Friction and Wear of Self-Mated High-Performance Polymer Blends

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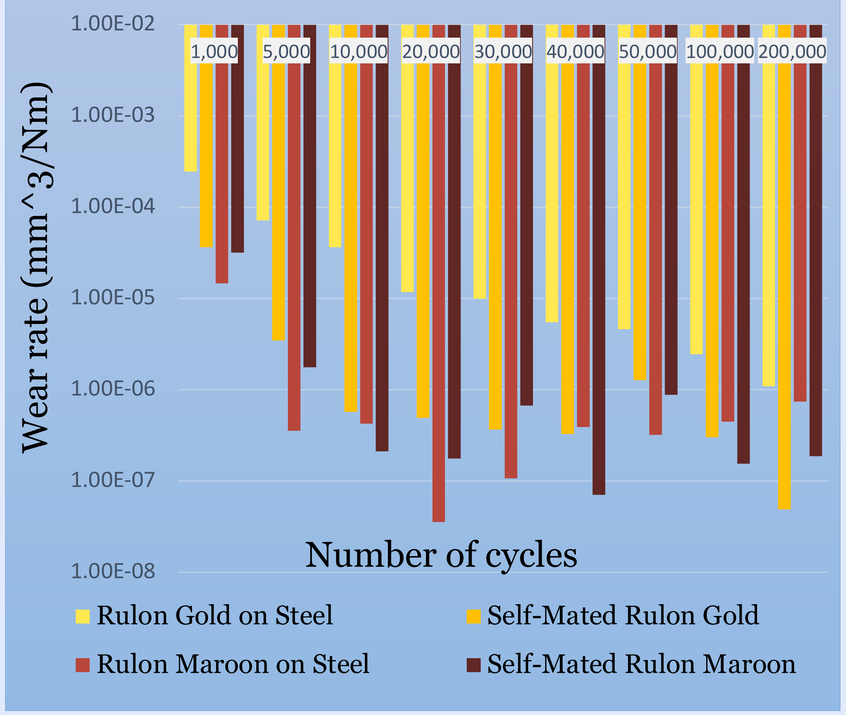
Abstract

Tribology is the study of friction and wear and helps us understand how surfaces interact with one another. Additionally, tribometers measure wear of a polymer across a sliding surface, which enable researchers to contribute their work toward the field of tribology. I have incorporated various methods toward this project such as the computer application MATLAB, scales accurate to the one-hundred thousandths place, and tribometers. These devices contribute to obtaining the wear rate of the samples tested, each of which consists of a high-performance polymer proprietary blend. After hundreds of thousands of cycles are completed by the tribometer, an overall wear rate is able to be calculated. In materials science, the balance between a material's wear rate and rate of friction can give insight into the effectiveness of a material's use in industry. This project contributes toward the goal of improving this balance and helps enhance the knowledge of materials science through the action of testing these high-performance polymer proprietary blends.

Introduction

- Tribometry is important because it helps gain an understanding into how surfaces interact one another, explains tribo-chemical interactions, and how surfaces change over time
- The purpose of this study is to unlock a new realm of tribology to gain insight into how self-mated polymers interact
- While self-mated polymer testing is not new, self-mated Rulon polymers is unique in wear-rate testing
- Two polymers, Rulon Gold and Rulon Maroon, were tested across steel substrates and in a self-mated manner (against themselves)
- The results from the data give insight into how these polymers may perform when in industrial applications

Wear Rate vs Number of Cycles



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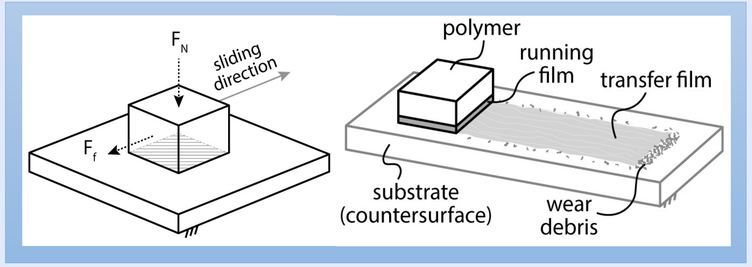
Methods

- Friction Force is measured by instruments connected to the tribometer
- Normal Force is programmed to remain constant as the tribometer completes the allotted cycles assigned to a test
- Following every test, each sample is massed individually so that water loss caused by a drop in humidity remains undetected
- The tribometer is placed in a humidity-controlled glove box, which helps to yield accurate measurements when each sample is massed
- Wear rates for each sample in each test cycle as well as the overall wear rate for each sample were obtained by the following equation:

$$Wear\ Rate = \frac{mm^3}{N \cdot m}$$



Discussion

- This research provides an outlook if proprietary-blended materials are able to yield useful data when tested against steel and themselves (self-mated)
- When the data is analyzed, Self-Mated Rulon outperforms its Rulon Gold on Steel counterpart with a lower wear rate
- The Self-Mated Rulon Maroon yields a lower wear rate compared to Rulon Maroon on Steel as the number of cycles increases
- Rulon polymers are industry-standard and novel research as such makes way for future testing