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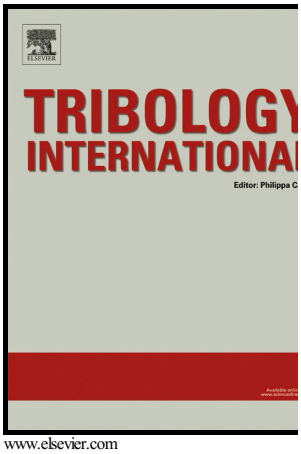

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Fretting wear behaviour of acrylonitrile-butadiene rubber (NBR) for mechanical seal applications

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Abstract: The fretting wear behaviour of acrylonitrile-butadiene rubber (NBR) was studied. The variation of fretting running behaviour, coefficient of friction (COF) and wear mechanisms as a function of displacement amplitude and load were discussed in detail. Results showed that the sticky layers on the worn surface played an important role in fretting wear. Various damage characteristics could be exhibited in different fretting running regimes, and the fretting characteristics were strongly dependent on the displacement amplitude. However, the normal load had little effect on the evolution of the fretting wear. The results of X–ray photoelectron spectroscopy (XPS) revealed that no thermal degradation occurred in rubber during fretting tests.

Key words: fretting wear; NBR; tribochemistry; mechanical seals

1. Introduction

Rubber is widely used to manufacture rubber-moving components, such as rubber bearings, seals, automobile tyres, and brake blocks, in modern industrial applications [1–3]. Elastomer seal is a critical component in a hydraulic and pneumatic system, such as rod, piston, valve, and pump seals, because this seal can prevent the leakage of fluid (liquid or gas) into the surroundings, which leads to environmental pollution or failure of other machine components [2]. Particularly, in dynamic seals, the seal is installed between the two surfaces where the movement is a reciprocating sliding. Then, surface wear gradually occurs and it can causes leakage during operation. Therefore, the sealant should have good mechanical, physical and chemical properties, especially tribological properties [4, 5].

Fretting commonly occurs in structures or machine elements that are clamped together or are contacted while undergoing repeated alternating slippage over surfaces. Fretting damage can occur as a result of crack nucleation and growth, or fretting wear, or a combination of both, which ultimately leads to catastrophic failure [6]. For instance, the rubber O-ring is often used as the secondary seal in a mechanical face seal [4]. Fig.1 shows a schematic of a

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