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EXPERIMENTAL ANALYSIS AND OPTIMIZATION IN REDUCTION OF GEAR NICK

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ABSTRACT
The production area has many working lines like input speed gear , output speed gear , input shaft , output shaft , differential gear , sleeve etc .each line has unique working according to the output . Every single line has a major problem or defects in it . The 5 & 6 input speed gear line has the major problem (i.e.) the gear nicking .This gear nicking occurs majorly in gear shaving machine during the internal maching of the gear tooth. This nick alsooccurs because of metal clamping , overloading in the stopper ,careless handling , storage and vibration in the conveyors .So due to the high percentage of occurance in the gear shaver machine , the defect should be reduced there. Therefore the gear nick is chosen , so that the defect and rework time will be reduced and the direct pass ratio is increased .

INTRODUCTION

A gear is a rotating machine part having cut teeth , which mesh with another toothed part to transmit torque , in most cases with teeth on the one gear being of identical shape , and often also with that shape on the other gear. Geared devices can change the speed, torque , and direction of a power source. 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 a simple machine. The Most common situation is for a gear to mesh with another gear; however, a gear can also mesh with a non-rotating toothed part, called a rack , there by producing translation instead of rotation.

LITERATURE REVIEW

A. Bravo, L. Toubal, D. Koffi, F. Erchiqui, had given the ideal solution over Gear fatigue life and thermomechanical behavior of novel green and biocomposite materials VS high-performance thermoplastics. In many applications, metal materials have been replaced by plastic materials because of their functionality and cost advantages. Despite their many benefits, the intensive use of plastics and composites raises sustainability issues because of the depletion of non-renewable petroleum resources and the pollution that is generated. Thus, alternative ecological solutions for plastic materials are necessary; however, little is known regarding ecologically designed materials. In this study, we propose two types of

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innovative holding materials. The first is a semi-ecological polyethylene bio-composite gear reinforced with birch fibers, and the second is a fully bio-sourced natural polyethylene with birch fibers. This study is the first time such fully ecological composite plastic materials have been tested. The tests record the evolution of the fatigue and temperature over time under various operating conditions. Furthermore, acoustic emission is used to assess the evolution of fatigue cracks. The results indicate that the fully ecological materials are feasible and offer an alternative to traditional materials, such as engineering plastics, likely at a lower cost. The mode of failure indicates that changes are needed in lubricant choice and gear design. Gear tooth failure modes can be classified into two major categories, first one is lubricant-related failure and another one is nonlubricant-related failure. Failure modes related to lubricants are Hertzian fatigue commonly called as pitting and micro pitting, adhesive and abrasive wear, scuffing, etc. (Ku 1975). Pitting is a fatigue failure mostly found near spur gear pitch line. This type of failure usually originates from surface cracks. When the crack is grown to some extent, they separate a piece of material , thus a pit is formed. When several pits merge together, a large pit referred as „spall" is formed. The main cause for micropitting is operating conditions like load, temperature, speed, lubricant film thickness, lubricant additives, and material properties (Winter & Oster 1987; Antoine & Besson 2002; Hohn et al 2005; Lipp& Hoffmann 2003; Martins &Seabra 2008). To extend pitting life, contact stress must be kept low and lubricant film thickness must be high. Micro- pitting occurs mainly due to lubricant failure, it originates from micro cracking below the pitch line (Hohn&Michaelis 2004). Finite Element Analysis (FEA) is one of the most accurate method that can be used for verification of the results obtained from other methods (Andrzej et al 2006). Gear failures are classified into two main groups. One is a failure at the root because of inadequate bending strength. Second one is a failure on the surface of the teeth. For theoretical calculation, Hertzian equation can be used for contact stress calculation and Lewis equation can be used for bending stress calculation (Sushil 2012). Bathe (1996) has described the general procedures of Finite Element Techniques. Huseyin&Eyercioglu (1995) found the stresses developed in the tooth root fillet of the spur gear using Finite Element Method. Wilcox & Coleman (1973) used FEM to analyze the gear tooth bending strength for a solid gear and the result has a good agreement with measurements taken from photo elastic stress. The main cause for crack failure is tensile stress. So, that crack initiates usually at the tensile side. Bibel et al (1991) have developed a spur gear model for stress analysis using Finite Element Model (FEM) and load was applied to the central tooth. Largest bending stress was produced when the full load was acting at the highest point of single tooth contact (HPSTC). ISO/TC-60 recommends a load applied at the highest point of single tooth contact for computing stress and virtual load radius (Pedrero et al 1999).

