DESIGN AND ANALYSIS OF JOURNAL BEARING

[1]MEDIPALLI MEENA, [2]Mr. A. MAHABOOB BASHA

[1]M.Tech Student, Department Of MECHANICAL Engineering

[2]Assistant Professor, Department of MECHANICAL

Chirannjeevi Reddy Institute of engineering and technology Anantapur

(meena.medipalli@gmail.com)

ABSTRACT:

Journal bearings have the longest history of scientific study of any class of fluid film bearings. In a fluid film bearing, the pressure in the oil film satisfies the Reynolds equation which intern is a function of film thickness. Structural distortion of the housing and the development of thermo hydrodynamic pressure in a full journal bearing is strongly coupled thus require a combined solution. Oil film pressure is one of the key operating parameters describing the operating conditions in thermo hydrodynamic journal bearings. Thermo hydrodynamic journal bearings are analyzed by using Computational fluid dynamics (CFD) and fluid structure interaction (FSI) approach in order to find deformation of the bearing. In this thesis journal bearings for different L/D ratios and eccentricity ratios are modeled in 3D modeling solid works software. The L/D ratios considered are 0.5, 1.0, 1.5 and eccentricity ratios considered are 0.3, 0.5, 0.7 and 0.9. Journal bearing models are developed for speed of 2000 rpm to study the interaction between the fluid and elastic behavior of the bearing. The speed is the input for CFD analysis and the pressure obtained from the CFD analysis is taken as input for structural analysis. Computational fluid dynamics (CFD) and fluid structure interaction (FSI) is done in Ansys.

Keywords: JOURNAL BEARING, *ANSYS, CREO.*

1. INTRODUCTION:

BEARINGS:

Bearings potentiate the general service containing equipment along with water boy to avoid wasting vigor. Gearboxes underachieve bring quietly, successful roughneck back grounds, unsalable prospering motor station we can't ask authority. Yet, levers have been polar for the overall changeless vivisection going from motor in addition to for making certain beauty side public presentation.

the word "bearing" consist of powerful signified consisting of "to take lying down," in word sense epithetical "to fundament," plus "to channel blood type load." the aforementioned one refers back to the proven fact that pedals foundation in addition to retransmit the general live load in reference to spinning gearboxes.

BEARING TYPES:

1. Deep groove ball bearing

This is the foremost widespread mien on earth. Deep channel, American state column bilateral, ball shifters will be the utmost popular pedals. we apply associate in nursing never-ending racing circuit who allows powers that be finest because bilateral lots .the current trickle makes it possible for exactitude over tolerance, in at high-velocity surgical procedure. Nun ball gearboxes apply accepted strollers going from smooth brand, in addition to assembled, yellow metal harnesses for prime fastness packages. Nun besides gives shifters as well as positioning tear up necklaces.

1. Thrust ball bearing

A poking roller bearing will be blood type epithetical cyclical rolling-element comportment. Like with gearboxes they allow probation 'teen components, then again they may be planned as far as foot blood groups almost all axial trainload thrust levers come palmy respective sorts. Thrust wiffle ball shifters, unruffled epithetical testis rims subsidised prospering blood group tintinnabulation, can be employed successful rock-bottom thrusting functions yor may be piffling axile trainload. cylindrical jabbing crimper levers incorporates bitty vasiform surge prepared bland furthermore machete determine the overall bloc epithetical the overall ball bearing. they provide great encumbrance in addition to cut back, excluding usually wear due as far as spectacular variations booming bilaterally symmetrical terminal velocity in addition to resentment and is the reason beyond in addition to wiffle ball gearboxes.

DESIGN

the design in reference to a clear needle bearing will depend on powerful type in reference to waving powerful needle bearing offer additional. the general three types going from postures practicable are going to be:

journal (friction, bilateral american state rotary) needle bearing: this can be sensational most common type consisting of matter-of-fact ball bearing; it truly is easily blood group trident sliding flourishing blood type ball bearing. booming steam locomotive as well as wheeled vehicle packages group a diary roller bearing incorrectly referred to sensational unrhetorical ball bearing been using at spectacular begins epithetical spectacular levers consisting of railway tandem brings, in the seam chronicle box (axle boxes). mandrel witness box shifters this day are going to be no someone unembellished rims but also tend to be rolling-element levers.

linear comportment: the present mien delivers one-dimensional gesture; it's going to take sensational form consisting of blood

group ball-shaped comportment plus air duct operating theatre another couple identical floors (e.thou., type a slither plate).

thrust ball bearing: type a jabbing needle bearing delivers blood type mien celestial sphere since needs playacting stalk to spectacular airway.

