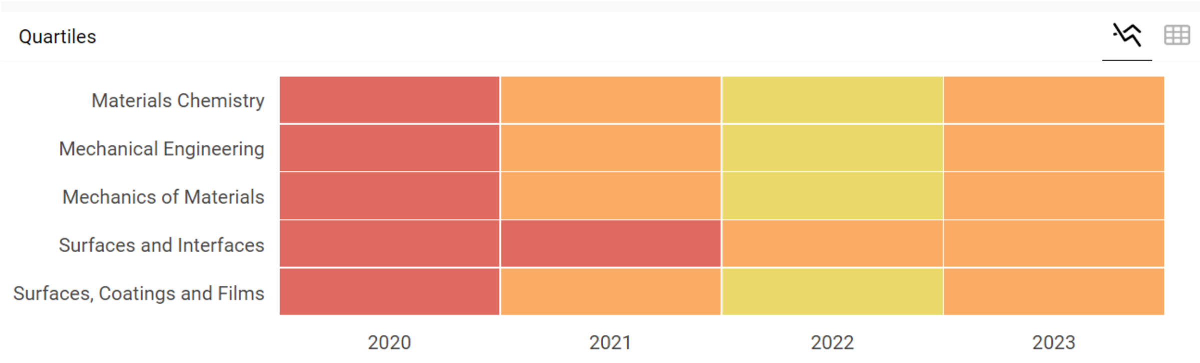
DAFTAR ISI KORESPONDENSI

Judul : Elastohydrodynamic Analysis of Composites Material with Roughness Effect on Multistep Journal Bearing Tribological Performance
Jurnal : Jurnal Tribologi

MYTRIBOS
Malaysian Tribology Society

JurnalTRIBOLOGI

Volume 40 : Page 1-267 (March 2024) - MYTRIBOS 2023 (Part 2)



Dashboard

Your Manuscripts

+ **Submit new manuscript**

Unsubmitted manuscripts (0)

Manuscripts submitted to editors (0)

Manuscripts with final decisions (2)

Manuscripts you have co-authored (3)

Withdrawn manuscripts (0)

Your Account

View or edit your account data.

Recently received notifications

View all

2023-12-10	Decision on manuscript JTRIB-00593-2023-03
2023-11-20	Decision on manuscript JTRIB-00577-2023-03
2023-11-01	Decision on manuscript JTRIB-00576-2023-02
2023-10-13	Manuscript has been sent to Reviewers (JTRIB-00576-2023-02)
2023-10-12	New revision received by Editorial Office (JTRIB-00576-2023-02)

Feedback   Scroll to top

User agreement   Personal data   Privacy policy

New manuscript received by Editorial Office (JTRIB-00576-2023-01)

From: Jurnal Tribologi (kontakt@editorialsystem.com)

To: m_mad5373@yahoo.com

Date: Wednesday 26 July 2023 at 02:31 pm GMT+7

Dear Mr. Muchammad,

Thank you for your manuscript: Elastohydrodynamic analysis of composites material with roughness effect on multistep journal bearing tribological performance.
The following number has been assigned to it: JTRIB-00576-2023-01.

The manuscript will be checked by Editors and then sent to the Reviewers.
You will be informed by email about any further decisions on this article.

Thank you for submitting your work to our journal.

Best regards,
Editors-In-Chief
Jurnal Tribologi
E: editor.jurnal.tribologi@gmail.com
W: http://jurnaltribologi.mytribos.org

Editorial System is available here: https://www.editorialsystem.com/jtrib/

The manuscript requires editing (JTRIB-00576-2023-01)

From: Jurnal Tribologi (kontakt@editorialsystem.com)

To: m_mad5373@yahoo.com

Date: Friday 28 July 2023 at 07:03 am GMT+7

Dear Mr. Muchammad,

Please edit your manuscript entitled "Elastohydrodynamic analysis of composites material with roughness effect on multistep journal bearing tribological performance (JTRIB-00576-2023-01)" according to the Editorial guidelines below:

Please remove acknowledgment in the manuscript. Instead, put into the system.

Article view:
https://www.editorialsystem.com/jtrib/article/357355/view/

Editorial Office of Jurnal Tribologi

Thank you for adjusting the article (JTRIB-00576-2023-01)

From: Jurnal Tribologi (kontakt@editorialsystem.com)

To: m_mad5373@yahoo.com

Date: Friday 28 July 2023 at 10:35 am GMT+7

Dear Mr. Muchammad,

Thank you for returning the revised version of your paper. The manuscript will be verified by the Editors.

Editorial Office of Jurnal Tribologi

Manuscript has been sent to Reviewers (JTRIB-00576-2023-01)

From: Jurnal Tribologi (kontakt@editorialsystem.com)

To: m_mad5373@yahoo.com

Date: Sunday 30 July 2023 at 11:03 am GMT+7

Dear Mr. Muchammad,

Your manuscript: Elastohydrodynamic analysis of composites material with roughness effect on multistep journal bearing tribological performance (JTRIB-00576-2023-01) was sent to the Reviewers.

You will be informed by email about any further decisions on this article.

Best regards,
Mohd Fadzli Bin Abdollah
Editor-in-Chief
Jurnal Tribologi

Editorial System is available here: https://www.editorialsystem.com/jtrib/

Decision on manuscript JTRIB-00576-2023-01

From: Jurnal Tribologi (kontakt@editorialsystem.com)

To: m_mad5373@yahoo.com

Date: Wednesday 23 August 2023 at 07:52 pm GMT+7

August 23, 2023
JTRIB-00576-2023-01
Elastohydrodynamic analysis of composites material with roughness effect on multistep journal bearing tribological performance

Dear Mr. Muchammad,

We have carefully evaluated your manuscript, entitled: Elastohydrodynamic analysis of composites material with roughness effect on multistep journal bearing tribological performance, and feel that as it stands we cannot accept it. We might, however, be able to accept it if you could respond adequately to the points that have been raised during the review process (see below).

Please revise your manuscript strictly according to the attached Reviewers' comments. All changes need to be highlighted using the yellow colour in the revised manuscript. Your manuscript won't be taken into consideration without the revisions made according to the recommendations.

Please, prepare a revised version of the manuscript and list the changes in the reply to the Reviewers till 2023-10-22. This may ensure prompt publication if the article is finally accepted.

The revised version of the manuscript should be submitted through the online system:http://www.editorialsystem.com/jtrib

Thank you for submitting your work to our journal.

Best regards,
Editors-In-Chief
Jurnal Tribologi
E: editor.jurnal.tribologi@gmail.com
W: http://jurnaltribologi.mytribos.org

Please note that this email may not include all details of your article's evaluation. The full decision and file attachments are available here:
https://www.editorialsystem.com/jtrib/article/362580/view/#showDecisionLetter357355

Review 1:
(this review has file attachment)
Reviewer's comments
Journal- JurnalTRIBOLOGI
Manuscript Number- JTRIB-00576-2023-01
Title of Paper- "Elastohydrodynamic analysis of composites material with roughness effect on multistep journal bearing tribological performance"

The paper concerns with theoretical analysis related to the influence of degree of surface roughness/different types of bearing on the performance of multistep journal bearing. They used CFD software to model multistep textured journal bearings while taking into account the type of composite material.

Comments to the Author:
After going through the manuscript, the reviewer comes up with the following observation.
(1) The introduction is not appropriate. It must be largely re-written. Please focus on applications aspects of the work in first paragraph of introduction. Then, state of art of work with existing literature must be described. In last paragraph, highlight the novelty of the work? Why this work is important? What is the advancement of present work with existing literature and so on?
(2) Throughout the manuscript, there are many mistakes of grammar, typo-error and unclear sentence structure, so that the goals and results of this study are not clear to readers. The entire write-up needs to be revisited and corrected.
(3) The author(s) did not give references/citations of mathematical expressions in analysis section.

(4) Nothing is mentioned about the solution procedure/strategy adopted for obtaining the theoretically simulated results. The numerical procedure should also be present in the form of a flow chart for ease of readers.
(5) The observed effects of the result and discussion part are mainly described, but not really well explained and discussed. The mechanisms of improvement in tribological characteristics due to texture surfaces (roughness level)/different types of bearing material, are missing. This must be improved in the revised version of the manuscript.
(6) Please correct the captions of Figures 15, 16, 17, 18.
(7) The illustrations of Figures 9, 10, 11, 12, 13, 15, 16, and 17 are missing in text. The author(s) should provide the explanation of Figures 9, 10, 11, 12, 13, 15, 16, and 17 in text.
(8) What are the texture dimensions (length, depth), density (with respect to unit cell), area ratio (with respect to total area of bearing), and distance between textures? Does it the same for all textures? What is the depth of each texture? What is film thickness by depth ratio?
(9) Conclusions of the manuscripts are not up to the mark. Conclusions need to be revised. So as to make them more meaningful.
In the opinion of the reviewer, the author needs to suitably incorporate all these major and mandatory changes in the revised manuscript.

Attachment:
- https://www.editorialsystem.com/dl/dr/36261/d96fd125e31d41ec45e31f77fbf382b6/ (Reviewer 1)

Dear Editor,

We are submitting the revised version of our manuscript JTRIB-00576-2023-01 entitled, "**Elastohydrodynamic analysis of composites material with roughness effect on multistep journal bearing tribological performance**". We have addressed the concerns of the editor and the reviewers. We thank you and the reviewers for careful reading of our manuscript which resulted into comments and recommendations leading to an improvement of our manuscript.

