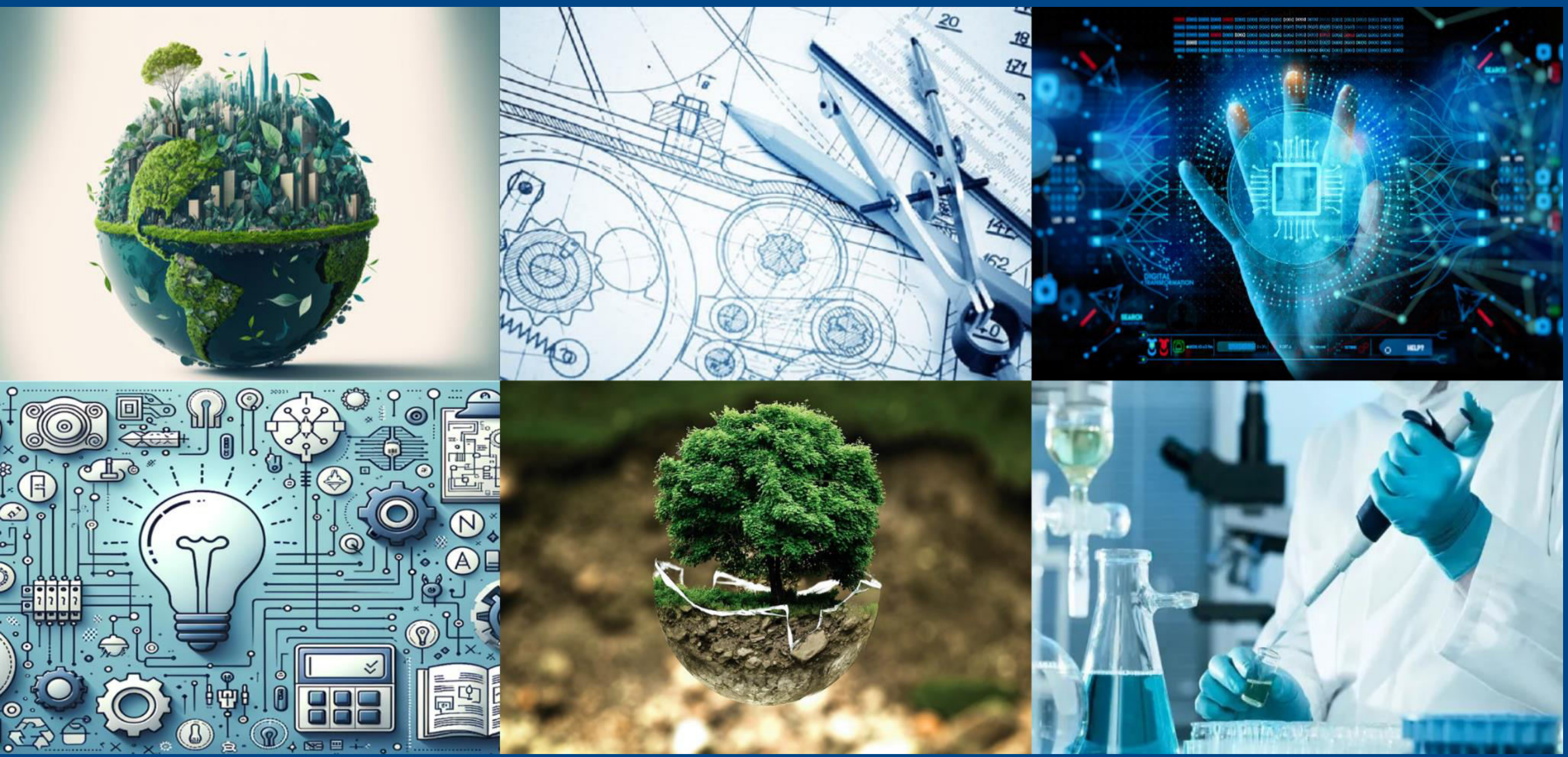
ISSN: 2582-7219

International Journal of Multidisciplinary Research in Science, Engineering and Technology

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.206

Volume 8, Issue 6, June 2025

www.ijmrset.com ijmrset@gmail.com +91 6381 907 438 +91 63819 07438

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Performance Characteristics of Pressure Profile of Journal Bearing by using different types of lubricating oil

