ANALYSIS OF TWO STAGE BEVEL GEAR BOX FOR REDUCTION IN INPUT SIDE BEARING TEMPERATURE – A REVIEW

Pragnesh Kanzariya[1], Dr. P.M.George[2], Mr. P.M.Agrawal[3]

1Student, Mechanical Department (M.E.), B.V.M. Engineering College, Gujarat, India
2 Professor, Mechanical Department, B.V.M. Engineering College, Gujarat, India
3Associate Professor, Mechanical Department, B.V.M. Engineering College, Gujarat, India

ABSTRACT

In today's era, efficiency of any machine is very crucial. Gearbox is a very important component for transmission of power from one shaft to another having short distance between centers. If efficiency of gearbox is less, then it affect efficiency of whole system. So it is required to improve efficiency of gearbox. In this gearbox, it has been observed that temperature at input side shaft bearing is higher than permissible limit. This paper involves discussion of analytical approach and simulation approach for reduction in bearing temperature. ANSYS CFX is very useful soft ware package to simulate fluid condition and temperature distribution is carried out by steady state thermal analysis. Boundary conditions and meshing methods used for simulation of temperature are discussed in this paper.

Keyword :- *CFD, CFX, MRF, Churning loss, Windage loss*

1. INTRODUCTION :

Generally gearbox is used to transmit power from one shaft to other shaft in short distance. So, efficiency is more concern with power transmit element. Gear power losses are classified into load dependent losses and no-load dependent losses. Gear power loss in a gearbox includes gear, bearing, seal and auxiliary losses. Gear and bearing conclude both type of losses. No-load bearing losses dependent on type, size, arrangement of bearing, lubricant viscosity and oil supply to bearing.

In this case splash lubrication system is use for lubrication and heat removal purpose. If adequate amount of oil is not supply to bearing then this power losses of bearing increases and it causes adverse effect on efficiency of gear box. So it is very important to analyse oil flow system. There are many parameters which affect the efficiency of gear box. Out of them one is heat dissipation rate. Heat is generated due to power losses in gear and bearing. In bearing, generally main reason of heat generation is lack of oil supply. The oil film thickness create in bearing also play role for heat generation.

2. LITERATURE REVIEW :

B. R. Hohn, K. Michaelis, M. Hinterstoiber[1] discuss about various power losses like gear, bearing, seal, auxiliary within gearbox and effect of some parameters on the power losses and efficiency of the gearbox. These parameters are immersion depth of the component, viscosity of oil, additive added in oil, etc. They worked out on influence of design and operating temperature on bearing losses. They concluded that maximum efficiency could be achieved by change of lubricant type, viscosity and supply to the component.

Jurgen Liebrecht, Xiaojiang Si, Bernd Sauer, Hubert Schwarze[2] discuss about experimental investigation of the drag and churning losses in tapered roller bearing. They also focus on influence of rotational speed, oil viscosity and oil level on the windage and churning loss of the tapered roller bearing. They also work out on CFD simulation of single phase flow considering the air content and influence of air content on windage and churning

loss. So, from this research paper, we can get idea about effect of various parameter on churning loss and minimize their effect on this losses.

Serge A. Cryvoff, Asoke K. Deysarkar[3] discuss about method to find bearing oil film thickness. They established a series of reference oils, to measure their bearing oil film thickness. So from this we can measure the oil film thickness for this bearing.

F. Concli, C. Gorla[4] discuss about influence of operating and geometry parameter on the windage and churning loss of the gears. They conclude that oil level affect more on windage and churning loss of the gear and disc, they also give comparison of two approaches like sliding mesh and Moving Reference Frame (MRF).

Carlo Gorla and et. al.[5] discuss about CFD simulation for churning losses which occur when simple disc or gear is placed in enclosed geometry filled with oil. They prefer specific meshing method for meshing of the gear and CFD energy model required for this type of geometry. They conclude that error between experimental and CFD analysis is within 5% for this setup.

