1.3.3 Percentage of programmes that have components of field projects / research projects / internships during the last five years.

Sample Evaluated project report/field work report submitted by the students.

Sample Evaluated PG - Project Report - 1
1.3.3 / Link 1.3

Sample Evaluated PG - Project Report - 2
1.3.3 / Link 1.4

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Sample/Reference of Project Report (PG)

GOVERNMENT COLLEGE OF ENGINEERING,

SALEM – 636011

BONAFIDE CERTIFICATE

Certified that this Report titled **"EXPERIMENTAL STUDIES ON ROTARY FRICTION WELDED UNS S30400 AND UNS S31803 TUBES"** is the bonafide work of **SAVITHAROJA P (REG.NO. 61772163005)** who carried out the project work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

Rotary Friction Welding (RFW) is one of the type of solid state joining process used for joining both ferrous and non-ferrous materials. The reality that joining of alloys could be usually faced problems in many sectors that includes automotive, aircraft, mining, pump making, heavy duty industries, oil and gas industries, etc. where fusion welding is not possible due to large difference in physical and mechanical properties of the components to be joined. One of the reason that make rotary friction welding popular among manufacturers is its unique ability to join dissimilar metals. In this study, Austenitic stainless steel (UNS S30400) and Duplex stainless steel (UNS S31803) tubes are joined using design of experiment (DOE) method. Similar and dissimilar joints of Austenitic stainless steel and Duplex stainless steel are performed using Taguchi method. Mechanical properties and metallurgical properties for both similar and dissimilar welding of Austenitic and Duplex stainless steel are done. Tensile strength is found to be increased with increase in upset pressure and heating pressure. The fracture analysis reveals ductile pattern of fracture with dimples. Microstructure analysis showed recrystallization grain in the weld zone compared to partially deformed zone (PDZ) and weld zone (WZ). Corrosion studies showed that lower the current density, the higher was the corrosion resistance.

Keywords: *Rotary Friction Welding, Mechanical Properties, Metallurgical properties, Tensile test, Fractography Analysis, Micro Analysis and Review Corrosion study.*

Sample/Reference of Project Report (PG)

4.4.2 Dissimilar UNS S30400 – UNS S31803 Joints

Tafel plot of current vs potential for similar UNS S30400 - UNS S31803 tubes is shown in Fig.4.19 and table 4.10 shows corrosion rate of low, high and optimized parameters.

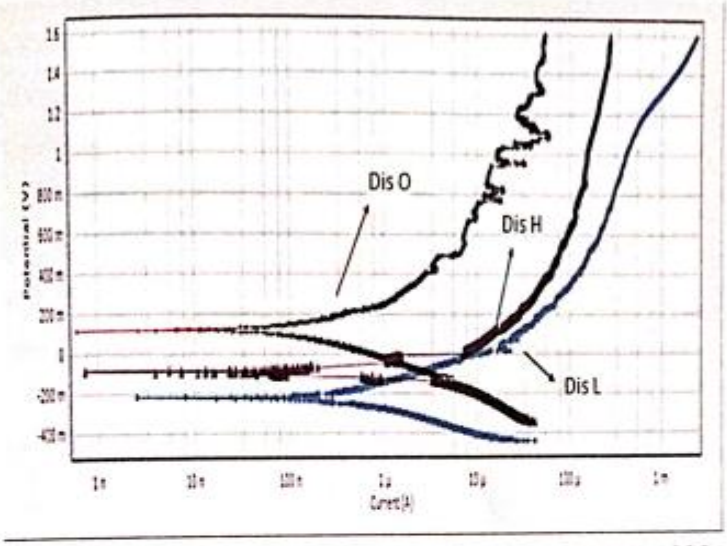

Fig.4.19 Tafel plot for dissimilar UNS S30400 - UNS S31803 tubes

Table 4.11 Corrosion rate of dissimilar UNS S30400 - UNS S31803 tubes

Dissimilar UNS S30400-UNS S31803	Current Density (I_{corr}) μA	Corrosion rate (mpy)
Low	0.695331	0.31601
High	0.224702	0.051587
Optimized	0.11351	0.00010212

CHAPTER 6

CONCLUSION

Similar and dissimilar welding of UNS S30400 and UNS S31803 were studied in this project. The strength of the joint was analyzed by tensile test. Experiments were conducted with DOE concepts to investigate the effect of heating pressure, upset pressure, heating time and upset time on tensile strength and microstructure.

