ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE) Vol. IV, Issue VIII, August 2018

CHARACTERISTICS OPTIMIZATION OF Al_2Co_3 AND TiO_2 FOR SPUR GEAR

[1]S.Surendar, [2]L.Ajeeth, [3]V.R.Dharanidharan, [4]T.Karthik, [5]N.Prabhu
[1]Assistant Professor, Department of Mechanical engineering, Knowledge Institute of Technology, Salem,
[2,3,4,5] UG Scholar, Department of Mechanical engineering, Knowledge Institute of Technology, Salem.
[1]surendarstars@gmail.com,[2]ajeelogu@gmail.com,[3]dhayalanvr@gmail.com,[4]tkarthiksmk@gmail.com,[5]prabhunallaswamy@gmail.com

Abstract: A gear or "gear wheel" is a rotating machine part having cut teeth, or cogs, which mesh with another toothed part in order to transmit power. Two or more gears working in tandem are called a transmission and can produce a mechanical advantage through a gear ratio and thus may be considered . Gears are mostly used in the mechanical field for power transmission, this project reports on stress analysis on spur gears. Spur gear made of stainless steel is considered as the conventional model in this project. The conventional model is optimized with carbon fiber and e glass epoxy material and the analysis is carried out. Boundary constrains are defined and the total deformation for model are calculated and the results are tabulated.

KEYWORDS: Gear, ANSYS, FEA, Composite Materials.

1 INTRODUCTION

Spur gears are the simplest and most common type of gear. Their general form is a cylinder or disk. The teeth project radially, and with these straight-cut gears, the leading edges of the teeth are aligned parallel to the axis of rotation. These gears can only mesh correctly if they are fitted to parallel axles. The torque ratio can be determined by considering the force that a tooth of one gear exerts on a tooth of the other gear. Consider two teeth in contact at a point on the line joining the shaft axes of the two gears. The torque ratio can be determined by considering the force that a tooth of one gear exerts on a tooth of the other gear. Consider two teeth in contact at a point on the line joining the shaft axes of the two gears.

A gear is component within a transmission device. Transmit rotational force to another gear or device. A gear is different from a pulley in that a gear is a round wheel. Mesh with other gear teeth, allowing force to be fully transferred

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE) Vol. IV, Issue VIII, August 2018

without slippage. Depending on their construction and arrangement, geared devices can transmit forces at different speeds, torques, or in a different direction, from the power source.

2 LITERATURE REVIEW

[1] Yi Guo and Robert G. Parker worked on study of the nonlinear tooth wedging behavior and its correlation with planet bearing forces by analyzing the dynamic response of an example planetary gear. The results show significant impact of tooth wedging on planet bearing forces for a wide range of operating speeds. To develop a physical understanding of the tooth wedging mechanism, connections between planet bearing forces and tooth forces are studied by investigating physical forces and displacements acting throughout the planetary gear. A method to predict tooth wedging based on geometric interactions is developed and verified. The major causes of tooth wedging relate directly to translational vibrations caused by gravity forces and the presence of clearance-type nonlinearities in the form of backlash and bearing clearance.

[2] ZhipengFeng et al. have studied Fault diagnosis of planetary gearboxes. They proposed a simple yet effective method to diagnose planetary gearbox faults based on amplitude and frequency demodulations. They use the energy separation algorithm to estimate the amplitude envelope and instantaneous frequency of modulated signals for further demodulation analysis, by exploiting the adaptability of Teager energy operator to instantaneous changes in signals and the fine time resolution. With the proposed method, both the wear and chipping faults can be detectedand located for a sun gear of the planetary gearbox test rig.

[3] A. Kahraman et al. had a main objective of study is to investigate the dynamic effects on gear stresses as afunction of gear rim thickness parameters and the number of planets in the system. A deformable body dynamic model is used to simulate a typical automotive automatic transmission planetary unit. A new rim thickness parameter will be introduced that takes

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE) Vol. IV, Issue VIII, August 2018

into account the size of the gears. The model will be used to quantify the impact of the gear rim flexibilities on dynamic gear stresses. The relationship between the bending modes of the gears and the number of planets in the system is also demonstrated quantitatively

[4] Chien-Hsing Li et al. worked on batch module called integration of finite element analysis and optimum design by taking gear systems as testing examples. A simple and practical method was International Journal on Mechanical Engineering and Robotics (IJMER) ISSN (Print) : 2321-5747, Volume-3, Issue-4,2015 35 developed, by which this module was enabled to search for contact nodes and elements and to automatically define the contact surfaces for contact analysis. The module will automatically construct the geometrical model, analyze contact stress and solve for the optimal solutions when gearing parameters are input. The results are expected to enhance the technology of gear system design.