Sourabh Prasad[1], Ashesh Tiwari[2]

Post Graduation Scholar, Department of Mechanical Engineering, Institute of Engineering and Technology, Devi Ahilya University, Indore, India[1]

Professor and Head, Department of Mechanical Engineering, Institute of Engineering and Technology, Devi Ahilya University, Indore, India[2]

ABSTRACT: Journal Bearings are widely uses in manufacturing (Specially in machines) due to their ability to support rotating shaft, reduce friction and ensure smooth operation of machinery. It operates under hydrodynamics lubrication. These lubricating oil creates a thick film between the surface of bearing and shaft. Which reduces the metal to metal surface contact between them, due to this friction reduces and life of bearing and shaft increases. A good lubricating oil also reduces the energy losses or we can save the energy.

In this paper we present an experimental study of pressure distribution on hydrodynamic journal bearing with SAE 20W50, SAE 20W40, SAE 15W40, SAE 10W40, SAE 10W30, SAE 5W30 lubricating oils. Hydrodynamic journal bearing used for test whose diameter of journal is 49.5mm, diameter of bearing is 50mm and effective width of bearing is 100mm. A constant load is applied at a two different journal rotational speed 750, 1000 rpm. From the experiment data is generated and by using those data form the pressure profile of different lubricating oil and compared their pressure profile curve.

KEYWORDS: Hydrodynamic bearing, Journal bearing, Lubricating oil, thick film lubrication, Pressure profile, Pressure distribution.

I. INTRODUCTION

Journal bearings are common in many types of machinery. The main function is to support radial load and facilitate motion and as well as transfer of power. A journal bearing consists of two main components where the shaft called journal rotates freely in its shell or bushing known also as bearing.[1] Journal bearings are used as essential bearings in most rotating machinery, such as steam turbine, blower, compressor, internal combustion engine, rolling mills and ship propulsion shafts etc. There is a need for improvement in journal bearings performance [2].Oil-lubricated sliding bearings are commonly employed in highspeed rotating and reciprocating machines such as turbines and compressors due to their good load-carrying capacity and durability [3].Oil is used in journal bearings to create a thin film between the rotating shaft and the bearing housing, significantly reducing friction and wear by preventing direct metal-to-metal contact, essentially allowing the shaft to rotate smoothly with minimal resistance, this lubrication also helps to dissipate heat generated during operation and flush away debris from the bearing surface. [4] Hydrodynamic Journal bearing is a critical power transmission component that carry high load in different machineries. It is essential to study the performance characteristics under the different loading and operating conditions. The behaviour of Hydrodynamic Journal Bearing is also dependent on lubricant used.[5]. We will measure the pressure which are exerted on the surface of journal bearing. By uses oil it creates a thin film of lubricants between a rotating shaft and a stationary bearing shell, which minimizes direct contact between the surfaces therefore reducing friction and allowing smoot rotation. This lubricating film is generated by the shaft rotation essentially “floating” the shaft within the bearing through a hydrodynamic principle, where the oil is drawn into the converging gap between the shaft and bearing creates pressure that supports the load and lifts the shaft slightly.