Following conclusions have been derived from above results and discussions:

- In the present study, similar and dissimilar joints of UNS S30400 and UNS S31803 were welded successfully using DOE method.
- Taguchi method can be effectively used to find optimum condition for similar and dissimilar welding of UNS S30400 and UNS S31803.
- The tensile strength value of welded material at the joint increases with increase in upset pressure. It was found that heating pressure and upset pressure has the greater influence on the joint strength.
- From fractography analysis, it reveals ductile mode of fracture with dimples for both similar and dissimilar joints.
- From microstructure analysis, fine recrystallized grains observed in WZ and coarse grains in PDZ for both similar and dissimilar joints.
- Corrosion resistance of weld was better than the base material which was conformed through potentiodynamic polarization curves.
- Compared the similar Austenitic, similar Duplex, dissimilar Austenitic – Duplex SS, similar Duplex SS welded samples have high tensile strength and dissimilar welded samples have high corrosion resistance.

Sample/Reference of Project Report (PG)

DEPARTMENT OF MECHANICAL ENGINEERING

GOVERNMENT COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to Anna University, Chennai)

Salem-636011

DISSERTATION PHASE - I

MARCH 2023

This is to certify that this project work entitled

DESIGN AND ANALYSIS OF LIQUID SUCTION HEAT EXCHANGER IN A VAPOUR COMPRESSION REFRIGERATION SYSTEM

is the bonafide record of project work done by

DIVAGARAN P (Register Number: 61772153201)

of M.E. Thermal Engineering during the year 2021–2023

2/3/23

Project Guide

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Submitted for the Dissertation Phase – I Viva-Voce examination held on 27.03.2023 / FN

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27/3/23

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Sample/Reference of Project Report (PG)

ABSTRACT

Performance enhancement of the vapour compression refrigeration systems to gain better refrigerating effect and COP is the current need. This study investigates the effect of adding a liquid-suction heat exchanger on the performance of a vapour compression refrigeration system by using R134a. In this application the liquid line is usually placed in contact with the suction line, forming a counter flow heat exchanger. The liquid line is welded to the suction line in the lateral configuration. The temperature of the vapour refrigerant coming out from the evaporator is less than the temperature of the liquid coming out from the condenser. Before the expansion process, heat is transferred from the liquid line to the suction line. As a consequence this in turn reduces the refrigerant quality at the inlet of the evaporator and therefore increases the refrigerating capacity. The LSHX is designed using SOLIDWORKS software for the VCR system and the design is based on the rate of sub-cooling and super-heating. Next to that an analysis is done using ANSYS WORKBENCH on the stream of ANSYS fluent simulation on LSHX to analyze the temperature distribution and velocity of fluid flow. The results revealed that the liquid- suction heat exchanger has a significant effect on the system performance as it influences the sub-cooling and super-heating temperatures. A theoretical analysis has been carried out on the effect of liquid suction heat exchanger on the cooling performance of VCR system. The main objective of this project is to evaluate the performance of modified system with liquid-suction heat exchanger and system without liquid-suction heat exchanger by using R134a and compare their performance improvement with the existing system.

- **Cell zone conditions:** Inner and outer fluid assigned as R134a and inner and outer solid pipe assigned as material copper.
- **Boundary Conditions:** Boundary conditions are used according to the need of the model. The inlet and outlet conditions are defined as mass flow inlet and pressure outlet. As this is a counter-flow and parallel flow with two tubes as there are two inlets and two outlets. The walls are separately specified with respective boundary conditions. No slip conditions are considered for each wall. Except the tube walls each wall is set to zero heat flux condition.