[5] J.R. Gom à Ayatshad presented a methodology for the kinematic analysis of complex gear trains comprised of planetary gear trains. It is based on the utilisation of hypergraphs, which provides a novel view into the analysis of this type of power trains. The method presented here provides a way to define the kinematic relations existing between all the branches of a mechanism, including branches with a variable speed ratio.

[6] Je`ro^meBruye` et al. had evaluated the impact of tolerance on gear quality, designers need to simulate the influences of tolerance with respect to the functional requirements. To do so, they use AGMA or ISO tables, or they perform experimentations. They have

3 MATERIAL PROPERTIES

3.1 ALUMINIUM CARBIDE

Aluminium carbide has an unusual crystal structure that consists of alternating layers of Al_2C and Al_2C_2. Each aluminium atom is coordinated to 4 carbon atoms to give a tetrahedral arrangement. Carbon atoms exist in 2 different binding environments; one is a deformed octahedron of 6 Al atoms at a distance of 217 pm. The other is a distorted trigonal bipyramidal structure

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE) Vol. IV, Issue VIII, August 2018

of 4 Al atoms at 190–194 pm and a fifth Al atom at 221 pm. Other carbides (IUPAC nomenclature: methides) also exhibit complex structures.

Aluminium carbide is prepared by direct reaction of aluminium and carbon in an electric arc furnace.[3]

$$4\ Al + 3\ C \rightarrow Al_4C_3$$

An alternative reaction begins with alumina, but it is less favourable because of generation of carbon monoxide.

$$2\ Al_2O_3 + 9\ C \rightarrow Al_4C_3 + 6\ CO$$

Silicon carbide also reacts with aluminium to yield Al_4C_3. This conversion limits the mechanical applications of SiC, because Al_4C_3 is more brittle than SiC.[6]

$$4\ Al + 3\ SiC \rightarrow Al_4C_3 + 3\ Si$$

In aluminium-matrix composites reinforced with silicon carbide, the chemical reactions between silicon carbide and molten aluminium generate a layer of aluminium carbide on the silicon carbide particles, which decreases the strength of the material, although it increases the wettability of the SiC particles.[7] This tendency can be decreased by coating the silicon carbide particles with a suitable oxide or nitride, preoxidation of the particles to form a silica coating, or using a layer of sacrificial metal.[8]

An aluminium-aluminium carbide composite material can be made by mechanical alloying, by mixing aluminium powder with graphite particles.

Small amounts of aluminium carbide are a common impurity of technical calcium carbide. In electrolytic manufacturing of aluminium, aluminium carbide forms as a corrosion product of the graphite electrodes.[9]

In metal matrix composites based on aluminium matrix reinforced with non-metal carbides (silicon carbide, boron carbide, etc.) or carbon fibres, aluminium carbide often forms as an unwanted product. In case of carbon fibre, it reacts with the aluminium matrix at temperatures above 500 °C; better wetting of the fibre and inhibition of chemical reaction can be achieved by coating it with e.g. titanium boride.

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE) Vol. IV, Issue VIII, August 2018

3.2 TITANIUM OXIDE

Titanium dioxide, also known as titanium(IV) oxide or titania, is the naturally occurring oxide of titanium, chemical formula TiO_2. When used as a pigment, it is called titanium white, Pigment White 6 (PW6), or CI 77891. Generally it is sourced from ilmenite, rutileand anatase. It has a wide range of applications, from paint to sunscreen to food coloring. When used as a food coloring, it has E number E171. World production in 2014 exceeded 9 million metric tons.

