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*RESEARCH ARTICLE*

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# REVIEW PAPER ON TEETH FAILURE OF BEVEL GEAR OF TEXMACO HI SPIN RING SPINNING MACHINE

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## *Manuscript Info*

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## *Abstract*

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The bevel gear is use in the ring spinning machine to lift the spindle mechanism. The bevel gears are attached with the cam for spinning the yarn about spindle. During the working tangential force is acting on bevel gear. Which may cause to break the teeth? The tangential load which is applied on the gear is from pinion. The bevel gear are working similar to the bevel gear and transmitting the power. The intersection axis of both the gear and pinion at right angle to each other. The failures of the gear are due to low strength of the gear material. The beam strength of the bevel gear is low as compare to the tangential load that's why thebevel gear fails. By changing the various material of gear we can prevent the gear from failure. The design modification involves changing the material. But in that case by changing the dimension likes to change the module and thickness which may affect the working of machines. Similarly to change in the setup of machine in that case it is desirable to chance the material of bevel gear with high strength material than the existing one. The main cause of bevel gear failure is due to bending stress is more than the allowable stress of that gear material. So in this paper we increase the beam strength of gear by using various gear material.

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## Introduction:-

Gear is one of the most critical components in mechanical power, for transmission system. The surface strength bending and of the gear tooth are considered to be one of the main parameters for the failure of the gears. For design analysis of bevel gear and to reduce their failure the stresses are becoming increasingly important. All the analytical investigations would be carried out on the basis of Lewisstress formula and contact stresses are calculated by using Hertz formula of contact stress. Bevel gears typically have a straight or spiral tooth line and varying tooth profile in normalcross section at different radius from major to minor diameter.These Bevel gears are engaged with spur or helical in volutes pinions at intersecting or crossed axes.

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**About Hi- Spin Ring Spinning Frame Machine:-**

Texaco Mo –Hi-Spin Ring Spinning Frame is design and manufacture to run at the highest obtainable spinning speed inthe industry with ring and traveler combinations..However, to fully utilize the design and manufacturing of this machine careful handling by the operator is essential.

**Redesign:-**

Much more frequently, engineering design is employed to improve an existing design .the task may be to redesign a component in a product that is failing in service or to redesign a component so as to reduce its cost of manufacture. Often redesign is accomplished without any change in the working principal or concept of original design. For example, the shape may be change to reduce a stressconcentration or a new material substitute is reduce weight or cost. When redesign is achieved by changing some of the design parameter, it is often called variant design.

**What is a Bevel gear:-**

This is a pseudo bevel gear that is limited to $90^0$ intersection axis. The Bevel gear is a circular disc with a ring of teeth cut in its side face, hence the name Bevel gear. Tooth elements are tapered toward it's center. The made is spur or helical pinion.

**Characteristic of Bevel gear:-**

1. The pinion of Bevel gear is either a spur or ahelical gear.
2. Bevel gears are mounted on intersecting shaftthat is at right angle to each other.
3. The teeth of Bevel gear can be straight or curved.

**Bevel gears have some of the following advantages:-**

1. They can be cut with gear shapers and spurgear cutter.
2. The axial position of the pinion is not critical asin case of bevel gear.
3. Reduce level of noise due to the very low level oftransmission error.

**Fig.No.1:-** Bevel gear.

**Gear Failures**

When the teeth mesh with each there metal contact which gives rise to contact stresses results in development of surface wear namely scoring, pitting and surface cracking. This is mainly due to lack of lubricant between the surfaces or inclusion of corrosive material like dirt, scales, rust between the contact surfaces.

The study revealed that gears made of case hardened steel failed by bending and tooth breakage while the non heat treated material, structural steel gears mostly failed by scoringand pitting. The gears made of cast iron mostly failed by bending of tooth. Fatigue failure of the gear teeth is the most common failure gearing system.

The tooth fails in fatigue by two ways.

(i) Tooth bending fatigue

(ii) Surface contact fatigue failure.

Fatigue failure of gear teeth are result of different conditions prevailing during operation or inaccuracy within the gears.

