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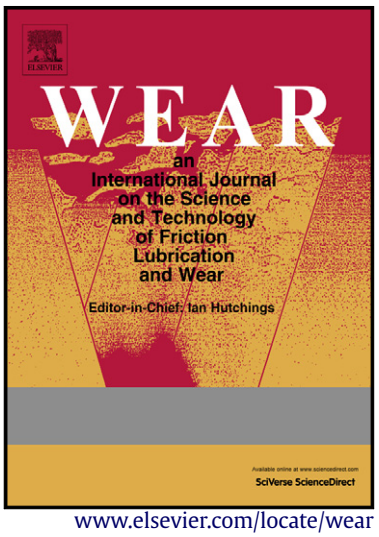

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Mapping the friction between railway wheels and rails focusing on environmental conditions

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ABSTRACT

The coefficient of friction between railway wheels and rails is crucial to the railway adhesion, further greatly affecting railway operation and maintenance. Since the wheel–rail system is an open system, the coefficient of friction is significantly influenced not only by various types of contaminants but also by environmental conditions. This paper conducted a set of pin-on-disc tests measuring the coefficient of friction focusing on the influence of environmental conditions (relative humidity and temperature). In addition, influences of iron oxides, leaves and glycol/water mixtures on the coefficient of friction were also studied. The friction results are shown in the form of friction maps. Results indicate that iron oxides on the surfaces can prevent the samples from large friction reduction particularly at the low temperature. The friction mechanism is also discussed with the help of scanning electron microscopy photos. On the other hand, effects of leaves in reducing the coefficient of friction become limited with the presence of the glycol/water mixture.

Keywords: Rail-wheel tribology; Mapping; Sliding friction, traction; Steel

1. Introduction

In order to attract more customers and to compete with other means of transportation, railway service needs to fulfil requirements such as punctual, comfortable, and low cost [1]. Adhesion between the wheel and rail is crucial since it affects all these aspects. Adhesion can be defined as the transmitted tangential force in the longitudinal direction between the wheel and rail. Adhesion is usually referred in the form of adhesion coefficient which is the ratio between the adhesion force and the normal force. The value of the adhesion coefficient depends on two factors: the relative sliding which is known as creep and the coefficient of friction which is the limitation of the adhesion coefficient. The value of the creep depends on the relative motion between the wheel and rail which is related to the vehicle dynamics. The coefficient of friction between two surfaces is often studied from a tribological aspect. Since the wheel–rail system is an open system, the friction between railway wheels and rails is significantly affected by various types of contaminants. Contaminants form a third-body material which is chemically different from bulk materials [2].

Contaminants, such as water, oil and sand, are discussed by many researchers [2–5]; measures that can be taken to combat these contaminants are also presented in literatures [3,6,7]. Fig.1 shows the coefficient of friction measured in the field by a pendulum rig and a hand push tribometer under different conditions. More details of the field measurements can be found in [8]. Leaves are believed to be a key factor in reducing the coefficient of friction on tracks in the fall [9]. Glycol/water mixtures are used as anti-freeze fluids on tracks in the winter. Glycol/water mixtures could sometimes be mixed with leaves, which were reported to greatly reduce

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