3. Gear manufacturing process flow

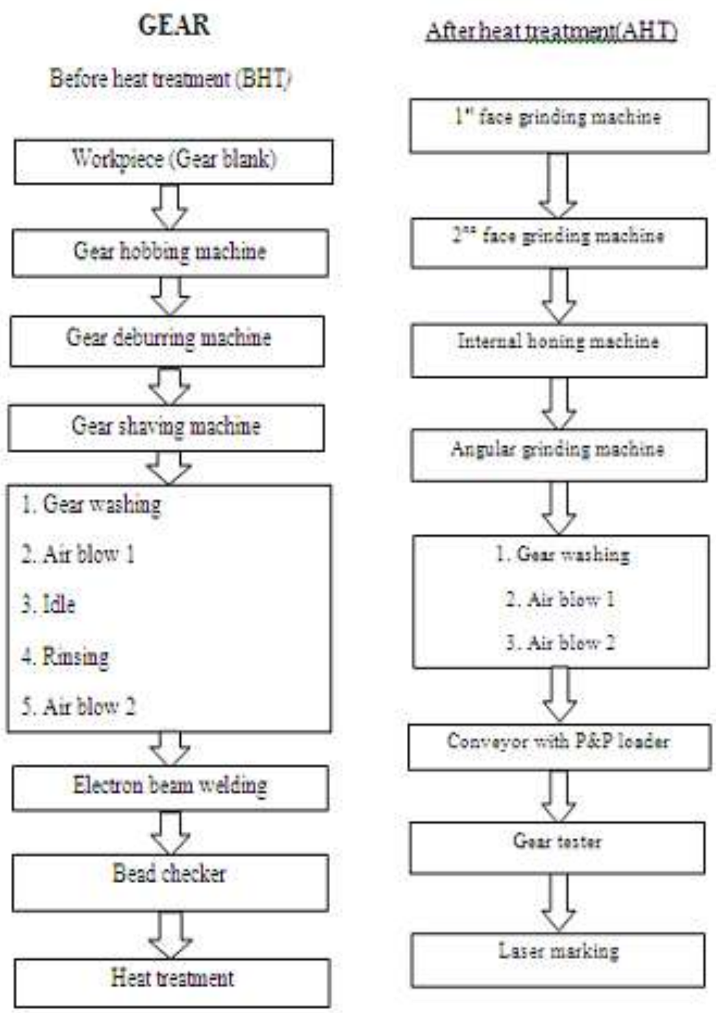

Figure 1 Gear manufacturing process flow

NICK
The defects that occurs over the gear tooth by bulged form in microns is said to

On analysing one day , the readings are tabulated below :

TABLE 1 NICK READING

S/NO	OBD	NICK	RUN	INSIDE 1
1	100.138	**0.032**	0.024	0.018
2	100.136	**0.038**	**0.062**	0.017
3	100.165	**0.028**	0.022	0.011
4	100.155	**0.026**	0.023	0.012
5	100.125	**0.111**	**0.061**	0.015
6	83.728	**0.026**	0.017	0.019
7	**83.717**	0.016	0.009	0.025
8	83.126	**0.028**	0.043	0.021
9	83.755	**0.039**	0.022	0.023
10	83.768	**0.033**	0.019	0.018

- These readings are displayed in the monitor , which are been checked by the master gear. It compares the actual value with the standard value .
- From the above readings nick plays the major part , so problem is analysed and suitable implement is given .
- The defects are highlighted because of the maximum and minimum tolerance value

IMPLEMENTATION TO THE PROBLEM :
To reduce the nick defect in the clamping , we implement the nylon material according to the wear and tear characteristics. The term "NYLONS" refers to the group of plastics known as polymides . Nylon is used in the production of film and fiber, but is also available as a moulding compound . The material is available as a homopolymer , co-polymer or reinforced. Nylons may also be blended with other engineering plastics to improve certain aspects of performance .

