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Improve the Thermal Efficiency of Gearbox Using Different Type of Gear Oils

Nirvesh S. Mehta, Nilesh J. Parekh, Ravi K. Dayatar

Abstract— Gear box performance is dependent on viscosity of lubricant oil and due to the thermal effect of heat generated in side of an oil span of gear box. Thus if we change properties of an oil, the performance of gear box does change. The effect on gear box performance will be studied by CFD Analysis. CFD analysis of gear box is carried out for different viscosity oils. For the analysis purpose design of Maruti Omni's gear box is used. Compression of thermal analysis is done for different viscosity oils are SAE 85W 140 (High Grade), SAE 85W 140 (Commercial), SAE 80W 90 (High Grade),SAE 80W 90 (Commercial), SAE 75W 90 (High Grade),SAE 75W 90 (Commercial),SAE EDIB (Suggested Oil). So it is proved that suggested oil SAE EDIB is better than available market oils.

Index Terms—About four key words or phrases in alphabetical order, separated by commas.

I. INTRODUCTION

Gearboxes are used in almost every industry right from power to marine, and also include agriculture, textile, automobiles, aerospace, shipping etc. There are different types of gearboxes available for varying uses. Gear box performance is depends on viscosity of lubricant oil and due to the thermal effect of heat generated in side of oil span in gear box changes in properties of oil is taken place. Due to this, whatever changes taken place in viscosity of oil and due to that what will be the effect on gear box performance will study by analysis in CFD in gearbox. CFD analysis has been carried out on different oils having different viscosity which affects the performance of gear box. For that, a model of gear box is generated with the help of 'Solid works' software and analysis is carried out in 'ANSYS' software.

II. CFD ANALYSIS OF GEARBOX

For CFD Analysis of gear box first of all modal of gear box is prepared in solid works which is shown in fig 1. After making the modal it is imported in ANSYS workbench. For CFD Analysis first of all meshing of gear box is done. The element chose for meshing by ANSYS is ten nodes tetrahedral shown in fig.2 this element is good for meshing in curvature area. After meshing required boundary conditions are inserted in pre processor

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A. *Prepare* ***modal gearbox***

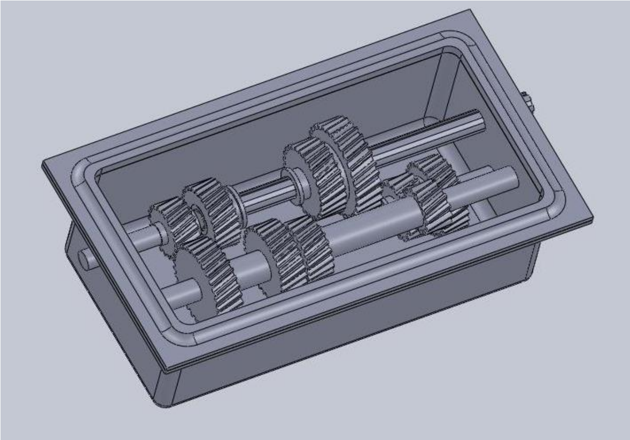

Fig 1 : Modal of gear box

B. *Meshing of Gearbox*

To do this, FEA software typically uses a CAD representation of the physical model and breaks it down into small pieces called finite "elements" (think of a 3-D puzzle). This process is called "meshing".

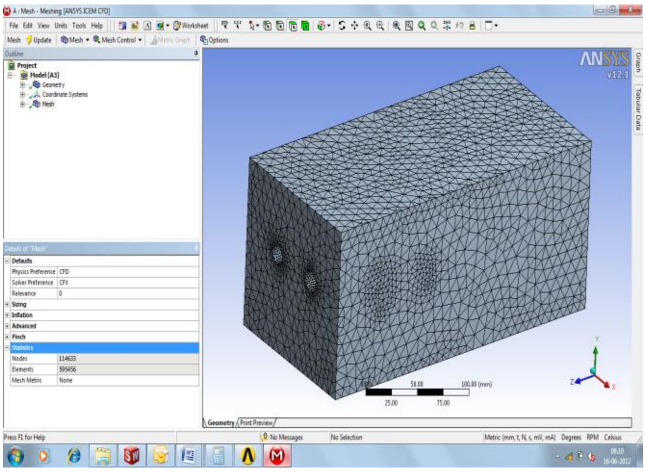

Fig 2 : Meshing of gear box

C. *Material Property*

Materials in the Workbench are imported from material library available in ANSYS database. If the material is not available in material library then it also defines manually.

