CFD Simulation and Analysis of Lubricating Oil for 4-Speed Automobile Gearbox

Shyam K. Dabhi, Nilesh J. Parekh, Bindiya A. Parikh

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. The equations of fluid mechanics which have been known for over a century are solvable only for a limited no. of flows. The known solutions are extremely useful in understanding fluid flow but rarely used directly in engineering analysis or design. CFD makes it possible to evaluate velocity, pressure, temperature, and species concentration of fluid flow throughout a solution domain, allowing the design to be optimized prior to the prototype phase.

Keywordss— Modelling, Ansys, HG(high grade oil), CO(Commercial oil).

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. 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 GEAR BOX

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.When you submit your final version, after your paper has been accepted, prepare it in two-column format, including figures and tables.

Table I: Meshing detail of gearbox

Number of Nodes	114634
Number of Elements	595466

A. Geometry model of Geabox.

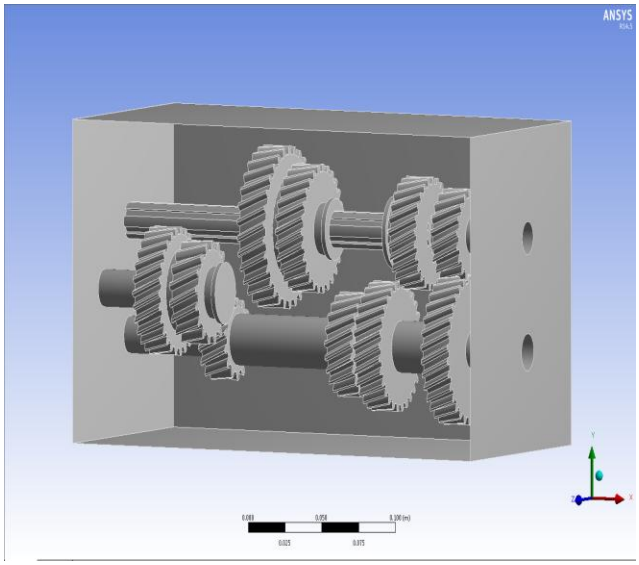

Fig 1 : Section view of gear box

B. Meshing of Gearbox

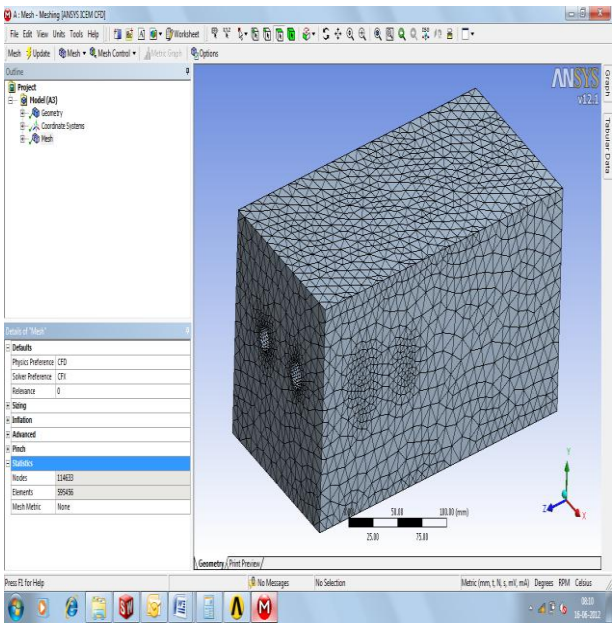

Fig 2: Meshing of gear box

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.

C. Material Property of SAE80W90

Material Property of gear oil SAE80W90 (High Grade oil) and SAE 80W90 (Commercial oil) inserted in ANSYS is shown in fig 3. and fig.4.