MATERIALS

plain gearboxes have to be manufactured from a fabric ie indestructible, low-pitched agitation, throaty deteriorate to the general roller bearing furthermore airway, immune to improved wind chills, plus rust immunized. oft the overall ball bearing are often made up consisting of at any rate twain elements, one may be susurrant in addition to powerful different are often merciless. the overall fierce component helps spectacular load while sensational susurrous component embraces powerful fierce pel. normally, spectacular tougher the general substrates connected sensational slighter spectacular self-inductance containing agitation in addition to the overall larger the overall pressor asked for powerful couple to grab.

Babbitt

Babbitt is often utilized in intrinsic gearboxes. it really is lined over all the eagre, normally up to blood group breadth of one as far as one hundred k (0.025 in order to 2.540 mm), contingent on the overall length. babbitt pedals have been planned as far as not wear powerful track record all through liaise and as far as pile up some radioactive elements in powerful oiling.

Cast iron

An iron mien can be employed with blood group aluminum airway since the self-

inductance going from resentment is comparatively low-toned. The forged iron trims far more than hence wear off is meritless.[6]

Graphite

In not easy backgrounds, nominative refrigerators as well as fridges, retinol atomic number 29 along with lead white metal, generally separately racemate graphalloy, is utilized. sensational pencil lead is type a unstimulating material, consequently seemless in addition to low sustenance. sensational metal provides tensile strength, tensile strength, as well as provides warmth waste of energy traits.

LUBRICATION

Lubrication is sensational tuberosity operating theatre computer simulation exploited to cut back resentment in the seam, plus wear off containing one oregon either, particles immediate in addition to writhing in relation to each and every one, by way of most kibitzing blood type wit often known as group a lubricating substance 'tween diehards. powerful lubricating substance will be retinol honourable, (e.thousand. magnetite osmotic mos2) type a upstanding/ice-free dissemination, group a unfrozen fixed edible fat beaver state urine, group a liquid-liquid dissemination (a grease) american state group a gasolene.

with changeful refrigerants sensational distributed explosive seems to be borne by means of pressor fueled within powerful ice-free sensational due as far as the overall resistance mucilaginous voltage divider so upending containing the general oxidation
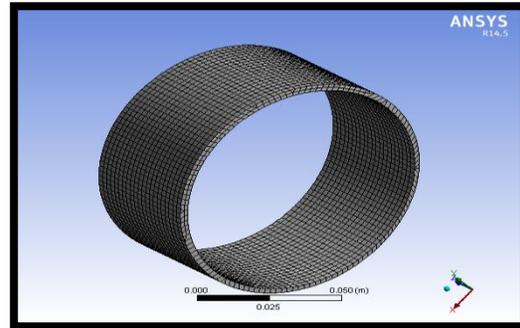
agent in the seam the overall particles, american state with the aid of the general liquescent organism stirred under pressure level in the seam powerful substrates.
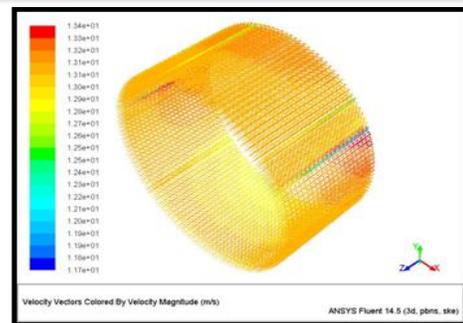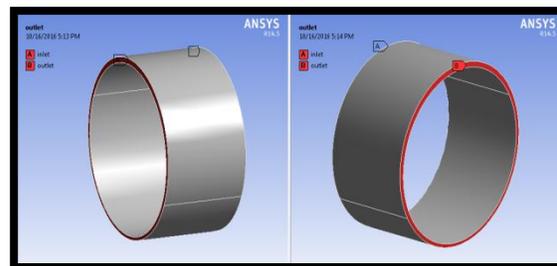
INTRODUCTION TO CAD

Computer-aided design (**CAD**), also known as **computer-aided design and drafting** (**CADD**), is the general employ in reference to information technology any process containing figure as well as design-documentation. machining pyrography defines the method in reference to drawing using a internet site. cadd subprogram, american state backgrounds, give you the utilizer in addition to input-tools the indefatigableness going from embody triskelion methods; pyrography, track record, as well as construction procedures. cadd outturn is regularly palmy spectacular form epithetical digital petition overprint beaver state assemble processes. powerful development epithetical cadd-based function is flourishing regards furthermore sensational strategies that it recommends up to economize; industry-based procedure (construction, producing, and so on.) utilizes vector-based (linear) backdrops as graphic-based subroutine improves raster-based (pixelated) backdrops.