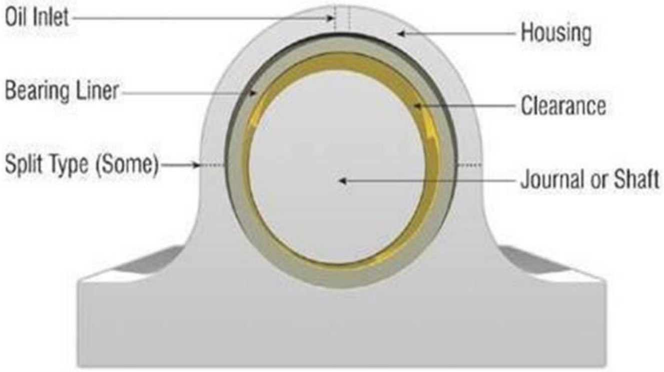


Fig1. Hydrodynamic journal bearing

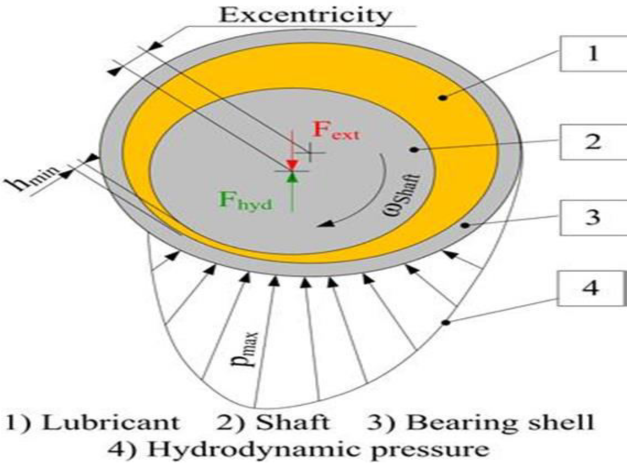


Fig2. Pressure distribution curve

II. RESEARCH GAP

A significant research gap exist to how varying oil properties like viscosity, additives and base oil composition impact bearing performance under the diverse operating condition, including high speeds, heavy loads and extreme temperature by using different lubricants oil.

How does the viscosity grade of different base oils affect journal bearing friction and wear under varying load and speed conditions.

In the manufacturing industry the machines are operating at low load and high and medium speed so it is crucial to the life of machine component and the energy consumption which overall affect on the costing of manufacturing of product so that's why the according to the process the good lubricating oil is essential.

III. LITERATURE REVIEW

1. An Experimental Investigation of Hydrodynamic Journal Bearing with Different Oil Grades. Port-Said Engineering Research Journal. September 2019. Marey N.M

- He finds in his Experimental steady , the values relating to the maximum film pressure ratio P0/Pmax for the lubrication oils being tested, that is, SEA 20W50, SEA 10W40 and SEA 5W30 at maximum speed of 400 RPM were 0.2, 0.6 and 0.3 respectively.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

2. Research on the lubricated characteristics of journal bearing based on finite element method and mixed method. Ain Shams Engineering Journal 2013. Zhou W, Wang Y, Guangkuan W, Bo Gao , Zhang W.

- He find the pressure is symmetric in the axial direction while it increases first and then decreases to zero remarkably at the place of minimum thickness of lubricant film in the circumferential direction. In addition, the pressure peak curve presents nonlinear characteristics with the change of diameter, viscosity and external force.

3. Experimental study on hydro- thermal behaviour of journal bearing oil film profile in a slow speed diesel engine. Alexandria Engineering Journal 2023. Nour A. M, Wael M, Mohamed F.

- In contrast, with 20W50 at the same operational conditions but under different loads, that difference represented 13.7%. Hence, 5W40 evidently offers a better alternative than 20W50 in such operational conditions based on the lower values obtained regarding Pmax difference.
- By contrast, 20W50 outperforms 5 W40 at 104 rpm (MCR) owing to the diminishing values of Pmax difference. The lower viscosity 0W30 reduces friction between oil molecules and thus enhances load carrying capacity.

4. Evaluation of Oil Film Pressure and Temperature of an Elliptical Journal Bearing - An Experimental Study. Tribology in Industry 2016. Singla A, Chauhan A.

- The oil film pressure and temperature increases with the increase in load from 500N to 2000N at the fixed speed for all the three grades of lubricating oil. With the increase in load from 500 to 2000 N at constant journal speed = 5000 rpm for lubricating oil - 2, there has been 11% rise in pressure and 4°C rise in temperature has been observed.

5. Performance Evaluation of Hydrodynamic Journal Bearing using Gearbox and Engine Oil (SAE90 and SAE20w50) by Experimental and Theoretical Methods. International Journal of Mechanical Engineering And Information Technology 2015. Yunus M, Munshi S.M.

- Variation of pressure distribution with respect to angle of rotation (degrees) for both SAE20w50 and SAE 90 oils revealed a pressure increases from 0 to 800 of rotation and then decreases for the remaining rotation of bearing. This clearly indicates the presence of a hydrodynamic lubrication which is the need of highspeed journal bearing.