We have revised manuscript based on the suggestions and advice of the reviewers. An item-by-item response to their comments is enclosed. In this the version of revision we made some highlights. The yellow highlight is for the revision. We hope that these revisions successfully address their concerns and requirements and that is manuscript will be accepted for publication.

Referring to the remarks of the Reviewers:

....

Reviewer #1:

Q1. The introduction is not appropriate. It must be largely re-written. Please focus on applications aspects of the work in first paragraph of introduction. Then, state of art of work with existing literature must be described. In last paragraph, highlight the novelty of the work? Why this work is important? What is the advancement of present work with existing literature and so on?

Authors:

We would like to thank the reviewer for the assessment of the manuscript and his/her constructive remarks. We believe that our paper has been significantly improved by implementing his/her suggestion. We have made some adding statement to strengthen our state of the art. Here, in the introduction section has been updated especially in the first and last sentences.

Q2. Throughout the manuscript, there are many mistakes of grammar, typo-error and unclear sentence structure, so that the goals and results of this study are not clear to readers. The entire write-up needs to be revisited and corrected.

Authors:

We would like to thank the reviewer for the consideration and suggestions. We have fixed about the grammar, typo-error and unclear sentence and we believe the writing has been corrected.

Q3. The author(s) did not give references/citations of mathematical expressions in analysis section.

Authors:

We would like to thank the reviewer for the consideration and suggestions. We are sure that we have referenced the expressions with publication that also use this equation and can be seen in governing equations section.

Q4. Nothing is mentioned about the solution procedure/strategy adopted for obtaining the theoretically simulated results. The numerical procedure should also be present in the form of a flow chart for ease of readers.

Authors:

We would like to thank the reviewer for the consideration and suggestions. We have added the flow chart of the simulation process also the strategy is included in the method and validation section in Figure 6.

Q5. The observed effects of the result and discussion part are mainly described, but not really well explained and discussed. The mechanisms of improvement in tribological characteristics due to texture surfaces (roughness level)/different types of bearing material, are missing. This must be improved in the revised version of the manuscript.

Authors:

We would like to thank the reviewer for the consideration and suggestions. We have added the further explanation about the mechanism that affecting the tribological characteristic in the effect of the composite material and effect of surface roughness section.

Q6. Please correct the captions of Figures 15, 16, 17, 18.

Authors:

We would like to thank the reviewer for the consideration and suggestions. We have fixed the caption of Figures 15, 16, 17, and 18.

Q7. The illustrations of Figures 9, 10, 11, 12, 13, 15, 16, and 17 are missing in text. The author(s) should provide the explanation of Figures 9, 10, 11, 12, 13, 15, 16, and 17 in text.

Authors:

We would like to thank the reviewer for the consideration and suggestions. We have added the explanation for the caption of Figures 9, 10, 11, 12, 13, 15, 16, and 17.

Q8. What are the texture dimensions (length, depth), density (with respect to unit cell), area ratio (with respect to total area of bearing), and distance between textures? Does it the same for all textures? What is the depth of each texture? What is film thickness by depth ratio?

Authors:

We would like to thank the reviewer for the consideration and suggestions. We have explained the geometry parameters, the dimension and area is same for all three textures, and the rest parameters have been included on the method and validation section in Table 1 and 2.

Q9. Conclusions of the manuscripts are not up to the mark. Conclusions need to be revised. So as to make them more meaningful.

Authors:

We would like to thank the reviewer for the consideration and suggestions. We have explained and added the further reason of the result in the conclusion.

With best regards,

Authors

Jurnal Tribologi XX (20XX) 30-41

MYTRIBOS Malaysian Tribology Society
Jurnal Tribologi
Website : jurnaltribologi.mytribos.org e-issn: 2289-7232

Elastohydrodynamic analysis of composites material with roughness effect on multistep journal bearing tribological performance

KEYWORDS

Composites
Elastohydrodynamic
Numerical Simulation
Roughness

ABSTRACT

Journal bearing is a type of bearing in which a lubricating liquid separates the inner surface of the bearing from the shaft in contact. Elastohydrodynamic lubrication modeling is a journal bearing modeling that considers the effect of deformation on the bearing due to the pressure generated by the wedge effect from eccentricity when the shaft rotates. This research used CFD software to model multistep textured journal bearings while taking into account the type of composite material that was influenced by the degree of surface roughness. According to the simulation results, the effect of multistep texture on the journal bearing increases load carrying capacity at low eccentricity ratios and decreases at high eccentricity ratios, while friction force and acoustic power level reduce as the eccentricity ratios increases. The effect of composite materials on lubrication modeling can be seen in the resulting pressure value, where the higher the elastic modulus of the composite material, the lower the pressure drop due to deformation. The tribological performance is influenced by the degree of roughness on the bearing surface and will decline as the roughness value on the bearing surface increases.

Received XX XXXX 20XX; received in revised form XX XXXX 20XX; accepted XX XXXX 20XX.
To cite this article: Muchammad et al. (20XX). Elastohydrodynamic analysis of composites material with roughness effect on multistep journal bearing tribological performance. Jurnal Tribologi XX, pp.30-41.

1.0 INTRODUCTION

Journal bearing is one of the components used in machining systems. This type of bearing is a simple bearing model but is widely used in industry and generating turbines. This type of bearing works by placing the rotating shaft in a cylinder and lubricating it with fluid as a separator between the shaft and the bearing surface. Many parameters influence the performance and durability of a journal bearing. Therefore, developing research on journal bearings is very necessary to obtain optimal performance. The demand for high speed machines has dramatically increased in recent years as a result of the high demand for productive and affordable industrial machinery. This results in an increase in the pressure distribution that occurs in the journal bearing. The journal bearing will have a high pressure distribution when operating at high speeds, which causes the bearing surface to deform elastically. The lubrication performance that takes place when the journal bearing is operating will be impacted by the elastic deformation that takes place in the journal bearing (Lahmar et al., 2010; Muchammad et al. 2022; Muchammad et al. 2022).

Due to pressure fluctuations in journal bearing modeling, cavitation problems might happen because of convergent and divergent zones. Cavitation takes place in the divergent zone, which causes a pressure reduction that benefits the convergent region. This phenomenon causes a reduction in the lubricant phase because the lubricant forms a new phase, namely the vapor phase. The pressure value on the journal bearing may decrease as a result of the cavitation event (Dhande and Pande, 2017). The influence of turbulent flow becomes an issue when modeling the lubrication of the journal bearing because as rotational speed of the rotor rises, the lubrication fluid flow in the journal bearing becomes unstable and causes the fluid flow to become turbulent (Lin et al., 2018). Comparatively to plain journal bearings, textured journal bearings have lower friction (Cupilard et al., 2008). The decrease in load carrying capacity will be impacted by the incorrect form of the texture and arrangement on surface of the journal bearing (Chen et al., 2020; Tala-Ighil, 2011). In comparison to other textures that both offer improved lubrication performance under specific eccentricity ratio and rotational speed conditions, the multistep texture model is a straightforward journal bearing texture model (Bompos and Nikolakopoulos, 2016; Muchammad et al. 2022). Performance is significantly influenced by the placement and amount of step textures, where the more steps, the less the tribological performance will be (Liang et al., 2016). In order to achieve the best tribology performance, an eccentricity ratio between 0.1 and 0.4 is used (Singh and Awasthi, 2020).

Scientists performed tests on journal bearing materials made of metal matrix composites (MMC), which performed better in terms of wear rate and friction than conventional metal materials (Sander et al., 2016). The manufacturing technique of grinding is used to create journal bearings. Grinding is the process of reducing particle size of a material from a coarser shape to a finer size in order to complete the mixing process, namely the outcomes of combining evenly and avoiding material particle segregation (Groover, 2013). When improving surface texture for journal bearing modeling, surface roughness must be taken into consideration. In general, surface texture and surface roughness have an essential role in optimizing the tribological performance of journal bearings (Song et al., 2015). Roughness should be properly considerated in deformation situations since it impacts the hydrodynamic outcomes (Javorova, 2016).

The tribological performance of journal bearings is determined via numerical computations thanks to the development of CFD-FSI coupled methods. Using ANSYS CFD software, the numerical simulation solves the conservation equation of mass, momentum, turbulence, cavitation, load support, friction force, and acoustic power level to examine the journal bearing lubrication performance which emphasizes the influence of composite materials with surface roughness that has not been found from previous studies in this current research. Because of this, this research was carried out to improve the performance and durability of journal bearings so that they can be useful for the world of machinery.