Titanium dioxide occurs in nature as the well-known minerals rutile, anatase and brookite, and additionally as two high pressure forms, a monoclinic baddeleyite-like form and an orthorhombic α-PbO_2-like form, both found recently at the Ries crater in Bavaria. One of these is known as akaogiite and should be considered as an extremely rare mineral. It is mainly sourced from ilmenite ore. This is the most widespread form of titanium dioxide-bearing ore around the world. Rutile is the next most abundant and contains around 98% titanium dioxide in the ore. The metastable anatase and brookite phases convert irreversibly to the equilibrium rutile phase upon heating above temperatures in the range 600–800 °C (1,112–1,472 °F).[10]

Titanium dioxide has eight modifications – in addition to rutile, anatase, and brookite, three metastable phases can be produced synthetically (monoclinic, tetragonal and orthorombic), and five high-pressure forms (α-PbO_2-like, baddeleyite-like, cotunnite-like, orthorhombic OI, and cubic phases) also exist:

For specialty applications, TiO_2 films are prepared by various specialized chemistries.[27] Sol-gel routes involve the hydrolysis of titanium alkoxides, such as titanium ethoxide:

$$Ti(OEt)_4\ 2\ \ H_2O \rightarrow TiO_2 +\ 4\ EtOH$$

This technology is suited for the preparation of films. A related approach that also relies on molecular precursors involves chemical vapor deposition. In this application, the alkoxide is volatalized and then decomposed on contact with a hot surface:

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE) Vol. IV, Issue VIII, August 2018

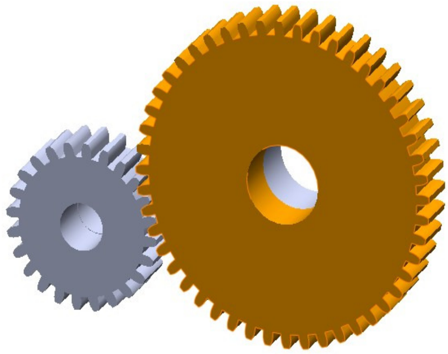
4 METHODOLOGY

The following methodology has been adopted to achieve the project objective and to develop a 3D model of spur gear using Solid works. To develop a assembly model of spur gear and solve the same using Ansys. To plot the bending and contact stresses of different spur gears .Compare the results of different materials. Conclude the work based on the observations

5 MODELING

Modeling Methodology Spur gear modeling is done using the solid works 2013. The gear parameters are modeled as per the design calculation. Steps Involved in the Modeling of Spur gear. The involute profile was created using the geometrical construction procedure. The single involute created was patterned using the circular array. The cross section of the spur gear was completed in the sketcher environment. The above created cross section was converted into a solid gear by extruding the gear to the face width calculated above

5.1 EXTRUDE FOR SPUR GEAR TEETHS

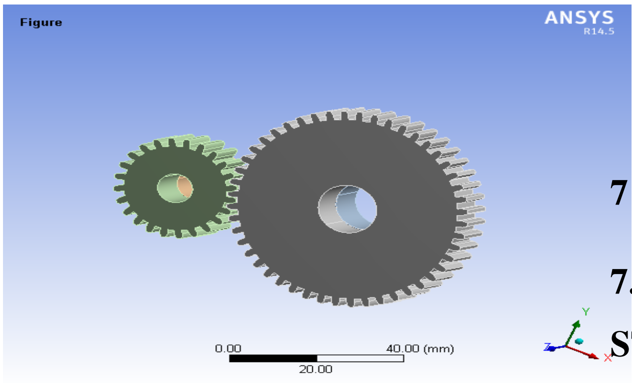


6 ANALYSIS

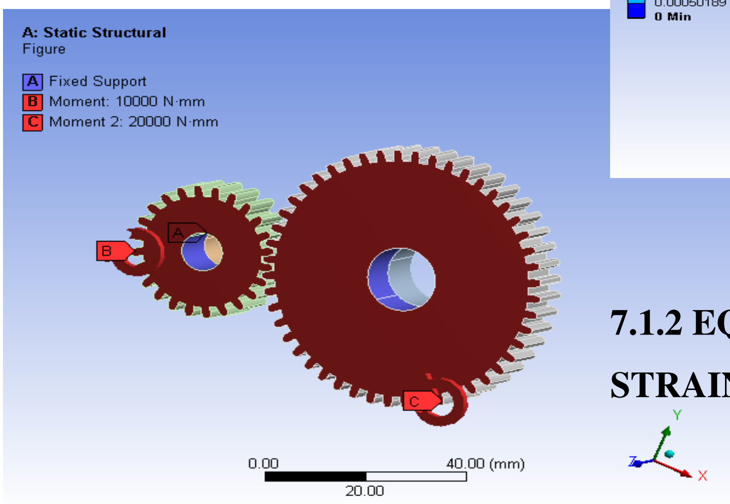
The ANSYS workbench environment is an initiative up front finite element analysis tool that is used in conjunction with CAD systems and Design Modeler. ANYSYS workbench is a software environment for performing structural, thermal, and electromagnetic analyses. The class focuses on geometry creation and optimization , attaching existing geometry, setting up the finite element model, solving and reviewing results.

