INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study	:	**Ph.D.**
Thesis Title	:	**Performance of injection-moulded carbon nano-tube polypropylene asymmetric gears**
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Thesis Submitted to the Department/ Center	:	**Mechanical Engineering**
Date of completion of Thesis Viva-Voce Exam	:	**11.11.2016**
Key words for description of Thesis Work	:	**Polymer gear; surface temperature; air cooling; surface topology; tribology; fatigue; carbon nano-tube; asymmetric profile**

SHORT ABSTRACT

Polymer composite gears are being utilized in many engineering applications due to their light weight, self-lubrication, cost effectiveness, and mass production capabilities. However, thermal sensitive mechanical properties of the polymers limit their extended usage. During service, polymer gears generate heat caused by repetitive tooth surface interaction and material hysteresis. In this work, an attempt was made to investigate the potential of using air cooling, asymmetric tooth profile and carbon nano-tube (CNT) reinforcement in polypropylene gears to enhance the performance.

Performance of injection-moulded polypropylene (PP) gear was evaluated with and without air cooling, using in-house developed power absorption gear test rig. Measurement of gear weight, surface temperature and periodical measurement of tooth thickness confirmed the enhancement of wear resistance and gear life by the air cooling.

The effect of mating gear manufacturing process, wire-cut electric discharge machining (WEDM) and conventional hobbing over the injection-moulded polypropylene gear performance was investigated. Test gear exhibited improved wear resistance when paired with conventional hobbed steel gear compared to the WEDM steel gear. The effect of mating gear surface roughness over the performance of injection-moulded asymmetric polypropylene gears were evaluated by pairing with three asymmetric steel gears having different surface roughness. Test gears paired with steel gear having higher surface roughness exhibited higher net surface temperature and inferior wear resistance. Durability of the injection-moulded symmetric (20/20) and asymmetric (34/20) gears were evaluated to understand the effect of drive side pressure angle. The increased radial distance of highest point of single tooth contact point and decreased contact ratio contributed to the poor performance of asymmetric gears.

The mechanical, tribological, and thermal behaviour of various (1–5 wt%) carbon nano-tube reinforced polypropylene was evaluated. Hardness and wear resistance has increased upto 1 wt% CNT-PP and decreased beyond 1 wt% due to the agglomeration. 1 wt% CNT–PP composite gear was injection-moulded and its performance was compared with unreinforced polypropylene gear. 1 wt% CNT–PP gears exhibited lower surface temperature and slightly higher transmission efficiency. Carbon nano-tube reinforcement has improved the test gear wear resistance and fatigue life.