Transforming Space Plastic Waste into Lubricants for Sustainable Space Missions

Md Hafizur Rahman, Soumya Sikdar, Advisor: Pradeep L. Menezes

Department of Mechanical Engineering, University of Nevada, Reno

Abstract:

Plastic pyrolysis is a viable technique to produce oil to reduce the detrimental effect of plastic waste pollution in the space. However, the tribological performance of waste plastic oil (PO) is poor. Earlier, solid lubricant additives have been introduced in studies to improve its tribological performance. Current study aims to explore the potential of phosphonium-based ionic liquid additives for improving the tribological performance of PO as a lubricant. A bio-based ionic liquid: trihexyl tetradecyl phosphonium saccharinate (P-Sacc) was evaluated as a potential liquid lubricant additive for PO at varying concentrations (0-10 vol%) under boundary lubrication conditions. It was found that 2% P-Sacc provided lower friction and wear overall. Ionic liquids mainly consist of anion and cationic moieties and form an adsorption layer on metallic surfaces dominated by surface adhesion. Such adsorption layer reduced the friction and wear significantly. Raman spectroscopy on the wear tracks supports this finding. This finding suggests that the use of waste plastics to produce alternative lubricants with the addition of ionic liquid additives could be a viable approach to reducing plastic waste pollution and maintaining a carbon cycle beyond earth in space explorations..