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Thermal Analysis and Tribological Investigation on TPU and NBR Elastomers Applied to Sealing Applications

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Abstract

This study investigates the contact temperatures reached due to frictional heating on TPU (Thermoplastic polyurethane) and NBR (Nitrile butadiene rubber) seal surfaces during operation. These elastomers present limited thermal resistance so an excessive temperature rise may affect their tribological performance. Sliding tests of the elastomers against steel cylinders were carried out and the surface temperature evolution was acquired during the tests using a high precision infrared camera. Frictional behaviour and temperature curves were analyzed. The influence of the experimental parameters, such as the sealing material, sliding velocity, applied load and steel surface conditions was examined. Experimental thermal results were compared with those calculated through well-established analytical models, in order to determine the advantages and limitations of the latter.

Key Words: frictional heating, contact temperature, polymers, elastomeric seals.

1 Introduction

Elastomeric seals can be found within many mechanical devices such as engines, gearboxes, pumps, flight controllers and a wide range of actuators, among others. Hence, currently there is a wide range of seal geometries and materials that enables their use in several industrial sectors such as automotive, aerospace, manufacturing, and aggressive environments such as off-shore. However, industry is continuously seeking higher performance mechanical components which is a challenge for seal materials researchers due to the limited thermal resistance of the majority of the polymers. In the case of dynamic sealing applications, the temperature to that in-use materials are exposed, is the sum of both the environment and temperature rise caused by the frictional heating. The importance of considering frictional heating effects on sealing applications has been demonstrated by the author [1].

Most of the frictional energy generated during sliding is converted into heat resulting in the temperature rise of the rubbing surfaces. In the case of polymers, their thermal resistance is below 300ºC.