three PHE Design
1	Pressure (Pa)	6.6 e^5	1.12e^6
2	Turbulence Kinetic energy	6.31 e3	2.629 e4

The air with moisture, its pressure is high and when it acts on the refrigerant tube, the erosion and stress will be high and if this happens continuously, the tube will puncture. Whereas if the air turbulence is high, the heat transfer will be high and the efficiency of the heat exchanger will increase and the high velocity is also not good for the tube.

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