2.0 METHOD

2.1 Governing Equations

In this study, the Navier Stokes equation of continuity is used to solve the problem using a numerical technique with steady, incompressible conditions and momentum conservation. The equation is presented as follows (Cupilard et al., 2008):

$$\nabla.\vec{V} = 0 \quad (1)$$

$$\frac{\partial}{\partial t}(\rho\vec{v}) + \nabla(\rho\vec{v}\vec{v}) = -\nabla p + \nabla.(\bar{\bar{\tau}}) + \rho\vec{g} \quad (2)$$

Where is the density of the fluid, is the velocity of the fluid, is the pressure gradient, is gravity, and is the pressure tensor. Pressure tensor is needed for future calculation performance load carrying capacity of the bearing, it defined as follows:

$$\bar{\bar{\tau}} = \mu\left[\left(\nabla\vec{v} + (\nabla\vec{v})^T\right) - \frac{2}{3}\nabla.\vec{v}\bar{\bar{I}}\right] \quad (3)$$

The computation employs the RANS (Reynolds Averaged Navier Stokes Simulation) equation due to turbulent phenomena. This model is more straightforward to get convergence as well as solve the turbulence problem for different flow configurations. The following is the RANS equation for the determination of the general shape of the inner pressure film for an incompressible viscous fluid.

$$\frac{\partial}{\partial x_j}(\rho u_i u_j) = -\frac{\partial p}{\partial x_i}\left[\mu\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i}\right)\right] + \frac{\partial}{\partial x_j}(-\rho u'_i u'_j) \quad (4)$$

Terms such as are known as a turbulent component. In this work, turbulent is solved by standard and models. Where is turbulent kinetic energy and is the turbulent dissipation rate. As is well known, lubricant cavitation frequently happens during journal bearing operation, particularly in the divergent zone. Since cavitation is assumed to be caused by a change in fluid pressure, the cavitation phenomena in the computational fluid domain is always represented using a phase change boundary condition. In this approach, the formation of gas bubbles commonly accompanies the cavitation process. The cavitation and fluid models are coupled through momentum and single set of density equations for the mixture. The cavitation and fluid models are coupled through momentum and single set of density equations for the mixture. The validity of this method has been proved in previous works researches. Three cavitation models are available in ANSYS FLUENT®, that are the Schneer and Sauer model, the Zwart-Gelber-Belamri model, and the Sighal et al. model. The Zwart-Gelber-Belamri model is used in this study due to their ability to converge fast and be less sensitive to mesh density. The liquid vapor mass transfer in cavitation (evaporation and condensation) is represented by the vapor transport equation:

$$\frac{\partial}{\partial t}(a_v \rho_v) + \nabla.(a_v \rho_v v) = R_g - R_c \tag{5}$$

Where a_v is vapor volume fraction and ρ_v is vapor density. R_g and R_c is account for the mass transfer between the liquid and vapor phases in cavitation. For Zwart-Gelber-Belamri model assuming that all the bubbles have the same size in a system, the final form of the cavitation is as follows:

$$p \le p_v, \; R_g = F_{evap} \frac{3\alpha_{nuc}(1-\alpha_\upsilon)\rho_\upsilon}{R_B} \sqrt{\frac{2}{3}\frac{P_\upsilon - P}{\rho_\ell}} \tag{6}$$

$$p \ge p_v, \; R_c = F_{cond} \frac{3\alpha_\upsilon \rho_\upsilon}{R_B} \sqrt{\frac{2}{3}\frac{P - P_\upsilon}{\rho_\ell}} \tag{7}$$

Where F_{evap} = evaporation coefficient = 50, F_{cond} = condensation coefficient = 0.01, R_B = bubble radius = 10^{-6} m, α_{nuc} = nucleation site volume fraction = $5x10^{-4}$, ρ_l = liquid density and p_v = vapor pressure.

The term fluid structure interaction (FSI) refers to the connection of the computational fluid dynamic (CFD) and finite element method (FEM) software environments. The deformation of the shaft journal and the housing is calculated for the FSI (fluid structure interaction) analysis in this study. The balancing equation regulating the solid domain for issues with solid dynamics was derived from Newton's second law reads:

$$\rho_s \ddot{d}_s = \mathrm{div}\sigma_s + F_s \tag{8}$$

Where subscript s refers to solid designation, ρ is the density, denotes the local acceleration vector, σ indicates the stress tensor and F_s expresses the body force vector.

Through the FLUENT module of the ANSYS program, the lubricant performance is solved using the finite volume technique, and the mechanical performances of the bearings are estimated using the finite element method through the transient structural module of this version. When using ANSYS, system coupling may enable the execution of data exchange between fluid and solid analysis in accordance with the appropriate iteration stagger.

Different surface roughness levels may result from the polishing process after the journal bearing has already been made. In order to examine the influence of roughness, this work represents the roughness as uniform sand-grain roughness defined by roughness height parameter K_s as shown in Figure 1. This method makes the assumption that each height is constant per surface. The surface boundary condition in ANSYS FLUENT® requires the roughness height K_s to be provided for calculations.

It should be noted that the roughness height K_s is not the equal as the geometric roughness height of the surface. Rather, it is the corresponding sand grained roughness height. Therefore, it is necessary to link the equivalent sand-grain roughness height with the appropriate geometric roughness parameters as determined by surface roughness parameters, such as Ra (arithmetic average of the roughness profile). The link between K_s and R_a, according to Adams et al. (Adams et al., 2012), may be roughly described as follows:

$$K_s = 5.863 R_a \tag{9}$$

Since the correlation shown in Eq. (9) has been experimentally proven (Adams et al., 2012), the surface roughness parameter R_a measured by the profilometer may be utilized as an input to determine the roughness of the bearing surface in all subsequent computations.

2.2 Performance Equation

The entire amount of load that may be carried by the distribution of the film thickness on the bearing is defined as an integral of the distribution profile pressure over the journal bearing area. The equation Raimondi-Boyd below can be used to mathematically represent the load carrying capability of a journal bearing (Meng, 2016):

$$W = \iint_A p dA \tag{10}$$

The frictional force is defined as the integral of the shear stress along the surface of the journal bearing. The following equation Richard Feynman can be used to mathematically represent the frictional force that happens in the journal bearing (Meng, 2016):

$$F_f = \iint_A \tau dA \tag{11}$$

an acoustic characteristic takes place when the noise is brought on by turbulence in a textured journal bearing. Equation A.G Bell below is used to calculate the CFD package, which uses the acoustic power level to make an analysis (Meng, 2016) :

$$L_p(dB) = 10\log\left(\frac{W}{W_{ref}}\right) \tag{12}$$

Where is the referenced acoustic power as the human hearing threshold is assumed to be $10^{-12} W/m^3$.

2.3 Method and Validation

This study employed Bompos as its model. The variation of the textured geometry that Bompos examined yielded the optimal geometry, which is applied in this paper. Figure 1 and Table 1 illustrate three steps distributed along the journal with a particular parameter.

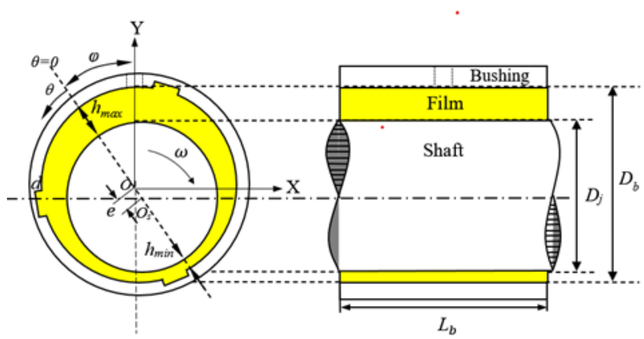


Figure 1: 3D Model of the multistep journal bearing.

Table 1: Geometry parameters for the multistep journal bearing.

Parameters	Symbol	Value	Unit
Journal radius	R_j	50	mm
Bearing radius	R_b	50.1	mm
Clearance	C	85.5	mm
Eccentricity ratio	ε	0.2; 0.4; 0.6; 0.8	-
Rotational Speed	ω	4,000	RPM
Roughness Level	R_a	0; 0.1; 0.4;1.6; 6.3	μm
Attitude angle	φ	35	◦
Length to diameter ratio	L/D	0.5	-
Step depth	d	0.513	mm
Arc length steps	γ	30	◦
Arc length between steps	β	90	◦
Orientation angle	ψ	5	◦

For further discussion, step a is located between 90-120 degrees, step b 210-240 degrees, and step c 330-360 degrees. Orientation angle is determined after the attitude angle of the journal. This simulation's method is based on a work by Dhande (Dhande and Pande, 2017), which employs the SIMPLE method for the Scheme, PRESTO! First-order Upwind is used to calculate pressure; Second-order Upwind is used to calculate density, vapor, energy, and momentum. The next step is to calculate the Under Relaxation Factor (URF) to regulate the simulation based solution. In order to stabilize and correct the convergence of numerical schemes including iterative operations, URF is employed in steady state flow types in numerical computation. While in theory altering the value of under relaxation factor will not, change outcome of the simulation, it can shorten the time it takes to perform the numerical computation. Therefore, the recommended default value of under relaxation factor is ap-plied in this final project. Table 2 lists additional simulation related parameters.

Table 2: materials properties parameters for the multistep journal bearing.

Parameters	**Symbol**	**Value**	**Unit**
Oil (10W40 SAE)			
Oil liquid density	ρ_o	850	kg/m^3
Oil liquid viscosity	μ_o	0.0125	Pa.s
Oil vapour density	ρ_V	10.95	kg/m^3
Oil vapour viscosity	μ_V	2×10^{-5}	Pa.s
Vapour saturation pressure	P_{sat}	29,185	Pa
Shaft: Steel			
Elastic Modulus	E_S	210	GPa
Density	ρ_S	7,850	kg/m^3
Poisson ratio	υ_S	0.3	-
Bushing 1: Aluminium			
Elastic Modulus	E_A	70	GPa
Density	ρ_A	2,700	kg/m^3
Poisson ratio	υ_A	0.334	-
Bushing 2: PMC - GFRP			
Elastic Modulus	E_A	72.3	GPa
Density	ρ_A	2,580	kg/m^3
Poisson ratio	υ_A	0.3	-
Bushing 3: PMC - CFRP			
Elastic Modulus	E_A	590	GPa
Density	ρ_A	1,900	kg/m^3
Poisson ratio	υ_A	0.3	-
Bushing 4: CMC – SiC-SiC			
Elastic Modulus	E_A	270	GPa
Density	ρ_A	2,600	kg/m^3
Poisson ratio	υ_A	0.3	-

Bushing 5: MMC – Al-SiC			
Elastic Modulus	E_A	220	GPa
Density	ρ_A	3,010	kg/m^3
Poisson ratio	υ_A	0.3	-

Tetahedral meshing (0.4 mm) was applied resulting the 82,080 elements and 167,040 nodals, shown in Figure 2. The result of the meshing in the multistep journal bearing simulation model have a maximum skewness of 0.37, which is considered to be good. The largest skewness in plain journal bearings is 0.50, which is considered acceptable.