IV. EXPERIMENTAL SETUP

The experiment was conducted on the journal bearing apparatus. The apparatus which used whose section in fig 3.and the apparatus in fig 4 In this the journal bearing mounted freely on a steel journal shaft. The large diameter journal shaft is fixed directly onto a motor shaft. The speed of the motor shaft is finely controlled by the controlled unit. The journal bearing has fourteen equispaced pressures tapping around its circumference and four additional pressure tapping along its width. The latter four tapping are positioned on the topside of the bearing and on a vertical radial plane. Both the ends of bearing are sealed by oil paper. Small weights are added to the two rods during test to maintain the bearing in its normal position when taking readings. The weights are freely adjustable along the rods. Oil film pressures are monitored in a 330cm (11ft) tall, 18 tube and manometer board reading directly in head of lubricant. Clear flexible plastic tubes connect the manometer tubes to the MS nipples around the bearing and thus permit the bearing to turn freely. The upper ends of the manometer tubes are connected to a common manifold and any overflow is returned to a reservoir contained on there left hand side of the manometer board. This reservoir is connected to the bearing by a flexible plastic tubes. Oil from this supply reservoir enters the bearing at both ends at its lowest point and outside the actual bearing area.

V. EXPERIMENTAL PROCEDURE

For performing the experiment first chek all the equipment is properly fixed after that take the first lubricating oil and fill in the oil container than wait for 5 – 10 min to oil goes in all the tubes properly. After that start the motor at 750 rpm and wait for some time for filling the oil in all tubes and after that oil pressure in the tubes settel down so note down the oil pressure reading from all tube scale which attached with the all tubes. Then give rest or the moter for 30 min and then again start the motor but at this time 1000 rpm and wait for some time for settel down the reading in all tubes then note down the readings. From these reading we have form the pressure profile. After the first oil uses remove the oil from all the tubes and clean the tubes then fill the next lubricating oil and repeat the same procedure which we have used for the first oil and follow same for all types of oils and note down the reading. Fig 5 shows the example for reading.

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

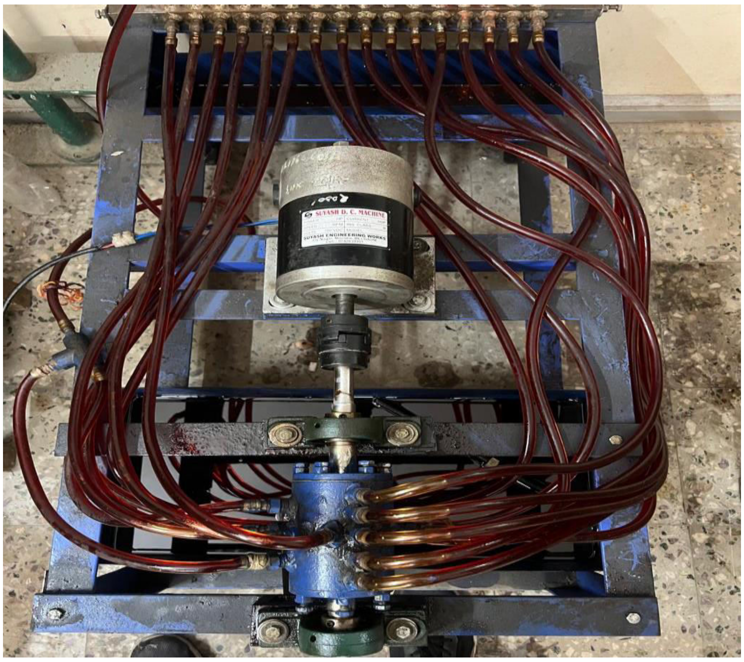


Fig3 Section of apparatus

Fig4 Journal Bearing Apparatus

Fig5 From apparatus pressure reading

VI. RESULT AND DISCUSSION

The following results has come from the experiment which has conducted on the journal bearing apparatus with the SAE 20W50, SAE 20W40, SAE 15W40, SAE 10W40, SAE 10W30, SAE 5W30 lubricating oils at a constant load at different speeds. Pressure distribution profile relating to each type of lubricating oil which shown individually shown below. The reading which have generated shown in table individually and their pressure distribution curve.**Scaling of value is 10cm = 1 point in all the pressure distribution curve.**

1. SAE20W40

No of tubes	1	2	3	4	5	6	7	8	9	10	11	12
1000rpm (cm)	92.5	90	77.5	23.5	32.5	60	18.5	0	42.5	62.5	60	71.5
750rpm (cm)	92.5	90	85	35	38.5	52.5	18.5	5	46.5	65	62.5	71.5