D. *Boundary Condition*

In Pre processor various boundary condition is define. In present analysis first step in pre processor is define the domain. There are one domain are define gear oil. Here the gear is defining as rotating domain and speed of rotation is 5000 rpm.

This rotation effect is transferring to the oil which also rotating domain. The input temperature at outer surface of the heater is given as boundary condition is 100° c.

Details of domain in flow analysis are shown in fig.3

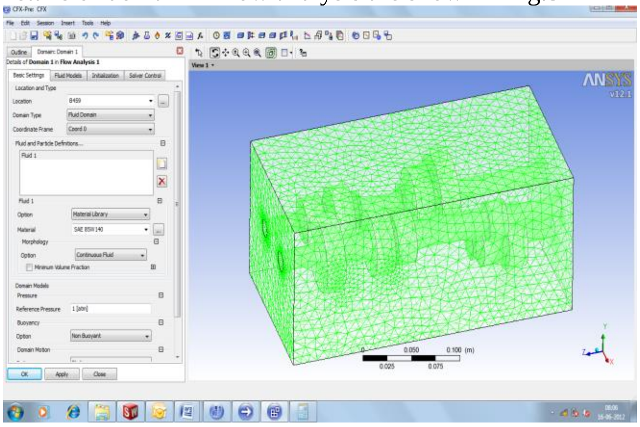

Fig.3 Details of domain in flow analysis

Boundary condition details of wall in domain in 1 in flow analysis shown in fig.4 below;

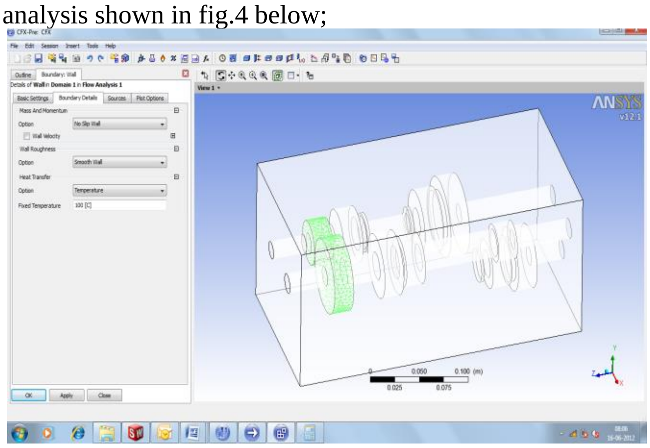

Fig.4 Details of Wall in Domain in 1 in flow analysis

E. POST PROCESSOR

A select set of results is available for the user to view and interrogate. The set of results include fundamental stress, strain, deformation, thermal, shape optimization, mode shape, and fatigue. Finally all result is showing in post processor for different type of oil. All result of temperature difference and viscosity difference for different oils are shown below.

III. TEMPERATURE DISTRIBUTION OF DIFFERENT OILS

A. SAE 85W140 (HIGH GRADE)

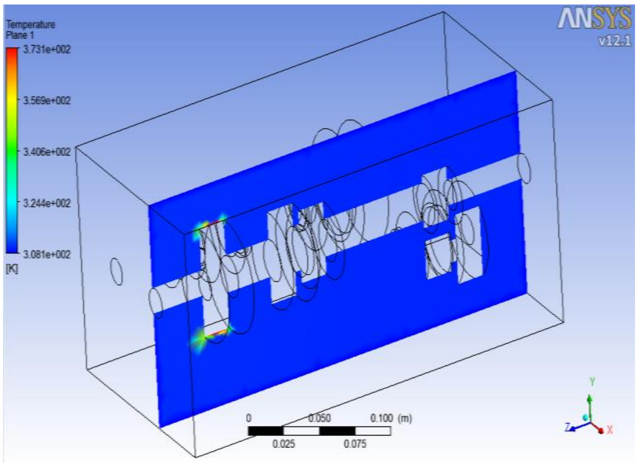

Fig 5 : Temperature distribution for SAE85W140 (High Grade)

