NOVATEUR PUBLICATIONS
International Journal of Innovations in Engineering Research and Technology [IJIERT], ISSN: 2394-3696
Conference Proceedings of i - Mechanical Engineering Students Conference 2018 (i – MESCON 18)
28th December, 2018

PAPER ID –HP06

REVIEW ON VARIOUS METHOD TO INCREASE HEAT DISSIPATION IN HYDRAULIC SYSTEM

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***Abstract*—Hydraulic Power pack units are main driving components of driving system. Consisting mainly a motor, a reservoir and a hydraulic pump these units can generate a tremendous amount of power to drive any kind of hydraulic ram. Hydraulic power units are based on Pascal's law of physics drawing their power from ratios of area and pressure. Heating of hydraulic oil in operation is caused by inefficiencies. Inefficiencies result in losses of input power, which are converted to heat. In this work an attempt is made to suggest the best method for cooling of hydraulic system, by studying various methods for increasing heat dissipation in hydraulic system (power pack).**

Keywords—Hydraulic Power Pack, Thermal Conductivity, Heat Transfer Coefficient, Heat Dissipation, Hydraulic system, Industry problem.

I. INTRODUCTION

Hydraulic Power Pack Basic Circuit A hydraulic system employs enclosed fluid to transfer energy from one source to another, and subsequently create rotary motion, linear motion, or force. Hydraulic power units apply the pressure that drives motors, cylinders, and other complementary parts of a hydraulic system. Unlike standard pumps, these power units use multi-stage pressurization networks to move fluid, and they often incorporate temperature control devices. The mechanical characteristics and specifications of a hydraulic power unit dictate the type of projects for which it can be effective

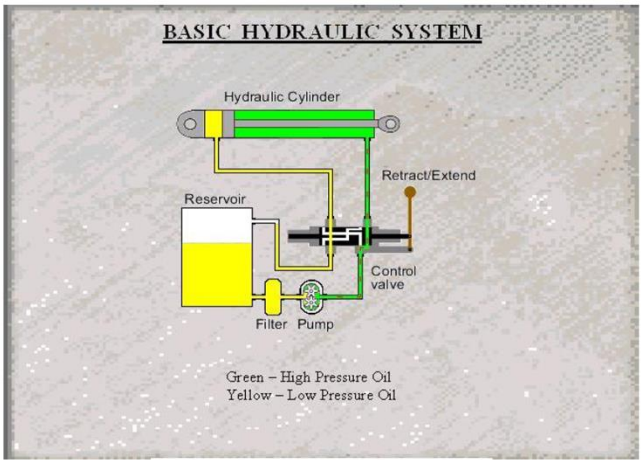

Figure 1 Basic Hydraulic System

Some of the important factors that influence a hydraulic power unit's performance are pressure limits, power capacity, and reservoir volume. In addition, its physical characteristics, including size, power supply, and pumping strength are also significant considerations. To better understand the operating principles and design features in a hydraulic power unit, it may be helpful to look at the basic components of a standard model used in industrial hydraulic systems.

As the temperature of hydraulic oil increases, input power falls – and if the total loss of power is greater than the heat dissipated, the hydraulic system will eventually overheat. And if oil overheats, it loses its lubricating properties and increases friction and wear on hydraulic components, meaning hardened seals and increased wear to the system. Another problem caused by high oil temperatures is reduced oil viscosity – which often leads to oil leakages. Because hydraulic components are constructed with very close tolerances, high heat and lubrication loss can also cause severe damage or seizure.

Repairs can be costly and at worst, operations may have to close down. In many cases it is possible to do without cooling of the power unit because due to the reduced energy consumption the hydraulic fluid will not heat up excessively. This in turn allows a compacter design which reduces complexity and acquisition costs.

II. REASON FOR HYDRAULIC COOLING

The viscosity of hydraulic oil needs to be suitable during operation for both transmissions of power and lubrication. This is very difficult to get right when there is a huge gaping hole between the temperatures of oil at a cold start, say 5°C, and that after continual running at 110°C. It's going to be hard to get hold of oil that can manage to perform in that type of scenario. Although seals and hoses are improving in design and materials all the time, they can still operate at their best with a temperature of 82°C before degradation begins. Even just 10°C above that temperature can have a huge effect on their lifespan. Hydraulic oil that gets very hot can suffer from oxidation (air) and hydrolysis (water).