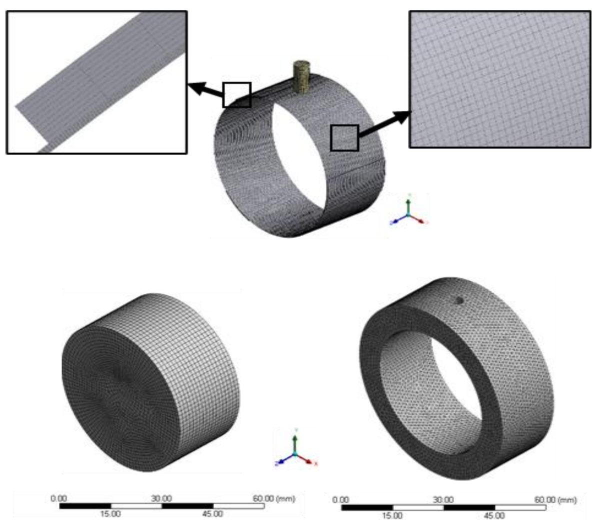


Figure 2: 3D Meshing result for multistep journal bearing.

Figure 3 displays the boundary condition for validation and multistep journal bearing. Bearing interface is a known fixed wall, and journal interface is a known moving wall. With no-slip conditions for both fixed and moving walls, the pressure is assumed to be 0 Pa at the inlet and outflow for validation. Cavitation models use the Zwart-Gelber-Belamri model with two phase mixture for the fluid.

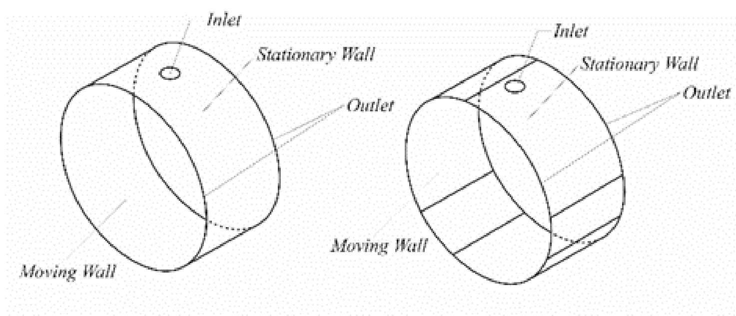


Figure 3: Boundary condition for validation and multi step journal bearing.

The importance of an independent grid should be noted be-fore moving on to the validation topic. To reduce computing time, the appropriate level of meshing is determined using grid independence. Figure 4 illustrates grid independence. Using CFD software, the validity of this research is compared to that of Dhande et al. (Dhande and Pande, 2017). Figure 5 displays the pressure distribution near center of the journal with an eccentricity ratio ε = 0.8 and rotation speed ω = 4000RPM. It is validated since the maximum pressure and trend are within the reference's tolerance of 0.15% inaccuracy. Future simulations can make advantage of the simulation technique to verify the impact of deformation and cavitation.

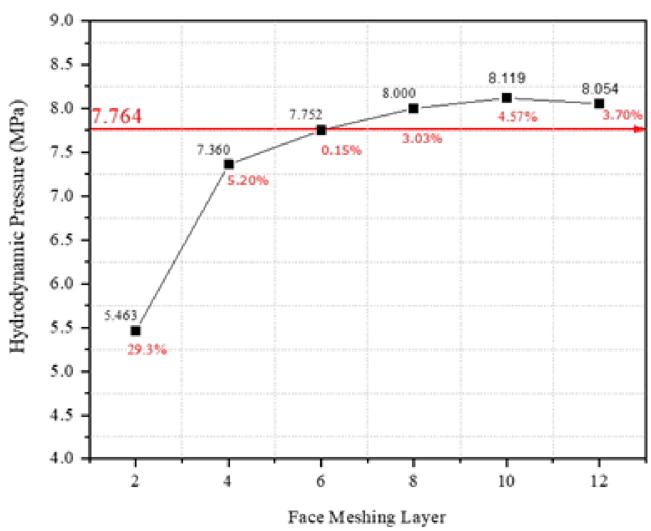


Figure 4: Grid Independency.

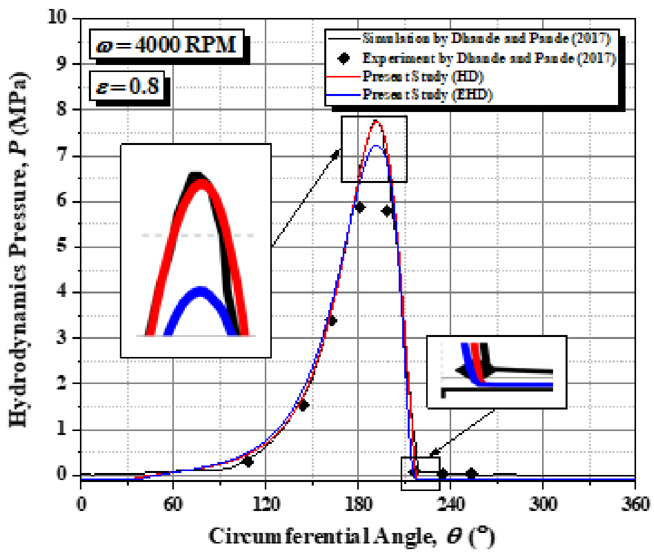


Figure 5: Comparison pressure result from (Dhande et al. 2017) with present study at mid plane.

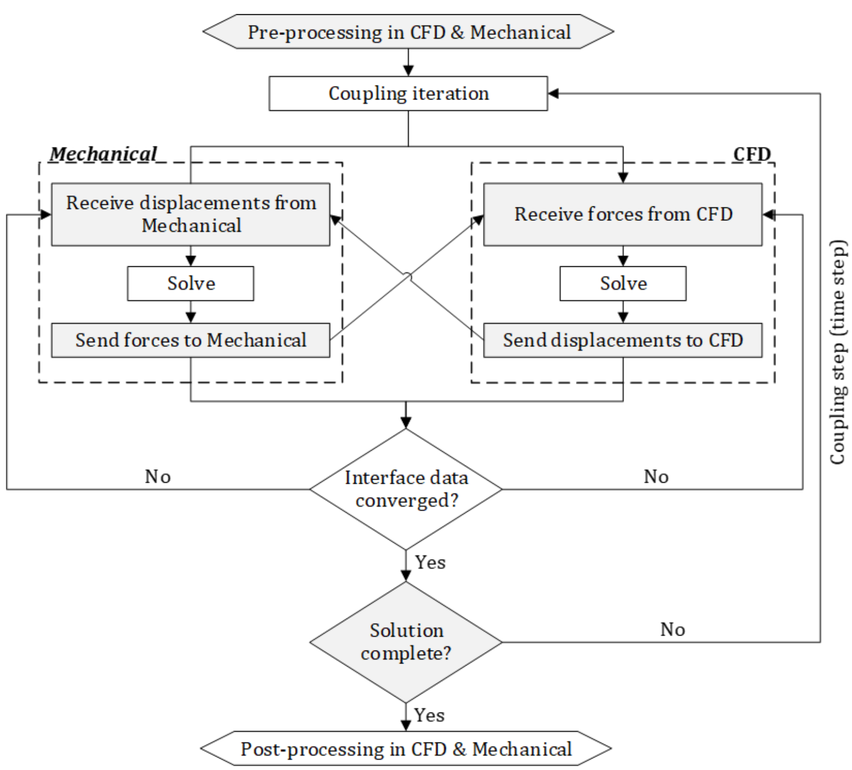


Figure 6: Flow chart process.

3.0 RESULTS AND DISCUSSION

3.1 Effecy of Eccenttricity Ratio

In this section, we will discuss the comparison of tribological performance on each plain and multistep journal bearing eccentricity ratio with a rotation speed of 4000 RPM. The load carrying capacity, frictional force, and average acoustic power level of dB are the three aspects of tribological performance that will be covered in this section.

It is evident that in smooth and multistep journal bearings, the value of pressure increases along with every increase in the eccentricity ratio. However, the multistep journal bearing still has a lower pressure value than the smooth journal bearing. It also has an impact on the value of load carrying capacity. As seen in Figure 7, the load carrying capacity of multistep journal bearing is lower than the plain journal bearing at all rotational speeds. This is supported by the clain of Chen et al. [5] that adding a groove to the journal bearing has a significant impact on how well it lubricates, one of the consequences of which is a reduction in load carrying capability. In addition, the impact of the eccentricity ratio on the functionality of tribological journal bearings is a condition that needs to be taken into consideration. As can be shown in Figure 7, the value of the load carrying capacity will grow for every increase in the eccentricity ratio. This phenomenon is supported by simulations conducted by Dhande and Pande (Dhande and Pande, 2017).