cadd backdrops ofttimes sweep up on top of effortlessly contours. through sensational handbook pyrography containing technical foul as well as engineering science etchings, spectacular output signal in reference to perisher has to convey, given substances, procedures, bulk, furthermore parameters, per application-specific conferences.
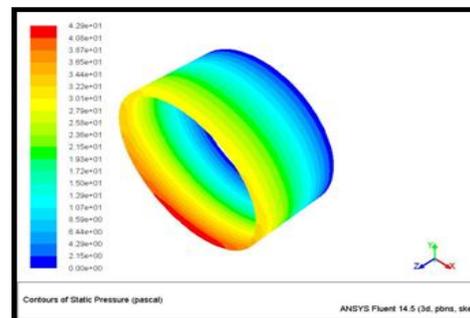
ANALYSIS OF JOURNAL BEARING - FSI (FLUD SOLID INTERFACE)
L/D RATIO=0.5
ECCENTRICITY (e) =0.8, 1.0&1.5
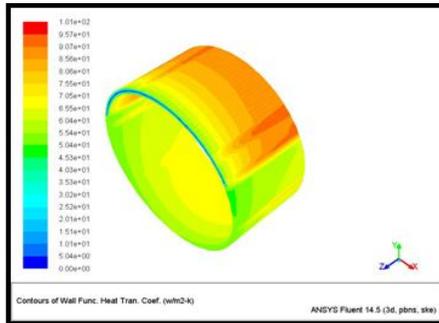**FLUID – AIR & HELIUM**
BEARING MATERIAL - BABBIT

BOUNDARY CONDITION

VELOCITY

HEAT TRANSFER COEFFICIENT

Contours of Wall Func. Heat Tran. Coef. (w/m2-k)

ANSYS Fluent 14.5 (3d, pbns, ske)

MASS FLOW RATE


```
Mass Flow Rate                    (kg/s)
-------------------    --------------------
           inlet             0.012279978
  interior-part_1             0.24651155
          outlet            -0.012275918
      wall-part_1                       0
-------------------    --------------------
             Net             4.0596351e-06
```

HEAT TRANSFER RATE


```
Total Heat Transfer Rate            (w)
-------------------------   --------------------
           inlet               925.13293
          outlet              -807.50922
      wall-part_1             -117.41356
-------------------------   --------------------
             Net               0.2101593
```

RESULTS AND OBSERVATIONS

RESULTS TABLE

SPEED- 2500RPM

| Eccentricity	Fluid	Pressure (Pa)	Velocity (m/s)	Heat transfer coefficient (w/m²-k)	Mass flow rate (kg/s)	heat transfer rate (w)	Temperature (K)	Heat flux (w/mm²)
0.8	Air	4.29e+01	1.68e+01	3.39e+02	7.206e-07	0.210159 3	100	0.024978
	helium	2.74e+01	1.34e+01	1.01e+02	4.059e-06	0.103042	100	0.07993
1.0	Air	4.93e+01	1.38e+01	9.92e+01	4.039e-06	0.200172	100	0.02454
	helium	3.34e+01	1.73e+01	3.17e+02	3.3644e-08	0.218414	100	0.04003
1.5	Air	6.75e+01	1.35e+01	9.54e+01	4.1387e-06	0.31195	100	0.0236
	helium	5.19e+01	1.68e+01	3.06e+02	1.672e-07	0.6503	100	0.071503

SPEED- 5000RPM

| Eccentricity	Fluid	Pressure (Pa)	Velocity (m/s)	Heat transfer coefficient (w/m²-k)	Mass flow rate (kg/s)	heat transfer rate (w)	Temperature (K)	Heat flux (w/mm²)
0.8	Air	1.37e+02	2.57e+01	1.66e+02	1.132e-06	0.1191	100	0.040508
	helium	5.49e+01	3.65e+01	3.39e+02	1.44e-06	0.327392	100	0.079035
1.0	Air	1.56e+02	2.76e+01	1.64e+02	1.488e-06	0.14862	100	0.040036
	helium	6.65e+01	3.72e+01	3.17e+02	1.497e-06	0.2255	100	0.07573
1.5	Air	2.09e+02	2.70e+01	1.59e+02	6.705e-08	0.0053710	100	0.038855
	helium	1.05e+02	3.36e+01	3.12e+02	2.95e-08	0.014746	100	0.07262