These include gear misalignment, overloads on gears, dynamic imbalance, stress raisers, inconsistency in material and subsurface defects in critical areas. Factor affecting fatigue failure are material composition, geometrical discontinuity, surface condition , size factor, residual stresses, operating temperature, corrosion, fretting, operating speed

**Literature Survey**

Pravin M. Kinge et.al, have analyzed gearbox used in sugar industry. The main objective of research analysis was to improve the life of the gear. The reason found that for failure due to wear of gear teeth edges. This is caused due to high stress concentration along gear teeth edges. To relieve these stress concentration three modifications' in the design were done using ANSYS and again stress analysis of the modified gears carried out. The three design modifications were done asfirst, the edges of the gear teeth were tapered by an angle of 20 degree, second, making groove in the gear wheel and third, making holes at the root's of the gear teeth. They have proved that the expected increase in life of the gears of the gearbox would be three years.[1]

Dr. V. B. Sondur have discussed about theoretical and finite element analysis of load carrying capacity of asymmetric involute spur gears. In this paper they have presented a method for investigating the bending stress at the critical section of "Asymmetric Involute spur Gear". The gears with different pressure angle have been modified by using CATIA software and analysis was carried out. The results obtained by theoretical method have been checked by using ANSYS. From their work they have proved that bending stress can be minimized up to 30% by increasing pressure angle from 20° to 35°. Thus from their work it is clear that FEA can be the best technique for designing and analyzing mechanical component. [2]

James W. have explained various experimental techniques which can be used for analysis of fracture mechanics, strain measurements with electrical strain gauges and strain gauge circuits, theory of photo elasticity and brittle coating methods in the book 'Experimental Stress Analysis', McGraw-Hill Inc.[3]

Gitin M. Maitra, V.B. Bhandari, PSG College of Technology, Norton, P. C. Gope, M. F. Spotts et.al, have explained all the details of every type of gear including geometry, gear related parameters, force calculations, deflections, effect of heat generation, stress concentration, design criterion, load rating and efficiency of gears, friction in worm gears, material selection and strength rating of worm gears in their respective books.[4] Sameer Patil have discussed about 3D Photo elastic and FiniteElement Analysis of helical gear. They have

Discussed an industrial problem which uses spreading machine to spread bag ass. This spreading machine has Positive Infinite Variable gearbox system which contains helical gears. When machine In working condition helical pinion fails due to load coming on the teeth. It relived that the failure was due to stress concentration and bending stresses at root of gear tooth. Thecalculation of maximum tensile stress at gear tooth root was a three dimensional problem. They have analyzed the stress pattern by using 3D Photo elasticity techniques. Also they have verified obtained results. They have found out that the failure of helical gear of gear box may be due to improper alignment or due to improper heat treatment process during teeth hardening.[5]

Bensely In this paper failure investigation of crown wheel and pinion has been done. A fractured gear was studied detailed analysis using standard metallurgical techniques to identify the cause for failure. The study concludes that the failure is due to the compromise made in raw material composition by the manufacturer, which is obtained by the presence of high manganese content and non-existence of nickel and molybdenum.This resulted in high core hardness (460 HV) leading to prematurefailure of the pinion.[6]

Lewicki An experimental program to test the accessibility of using Bevel gears in a high-speed and high power environment was conducted. Four Bevel gear sets were tested, two sets at a time, in a closed-loop test stand at pinion rotational speeds to 18,100 rpm and to 270 kW (364hp). The test gear sets were two- half scale of the helicopter design gear set. Testing the gears at two-eighth power, the test gear set had slightly increased tensile bending strength and compressive stresses when compared to the full scale design.. All four sets of gears successfully run at 100 percent of design torque and speed for 40 million pinion cycles, and two sets successfully ran at 300 percent of torque for an additional 40 million pinion cycles. The results, although limited, demonstrated the feasibility of using Bevel gears for high-speed, high-load applications.[7]From the above literature survey it has been obtained that the failures of gears is when tooth load coming on the gears is more than the beam strength of the tooth. The failure of the teeth of gears is due to bending failure. Some other paper reports, technical articles, text book, design data book and catalogs are also reviewed.
Santosh S. Patil et al. [9] in this paper studied about the strain on the gear tooth at the connecting helical gear pairs by experimentally. He performed the experimental testing andanalysis of contact stress in helical gear. FEA analysis done and comparing with the experimental results and the result was good.