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE) Vol. IV, Issue VIII, August 2018

6.1 GEOMETRY VIEW OF SPUR GEAR ASSEMBLY IN ANSYS WORKBENCH



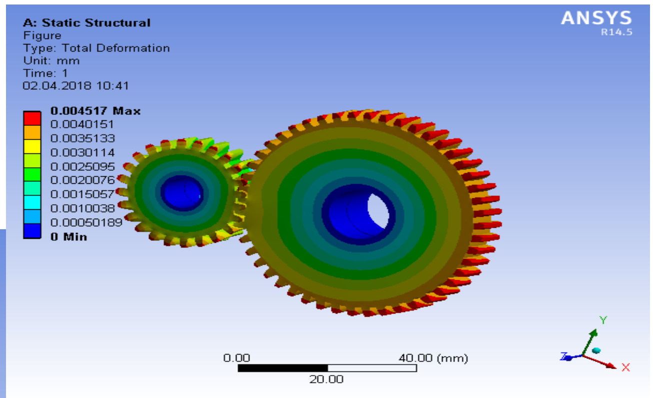
6.2 STATIC STRUCTRUL DEFINED ON SPUR GEAR IN ANSYS WORKBENCH



7 RESULT

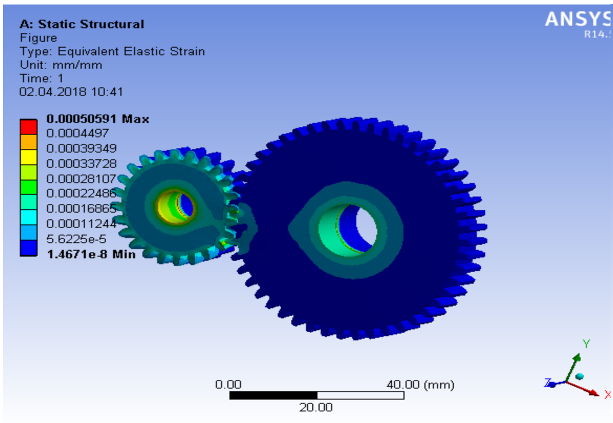
7.1 RESULTS FOR STAINLESS STEEL

7.1.1 TOTAL DEFORMATION

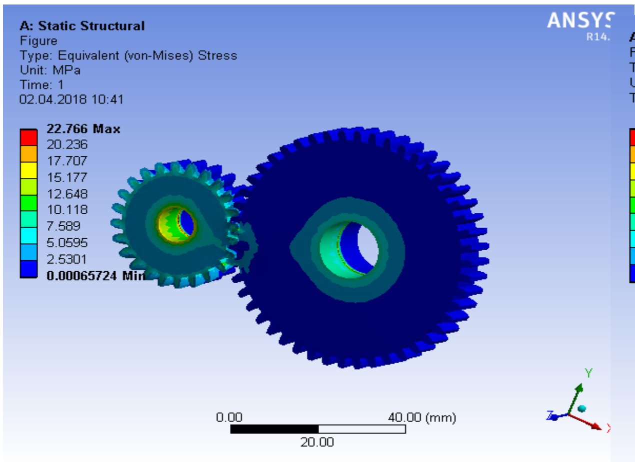


7.1.2 EQUIVALENT ELASTIC STRAIN

IJARMATE
ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE) Vol. IV, Issue VIII, August 2018