2. SAE20W50

No of tubes	1	2	3	4	5	6	7	8	9	10	11	12
1000rpm (cm)	105	97.5	70	35	30	35	0	0	32.5	53.5	82.5	92.5
750rpm (cm)	82.5	75	65	20	18.5	32.5	0	0	25	46.5	57.5	60

Pressure distribution curve

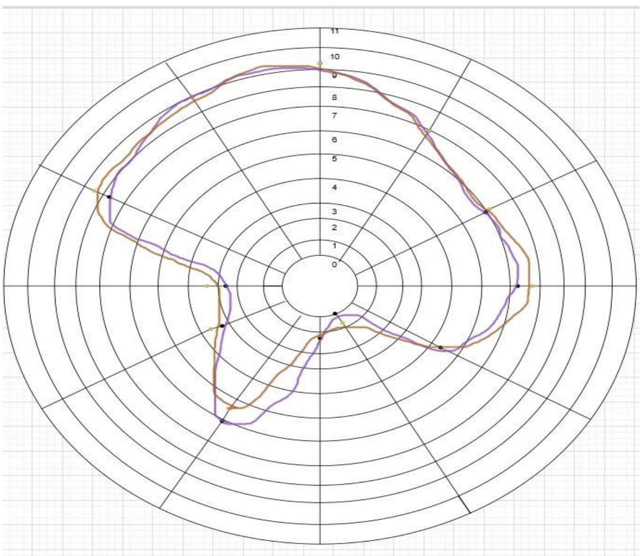


Fig SAE 20W40

1000rpm
750rpm

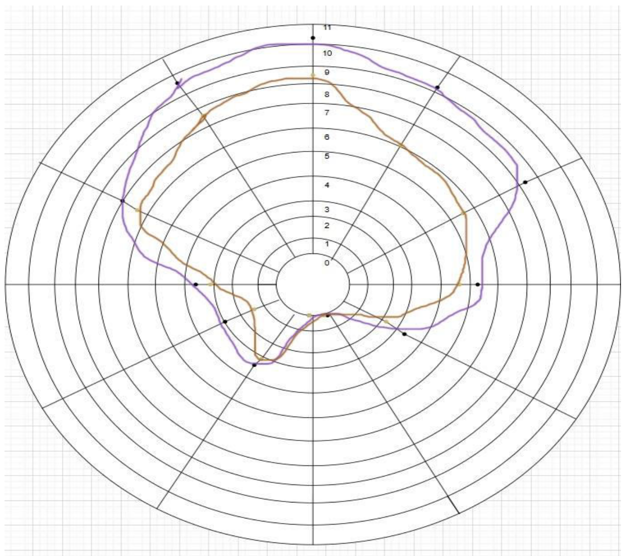


Fig SAE 20W50

1000rpm
750rpm

3. SAE15W40

No of tubes	1	2	3	4	5	6	7	8	9	10	11	12
1000rpm (cm)	77.5	75	47.5	25	17.5	32.5	0	0	30	35	42.5	50
750rpm (cm)	72.5	70	55	15	17.5	28.5	5	0	30	35	45	55

4. SAE10W40

No of tubes	1	3	3	4	5	6	7	8	9	10	11	12
1000rpm (cm)	90	80	55	33.5	15	22.5	0	0	27.5	38.5	55	68.5
750rpm (cm)	75	73.5	63.5	23.5	22.5	28.5	7.5	0	32.5	42.5	47.5	65

