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A Review on Important Factors Affecting Dry Sliding Friction

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Abstract

Friction is the resistance faced by one body when it slides or rolls over another body. The friction is not a property of material. It is a response observed during sliding or moving. The maximum friction is required in some applications such as automobile tires on the road, machining the materials, brakes, clutches etc., Alternatively, the friction should be low in some applications like bearings, sliding parts of machineries etc., Most of material failure is occurred due to improper observation of friction and wear behaviors. Hence, understanding of the frictional behaviors of various metal pairs is essential to design any engineering tools and equipment. Therefore, in this paper, the important factors affecting the sliding friction are described in detail.

Keywords: Different Metal Pairs, Friction, Important Factor, Vacuum

1. Introduction

The amount of resisting force acts opposite to its motion is called friction force. The ratio of 'friction force' to 'normal load' is called Co efficient of Friction (COF) and it is denoted as 'μ'. Friction can be broadly classified as: (a) Dry friction and (b) Fluid friction. If the contact surfaces are free from lubricant, then it is called dry friction. In Fluid friction, contact surfaces are partly or fully separated by lubricant. The friction is largely controlled by (1) relative movements of the surfaces in contact, (2) normal load and applied load, (3) environmental conditions, (4) surface texture of contact material, and (5) properties of contact bodies [1]. The COF varies from 0.001 (for light loaded rolling bearing) to greater than 10 (clean metal sliding against itself in vacuum environment) [2].

Normally, the sliding contact friction of all material is always higher than the rolling contact friction. The empirical friction laws are given below.

First law of friction: The friction is not dependent of the normal load.

Second law of friction: The friction force is not dependent of the total area of contact for any sliding surfaces.

Third law of friction: Once after motion starts, the kinetic friction force is not dependent of sliding velocity [3].

However, these three laws do not obey in all the situations and all the metal Pairs. For example, copper sliding against copper in air, the COF is low at low loads and it increases at high loads. At low load, copper oxidizes in air and forms low shear strength oxide film which separates the metal contact surfaces. However, this oxide film usually breaks down at high loads which leads to metal to metal contact. This metal to metal contact will cause for high friction [4].

Alternatively, AISI 440C stainless steel vs. Ni3Al alloy Pair in air exhibits low friction at high loads. Due to increased surface roughness, high quantity of wear debris is produced. It leads to high friction [5]. Irrespective of real area of contact, the COF of wooden slider vs. steel surface maintains constant which supports the second law of friction [3]. The high strength materials usually have high shear strain. The high strain materials exhibit low real area of contact and low friction [2]. Therefore, the friction behavior will not be uniform for all metals.

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