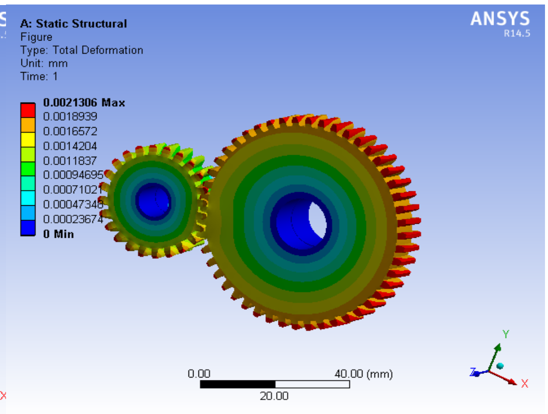
7.1.3 EQUIVALENT STRESS

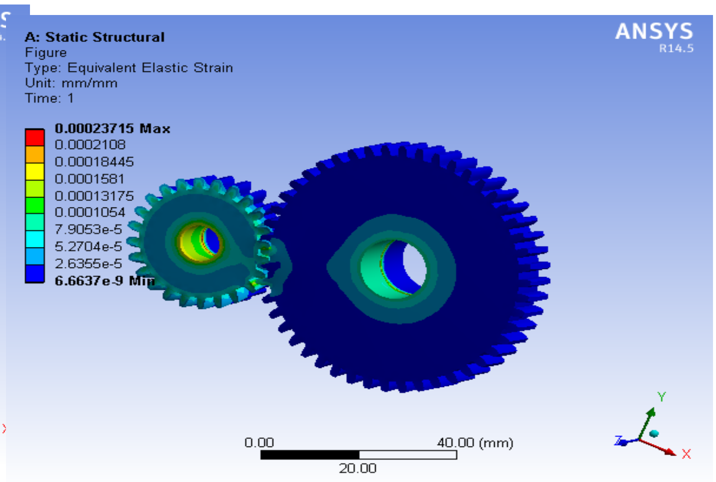


7.2 RESULTS FOR TITANIUM OXIDE

7.2.1 TOTAL DEFORMATION

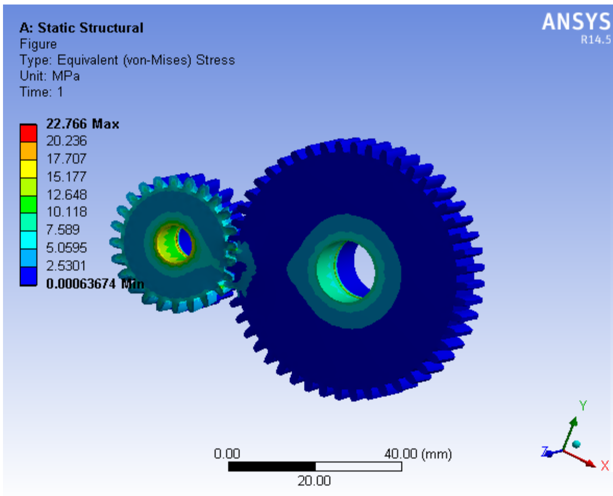
7.2.2 EQUIVALENT ELASTIC STRAIN





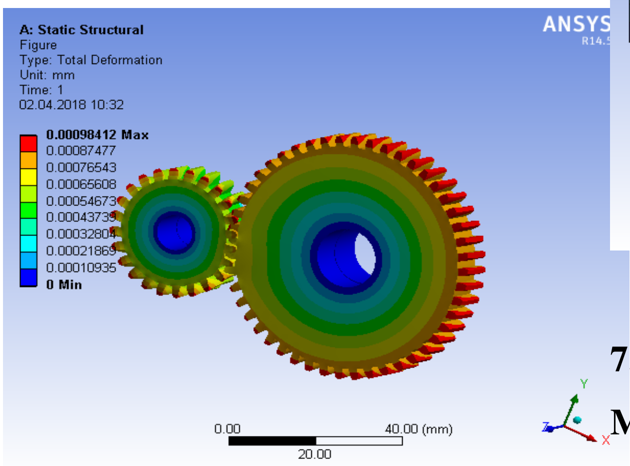
7.2.3 EQUIVALENT STRESS

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE) Vol. IV, Issue VIII, August 2018