CHEMICAL COMPOSITION
Its properties are determined by the R and R' groups in the monomers . In nylon 6,6 R' =6C and R=4C alkanes , but one also had to include the two carboxyl carbons in the di-acid to get the number

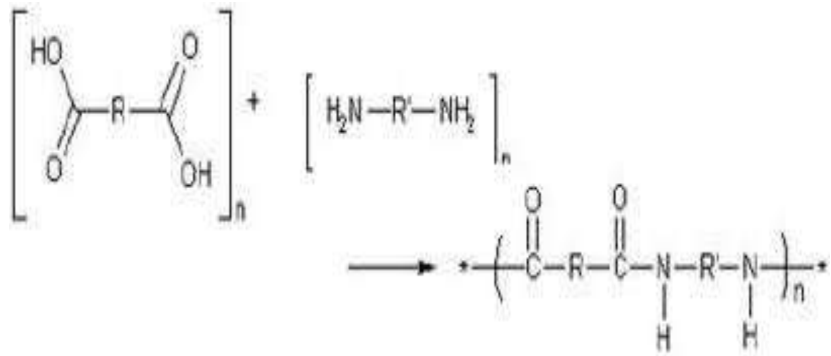

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Fig 1 Nylon Chemical Composition

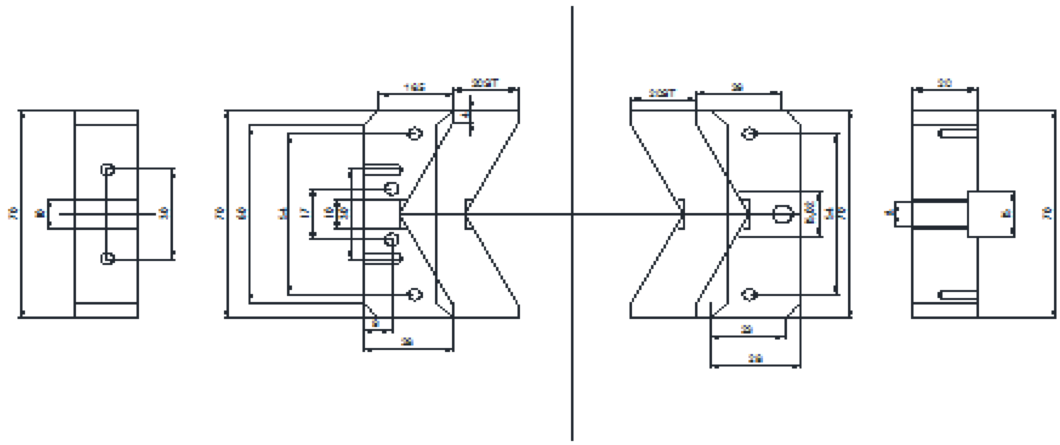
PROPERTIES OF NYLON

The majority of nylons tend to be semi-crystalline and are generally very tough materials with good thermal and chemical resistance . The different types gives the wide range of properties with specific gravity , melting point and moisture content tending to reduce the nylon number increases . Nylons can be used in high temperature environments . Heat stabilized systems allow sustained performance at temperature up to 185 `C .

Table 2 properties of nylon

PHYSICAL PROPERTIES	VALUE
Tensile strength	90-185 N/mm^2
Notched impact strength	50-13.0 KJ/m^2
Thermal coefficient of expansion	80 x 10^6
Max.Cont.use temperature	150-185^{o}C
Melting point	190-350^{o}C
Glass transition temp .	45'C
Density	1.13-1.35g/cm^3

DESIGN OF THE NYLON CLAMP IN 2D VIEW



All Dimensions are in mm

F

igure 2 clamp design in 2D view

Figure 3 Final implementation image

COMPARISON

The below table shows the percentage of nick reduction on one shift :

Table 3 Comparison

S.NO	DESCRIPTION	BEFORE IMPLEMENT	AFTER IMPLEMENT
1	NICK	**180**	**135**

2	**DIRECT PASS RATIO (OK JOB)**	**70%**	**77.50%**

CONCLUSION

A very important criterion on todays automobile field is life of the vehicle .Since the vehicle have proved to be the need of the near future .The vehicle must run smoothly with good comfort to customers for long life. In the transmission production line the nick defect is the major barrier . Its quantity at normal working conditions is 180 . After our implementation it is reduced to 135 . so the rework time is reduced and the direct pass ratio or the d\p ratio is summed up with 7.75 %.

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