

Investigation on Wear Characteristic of Biopolymer Gear

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Abstract. Polymer is widely used in many mechanical components such as gear. With the world going to a more green and sustainable environment, polymers which are bio based are being recognized as a replacement for conventional polymers based on fossil fuel. The use of biopolymer in mechanical components especially gear have not been fully explored yet. This research focuses on biopolymer for spur gear and whether the conventional method to investigate wear characteristic is applicable. The spur gears are produced by injection moulding and tested on several speeds using a custom test equipment. The wear formation such as tooth fracture, tooth deformation, debris and weight loss was observed on the biopolymer spur gear. It was noted that the biopolymer gear wear mechanism was similar with other type of polymer spur gears. It also undergoes stages of wear which are; running in, linear and rapid. It can be said that the wear mechanism of biopolymer spur gear is comparable to fossil fuel based polymer spur gear.

1. Introduction

Polymer has been chosen to replace steel in various application such as gearing due to its mechanical advantages and economical value. Its ability to operate with a little lubrication, low noise operation and light weight material are some of the advantages [1-6].

The abundance of polymer from the non-renewable source which is fossil fuel have raised problems such as disposing and recyclability. This brings about the emergence of biopolymer made from natural resource and more environmentally friendly. The usage of biopolymer in the gearing section has not yet gained traction which is what this paper targets to overcome.

Despite the same function, polymer gear does not behave as same as its counterpart, the steel gears even in the designing stage. They even have specific standards which are found in [7-9]. For polymer and engineering polymer gears, several types of research have been conducted which focuses on gear life [10], the effect of temperature [11-13] and the failure methods [14-17].

However, research on biopolymer gear is not yet available during the time of research. This research focuses on identifying the wear mechanism of biopolymer gear and whether it is comparable to fossil fuel based polymer gear. In this research, the following were used to identify wear mechanism and the failure of biopolymer gear; tooth fracture, tooth deformation, debris and weight loss. This method was also used by [12, 16, 18-20] in their research to identify failure of polymer gear

2. Methodology

The gears were designed in SolidWorks and followed the geometry shown in Table 1. The gears were then produced using injection moulding process. The parameters of injection moulding process are seen in Table 2. The test was done on a dedicated test rig seen in Figure 1.