© 2025 IJMRSET | Volume 8, Issue 6, June 2025| DOI:10.15680/IJMRSET.2025.0806216

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Pressure distribution curve

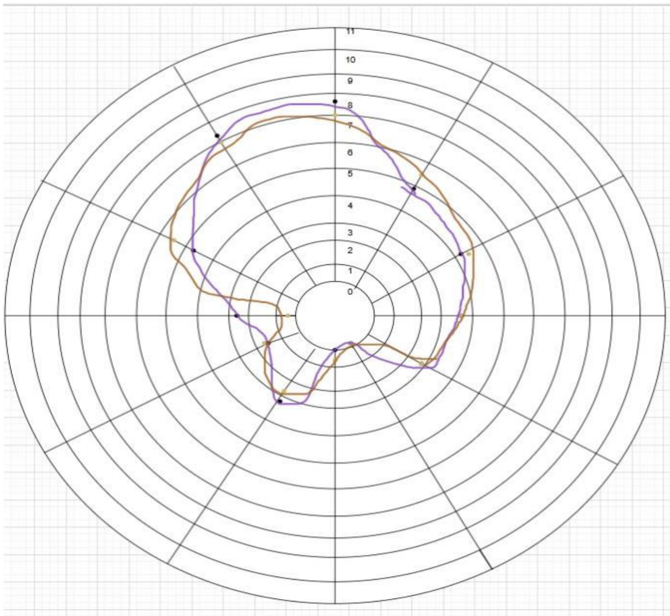


Fig SAE 15W40

1000rpm
750rpm

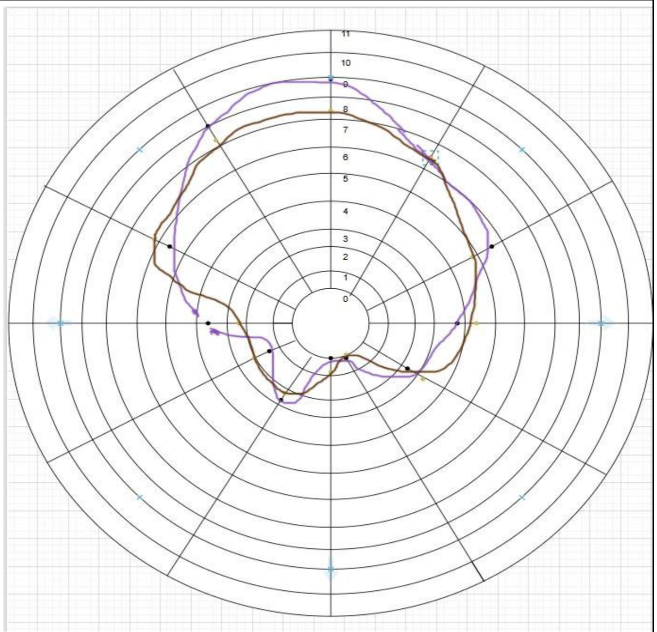


Fig SAE 10W40

1000rpm
750rpm

5. SAE10W30

No of tubes	1	2	3	4	5	6	7	8	9	10	11	12
1000rpm (cm)	95	92.5	87.5	37.5	42.5	55	25	15	52.5	57.5	60	76.5
750rpm (cm)	85	80	75	30	27.5	35	15	7.5	42.5	52.5	57.5	75

6. SAE5W30

No of tubes	1	2	3	4	5	6	7	8	9	10	11	12
1000rpm (cm)	105	95	83.5	50	47.5	60	30	23.5	62	63.5	70	80
750rpm (cm)	80	77.5	67.5	30	27.5	25	12.5	7.5	42.5	47.5	55	65