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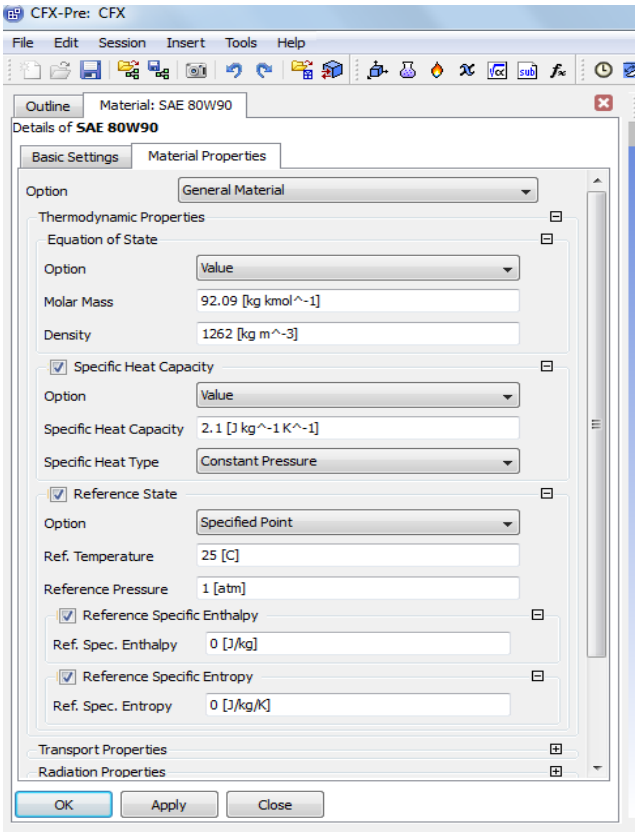

Fig 3: Property of SAE80W90 (High Grade)

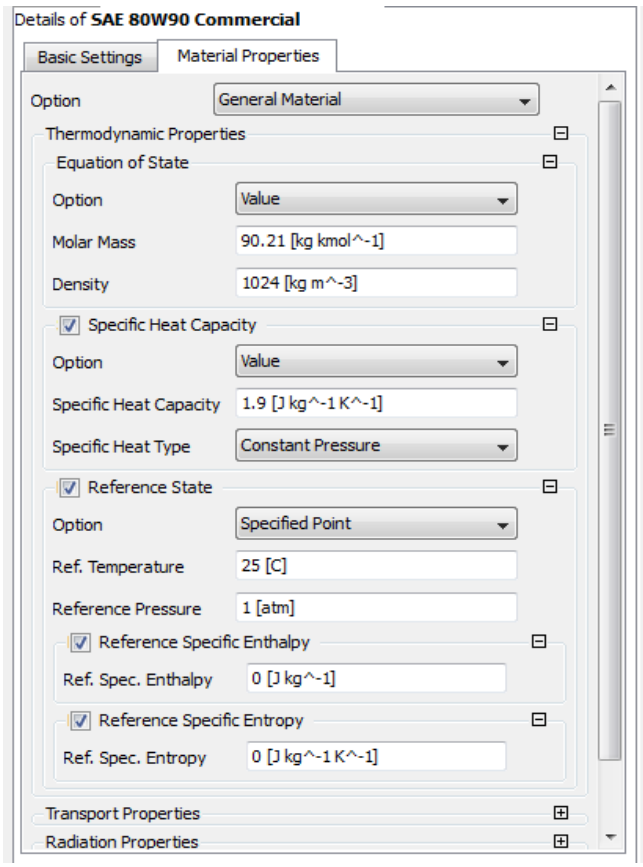

Fig 4: Property of SAE80W90 (Commercial)

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 shown in fig.5.

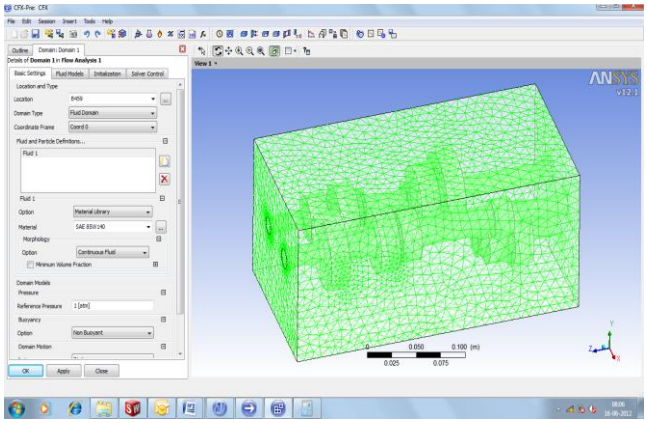

Fig 5: Boundary condition

Finally all result is showing in post processor for different type of oil. All result of temperature difference for different oils are shown below fig.6 and fig.7.