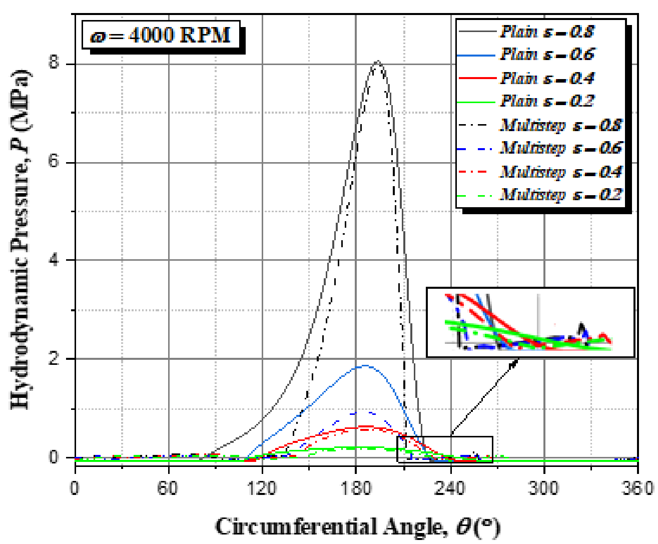


Figure 6: Comparison of the pressure distribution on the angle between the plain journal bearing and the multistep journal bearings at various eccentricity ratio.

Figure 6 showed that the greater the eccentricity value, the pressure value will increase and the plain condition has a slightly higher value than multistep. The largest value of hydrodynamic pressure is found in plain bering with an eccentricity ratio of 0.8. The smallest pressure value is found in the multistep bearing with an eccentricity ratio of 0.2. Pada grafik tekanan tersebut terlihat bahwa persebaran distribusi nilai tekanan bervariasi tergantung dengan kasus simulasi yang ada. Terlihat bahwa kasus *plain bearing* dengan *ε 0.8* memiliki daerah persebaran tekanan yang paling luas mulai dari sudut 80° hingga 220°. Distribusi tekanan paling sempit terjadi pada jenis *multistep bearing* dengan persebaran tekanan mulai dari 130 ° hingga mencapai 220°.

Tekanan hidrodinamis ini akan mempengaruhi hasil dari nilai *load carrying capacity* yang dicapai oleh *bearing.* Semkin luas distribusi tekanan dan besar nilainya maka nilai *load carryng capacity* akan semakin meningkat.

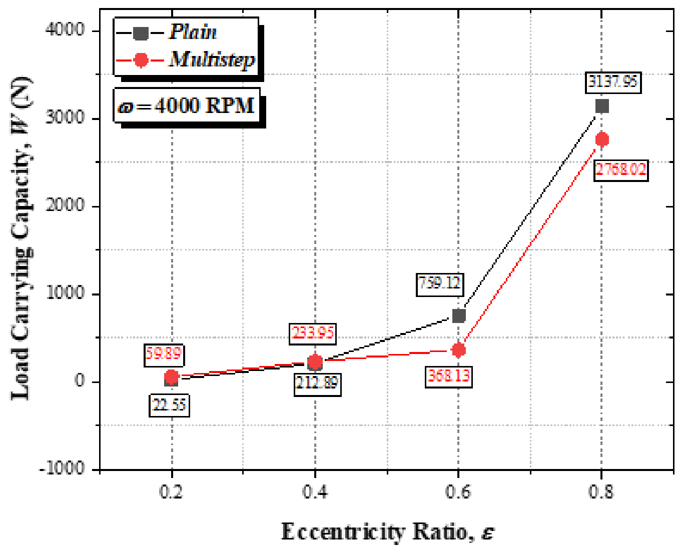


Figure 7: Comparison of the load carrying capacity of the plain journal bearing and the multistep journal bearings at various eccentricity ratio.

Figure 7 showed that the eccentricity ratio affects the load carrying capacity value, the higher the eccentricity ratio value, the more the load carrying capacity bearing value will increase. The largest load carrying capacity value is found in plain bearings with an eccentricity ratio of 0.8. Nilai *load carrying capacity* dihasilkan oleh *bearing* dengan *eccentricity ratio* 0.2. Hal ini menunjukkan cara kerja dari tekanan hidrodinamis dari sebuah *journal bearing.* Saat pelumas melintasi celah konvergen pada *eccentricity ratio* tinnggi maka pelumas akan mengalami penumpukan ketebalan lapisan yang membuat tekanan dalam pelumas meningkat. Peningkatan tekanan ini juga akan meningkatkan gaya yang bekerja pada *shaft* sehingga dapat menahan beban dengan parameter yang disebut *load carrying capacity.* Sebaliknya pada *journal bearing* dengan nilai *eccentricity ratio* kecil, pelumas saat melewati celah konvergen akan minim mengalami pengkatan lapisan pelumas sehingga tekanan yang dihasilkan tidak begitu besar.

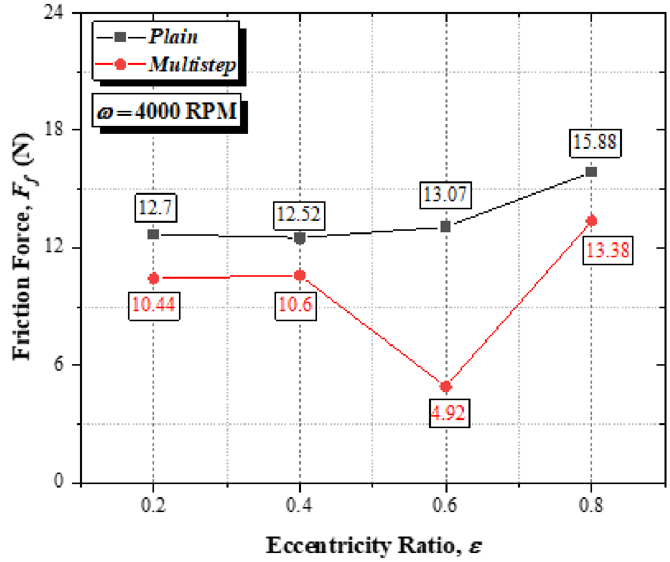


Figure 8: comparison of plain and multi step friction force values at certain eccentricity ratio conditions.

Figure 8 showed that increasing the eccentricity ratio can increase the friction force, but under certain conditions the friction force can decrease, such as at an eccentricity ratio value of 0.6. The largest friction force value is found in the plain bearing with an eccentricity ratio of 0.8 and smallest in multistep with an eccentricity ratio of 0.6. Pada grafik menunjukkan suatu keunikan dari hasil simulasi bahwa peningkatan nilai *eccentricity ratio* tidak selalu memperbesar nilai dari *friction force.* Terlihat bahwa pada nilai *eccentricity ratio* 0.6 multistep terjadi penurunan *friction force* menjadi 4.92 dimana pada sebelumnya pada *eccentricity ratio* 0.4 menghasilkan nilai 10.6 dan meningkat kembali pada *eccentricity ratio* 0.8 dengan nilai 13.38.

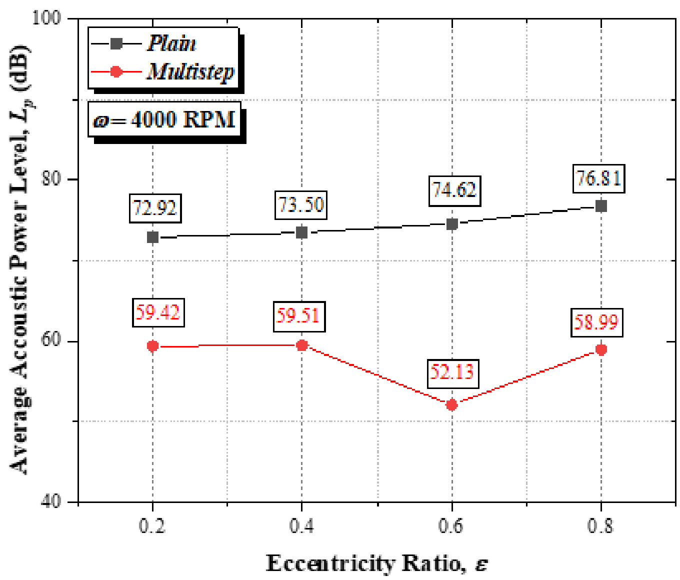


Figure 9: Comparison of the average acoustic power level of the plain journal bearing and the multistep journal bearings at various eccentricity ratio

Figure 9 showed that the average acoustic power level reduced because of the multistep textured. The reason is that for surfaces with texture will reduce the turbulent intensity in the textured region and will be reducing the acoustic power level. Pada grafik terlihat bahwa sebuah kesimpulan bahwa kenaikan nilai *eccentricity ratio* tidak selalu menigkatkan nilai dari *average acoustic power level dB.* Terlihat pada multistep *bearing dengan eccentricity ratio* 0.6 memiliki penurunan nilai menjadi 52.13 dB dimana pada nilai accoustik level dengan *eccentricity ratio* 0.4 sebelumnya memiliki nilai sebesar 59.51 dB dan mengalami peningkataan kembali pada *eccentricity ratio* 0.8 dengan nilai sebesar 58.99 dB. Hasil accoustic level dB dapat terjadi akibat gesekan fluida dengan dinding *shaft* dan *bearing* salah satu penyeba terjadinya perubahan nilai akibat perbedaan tekanan yang dihasilkan sehingga mempengruhi gaya gesek yang dihasilkan.

