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“A REVIEW ON PLATE HEAT EXCHANGER TUBES FAILURE ”

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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 heat exchanger served to heat up water basin (desalinated water) during the cold winter time. The water contains a high chloride level. Corrosion testing indicated susceptibility towards pitting corrosion especially at high temperature. It was suggested that controlling chloride level and proper adjustment of pH are the optimum solutions to avoid corrosion of heat exchanger pipes.

Key Words: 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

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.

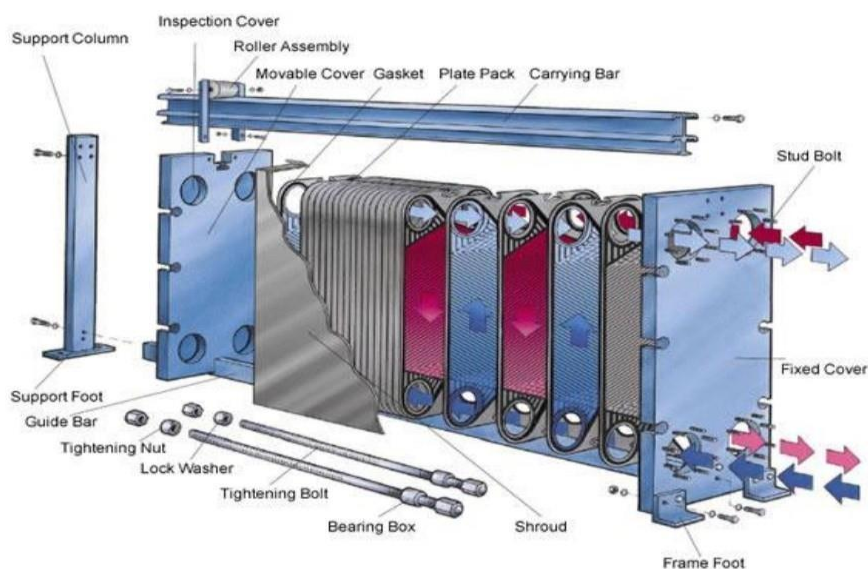


Figure 1 plate type heat exchanger

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 swirl 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.

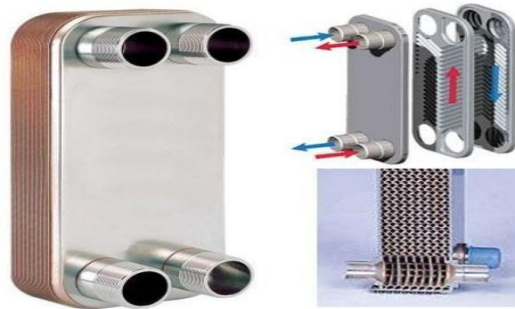


Figure2: Compact brazed exchanger Semi-Welded Plate and Edge

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.

exchanger.

