A Novel Approach for Contact Stress Analysis of a Spur Gear Tooth

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Abstract - Gearing is one of the most critical components in mechanical power transmission systems. Current Analytical methods of calculating gear contact stresses use Hertz's equations, which were originally derived for contact between two cylinders. Here the contact stresses are calculated using theoretical design standard formulae for contact stresses in Gears. So for contact stresses it's necessary to develop and to determine appropriate models of contact elements. Contact stress is generally the deciding factor for the determination of the requisite dimensions of gears.

Keywords *- Gearing*

I. INTRODUCTION

Spur gears have their teeth parallel to the axis and are used for transmitting power between two parallel shafts. They are simple in construction, easy to manufacture and cost less. They have highest efficiency and excellent precision rating. They are used in high speed and high load application in all types of trains and a wide range of velocity ratios. Hence, they find wide applications right from clocks, household gadgets, motor cycles, automobiles, and railways to aircrafts. Mild steel is a poor material for gears as it has poor resistance to surface loading. The carbon contact for unhardened gears is generally 0.4 % (min) with 0.55 % (min) carbon for pinions. Dissimilar materials should be used for the meshing gears – this particularly applies to alloy steels. Alloy steels have superior fatigue properties compared to carbon steels for comparable strengths. For extremely high gear loading case hardened steels are used the surface hardening method employed should be such to provide sufficient case depth for the final grinding process used.

A. SPUR GEAR

Teeth is parallel to axis of rotation can transmit power from one shaft to another parallel shaft. 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". Spur gears are gears in the same plane that move opposite of each other because they are meshed together. Gear 'A' is called the 'driver' because this is turned by a motor. As gear 'A' turns it meshes with gear 'B' and it begins to turn as well. Gear 'B' is called the 'driven' gear.

Fig.1 Driver and Driven

II. EXPERIMENTAL SETUP

The finite element method is most widely for find a real model of the geared set using the stress analysis in the pair of gears. The development off finite element analysis model of the spur gear assembly to simulate the contact stress calculation and bending stress calculation is play more significant role in the design of gears. The study is show that Hertz theory is the basis of contact stress calculation and Lewis formula is use for calculating bending stress is a pair of gear. Theoretically result obtained by Lewis formula and hertz equation and result found by comparable with finite element analysis of spur gear. Here for each and every shaft texture, it has been experimented on two different speeds with varying the load. The load subjected to the shaft is varying from No load condition to the load of 7kg subjected to the bearing. The speed variation has been taken for two shaft speeds of 1000 rpm and 1490 rpm. After investigating the effect of load, speed and shaft texture on the bearing the profile pressure has been measured, and then it has been compared with each other in terms of the pressure profile generated. It is also conclude that the Pressure profile of the Journal bearing is also Improve (Increase) using Bearing Inner surface texturing.

III. RESULTS AND FINAL ACTION

TABLE 1 SUMMERY OF TRIALS

Summary of Trials			
S. No.	Trial Content	Result	Final Action
1	In house Normalizing	Variation in Tip relief distortion reduced	Normalizing continued at Vendor
2	HT Fixture design change	There is no significant change in any of the profile parameter	HGL Fixture (flat tray type) to be used
3	Soaking Time increased 20 minutes to 35 minutes	) There is Significant diff. in Mean of tip relief distortion after In house Normalizing & Increase of Soaking Time. 2) After Change Mean of tip relief distortion reduced as per Graph.	Increase in Soaking time included in Heat Treatment work instruction
4	Cutter re sharpening done at HMCL in place of HGL	1) There is Significant difference in Mean in tip relief after cutter re sharpening improvement. 2) After Shaving Cutter Re sharpening Improvement variation in tip relief reduced	Cutter resharpening at two sources (HMCL Dharuhera & MATS Noida) with standardised specs 1. Fha (-10 to -13) 2. Ca (-2 to -3) 3. Cb (-10 to -11)