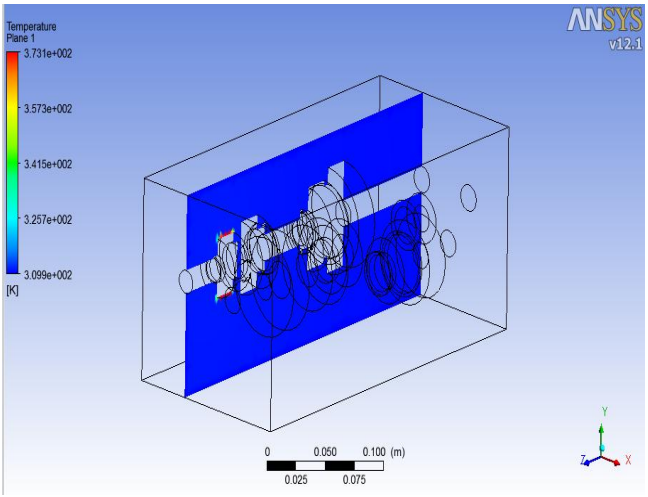

Fig 6: Temperature contour 80W90 (High Grade)

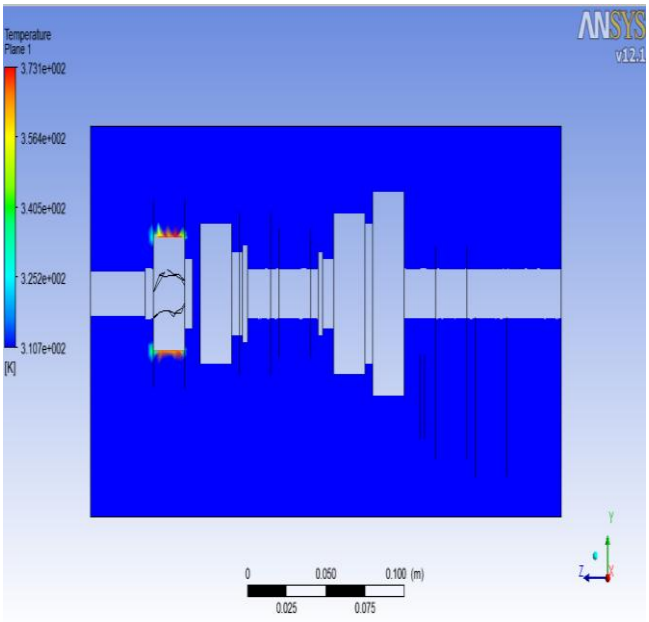

Fig 7: Temperature contour 80W90 (Commercial oil)

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III. EXPERIMENTAL SETUP OF GEARBOX

Fig. 8[8]experimental setup of gearbox

A special-purpose test set-up fig. 8 was developed in this study to allow a direct measurement of the power loss of an example of maruti Omni five speed (four forward and one reverse) automotive manual transmissions under varying load, oil viscosity and oil volume conditions at each gear range and find the temperature difference in gearbox

IV COMPARISON

Comparison between Practical Reading and ANSYS result is shown in table no.2 below.

Table no: 2 Result and Comparisons

	ANSYS RESULT	PRACTICAL READING
Maximum Temperature (SAE 80W90 HG)	373 k	374.3 k
Minimum Temperature (SAE 80W90 HG)	310.2 k	305.3 k
Maximum Temperature (SAE 80W90 Com.oil)	373	373.6 k
Minimum Temperature (SAE 80W90 Com.oil)	311	308.4 k

V. CONCLUSION

ANSYS is very important software for analysis purpose. The application of ANSYS is wide in engineering field. In table no 2 ANSYS and experimental result are compared and found in good agreement, thus proving the strength of model. After completing CFD Analysis Results, we can say that CFD Analysis is a good tool to avoid costly and time consuming Experimental Work. It also reduces the lead time of New Product Development Chain.

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