M. Chandra Sekhar Reddy[6] discuss about meshing condition used for taper roller bearing. It is very useful during meshing section in steady state thermal analysis of taper roller bearing.

M. Premkumar and Dr. C. J. Rao[7] discuss about boundary conditions given to the taper roller bearing for steady state thermal analysis. Using this data we can find temperature distribution within the bearing for different oils and flow rates.they discuss about main boundary conditions taken for tapered roller bearing are Conduction, Convection, Heat flow, Radiation.

Jafar Takabi and M. M. Khonsari[8] discuss about thermal network for bearing assembly. They also make mathematical model to solve the problem. They show that temperature of the bearing is increases by using higher viscosity oil. They take three oil samples, SAE 20, SAE 30 and SAE40. Out of these SAE 40 shows higher temperature during operation.

3. PROBLEM DISCRIPTION AND METHODOLOGY

This is two stage bevel gearbox using to transmit power to forced fan in cooling tower. Drawing sheet of gear box is shown in figure 1.The first stage is bevel gear and second stage is helical gear. All data related to this gear box is given in Table 1 and Table 2. Data related to bearing is shown in table 3. Problem in this type of gear box is that temperature in input side bearing is drastically increase and reaches at very high level than permissible like it reaches about 105˚ which is dangerous for the function of the gear box. So our task is to reduce bearing temperature eat input side and reach it about 80℃.

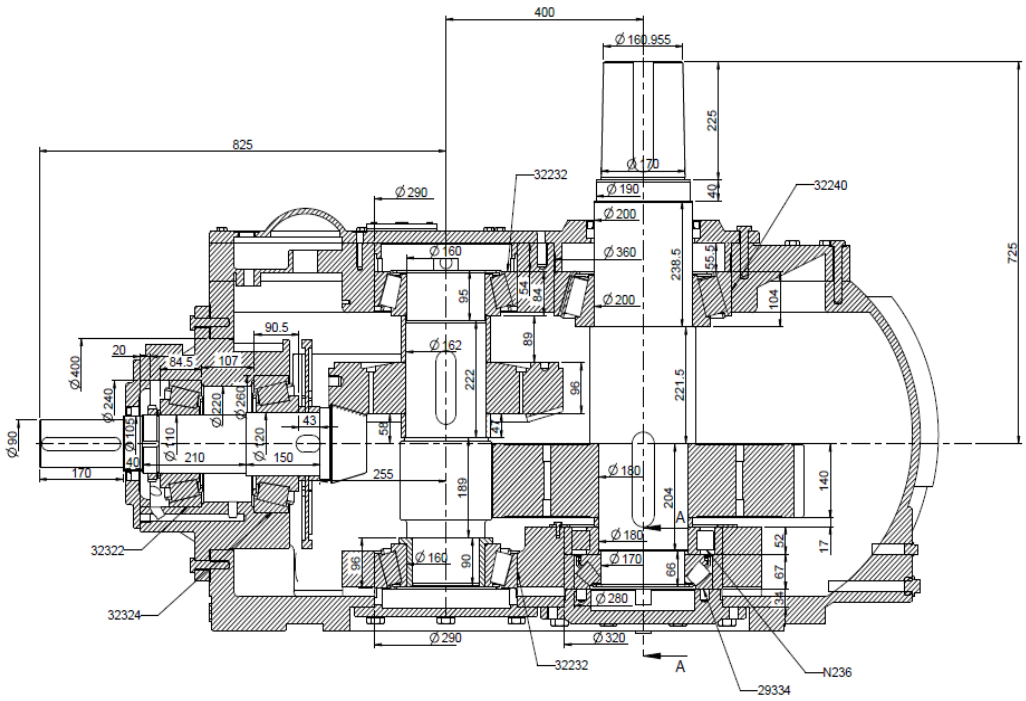

FIGURE 1 : Drawing of two stage bevel gear box

First of all we require to calculate all power loss related to gear, bearing, seal using analytic method. After finding these value of the losses then we analyze gear box for the oil path and then find the quantity of oil flow in the bearing. For this calculation we will require ANSYS CFX software package. Then we will calculate if this amount of oil will remove heat or not. If amount of oil flow in the bearing is less then our concentration will only on increase the amount of oil and again we will find flow rate of oil in the bearing using ANSYS CFX and if satisfactory data will get then we will implement in gear box. If we will get adverse data then we will require to find another way to remove heat by change in oil, change in oil level, change in bearing dimension, change in oil path, change in geometry of thrower.

