Seminar

Institute for Plasma Research

Title : Effects of variations in micro-geometry on the stresses and other parameters of an External-Internal Spur Gears pair
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Date : 08th April, 2019 (Monday)
Time : 04.00 PM
Venue : Committee Room #04, (New Building), IPR

Abstract

Gears are considered as important machinery elements used for power transmission. Some of the applications of gear drives are automobiles, marine vehicles, locomotives, industrial equipment, aircrafts, space equipment, and robotics and articulated remote handling systems in fusion machines. Though gears look simple toothed elements but their problems are far from trivial. Among all types of gears, spur gears are relatively simple to design, inexpensive to manufacture, and check for precision. Spur gears do not exert axial loads and exert only radial loads on bearings. Small variations in centre distance can also be tolerated in these gears. Due to ever-growing demand of higher load carrying capacities, improved surface and bending fatigue strength, low noise and vibrations, the research in the field of gearing systems has always been very attractive and popular among researchers and engineers to minimize failures by optimizing the macro and micro-geometrical parameters of the gears. The macro-geometrical parameters are module, pressure angle and addendum etc. *The micro-geometries are tooth profile modifications, which improves dynamic characteristics of the gears.* Each gears pair, whether internal or external, is unique in nature and requires thorough investigation to correctly predict the contact and bending stresses, load sharing, transmission errors, torsional and gear mesh stiffness etc. along the line of action. Gears are assumed rigid and corner contact is generally ignored in the traditional gear design methods. In reality, gears are made of elastic materials and corner contact may occur due to elastic deformation of loaded tooth pairs. This may cause abnormally high stresses in the tip region during gear action.

The objective of this research work is to predict the corner contact in an External-Internal spur gears pair by performing iterative loaded tooth contact analysis using FEA tool, and study the effects of variations in micro-geometries on the stresses (contact and bending) and other parameters (load sharing and contact ratio) over full mesh cycle. Several programs have been developed to estimate parameters of the internal and external gears, and generate true involute gears and also the gears with profile shift and micro-geometries (tip radius, circular relief and linear relief). Several cases with different micro-geometries have been studied. FEM results show high stresses in the gears' teeth without tip radius due to corner contact. The contact stress reduces drastically with tip radius and end reliefs on the gears' teeth. The contact stress and load sharing are also calculated analytically over complete mesh cycle, and compared with FEM results. The effect of profile modification on the bending stresses, load sharing and contact ratio in the gears has been found marginal.

The work provides a methodology for investigating the stresses in the profile modified External-Internal spur gears pair, which could be useful in the future R&D activities on customized high reduction geared rotary joints of the heavily loaded Remote Handling Systems where corner contact are envisaged due to large deformation in the gears teeth.