Hence they found that the gear dynamic stress test rig experimental setup proved that a suitable method for contact stress evaluation on gear tooth flank. From the above experimental setup study the effect of friction on gear contact stresses is significant and cannot be eliminated. Limitation is the experimental setup concludes that slight vibrations and wear misalignment.

Marina Franulovic et al. [14] studied the influence of pitch deviations on the loading capacity of high contact ratio of spur gear by experimentally and analytically. The experimental method was done by the photo elastic investigation. In this paper analytical calculations are presented and this will considerably improve the loading capacity calculations of high contact ratio gears and also provide further optimization of their design.

Naresh k. Raghuwanshi et al. [15] discussed the results of back- side contact which affect the mesh Stiffness of spur gear pair by using FEM. From the observation, shows the result, when the back-side contact occur the mesh stiffness value is slightly increased. The back-side contact may affect the vibration response.

**Design of Spiral Bevel Gear**

**Problem Formulation**

The Bevel gear and pinion is used in spinning machine gearbox. During operation it was observed thatthe Bevel gear fail due to load coming on the teeth. The failure starts at the central thickness of tooth and continue up to the root of the tooth. The failure occurs once within operational period of about certain days. So the industryhas replace Bevel gear which is not cost effective. The material of Bevel gear is cast iron and pinion is forged carbon steel SAE 1045.

In order to study failure analysis of gears in industries, the present work is prepared. Gears generally fail when the working stress exceeds the maximum permissible stress. The gears generally fail when tooth

Stress exceeds the safe limit. Therefore it is essential to determine the strength of that gear tooth is subjected to undera tangential load. Analysis of the gears strength is carried out so we can be prevented teeth from failure.

The design of the Bevel gear for power transmission in spinning machine plays an important role. This gear is used for moving the bobbins in upward and downward direction. These give the data of spinning machine for requiredparameter and fulfill the design requirement.

## Conclusion:-

In this project work, the failure of Bevel gear is due to the tooth load. The load i.e. axial load and radial load is lessas compare to tooth load. Due to this tooth load, the stress develop in tooth is more than the basic stress of gear, that why the gear fail. Due to gear fail, the machine is in breakdown stage, so the production is hampering.

## References:-


1. Sanket R. Choudhari, Dr. R. R. Gawande ‘Design Modification and Analysis of Bevel Gear of Ring Spinning Machine” International Journal for Research in Engineering Application & Management (IJREAM)
2. ISSN: 2454-9150 Vol-07, Issue-10, JAN 2022
3. Rushikesh A Padwe, Prof.A.C.Gawande, Prof. Pallavi S. Sarode “Redesign of Face Gear of Spinning Machine Using Finite Element Analysis” International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 03 Issue: 07 | July-2016
4. Pravin M. Kinge, Prof. B.R. Kharde, Prof. B.R. Borkar, “Stress Analysis of Gearbox”, IRACST – Engineering Science and Technology: An InternationalJournal (ESTIJ), ISSN: 2250-3498, Vol.2, No. 3, June 2012, pp 367-371.
5. Dr.V.B.Sondur, Mr.N.S.Dharashivkar, “Theoretical and Finite Element Analysis of Load Carrying Capacity of Asymmetric Involute Spur Gears”, International journal of research in aeronautical and mechanical engineering vol.1, July 2013, pp 67-73.
6. V.B. Bhandari, “Design of Machine Elements”,Tata McGraw Hill Publication Company limited, third edition, pp 730-750.
7. Gitin M. Maitra, “Handbook of Gear Design”, Tata McGraw Hill Publication Company limited. pp 4.1-4.43.
8. PrashantPatil, Narayan Dharashivkar, Krishnakumar Joshi, Mahesh Jadhav. “3DPhotoelastic and Finite Element Analysis of Helical Gear”, MachineDesign, Vol.3 (2011) No.2, ISSN 1821-1259 pp. 115- 122.
9. A Bensely, S Stephen Jayakumar, D Mohan Lal, G Nagarajan and A Rajadurai (2006), “Failure Investigation of Crown Wheel and Pinion”, Engineering Failure Analysis, Vol. 13, pp. 1285–1292.
10. Gears for Helicopter Transmissions”, NASA Technical Memorandum 105434, Prepared for Gearbox Configurations of the 90’s, sponsore.