Pressure distribution curve

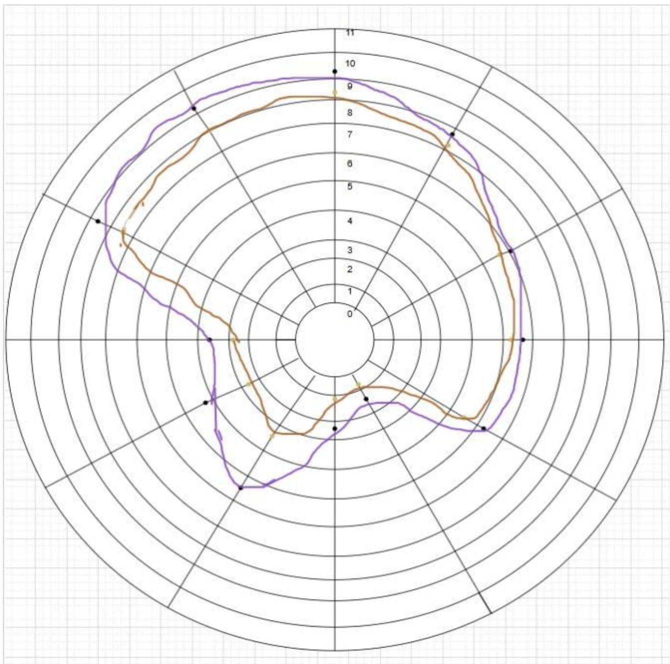


Fig SAE 10W30

1000rpm
750rpm

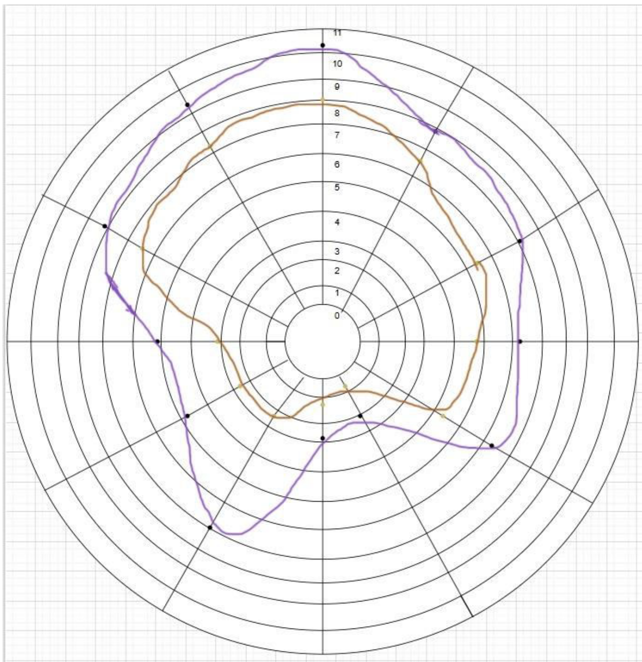


Fig SAE 5W30

1000rpm
750rpm

VII. CONCLUSION

From the experimented value the pressure distribution curve has generated which shown above. From those curve shows that at the different rpm speed the performance of the journal bearing has changed like at the 750rpm lubricating oil form the film around the shaft the less thick and at the 1000rpm the film is comparatively different of some oil but like 20W40 and 20W50 oil their curve at many points same. In the curve it is clearly shows that for different grade oil has a different pressure distribution curve some value same but various value has changed and also it has differences on the different rotating speed. The grades of oil changes which affects on their performance. From this the conclusion is form that these different grade oil is good for different application. So according to the application these oil can be used like for the heavy loads or low speed the 20W40 and 20W50 uses or if for low loads and high speeds or medium speeds the 5W30 and 10W40 can be uses.

VIII. ACKNOWLEDGMENTS

We would like to express our sincere gratitude to all those who have contributed to this research work. We are deeply thankful to the Institute of Engineering and Technology, Devi Ahilya University, Indore, and all faculty members for their invaluable guidance, insightful comments, and continuous encouragement throughout this research work.

REFERENCES

1. Basu S. K, Sengupta S.N, and Ahuja B.B, Fundamentals of Tribology. New Delhi: Prentice-Hall of India Private Limited, 2006.
2. B.S. Shenoy et al. Tribology international effect of nanoparticles additives on the performance of an externally adjustable fluid film bearing Tribology Int. (2012).

ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 8.206| ESTD Year: 2018|

International Journal of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

3. Patel NS, Vakharia DP, Deheri GM. A study on the performance of a magnetic fluid based hydrodynamic short porous journal bearing. J Serb Soc Comput Mech 2012.
4. Rasep Z, Muhammad Yazid M.N.A.W, Samion S. Lubrication of textured journal bearing by using vegetable oil: A review of approaches, challenges, and opportunities.
5. Kumar P, Gupta A.K, Experimental Investigation on Hydrodynamic Journal Bearing using SAE 10W30 Multi Grade Oil, International Journal of Advance Research and Innovation.
6. Marey N.M An Experimental Investigation of Hydrodynamic Journal Bearing with Different Oil Grades. Port-Said Engineering Research Journal. September 2019.
7. Zhou W, Wang Y, Guangkuan W, Bo Gao, Zhang W. Research on the lubricated characteristics of journal bearing based on finite element method and mixed method. Ain Shams Engineering Journal 2013.
8. Nour A. M, Wael M, Mohamed F. Experimental study on hydro- thermal behaviour of journal bearing oil film profile in a slow speed diesel engine. Alexandria Engineering Journal 2023.
9. Singla A, Chauhan A. Evaluation of Oil Film Pressure and Temperature of an Elliptical Journal Bearing - An Experimental Study. Tribology in Industry 2016.
10. Yunus M, Munshi S.M. Performance Evaluation of Hydrodynamic Journal Bearing using Gearbox and Engine Oil (SAE90 and SAE20w50) by Experimental and Theoretical Methods. International Journal of Mechanical Engineering and Information Technology 2015.