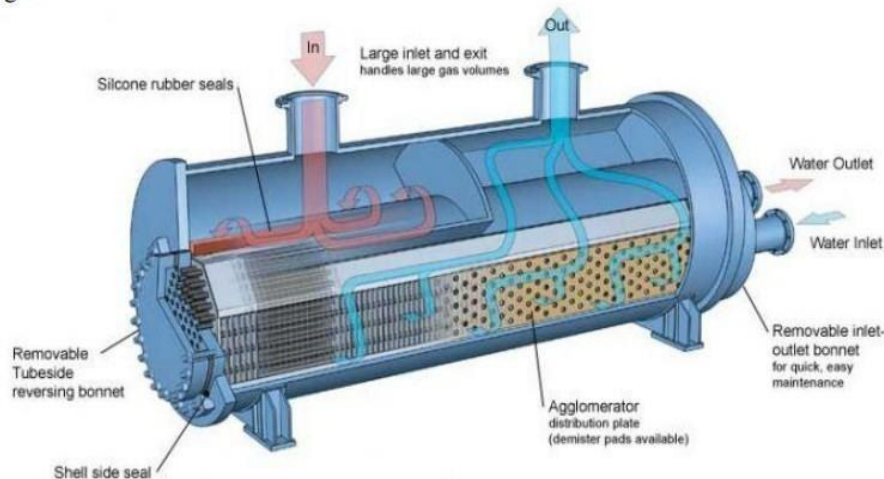


Figure 3: Shell and Plate Heat Exchanger

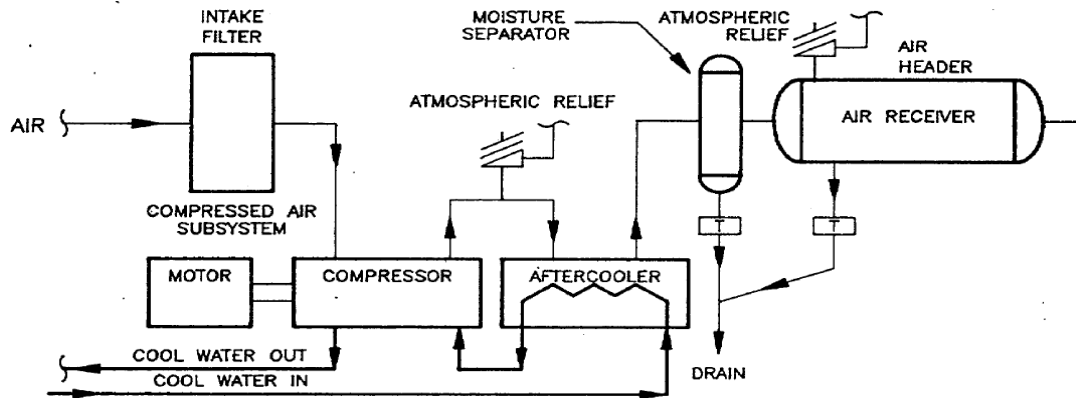


Figure 4 Flow diagram of air compression unit

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.

II. LITERATURE REVIEW

S.M. Pesteei et al. [2005] this paper present neighborhood heat move coefficients were estimated on balance tube heat exchanger with winglets utilizing a solitary warmer of 2 inch width and five unique places of winglet type vortex generators. The estimations were made at Reynolds number around 2250. Stream not set in stone by estimating the static strain drop in the framework. Results showed a significant expansion in the intensity move with winglet type vortex generators. It has been seen that normal Nusselt number increments by around 46% while the nearby intensity move coefficient works on by a few times when contrasted with plain balance tube heat exchanger. The most extreme improvement is seen in the re-dissemination zone. The best area of the winglets was with $DX = 0.5D$ and $DY = 0.5D$. The expansion in pressure drop for the current circumstance was of the request for 18%. [1]

C.B. Allison et al. [2007] explored the exploratory examination of the impacts of delta-winglet vortex generators on the exhibition of a blade and cylinder radiator is introduced. The winglets were organized in stream up design, and put straightforwardly upstream of the cylinder. This is an until recently untested design, however is remembered to enjoy specific benefits. Notwithstanding vortex age the stream is directed onto the cylinder surface expanding the limited speed slopes and Nusselt numbers around here. The review incorporates color representation and full scale heat move execution estimations. The outcomes are contrasted with a standard louver blade surface. It was found that the winglet surface had 87% of the intensity move limit however just 53% of the tension drop of the louver blade surface. They found that the intensity move instruments of the two balance surfaces contrast decisively. The louver balance surface works

with limit layer restoration and has various driving edges. The delta-winglet balance has less driving edges and depends prevalently on expanding convection through vortex age. As per the outcomes, the louver balance is better than the deltawinglet blade. Albeit intelligible vortices were created from the principal column of winglets, we question wether the downstream winglets produce a similar degree of vorticity. This suggests that main the principal column of winglets might be powerful in delivering vortices which can further develop heat move. [2]

Ya-Ling He et al. [2012] explored the intensity move upgrade and tension misfortune punishment for balance and-cylinder heat exchangers with rectangular winglet matches (RWPs) were mathematically researched in a generally low Reynolds number stream. The motivation behind this study was to investigate the crucial instrument between the neighborhood stream structure and the intensity move expansion. The RWPs were put with an extraordinary direction with the end goal of improvement of intensity move. The mathematical review included three-layered stream and form heat move in the computational area, which was gotten up in a position model the whole stream divert in the wind current bearing. The impacts of assault point of RWPs, line number of RWPs and situation of RWPs on the intensity move qualities and stream structure were analyzed exhaustively. It was seen that the longitudinal vortices brought about by RWPs and the impingement of RWPs- coordinated stream on the downstream cylinder were significant reasons of intensity move upgrade for balance and-cylinder heat exchangers with RWPs. It was fascinating to find that the tension misfortune punishment of the balance and-cylinder heat exchangers with RWPs can be decreased by changing the arrangement of a similar number of RWPs from inline cluster to staggered exhibit without lessening the intensity move upgrade. The outcomes showed that the rectangular winglet matches (RWPs) can fundamentally further develop the intensity move execution of the blade and-cylinder heat exchangers with a moderate tension misfortune penalty.[3]