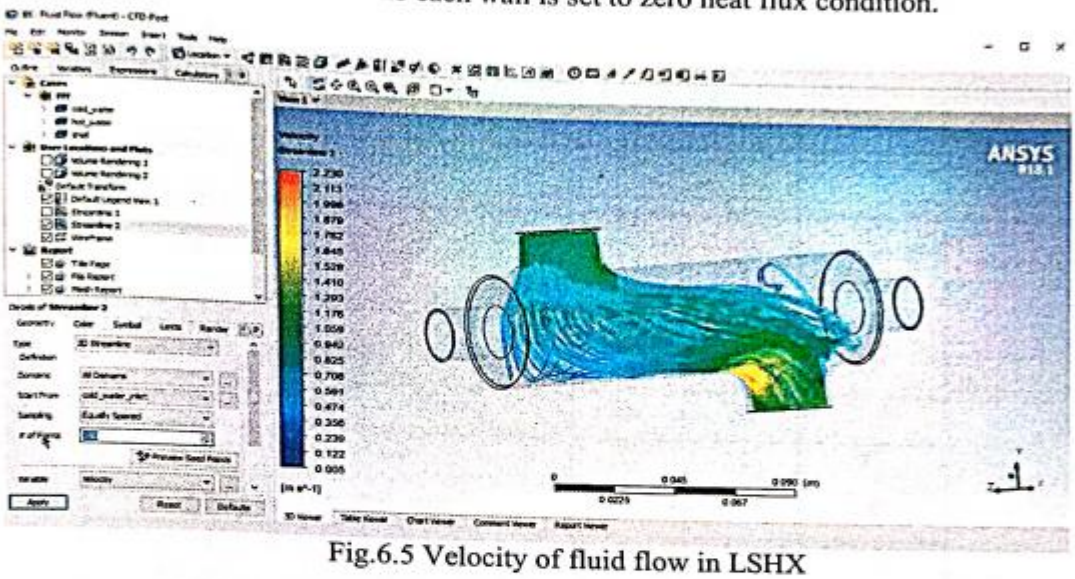

Fig.6.5 Velocity of fluid flow in LSHX

Using CFD methodology, this study explores the heat transfer and flow characteristics of liquid suction heat exchanger for counter flow. The outlet temperature of the fluids depends up on the mass flow rate of both fluids and varies when we alter flow rate. When the area of contact between the fluid and pipe increases heat transfer rate also increases significantly. From this we can observe that heat transfer rate is directly dependant on area through which the fluid flows. Thus from the velocity result above, we can conclude that the velocity of the fluid after the fluid temperature increase is high while the velocity of the fluid is getting low. And the from this we can say velocity and temperature are directly proportional and in our analysis the counter flow gives better heat transfer rate in which the temperature of the hot fluid at the outlet is almost equal to the temperature of the cold fluid at the inlet .

CHAPTER 9

CONCLUSION

Due to the increasing demand of refrigerator and the limited energy resources, there is an urgent need of improving the performance of vapour compression refrigeration system. Various methods can be used to improve the performance of the system. In the present work, the Liquid Suction Heat Exchanger (LSHX) method is reviewed as one of the sub-cooling methods. A complete design and analysis of LSHX has been made using SOLIDWORKS and ANSYS workbench based on requirement in the performance improvement in the existing VCR system. Under closer evaluation from the theoretical analysis, it can be summarised that:

- Due to the superheating process, the mass flow rate of refrigerant going into the compressor decreases. But if we assume that the mass flow rate is constant then according to our study, we concluded that on increasing the degree of sub-cooling, the COP of the VCR system is increased by 14 % on installing a liquid suction heat exchanger in case of R-134a refrigerant.
- Although the compressor power is only slightly affected by the change in state of the refrigerant entering the compressor, the refrigerant mass flow rate is reduced by 4.13 %.
- It also presented that R134a has high response to increase the refrigerant effect by 3.88 % when the liquid-suction heat exchanger used.
- Minimizes risk of liquid refrigerant presence at the compressor inlet which increases compressor life.
- Heat to be rejected in condenser is increased by 0.9 % on installing the LSHX on the VCR system using R134a.
- The superheating and sub-cooling effects were recorded with high value when the R134a was used in modified and no-modified systems.
- Installation of Liquid Suction Heat exchanger with existing Refrigeration is a very easy process. And costing is very less comparing to improvement in the refrigeration effect.