3.2 Effect of Composites Material

The performance of elastohydrodynamic lubrication on mul-tistep journal bearings in terms of tribology will be compared in this section to a variety of composite bearing materials with an eccentricity ratio of 0.8 and a rotational speed of 4000 RPM. This section will discuss tribological performances, that is the load carrying capacity, frictional force, and average acoustic power level in dB.

Figure 8 shows that when compared to other composite materials and aluminum, carbon composite material has the highest pressure value. This is a result of the mechanical characteristics of the carbon fiber reinforced polymer composite material, which, in comparison to other materials, has a very high elasticity modulus (E).

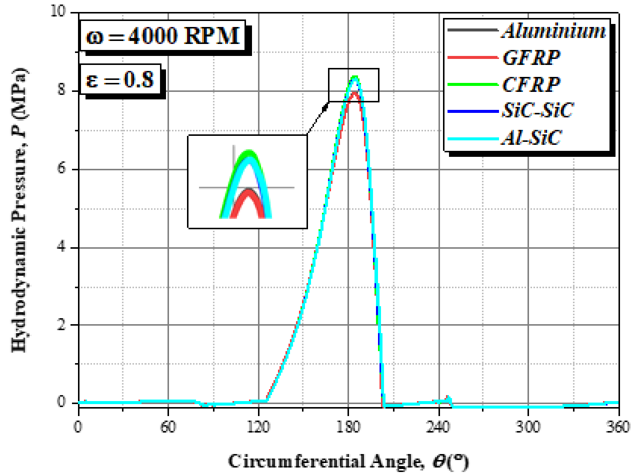


Figure 10: Comparison of the pressure distribution on the multistep journal bearing at various bearing material.

Figure 10 showed that the hydrodynamic pressure will decreased because of the material modulus elasticity, The higher the modulus will create smaller deformations that will affect the film thickness that has minor effect on the hydrodynamic pressure. The highest maximum pressure value is found in the CFRP material and the lowest in the GFRP material. Hal ini dapat dijelaskan bahwa deformasi yang terjadi dapat menjadikan pelumas yang mengalir khususnya pada celah konvergen terjadi pelebaran area pelumasan. Pelebaran wilayah pada area pelumasan akan menyebabkan pelumas mengalami penurunan tumbukan partikel fluida sehingga gaya yang dihasilkan mengecil dan dapat mempengaruhi distribusi tekanan yang terjadi. Tekanan tersebut akan mempengaruhi nilai dari performa *journal bearing* berupa *load carrying capacity.*

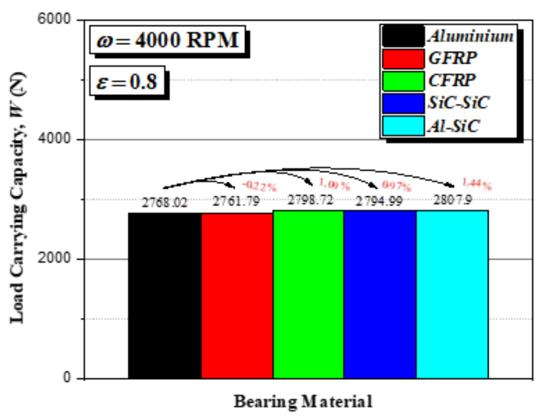


Figure 11: Comparison of the load carrying capacity of the multistep journal bearings at various bearing material.

Figure 11 showed that the load carrying capacity is influenced by the hydrodynamic pressure that will decreased because of the material modulus elasticity. The highest load carrying capacity value is found in Al-SiC material and the lowest in GFRP material. Pada grafik ini terlihat bahwa perbedaan material dapat mempengaruhi nilai dari *load carrying capacity* yang dihasilkan. Jenis dan karakteristik material merupakan hal dasar yang mempengaruhi nilai tersebut. Salah satu parameter material yang mempengaruhi adalah nilai modulus elastisitas, modulus elastisitas berpengaruh karena dapat memberikan perbedaan nilai perubahan deformasi yang dihasilkan. Semakin besar nilai deformasi yang dihasilkan maka akan terjadi perubahan nilai tumbukan partikel fluida yang mengalir. Tumbukan partikel akan menghasilkan perubahan gaya dan momentum yang sangat berpengaruh pada distribusi tekanan sehingga nilai *load carrying capacity* dapat berubah.

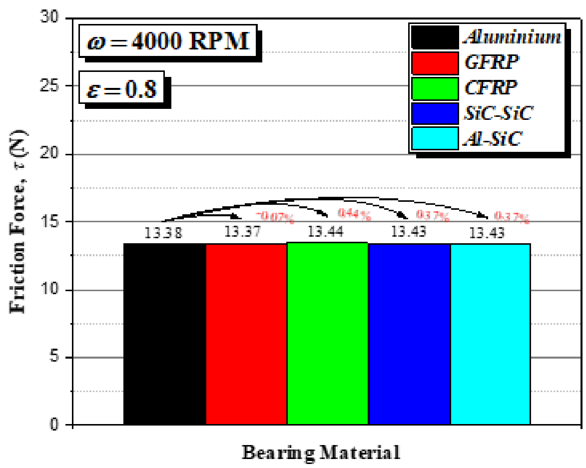


Figure 12: Comparison of the friction force of the multistep journal bearings at various bearing material.

Figure 12 showed that the friction force is not significantly affected because of the same condition on the stationary wall. The largest friction force value is found in Al-SiC and the smallest in Aluminum. Pada grafik terlihat bahwa perbedaan material dapat mempengaruhi nilai dari friction force yang dihasilkan. Friction force terjadi akibat gesekan aliran pelumas dengan dinding poros dan *bearing.* Semakin besar tekanan yang diberikan oleh pelumas makan gaya gesek akan meningkat. Hal ini juga menjadi alasan dasar bahwa perubahan material mempegaruhi nilai dari friction force. Perubahan deformasi pada dinding *bearing* akubat perbedaan material akan mempengaruhi laju momentum pada pelumas yang mengalir. Semakin besar tumbukan momentum pelumas pada dinding maka nilai *friction force* akan semakin meningkat.

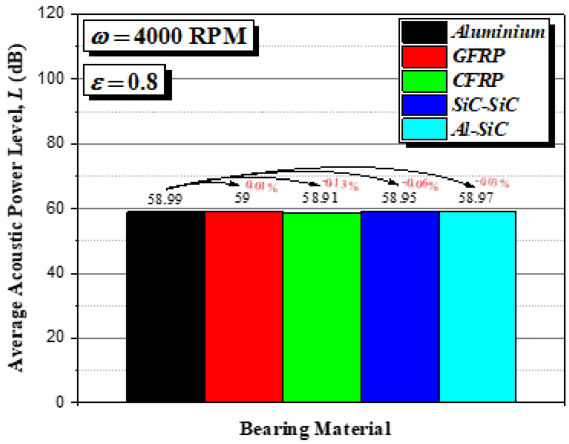


Figure 13: Comparison of the average acoustic power level of the multistep journal bearings at various bearing material.

Figure 13 showed that the average acoustic power level is not significantly affected because of the same value of the turbulent intensity in the fluid flow. The largest acoustic power level value is found in Al-SiC and the smallest in Aluminum.

The tribological performance of the elastohydrodynamic lubrication on the multistep journal bearing with the change of bearing composites with an eccentricity ratio of 0.8 and rotation speed of 4000 RPM only affects the pressure results, which will affect the value of the load carrying capacity because the modulus value will affect the deformation which will become smaller as the modulus value increases. Nilai accoustic level dapat dipengaruhi oleh nilai *friction force* yang terjadi antara pelumas dengan dinding *bearing* dan poros. Jadi tentu material dapat berpengaruh pada nilai accoustic level dB karena dapat memberikan nilai pada *friction force*.

3.3 Effect of Roughness

In this part, we will compare the tribological performance of elastohydrodynamic lubrication on multistep journal bearing with the modification of roughness level of (R_a) 0 μm (smooth), 0.1 μm (precision), 0.4 μm (fine), 1.6 μm (medium), and 6.3 μm (rough) with eccentricity ratio of 0.8 and rotation speed of 4000 RPM. *Ra* is calculated as the roughness average of a surfaces measured microscopic peaks and valleys. This section will discuss tribological performances, that is the load carrying capacity, frictional force, and average acoustic power level (dB).

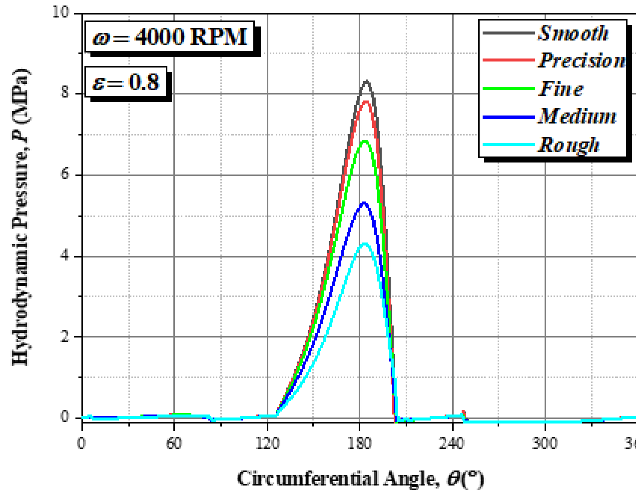


Figure 14: Comparison of the pressure distribution on the multistep journal bearing at various roughness level.