B. SAE85W140 (COMMERCIAL OIL)

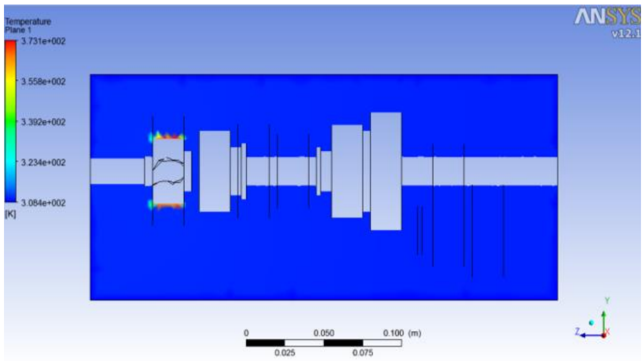

Fig 6: Temperature distribution for SAE 85W140 (Commercial Oil)

C. SAE 80W90 (High Grade)

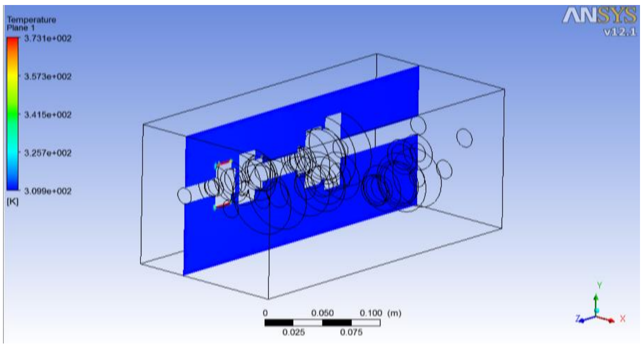

Fig 7: Temperature distribution for SAE 80W90 (High Grade)

D. SAE 80W90 ((Commercial Oil)

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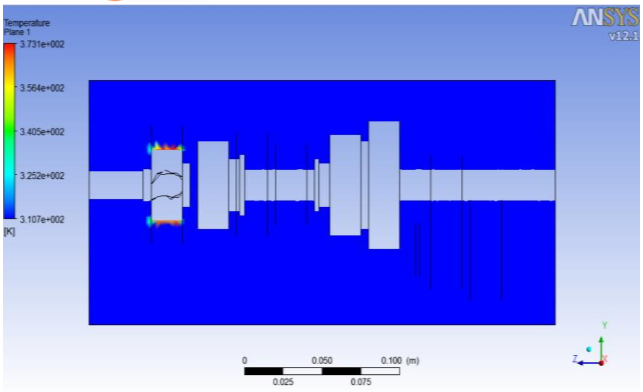

Fig Fig.8: Temperature distribution for SAE 80W90 (Commercial Oil)

E. *SAE 75W90 (High Grade)*

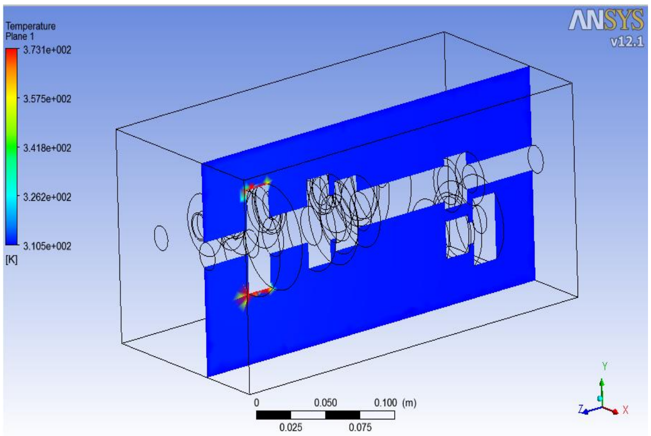

Fig 9: Temperature distribution for SAE 75W90 (High Grade)