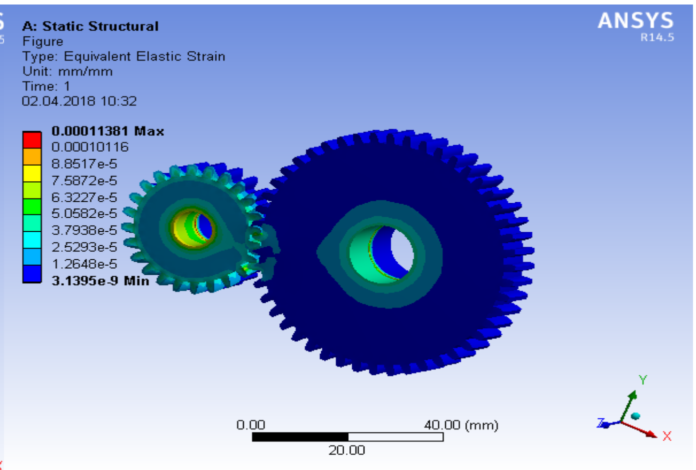


7.3 RESULTS FOR ALUMINIUM CARBIDE

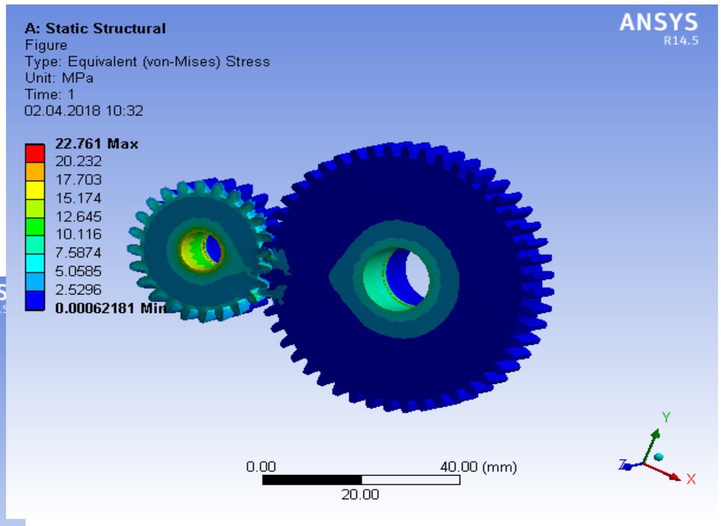
7.3.1 TOTAL DEFORMATION



7.3.2EQUIVALENT ELASTICSTRAIN



7.3.3 EQUIVALENT STRESS



7.4 RESULTS OF ABOVE MATERIALS

7.4.1 STAINLESS STEEL

STAINLESS STEEL	MIN	MAX

ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com
International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE) Vol. IV, Issue VIII, August 2018

Total deformation (m)	0	0.004517
Equivalent Elastic Strain(m/m)	$1.4671e^{-8}$	0.00050519
Equivalent stress	0.00065724	22.766

7.4.2 ALUMINIUM CARBIDE

ALUMINIUM CARBIDE	MIN	MAX
Total deformation (m)	0	0.00098412
Equivalent Elastic Strain(m/m)	$3.1395e^{-9}$	0.00011381
Equivalent stress	0.00062181	22.761

7.4.3 TITANIUM OXIDE

TITANIUM OXIDE	MIN	MAX
Total deformation (m)	0	0.0021306
Equivalent Elastic Strain(m/m)	$6.6637e^{-9}$	0.00023715
Equivalent stress	0.00063674	22.766

8 CONCLUSION

Experimental results from testing the spur gear under moment are listed in the Table. Analysis has been carried out by optimizing the material such as aluminium carbide and titanium oxide. The results such as total deformation, equivalent elastic strain and equivalent stress for each material are determined. Comparing the optimized materials and the conventional material, aluminium carbide and titanium oxide material has the low values of total deformation, stress and strain. Hence it is concluded that aluminum carbide and titanium oxide material is suitable for the spur gear. While carrying out this project we are able to study about the 3Dmodelling software (PRO-E) and Study about the analyzing software (ansys).

9 REFERENCE

[1] Carl C Osgood: Fatigue Design, 1st edition, Wiley-Interscience, 1970, New York.

[2] Kramberger J., Sraml M., Potrc I., Flasker J.: Numerical calculation of bending Fatigue Life of Thin-rim Spur Gears, J. Engineering fracture mechanics 71(4–6)(2004) 647

[3] Glodez S., Abersek B., Flasker J., Zen Z.: Evaluation of Service Life of Gears in Regard to Pitting, J. Engineering fracture mechanics, 71 (2004) 429

[4] Akata E., Altmbalik M.T., Can Y.: Three Point Load Application in Single Tooth Bending Fatigue Test for Evaluation of Gear Blank Manufacturing Methods, Int. J. Fatigue 26 (2004) 785

[5] Zeping Wei: Stresses and Deflection in Involute Spur Gears by Finite Element Method, M.Sc. Thesis, University of Saskatchewan, Saskatchewan, 2004

[6] Litvin F.L., Kim D.H.: Computerized Design, Generation and Simulation of Meshing of Modified Involute Spur Gears with Localized Bearing Contact and Reduced Level of Transmission. ASME. Des. 119(1997)96