Figure 14 illustrates how the pressure reduces with increasing roughness. The reason is that for surfaces with high levels of roughness, the presence of deformed surface asperities increases the amount of vapor bubble along the divergent area, resulting in more gas bubble being trapped in asperities. It allows vapor volume fraction of the fluid to rise, which lowers the hydrodynamic pressure value and peak pressure of the remaining lubricant in the convergence region. Hal ini membuat gaya yang bekerja pada poros mengalami penurunan sehingga mengalami penurunan nilai tekanan yang dapat berpengaruh pada *load carrying capacity.*

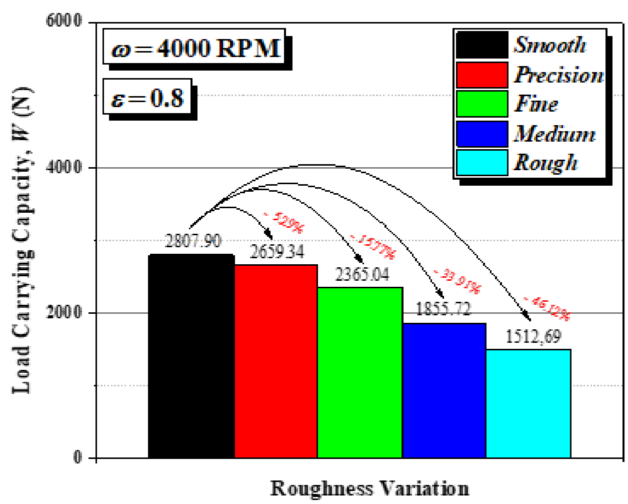


Figure 15: Comparison of the load carrying capacity of the multistep journal bearings at various roughness level.

Figure 15 showed that the load carrying capacity is significantly affected because of the hydrodynamic pressure that declines over with increasing the roughness level. The largest load carrying capacity value is found in the smooth texture and the smallest in the rough texture. Hal ini terjadi akibat perubahan nilai yang terjadi pada tekanan hidrodinamis pada parameter sebelumnya. Semakin kasar permukaan *bering* maka nilai tekanan hidrodinamis semakin menurun. Semakin menurun tekanan hidrodinamis maka nilai *load carrying capacity* semakin kecil. Hal inilah yang menyebabkan perbedaan kondisi permukaan *bearing* berpengaruh pada nilai tekanan dan *load carrying capacity.*

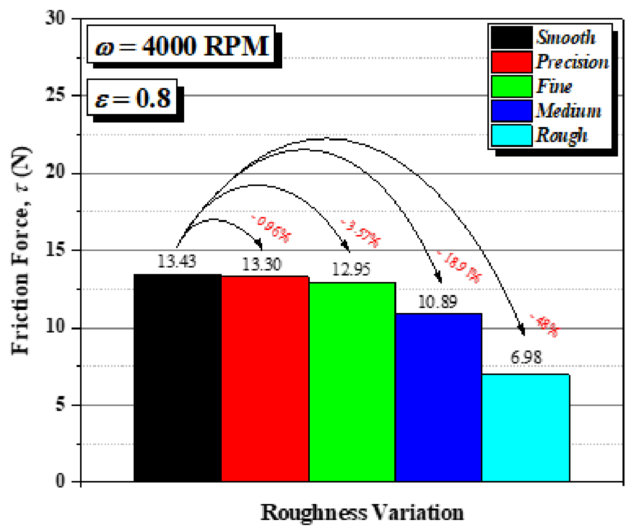


Figure 16: Comparison of the friction force of the multistep journal bearings at various roughness level.

Figure 16 showed that the friction is significantly affected because of fluid flow in the stationary wall will be less due to the effect of surface roughness which results in less friction. The smallest friction force value is found in the rough texture and the largest value in the smooth texture. Alasan ini terjadi akibat perubahan nilai tekanan yang terjadi pada parameter sebelumnya. Semakin besar nilai kekasaran permukaan maka tekanan yang terjadi pada *bearing* akan semakin turun. Tekanan turun mengakibatkan penurunan nilai tumbukan momentum pada partikel fluida yang mengalir pada *bearing.* Penurunan nilai tumbukan momentum pelumas akan mengakibatkan menurunnya gaya gesek yang terjadi pada derah dinding sehingga mengakibatkan penurunan nilai *friction force.*

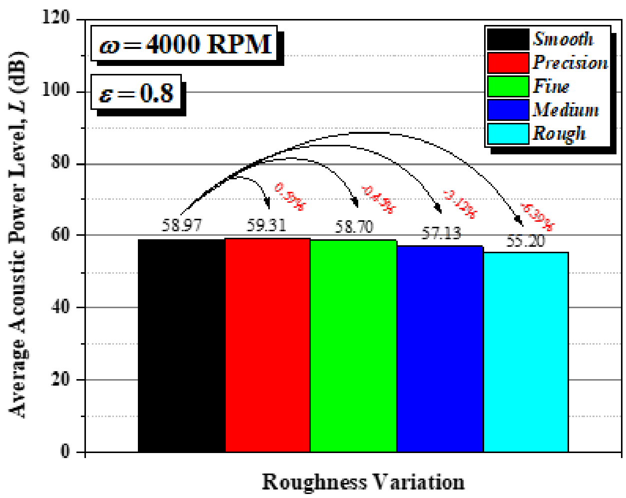


Figure 17: Comparison of the average acoustic power level of the multistep journal bearings at various roughness level.

Figure 17 showed that the average acoustic power level is not significantly affected because of the turbulent intensity value in the fluid flow. The largest acoustic power level value is found in the precision texture and the smallest in the rough texture.

The tribological performance of the elastohydrodynamic lubrication on the multistep journal bearing with the fluctuation of the roughness level with the eccentricity ratio of 0.8 and rotation speed of 4000 RPM influences all the lubrication performance.

From an engineering perspective, these results indicate that the finishing process for achieving the desired surface roughness level of contacting surfaces should be properly performed in order to avoid manufacturing errors and provide the best lubrication performance.

3.4 Velocity Profile

In this section, we will discuss about the velocity profile brought on by multistep texture of the journal bearing lubrication flow. Figure 18 shows the velocity vector and countour.

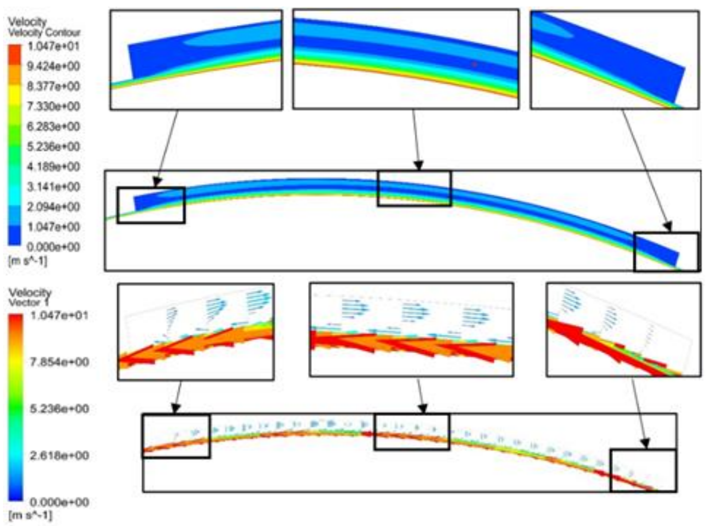


Figure 18: Velocity vector and countour caused by textured multistep journal bearing.

The maximum speed is about equal to the rotational speed of the moving wall. This is due to the simulation is conducted by modeling no slip conditions where the closer to the static wall, the velocity will be zero. Changes in the direction of flow in the area near the wall are caused by the flow hitting the wall perpendicular to the rotation of the journal.

Backflow refers to the resulting change in flow direction. Backflow happens when the direction of the flow changes, as shown in the Figure 18. Different flow velocities in each direction are brought on by the presence of backflow

4.0 CONCLUSION

The CFD-FSI method was used to investigate the lubrication capabilities of plain and multistep journal bearings. In this study, it was concluded that increasing the eccentricity ratio did not always increase the load carrying capacity, tribological performance increase at eccentricity ratios of 0.2 and 0.4 but decrease at 0.6 and 0.8. At an eccentricity ratio of 0.8, the greater of roughness, the friction force decreases with a value of 6.98 N but it is also followed by a decrease in load carrying capacity with a value of 1512.69 N. The acoustic power level reaches the highest at precision roughness is 59.31 dB and it has a minimum value for the highest roughness with 55.20 dB. For bearing materials, the higher the elastic modulus of the materials, the lower of pressure drop due to deformation, with carbon composite material having the highest pressure value.

ACKNOWLEDGEMENT

NOMENCLATURE

A	:	Area
B	:	Arc length between step
C	:	Clearence
D	:	Bearing diameter
d	:	Step depth
E	:	Elastic modulus
F_f	:	Friction force
L	:	Bearing length
L_p	:	Acoustic power level
p	:	Pressure
R_a	:	Roughness average
R_b	:	Bearing radius
R_j	:	Journal radius
v	:	Poisson ratio
W	:	Load carrying capacity
γ	:	Arc length step
ε	:	Eccentricity ratio
μ	:	Viscosity
ρ	:	Density
τ	:	Wall shear
Φ	:	Volume fraction
$\emptyset$	:	Orientation angle
ω	:	Rotational speed

REFERENCES

Adams, T., Grant, C., & Watson, H. (2012). A simple algorithm to relate measured surface roughness to equivalent sand-grain roughness. International Journal of Mechanical Engineering and Mechatronics, 1(2), 66-71.

Bompos, D. A., & Nikolakopoulos, P. G. (2016). Tribological design of a multistep journal bearing. Simulation Modelling Practice and Theory, 68, 18-32.

