Development of high-performance sustainable lubricants

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Abstract

Tribology is particularly important in today's world because so much energy is lost to friction in mechanical components. To use less energy, we need to minimize the amount that is wasted. Significant energy is lost due to friction in sliding interfaces. Therefore, finding ways to minimize friction and wear through new technologies in tribology is critical to a greener and more sustainable world. The loss of energy through undesired friction, as well as the gradual wearing out of mechanical components through repetitive sliding of two materials against each other represent an area where improvements in lubrication technology can directly impact rail transport. Specifically, the application of greases on rail tracks is critically important for reduced emissions of locomotives, improved longevity of rail infrastructure, and increased payload ability for rail providers. Today's focus and the requirement for low energy use, enhanced environmental compatibility, and reduced life-cycle impact are critical. Furthermore, recent governmental mandates, regulations, and incentives have motivated a changeover to such sustainable lubricants. One advancement in the area of lubrication technology that has received little attention is the development of high-performing and long-lasting lubricants.

The objective of the research is to develop high-performance engine oils where mineral base oil are replaced with PAO (polyalphaolefin) base oil. To reach these goals, the work has been separated into three phases: the first phase examining the dispersibility of nano clays extracted from tailings waste in PAO base oils; the second phase examines the rheology of the lubricants in an effort to further improve the nano clay enhanced oil through the addition of organomodifies to improve the dispersion of the nano clays in the base oil; and the final phase aims to characterize the friction and wear reducing ability of the newly produced engine oil and compare the properties with the commercial ones. The production of this lubricant would support the reduction of heavy metal contamination in the environment. The formulation of these nano-enhanced oil will be advantaged from the fact that the clay nanoparticles will likely be easily dispersed in the PAO base oil resulting from their inherent environmental conditioning received in the tailings. This functionality will likely reduce the processing required to formulate the oil, and thus its overall cost. The waste in the form of tailings can be converted into useful resource which advances clean-up environmental strategy. In this resaearch, I specifically address the improvement and lowered environmental impact of oil-lubricant through the development of nanoparticle enhanced sustainable lubricant using the by-products of reclaimed tailing ponds and high-performance PAO base oil. As a result, this will reduce carbon emission and quite simply better for the environment. Industries relying on petroleum-based products may be adversely affected financially when oil prices rise. Relying on sustainable products instead reduced on-demand requirement of petroleum-based products. This safety, environmental, and sustainability will drive the growth of the sustainable lubricant industry.

Keywords— Tribology, Engine oil, nanoparticle, sustainability

Biography

Dr. Jitendra Narayan Panda is currently working in the University of Calgary, Canada (UofC) as a postdoctoral associate. He has worked with the diverse team of international researchers. He is a Gold Medallist in B.Tech. He did M.Tech and PhD from IIT Delhi, India. At the UofC, he is working on enhancing the corrosion and wear resistance of hydraulic fracturing pipes using Epoxy polymer coatings along with some additives of various concentrations. He is also working on the development of sustainable oil and greases using various nanoparticle. In collaboration with other labs, I have been working on additive manufacturing of polyamide/carbon fiber composites ,rheological analysis of bio-degradable polymers both in solution and melt state. He has published more than 14 papers in reputed journals and served as invited reviewer for various polymer journals.

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