III. LITERATURE REVIEW

According to M.L.R.ChaitanyaLahari, Dr.B.Srinivasa Reddy ,in their paper of the of Hydraulic Power Pack performance by increasing enhancement of heat dissipation" described hydraulic unit is part of any system providing power movements and heating up is caused due to inefficiencies which leads input power to waste. Like the need of oil cooler it will act for the cooling function. Reservoir is simple rectangular box which dissipates the heat that has to be painted and corrosion resistant. Conversion of input into heat so to reduce heat generation the construction and design of tank has to be changed and modified for better operation. Also fins will help to escape and reduce the temperature rising.

The total heat transfer rate has been improved by changing the material of the tank from Mild steel to Aluminum for the power pack and the simulation can be done even when the power pack of greater capacity is used. The limitation of the work is that the pressure bearing capacity is more for Mild Steel where the same is less for Aluminum. Interpretation of the work has been analyzed using design expert software and error is only 0.01% where less than 0.05% indicates model terms are significant.

According to SaurabhJanbandhu, Prof. Dr. A.K.Mahalle, Er. Ravi Kotangale, suggested a separate filtration cum cooling subsystem which is to be placed apart from the main system such that for the maintenance purpose, by this our hydraulic system will work properly with the desired performance. This consists of motor pump, filter, heat exchanger, temperature gauges to indicate the temperature.

According to Mahendra M. Dhanait, N.C.Ghuge, focuses on the design and performance analysis of a single unit of oil cooler, which consists of base module aluminum block with concentric channels for oil passage moving about a heat pipe evaporator section which then dissipates the heat to a rectangular fin structure assisted by forced air cooling. The paper discusses the selection of heat pipe for the application of oil cooling and performance of the heat exchanger in terms of LMTD, effectiveness and overall heat transfer coefficient

IV. RESULT AND DISCUSSION OF AUTHOR

According to Lahari and Reddy when total heat transfer rate has been improved by changing the material of the tank from Mild steel to Aluminum for the power

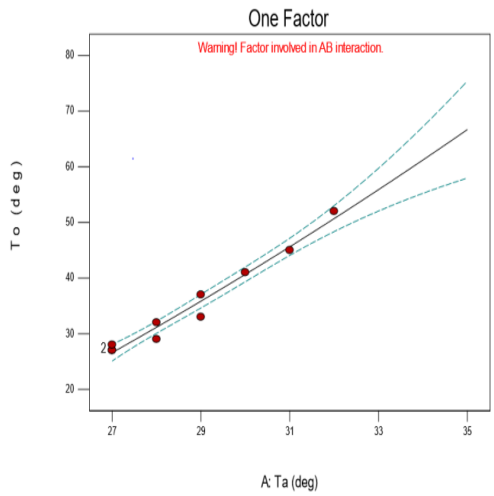

Figure 2(a):-Ta versus To for Mild

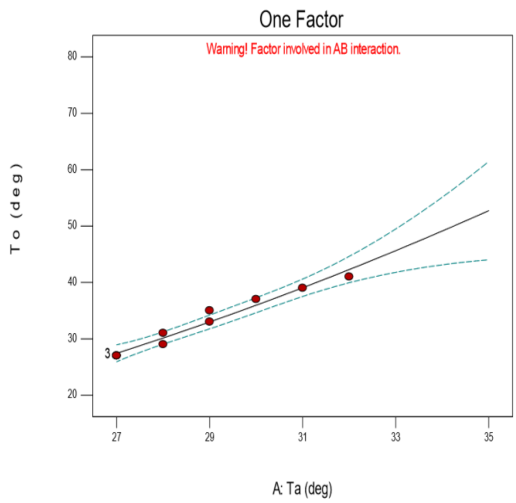

Figure 2(a):-Ta versus To for Aluminum

According to SaurabhJanbandhu, Prof. Dr. A.K.Mahalle, Er. Ravi Kotangale when separate system which will work as filtration cum cooling