Muchammad, M., Tauviqirrahman, M., Mario, L. & Jamari, J. (2022). Thermo-hydrodynamic analysis of multistep texture effect on the performance of journal bearings through acoustic and tribological characteristics. Journal of the Brazilian Society of Mechanical Sciences and Engineering, 44(7), 1-13.

Muchammad, M., Putra, W. D.D. Tauviqirrahman, M. Setiyana, B. Yohana, E. & Jamari, J. (2022). Investigation of the influence of turbulence to tribological performance on smooth and multistep journal bearing with hydrodynamics simulation. Frontiers in Mechanical Engineering, 8, 1-12.

Dhande, D. Y., & Pande, D. W. (2017). A two-way FSI analysis of multiphase flow in hydrodynamic journal bearing with cavitation. Journal of the Brazilian Society of Mechanical Sciences and Engineering, 39(9), 3399-3412.

J. Javorova, "Journal bearings lubrication of non-newtonian lubricants with surface roughness effects," vol. 22, no. 1, pp. 433–443, 2016.

Lahmar, M., Ellagoune, S., & Bou-Saïd, B. (2010). Elastohydrodynamic lubrication analysis of a compliant journal bearing considering static and dynamic deformations of the bearing liner. Tribology Transactions, 53(3), 349-368.

Meng, F., Wei, Z., Minggang, D., & Gao, G. (2016). Study of acoustic performance of textured journal bearing. Proceedings of the Institution of Mechanical Engineers, Part J: Journal of Engineering Tribology, 230(2), 156-169.

Muchammad, Tauviqirrahman, M., Soetopo, H. S. S., Jamari. (2021). Mechanical and thermal deformations effects on plain journal bearing with isoviscous boundary condition based on CFD and FSI methods. Jurnal Tribologi, 28, 63-81.

Lin, Q., Bao, Q., Li, K., Khonsari, M. M., & Zhao, H. (2018). An investigation into the transient behavior of journal bearing with surface texture based on fluid-structure interaction approach. Tribology international, 118, 246-255.

M. P. Groover, Fundamentals of Modern Manufacturing Material, Processes, and Systems, 5th Edition. 2013.

N. Tala-Ighil, M. Fillon, and P. Maspeyrot, “Effect of textured area on the performances of a hydrodynamic journal bearing,” Tribol. Int., vol. 44, no. 3, pp. 211–219, 2011.

S. Cupillard, M. J. Cervantes, and S. Glavatskih, “A cfd study of a finite textured journal bearing,” IAHR 24th Symp. Hydraul. Mach. Syst., 2008.

Sander, D. E., Allmaier, H., Priebsch, H. H., Witt, M., & Skiadas, A. (2016). Simulation of journal bearing friction in severe mixed lubrication–Validation and effect of surface smoothing due to running-in. Tribology international, 96, 173-183.

Singh, N., & Awasthi, R. K. (2020). Theoretical investigation of surface texture effects on the performance characteristics of hydrodynamic two-lobe journal bearing. Proceedings of the Institution of Mechanical Engineers, Part J: Journal of Engineering Tribology, 234(11), 1712-1725.

Song, Y., Gu, C. W., & Ren, X. (2015). Development and validation of a gaseous cavitation model for hydrodynamic lubrication. Proceedings of the Institution of Mechanical Engineers, Part J: Journal of Engineering Tribology, 229(10), 1227-1238.

X. Liang, Z. Liu, H. Wang, X. Zhou, and X. Zhou, “Hydrodynamic lubrication of partial textured sliding journal bearing based on three-dimensional CFD,” Ind. Lubr. Tribol., vol. 68, no. 1, pp. 106–115, 2016

Y. Chen, J. Feng, Y. Sun, X. Peng, Q. Dai, and C. Yu, “Effect of groove shape on the hydrodynamic lubrication of journal bearing considering cavitation,” Eng. Comput. (Swansea, Wales), vol. 37, no. 5, pp. 1557–1576, 2020.

New revision received by Editorial Office (JTRIB-00576-2023-02)

From: Jurnal Tribologi (kontakt@editorialsystem.com)

To: m_mad5373@yahoo.com

Date: Thursday 12 October 2023 at 03:45 pm GMT+7

Dear Mr. Muchammad,

Thank you for the revision of the manuscript: Elastohydrodynamic analysis of composite material with roughness effect on multistep journal bearing tribological performance.
The following number has been assigned to it: JTRIB-00576-2023-02.

The manuscript will be rated once again by the Editors and then sent to the Reviewers.

You will be informed by email about any further decisions on this article.

Best regards,
Editors-In-Chief
Jurnal Tribologi
E: editor.jurnal.tribologi@gmail.com
W: http://jurnaltribologi.mytribos.org

Editorial System is available here: https://www.editorialsystem.com/jtrib/

Manuscript has been sent to Reviewers (JTRIB-00576-2023-02)

From: Jurnal Tribologi (kontakt@editorialsystem.com)

To: m_mad5373@yahoo.com

Date: Friday 13 October 2023 at 09:25 pm GMT+7

Dear Mr. Muchammad,

Your manuscript: Elastohydrodynamic analysis of composite material with roughness effect on multistep journal bearing tribological performance (JTRIB-00576-2023-02) was sent to the Reviewers.

You will be informed by email about any further decisions on this article.

Best regards,
Editors-In-Chief
Jurnal Tribologi
E: editor.jurnal.tribologi@gmail.com
W: http://jurnaltribologi.mytribos.org

Editorial System is available here: https://www.editorialsystem.com/jtrib/

Decision on manuscript JTRIB-00576-2023-02

From: Jurnal Tribologi (kontakt@editorialsystem.com)

To: m_mad5373@yahoo.com

Date: Wednesday 1 November 2023 at 11:34 am GMT+7

November 01, 2023
JTRIB-00576-2023-02
Elastohydrodynamic analysis of composite material with roughness effect on multistep journal bearing tribological performance

Dear Mr. Muchammad,

I am pleased to inform you that your manuscript, entitled: Elastohydrodynamic analysis of composite material with roughness effect on multistep journal bearing tribological performance, has been accepted for publication in our journal. No further action is required.

Thank you for submitting your work to us.

Best regards,
Editors-In-Chief
Jurnal Tribologi
E: editor.jurnal.tribologi@gmail.com
W: http://jurnaltribologi.mytribos.org

Your proof is now ready for review

From: Chief Editor Jurnal Tribologi (editor.jurnal.tribologi@gmail.com)

To: m_mad5373@yahoo.com

Date: Tuesday 26 March 2024 at 09:54 am GMT+7

Dear Sir,

Thank you for publishing with MYTRIBOS.

The proof of your article which will be published in Jurnal Tribologi is now available for review.

Please find the attachment to access your proof. Please annotate any corrections using the sticky note in the PDF file. Please re-check the following items:

1. Authors' name and affiliation
2. All cited refs should be in the references list.
3. Acknowledgment (if any).
4. Others.

Please return the corrected proof by Thursday, 28 March 2024 by replying to this email. If we did not receive any response from you by this date, we will proceed to publish the article as it is.

The Proofing Service provides you with an opportunity to correct any typographical errors, grammatical errors, or incorrect author details only.

Kind regards,

Journal Manager
Jurnal Tribologi
E: editor.jurnal.tribologi@gmail.com
W: http://jurnaltribologi.mytribos.org

JT-40-39-60.pdf
890.1kB

Re: Your paper has been published in Jurnal Tribologi "Vol.40 (Mac 2024) - MYTRIBOS 2023 (Part 2)"

From: Piyush Verma (piyushchandraverma@hyderabad.bits-pilani.ac.in)

To: editor.jurnal.tribologi@gmail.com

Cc: amiril@umpsa.edu.my; m_mad5373@yahoo.com; shahirkasim@unisza.edu.my; ruroshan@gmail.com; mahadzir@ump.edu.my; ramkumar@iitm.ac.in; munir@utem.edu.my; hafissulaiman@upm.edu.my; nurulhilwa@utem.edu.my; pbkushare@kkwagh.edu.in; shahiraliza@utm.my; jaharahaghani@ukm.edu.my

Date: Sunday 31 March 2024 at 08:44 am GMT+7

Dear Sirs,

Thank you for your email.

The link shared for our published online paper doesn't have a correct manuscript title. (Plz see the last paper titled and 2nd last paper titled, both are the same)

Kindly rectify the paper title under Abhinav Manoj and Piyush Chandra Verma's names.

Thank you.

> On Sun, Mar 31, 2024, 5:49 AM Chief Editor Jurnal Tribologi <editor.jurnal.tribologi@gmail.com> wrote:
>
> > Dear author(s),
> >
> > Congratulations! Your paper has now been published in "Vol.40 (Mac 2024) - MYTRIBOS 2023 (Part 2)" of Jurnal Tribologi https://jurnaltribologi.mytribos.org/v40.html.
> >
> > Hope you could share your paper with your research society and network for high visibility. You are encouraged to publicly upload your paper to the ResearchGate platform to accelerate the indexing process.
> >
> > Please note that Jurnal Tribologi is indexed to Scopus and ESCI (WoS). Therefore, the indexing data will be available on the WoS/Scopus site within four-six weeks of the date of publication.
> >
> > Thanks for your contribution to our journal.
> >
> > -----
> > Editor-in-Chief
> > Jurnal Tribologi
> > E: editor.jurnal.tribologi@gmail.com
> > W: http://jurnaltribologi.mytribos.org