F. *SAE 75W90 (Commercial Oil)*

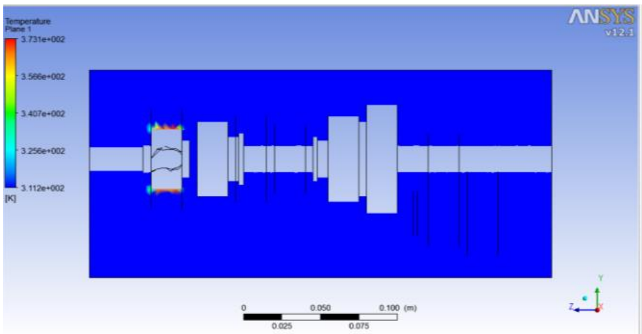

Fig 10: Temperature distribution for SAE 75W90 (Commercial Oil)

G. *SAE EDBI (Suggested Oil)*

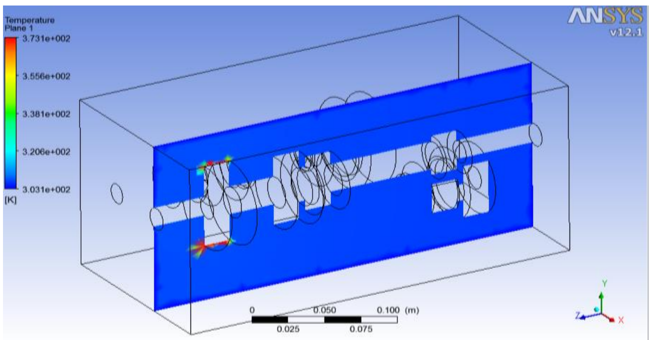

Fig 11: Temperature distribution for SAE EDBI (Suggested Oil)

IV. VELOCITY DISTRIBUTION OF DIFFERENT OILS

A. *SAE 85W140 (HIGH GRADE)*

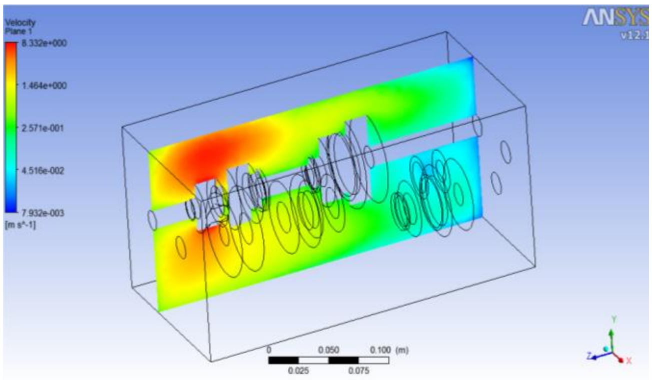

Fig.12: Velocity distribution for SAE 85W140 (High Grade)

B. *SAE85W140 (COMMERCIAL OIL)*

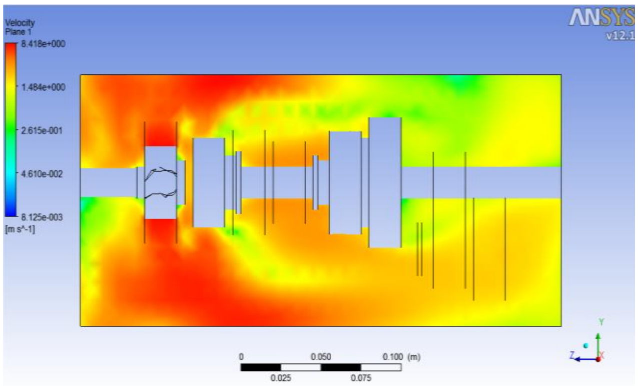

Fig.13: Velocity distribution for SAE 85W140 (Commercial)

C. *SAE 80W90 (High Grade)*

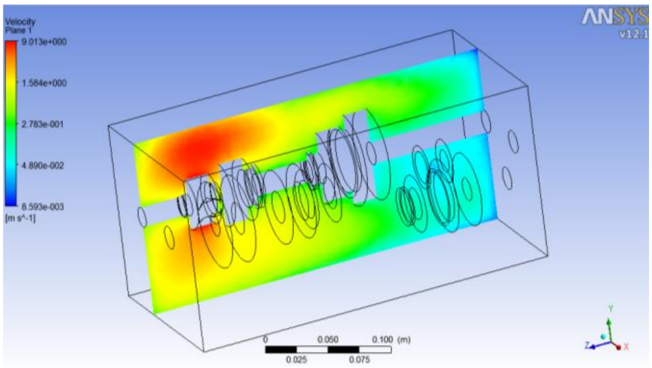

Fig.14: Velocity distribution for SAE 80W90 (High Grade)