DESIGNATION	NAME	BRAND	SHAFT SYSTEM	INNER DIAMETER (mm)	OUTER DIAMETER	WIDTH
32324	TAPERED ROLLER BEARING	FAG	INPUT	120	260	90.5
32322-A	TAPERED ROLLER BEARING	FAG	INPUT	110	240	84.5
32232-A	TAPERED ROLLER BEARING	FAG	INM	160	290	84
32232-A	TAPERED ROLLER BEARING	FAG	INM	160	290	84
32240-A	TAPERED ROLLER BEARING	FAG	OUTPUT	200	360	104
N236-E-M1	SPHERICAL ROLLER BEARING	FAG	OUTPUT	180	320	52
29334-E1	THRUST SPHERICAL ROLLER BEARING	FAG	OUTPUT	170	280	67

TABLE 1 : BEARING SPECIFICATION

PARAMETER	PROPERTY	UNIT
TYPE	ISO VG-320	
LUBRICANT BASE	MINERAL OIL BASE	
KINEMATIC VISCOSITY AT 40℃	320	mm^2/s
KINEMATIC VISCOSITY AT 100℃	22	mm^2/s
SPECIFIC DENSITY AT 15℃	0.9	

TABLE 2 : OIL PROPERTY

4. CONCLUSION & FUTURE SCOPE :

From the review of research paper we conclude that oil type, oil viscosity, oil level in gear box, flow rate of oil are affect the power losses and also affect the temperature of the oil and other component contact with oil. So to minimization of temperature is prior for effective working of bearing.

5. REFERENCES :

[1] Bernd-Robert H.,Klaus M., Michael H., " Optimization of Gear box Efficiency", Goriva i Maziva (Fuels and Lubricants) (2009), ISSN 0350-350X, GOMABN 48,4, pp. No. 441-480.

[2] Jurgen L.,Xiaojiang Si, Bearnd S., Hubert S., "Investigation of Drag and Churning Losses on Taper Roller Bearings", Journal of Mechanical Engineering 61(2015)6, pp. No. 399-408.

[3] Serge A. C., Asoke K. D., "Relating High-Temperature, High-Shear Viscosity to Bearing oil film Thickness Measurements", Journal of American Society for Testing and Materials STP 1068 (1989), pp. No. 74-90.

[4] Concli F., Gorla C., "Analysis of the power losses in geared transmissions - measurements based on open source codes", International Gear Conference (2014), pp. No.1131-1140.

[5] Carlo G., Franco C., Karsten S., Beand-Robert H., Michaelis K., Hansjorg S., Johann-Paul S., "CFD simulation of Splash Losses of a Gearbox", Advance in Tribology, Volume 2012, Article ID 616923, pp. No. 1-10.

[6] M. Chandra Sekhar Reddy, "Thermal Stress Analysis of a Ball Bearing by Finite Element Method", International Journal of Advanced Research in Engineering and Technology, Volume 6, Issue 11, November (2015), pp. No. 80-90.

[7] M. Prem Kumar, Dr. C. J. Rao, "Structural and Thermal Analysis on a Taper Roller Bearing", International Journal of Innovative Science , Engineering & Technology, Volume 2, Issue 1, January (2015), pp. No. 502-511.

[8] Jafar T., M. M. Khonsari, "Experimental testing and thermal analysis of ball bearings", Tribology International 60 (2013), pp. No. 93-103.