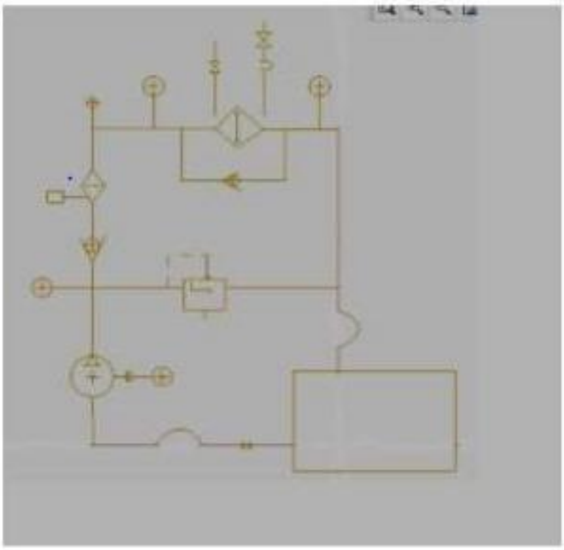

Figure 3:-Design and line diagram for filtering and cooling the main system

According to Mahendra M. Dhanait, N.C.Ghuge focuses on theHeat Pipe Oil Cooler Module with Cross Flow Structure for Hydraulic system

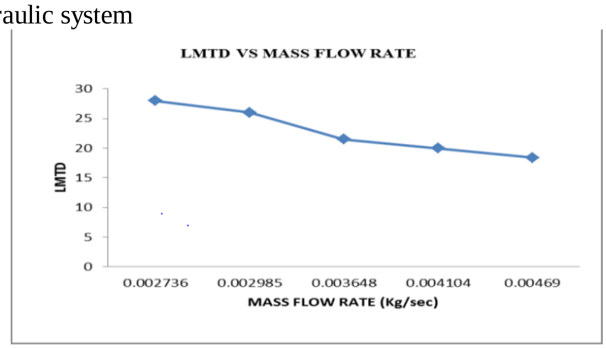

Figure 4:- Effect of logarithmic mean temperature difference (LMTD) of hydraulic system with surrounding v/s mass flow rate fluid in heat pipe.

It is observed from the graph that LMTD of heat pipe decreases as mass flow rate goes on increases. From above figure it is clear that value of LMTD is more for lower mass flow rate and as mass flow rate goes on increasing the LMTD goes on decreasing.

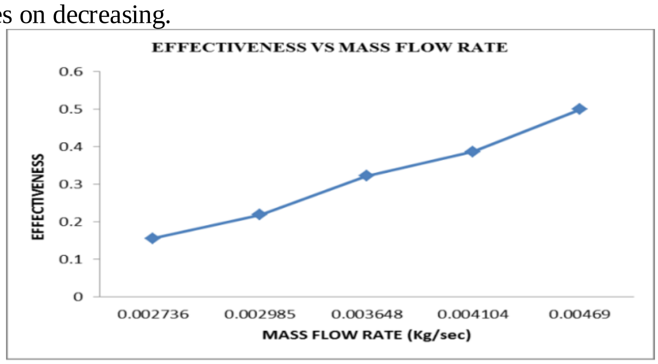

Figure 5:- Graph of Effectiveness v/s Mass flow rate

In figure for 0.1616Kg/sec mass flow rate the effectiveness is 0.15625 and it is increasing with increasing mass flow rate. For 0.2693Kg/sec mass flow rate the value of effectiveness is 0.5. It means the value of effectiveness is increase by 2.33 times than the first reading.

V. APPLICATION OF HYDRAULIC POWER PACK

- Vertical Turret Lathe is designed with hydraulic power pack compositely for various motions like clamping and holding it, unclamping is attended by hydraulic power system.
- Hydraulic systems are compacting versatile and reliable it is used integrally. Automation mechanization is easily done with hydraulic drives and controls.
- Industrial movement system is inconceivable without hydraulics so has to be maintained and studied for improved performance.

VI. CONCLUSION

From review of research paper, It is found the replacing the mild steel material in hydraulic power pack with aluminum will increase heat dissipation in system but aluminum has less strength than mild steel therefore it is not practically possible to replace it because hydraulic power pack has to go under large pressure (30 bar to 350 bar) .Similarly using heat pipe and separatecooling cum filtration system will give the best result but it will make the system bulky and complex therefore the best and optimum result will be obtained by mounting fins on tank reservoir.

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