M.C. Upper class et al. [2013] explored the intensity move improvement by different vortex generators mounted at the main edge of a level plate. They exhibited a 50-60% improvement in normal intensity move over the outer layer of the plate, utilizing delta-wing vortex generators. It is significant that a delta-wing resembles an isosceles triangle mounted evenly to the stream, and the approach is estimated between the plate and the incline of the delta. A delta-winglet then again resembles a right- calculated triangle (or half delta) mounted opposite to the plate, yet at an occurrence point estimated lined up with the gulf stream. Nobility and Jacobi shifted the approach from 25o to 55o, with the ideal improvement happening at an approach of 40o.[4]

Gullapalli and Sundén [2014] utilized strain and enthalpies to foster an overall legitimate technique. They concentrated on the results of reenactment strategies on pressure drop and intensity move was. The consequences of their review introduced that CFD-devices require general substantial upheaval models and limit circumstances. [5]

Aslam Bhutta et al. [2012] depicted Plate Intensity Exchangers (PHE) excellent with exceptionally less impediments and a lot more benefits among other intensity exchangers.[6]

Shah and Sekulic [2003] exhaustive examination abhorred that when two streams streaming at various temperatures experience one another and trade energy in an exchanger gadget cooling is achieved. They additionally related the benefits of plate heat exchangers over the other customary intensity exchangers like shell and cylinder heat exchanger. The conspicuous justification for giving the inclination to plate heat exchanger was that they can endure high tension and temperature. The functional circumstances for plate

heat exchangers are unstable however they actually endure those circumstances because of their plan. [7]

Dović et al. [2009]: laid out a summed up connection to characterize water powered and warm show as far as contact factor and Nusselt number for a plate heat exchanger which was single pass stream. Relations were created from chevron points in the midst of 15 and 65° and for chevron level to pitch proportions somewhere in the range of 0.26 and 0.4 B[8]

B. Prabhakara Rao et al. [2000] concentrated on the result of stream course inside channels on the warm Execution comparing to plate heat exchanger. To get warm recreation of a solitary pass plate heat exchanger a summed up model was introduced. This model analyzed stream deviation inside the diverts in exact way and simultaneously took counsel from accessible information. The results inferred that while considering just factor stream rate the effectiveness of the exchanger is subverted. Far proficient methodology is to view an adaptable stream rate alongside a stream subordinate heat transfer coefficient. The results determined that the audio effects of boundaries like, stream design, pace of intensity limit proportion, stream design, number of channels and plate math are significantly disconnected from the unfeasible model for 'lopsided stream rates however indistinguishable intensity move coefficient' utilized in past. NTU versus Viability character of a PHX and resultant Reynolds number (n) [7]

Marjan Goodarzi et al. [2015] utilized MWCNT based Nano liquids to Concentrate on pressure drop as well as intensity move for Plate Intensity Exchanger with counter stream layered plan. At first the thermo-actual properties were read up tentatively for Carbon Nanotube-based liquid to © 2021) were utilized as coolants to analyze the Nusselt number, convective intensity move coefficient, contact misfortune, siphoning influence and tension drop in plate heat exchanger with counter stream folded plan. FORTRAN code was utilized to Work out Nano molecule weight rates of 0.0% to 1.0% and Reynolds numbers extending from 2500 to 10,000 (unstable stream). Properties connected with nanofluids were concentrated by directing tests. The outcomes showed that intensity switch qualities of nanofluids can work on by expanding Peclet number and Reynolds range. However, in the event of specific material, expansion of nanomaterial part or Reynolds assortment could bring about ascending of required siphoning power despite the fact that the change is irrelevant. Every one of the analyses showed that the pace of intensity move and power utilization is less in water when contrasted with nanofluids. Further examination tracked down that heat dismissal limit of nanofluids is higher than water for a specific siphoning power. Hence, by taking MWCNT-water as a functioning liquid the exhibition of Plate heat exchanger can be upgraded. [10]