CONFIRM EFFECTIVENESS

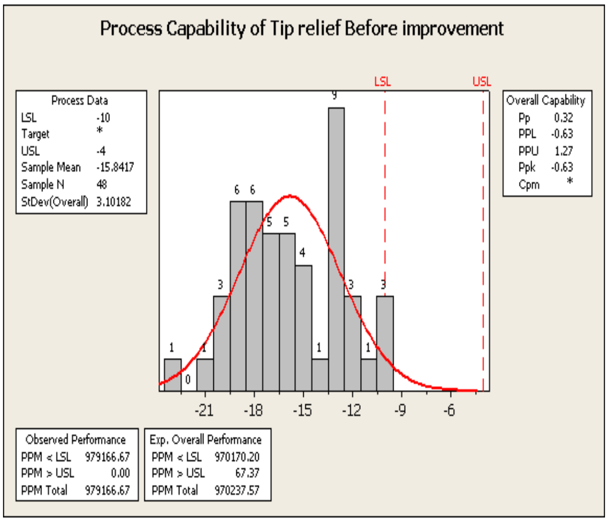

Fig 2 To shown or confirm effectiveness of experimentation

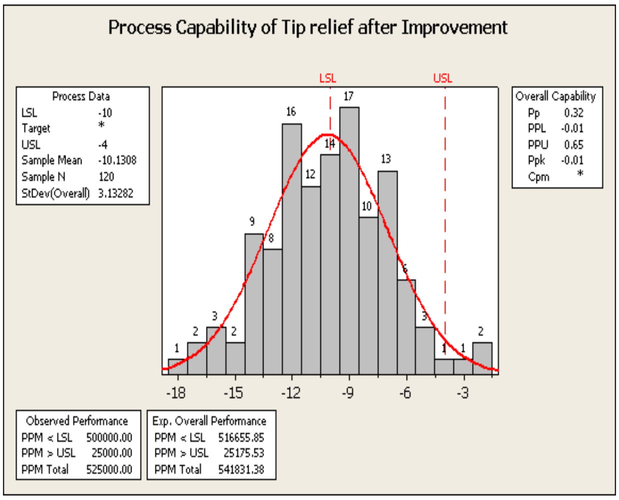

Fig 4 Process capability of tip relief after improvement

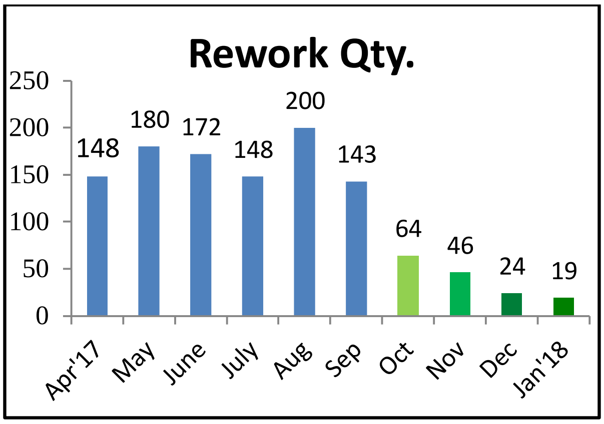

Fig 3 Rework quantity reduce due to GPD Teeth profile

TABLE 2 UPDATED PROCESS AUDITED SHEETS

Summary of Standardisation			
S. No.	Process	Standardisation Activity	Document Change
1	Hobbing	Process Control parameters	Process audit sheet
2	Shaving	Process Control parameters	Process audit sheet
		Cutter resharpening	Resharpening Work Instruction
3	Heat Treatment	HT cycle	HT work instruction

IV. CONCLUSION AND FUTURE SCOPE

In the present case texture only on steady surface is considered which can be further extended by considering textures on both the surfaces.

Gear performance can be also be evaluated by considering other texture parameters like temperature effect, effect of oil used, Change in r/c ratio, change in l/d ratio can be added to get effects of such parameters on the performance of the journal Gears.

For more precise and accurate results Design of experiment methods like TAGUCHI &ANOVA.

Implementation of A.I. technique such as Artificial Neural Network etc can be done to verify experimental results.

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