D. *SAE 80W90 (Commercial Oil)*

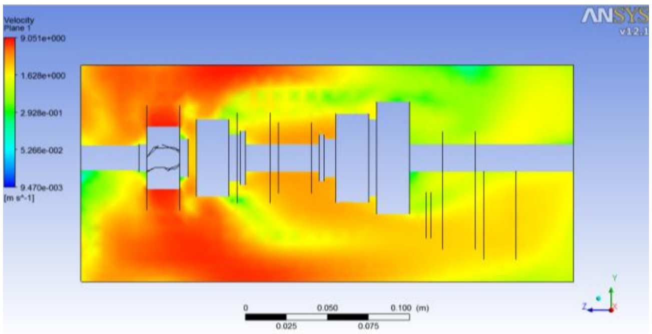

Fig.15: Velocity distribution for SAE 80W90 (Commercial)

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E. SAE 75W90 (High Grade)

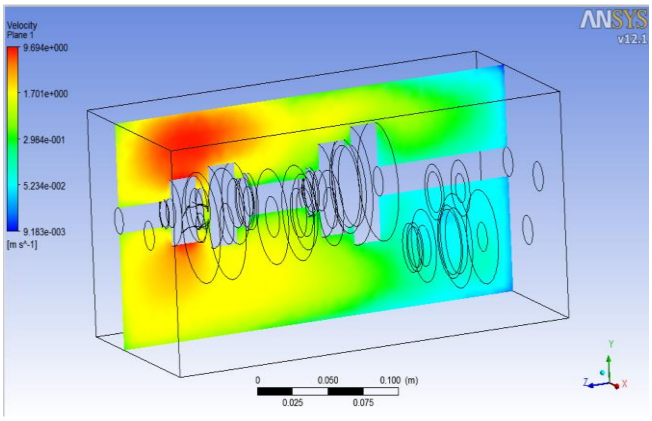

Fig.16: Velocity distribution for SAE 75W90 (High Grade)

F. SAE 75W90 (Commercial Oil)

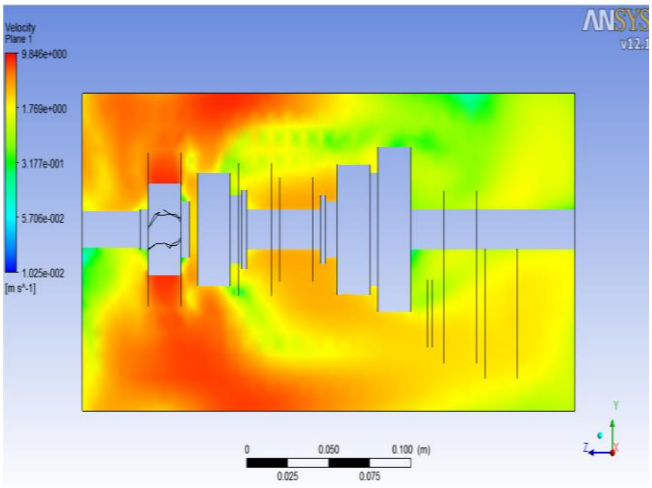

Fig.17: Velocity distribution for SAE 75W90 (Commercial)

G. SAE EDBI (Suggested Oil)

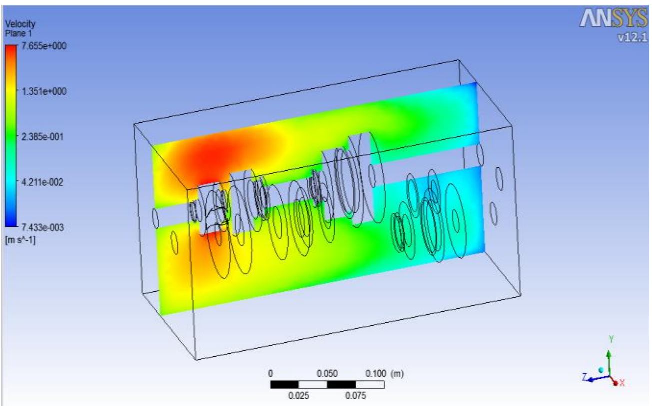

Fig.18: Velocity distribution for SAE EDIB

V. RESULT

Comparison of different type of gearoils result shown in table.1.