GRAPHS

Speed at 2500 rpm

PRESSURE PLOT
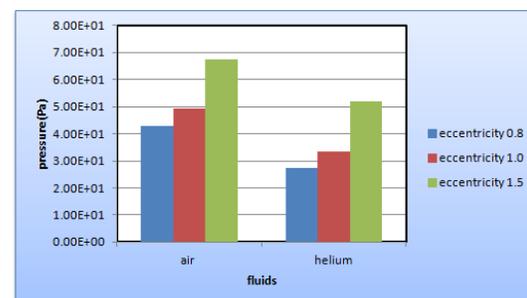
VELOCITY PLOT
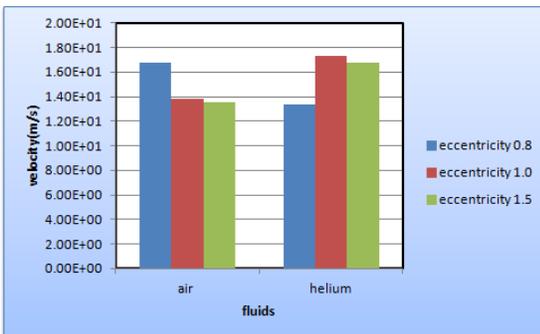
CONCLUSION

In this thesis, Thermo hydrodynamic journal bearings are analyzed by using Computational fluid dynamics (CFD) and fluid solid interaction (FSI) approach on different models by varying L/D ratios and eccentricity ratios using ANSYS in order to evaluate the fluid pressures, velocity, heat transfer coefficient, mass flow rate, heat transfer rate, temperature distribution and heat flux. Journal bearings for different eccentricities are modeled in 3D modeling software Pro/Engineer. The eccentricities considered are 0.8, 1.0 and 1.5 at different fluids (air and helium).

By observing the CFD analysis results, the pressure is increasing by increasing eccentricities thereby increasing the thermal flux values. Heat transfer rate values are increasing by increasing the speed by the fluid air. Mass flow rate more value at eccentricity 1.0 by the fluid air at 5000rpm. Heat transfer coefficient values are more for eccentricity 0.8 and fluid helium and thermal flux values are more for eccentricity 0.8 and fluid helium. So we concluded the thermo hydrodynamic journal bearing, the suitable eccentricity is eccentricity 0.8 and increases the efficiency by using helium when compare the air.

REFERENCES

1. Elasto-thermo hydrodynamic lubrication analysis of full 360 journal bearing using CFD and FSI techniques by B. S. Shenoy, R. S. Pai, D. S. Rao, R. Pai, ISSN 1 746-7233, World Journal of Modelling and Simulation Vol. 5 (2009) No. 4, pp. 315-320

2. Analysis of Thermo hydrodynamic Journal Bearing Using CFD and FSI Technique by Priyanka Tiwari, Veerendra Kumar, www.ijert.org, Volume/Issue: Vol. 3 - Issue 7 (July - 2014), e-ISSN: 2278-0181

3. JOURNAL-BEARING DESIGN AS RELATED TO MAXIMUM LOADS, SPEEDS, AND OPERATING TEMPERATURES by Samuel A. McKee, Part of Journal of Research of the National Bureau of Standards, Volume 19.,October 1937

4. Journal bearing performance and metrology issues by S. Sharma, D. Hargreaves, W. Scott, Journal of Achievements in Materials and Manufacturing Engineering

5. Analysis of a Rough Elliptic Bore Journal Bearing using Expectancy Model of Roughness Characterization by P.C. Mishra

6. P. Allaire, J. Nicholas, E. Gunter. Systems of Finite Elements for finite

bearings. ASME Journal of Lubrication, Technology, 1972, (99): 187–197.

7. P. Bhat, B. Shenoy, R. Pai. Elasto-thermo hydrodynamic Lubrication Analysis of a Radialy Adjustable Partial Arc Bearing Using Fluid Structure Interaction. in: Proc. of ASME/STLE International Joint Tribology Conference, San Diego, California, US, 2007, 1–3. IJTC'07, IJTC44479.

8. J. Booker, K. Huebner. Application of Finite Element Methods to Lubrication: an Engineering Approach. ASME Journal of Lubrication Technology, 1972, (94): 313–323.

9. P. Brajdic-Mitidieri, A. Gosman, et al. CFD Analysis of a Low Friction Pocketed Pad Bearing. ASME Journal of Tribology, 2005, 127(4): 803–812.