Muley and R. M. Manglik [1999] concentrated on pressure drop and stream heat move in (PHE) Plate heat Exchanger for chevron plates. U-type counter stream Plate heat exchanger (PHE) which is single pass was considered with three different chevron plate courses of action. Comparative plate courses of action for two plates with $\beta = 30^\circ/30^\circ$ and $60^\circ/60^\circ$, and one mixed plate arrangement with $\beta = 30^\circ/60^\circ$. In the event of water ($2 < Pr < 6$) stream rates inside the $600 < Re < 104$ order, records are introduced for f and Nu . Surface development factor (ϕ) and chevron point (β) showed an impressive impact on results The outcomes show significant impact of the chevron point, with any augmentation of (β) the worth of Nusselt number (NU) is expanded by three to multiple times. Same is the situation with surface development factor (ϕ). Contingent on (ϕ), (β) and Re , it was found that at consistent siphoning power the intensity move is gotten to the next level. [11]

Arun Kumar Tiwari et al. (2014) [Examined liquid stream and intensity move of a plate heat exchanger for one pass counter development chevron configuration plates taking (Al_2O_3 and CeO_2) as coolant. ANSYS Familiar a computational liquid elements device was utilized for the examination A plate heat exchanger was

planned with turning out liquid for testing as nanofluids and water. The CFD results were contrasted and the results of the exploratory investigation of intensity exchanger, and it was demonstrated that homogeneous combinations impersonation can be effectively used to gauge the plate heat exchanger which is nanofluid cooled. Nanofluids are valuable provided that their warm conductivity expansions notwithstanding undesirable consequence of flood in consistency their warm conductivity ought to increment. Because of layered plan of plate, choppiness advances and intensity move rate increments. The upper part gave off an impression of being at high temperature when contrasted with while the lower part, bigger temperature slant, and the aftereffect of intensity move is extra acceptable. The presentation of Water/CeO₂ as coolant was no question best determine the impact of various useful covalent gatherings. Surfaces of (MWCNT) Multi Walled Carbon Nanotubes were appended with Silver (Ag) and (Cys) Cysteine covalently to explore this issue. With the assistance of portrayal instruments, morphology and usefulness were explored to actually look at functionalization of surface. To register properties connected with warm, different nanofluids in light of water, for example, (MWCNT-GA) Gum Arabic-treated multi-walled carbon nanotubes, functionalized MWCNT with silver (FMWCNT-Ag) and cysteine.[12]

Harshvardhan Gupta et al [2021] Temperature fixation that are liable for changes in stream dissemination inside Plate Intensity Exchangers are analyzed in this paper. The persistence of this study is to amplify the associate in regards to liquid compartment in Plate Intensity Exchangers and its result on proficiency. Gravity, stream speed and Reynolds number are sure boundaries which can adjust stream circulation inside Plate Intensity Exchanger. The equivalent was affirmed by Bernoulli condition. Every one of the three boundaries for example Reynolds, consistency and gravity were Researched through isolation and change. Different examination papers on Plate Intensity Exchangers were considered and the itemized audit paper has been prepared.[13]

III. FAILURE EXAMINATION OF PHE STRUCTURE

Conditions and intelligent aftereffects of Sogginess Content

As we in general understand that water particles or moistness is especially dangerous to any mechanical structure. In light of soddenness, the display of the machine is diminished and there is in like manner an issue of utilization occurs in the machine.

The blower draws air through a confirmation channel. The channel takes out dust and other airborne particulate before pressure. As air enters the blower and is compacted, the temperature of the air rises.

The hot air goes through an intercooler (between stage cooler) on multi-stage blowers, to diminish the temperature and volume to be compacted in the succeeding stages, dissolve condensable exhaust, and save power. The pressed air then, enters the after cooler where further cooling and development occurs.

In systems with single stage blowers, the air goes through the after cooler from the power wellspring of the blower.

In any case, the clamminess present in the air goes in with the air and moves set aside as water in the elbow of the blower header which ought to be standard drained genuinely.

We considered assessing that water since we expected to figure out how much moistness was turning out with the confirmation air. We expected that the size of the elbow could never have perhaps taken care of an overabundance of water yet we were misguided as there was a great deal of water set aside.

The position and stream of the blower header elbow and beneficiary are shown in the figure underneath.

Fouling is the formation of unwanted material deposits on heat transfer surfaces during process heating and cooling. It occurs in all industries and most heat exchanger designs, with impacts ranging from heat transfer degradation to flow resistance and pressure drops.



Figure 5. Plate Heat Exchanger

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