Table:1 Comparison of oil

	EFFICIENCY DIFFERENCE	TEMPERATURE DIFFERENCE	VISCOSITY
SAE 85W140 1	17.42%	65 K	24.71 Cst
SAE 85W140 2	17.31%	64.7 K	22.67 Cst
SAE 80W90 1	16.94%	63.2K	24.5 Cst
SAE 80W90 2	16.72%	62.4 K	23.1 Cst
SAE 75W90 1	16.78%	62.6K	23.2 Cst
SAE 75W90 2	16.59%	61.9 K	22.8 Cst
SUGGESTED OIL (SAE EDIB)	19%	70K	25.14 Cst

VI. CONCLUSION

Result of temperature difference for different oils are shown below. **:** Generally high grade oils can be used for life time and commercial oils can be used for certain kilometers. It has been observed that if the temperature difference increase viscosity of oils are decrease from this range of oils, so the efficiency also increase. By the analytical work carried out on different oils having different viscosity and on the base of that it has been observed that different oils effects the performance of gearbox due to the occurrence of thermal effect. It has been also observed that the temperature difference of suggested oil is the highest, as compared to all listed oils. Due to these phenomena, the efficiency of suggested oil is higher among all listed oils. So suggested oil improve the performance of gearbox as compared to all listed oils.

REFERENCES

[1]. Seetharaman, S., Kahraman, A., Bednarek, G. and Rosander, P., 2008, “A Model to Predict Mechanical Power Losses of Manual Transmissions,” Automobiltechnische Zeitschrift, April 2008, Issue4, pp. 346-357.

[2]. Seetharaman, S., Kahraman, A., 2008, “Load Independent Spin Power Losses of a Spur Gear Pair: Model Formulation,” (in review) Journal of Tribology.

[3] Seetharaman, S., Kahraman, A., Moorhead, M. D., and Petri-Johnson, T. T., 2008, “Load Independent Spin Power Losses of a Spur Gear Pair: Experiments and Model Validation,” (in review) Journal of Tribology.

[4] Martin, K. F., 1978, “A Review of Friction Predictions in Gear Teeth,” Wear, 49, pp. 201-238.

[5] Yada, T., 1997, “Review of Gear Efficiency Equation and Force Treatment,” JSME Int. J., Ser. C, 40, pp. 1-8.

[6]. Li, Y., and Seireg, A. A., “Predicting the Coefficient of Friction in Sliding-Rolling Contacts,” Tribology Conference, K18

[7]. Heingartner, P, and Mba, D., 2003, “Determining Power Losses in the Helical Gear Mesh,” *Gear Technology*, September/October 2005, pp. 32-37.

[8]. Changenet, C., Oviedo-Marlot, X., and Velex, P., 2006, “Power Loss Predictions in Geared Transmissions Using Thermal Networks-Applications to a Six-Speed Manual Gearbox,” Transactions of the ASME, Vol. 128, pp. 61

[9]. Prakash D. Patel, “An Experimental investigation of power losses in manual transmission gear box”.

[10]. Carlo Gorla, Franco Concli, Karsten Stahl, Bernd-Robert Hohnet, Michaelis Klaus, Hansjorg Schultheiß, and Johann-Paul Stemplinger, “CFD Simulations of Splash Losses of a Gearbox”.

[11]. B. R. Hohnet F. Concli & C. Gorla, “Oil squeezing power losses in gears: a CFD analysis”,

[12]. V. Chernoray & M. Jahanmiri, “Experimental study of multiphase flow in a model gearbox”.

[13]. Solidworks software.

[14]. ANSYS V 12.1

[15]. Pro-E Wild Fire

[16]. www.peakantifreeze.com

[17]. Wikipedia “Gearbox”.

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