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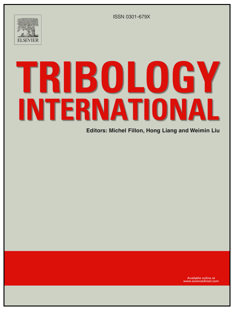

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EXPERIMENTAL INVESTIGATION OF THE PERMEABILITY OF A TRIBO-CONTACT IN DRY FRICTION CLUTCHES

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Abstract – The effect of the first order phase transition from solid organic material to gas on fading in dry clutches has been discussed recently. In the present paper the permeability of the contact layer being one of the key parameters determining if the sufficient gas cushion can occur, is measured for friction linings commonly used in the automotive industry. It is shown that the permeability at 20°C is too high. Chemical analysis shows that fluid compounds with high viscosity occur while heating the lining material alongside with gas. Further experiments indicate that the gas permeability of the contact decreases rapidly in presence of a viscous fluid. This result points out a promising direction for the further investigations of the fading phenomenon.

1. Introduction

Many non-linear and multi-domain effects can occur in mechanical systems where friction is part of the torque transfer system. Some of them are comfort-relevant for technical systems, others are safety-relevant, and therefore both are of fundamental interest in order to find safe operation conditions. One such effect is friction induced fading (or outgassing), which occurs between sliding surfaces of a friction clutch in a vehicle drivetrain. When high contact pressures (~0,5 MPa) are applied, temperatures in the contact area rise (600°C are quite usual in these applications), and cause a transition of the organic matrix of the clutch disc pad into the gaseous state. The appearance of the gas between the sliding surfaces implies a sudden drop of the transferable torque, which is often interpreted as a loss of effective function [1]. Although the effect itself can be easily observed and causes significant problems in different branches of mechanical and automotive engineering, a deeper understanding is required. Different principal physical mechanisms have been discussed in literature. A large group of papers has been devoted to the effect of thermoelastic instability in friction interfaces [2 – 6]. This effect being very important and definitely present in any strongly loaded friction contact however doesn’t take into account neither wear nor complex chemical processes unavoidable in organic friction linings. The effect of wear and its interaction with the thermoelastic effects, especially with the nonhomogeneous distribution of the heat generation sources within the contact surface has been investigated both analytically and experimentally in [7 –