



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student : Sarita Bharti
Roll Number : 156103032
Programme of Study : Ph.D.
Thesis Title: Performance Evaluation of Lubricated Polymer Gears
Name of Thesis Supervisor(s) : Prof. S. Senthilvelan
Thesis Submitted to the Department/ Center : Mechanical Engineering
Date of completion of Thesis Viva-Voce Exam : 28-07-2023
Key words for description of Thesis Work : Gear, injection molding, selective laser sintering, thordon, lubrication, sliding contact

SHORT ABSTRACT

Injection molded polymer gears are being widely utilized as they offer several advantages, such as lightweight, good damping capacity, easy production, low manufacturing cost, and good mechanical properties for low and moderate-load applications. Many works have been earlier attempted to improve mechanical properties by incorporating fiber reinforcement. In this work, an attempt has been made to investigate the potential of using oil lubrication for performance improvement. In addition, the present study also aims to check the feasibility selective laser sintering (SLS) process and elastomeric material (thordon SXL) for gearing application. The sliding contact performance of these materials was also investigated using pin on disc configuration. The surface durability of the test gear was investigated using a house-developed gear rig at various loading conditions and a constant rotational speed under dry and lubricated conditions by observing the thermal response of gear teeth, lubricant temperature, periodically monitoring gear teeth surface, and failure morphology.

Oil lubricant between the gear teeth provided smooth contact and reduced frictional heating by dissipating the generated heat effectively. Under the dry condition, different failure modes of pitting and thermal softening, along with tooth cracking near the pitch region were observed based on loading conditions in injection molded test gear. Test gears under lubrication conditions showed only scuffing but did not exhibit any cracks in the pitch region or other regions owing to improved heat dissipation characteristics. To understand the adhesion effect and influence of lubrication, dissimilar material gear pair (steel-injection molded polyamide) and similar material gear pair (injection

molded polyamide -injection molded polyamide) were evaluated. Due to low thermal conductivity and viscoelastic characteristics, frictional heating and hysteretic heating cause inferior life of polymer-polymer gear pair than steel-polymer at all the considered loading conditions.

Flat build configuration processed SLS gear exhibited enhanced surface contact performance at the lower load due to its brittleness and reduced ductility. However, under lubricated conditions, the lubricant diffused into the porous subsurface, which resulted in the reduction of material shear strength and inferior gear life. Due to its improved thermal stability, the lubricated SLS gear exhibited superior performance at a higher load compared to the dry condition. Thordon gear exhibited only tooth root cracks due to bending fatigue under dry as well as lubricated conditions. In contrast, the injection molded and selective laser sintered gear exhibited wear thermal failure, scuffing, and pitting based on loading as well as environmental conditions.

