



A new method for the assessment of traction enhancers and the generation of organic layers in a twin-disc machine

S.R. Lewis^{a,*}, R. Lewis^a, J. Cotter^b, X. Lu^b, D.T. Eadie^b

^a Department of Mechanical Engineering, the University of Sheffield, Mappin Street, Sheffield, S1 3JD, UK

^b LB Foster Rail Technologies Corp., Burnaby, B.C., Canada

ARTICLE INFO

Article history:

Received 2 October 2015

Received in revised form

26 March 2016

Accepted 19 April 2016

Keywords:

Traction enhancers

Leaf layers

Isolation

Sand

Wear

Adhesion

ABSTRACT

Low adhesion presents a major concern for many rail operators. Railway vehicles under these circumstances can experience a serious loss of braking capability giving rise to dangerous situations such as platform overruns and signals passed at danger. One cause of adhesion loss is autumn leaf fall, Fulford C. R. (2004) [1]. Leaves are run over by the wheels of a train and a chemical reaction occurs between the leaf and the rail steel, Cann P.M. (2006) [2]. This forms a black layer on the rail which when wet causes very low friction. These leaf layers have also been shown to be isolating and can interfere with railway signalling systems. Traction enhancers (also referred to in this paper as traction gels) have been developed as a new technique in combating the problems caused by leaf contamination. They consist of sand particles suspended in a water based gel and are designed to be delivered to the rail by the trackside or via mobile application systems. The aim of this work was to develop a technique for generating a representative leaf layer on the surface of a twin-disc rail specimen and using this to develop a test methodology for assessing the performance of a traction gel in terms of adhesion recovery, wear and its effect on wheel/rail isolation. A new repeatable method for generating a low traction leaf layer on the rail disc was developed. The traction gel tested was proven to quickly restore adhesion back to close to dry levels. The wear rate of the rail disc with the traction gel was lower than for a dry/uncontaminated contact. Isolation of the leaf layers and traction enhancer were measured using a representation of aT121 track circuit. This method can be used in the selection and benchmarking of other traction enhancing products before they are trialed in the field.

© 2016 Elsevier B.V. All rights reserved.

1. Introduction

Low adhesion presents a major concern for many rail operators. Railway vehicles under these circumstances can experience a serious loss of braking capability giving rise to dangerous situations such as platform overruns and signals passed at danger. One cause of adhesion loss is autumn leaf fall; whereby leaves fallen by the line side can be picked up by the turbulence caused by a passing train and deposited directly on the rail head [1]. These leaves are then run over by the wheels of a following train and a reaction occurs between the leaf and the rail steel [2]. This forms a black layer on the rail which when wet causes very low friction. These leaf layers have also been shown to be electrically isolating (non-conducting) and can thus interfere with railway signalling systems. Sand has long been a solution for such problems and is usually fired directly into the wheel rail contact from a hopper on

board the vehicle. However, sand can cause damage to the wheels and rail and other railway infrastructure. Traction enhancers (also referred to in this paper as traction gels) have been developed as an alternative solution to using sand alone. They consist in part of sand particles suspended in a water based gel and are designed to be delivered to the rail via pumping systems mounted on either a track vehicle or at the side of the track.

This paper discusses the development of a standard test to assess the performance of traction enhancers. The Sheffield University Rolling Sliding (SUROS) test rig was employed for this experiment and a commercially available traction enhancing gel was used. More information on the development of the rig can be found in [3]. Previous works have shown how sand in the contact could have adverse effects on track circuit isolation [4,5] and wheel/rail wear [5,6]. Friction modifiers (a different type of material with different purposes) have also been assessed before using the SUROS rig by Li et al. [7] and leaf layers have also been generated on the SUROS specimens by Vasić et al. [8] and Arias-Cuevas et al. [9]. In this work we report development of a new

* Corresponding author.

E-mail address: stephen.lewis@sheffield.ac.uk (S.R. Lewis).

method to generate a leaf layer and use of this method together with electrical isolation measurements to assess traction recovery performance of a traction gel.

The aim of these tests was therefore to develop a standard test to measure the performance of traction gels and other traction enhancing products. A commercially available traction gel was used to develop this standard test. A technique was also developed to generate a leaf layer on the surfaces of the test discs. This leaf layer provided a benchmark on which the performance of traction enhancers could be assessed. An electrical circuit was constructed to replicate the internal resistances of a TI21 track circuit. The TI21 track circuit is widely used on the UK rail network [5] and operates in the audio frequency range (approximately 100 Hz to 10 kHz). Track circuits are a vital part in railway signalling systems worldwide. They are used to detect the presence of a train on a section of track, thus adjusting nearby signalling and controlling traffic accordingly. Sections of track are usually electrically isolated from one another by means of an insulated joint as shown in Fig. 1. When no train is present the current flows freely from the transmitter to the detector indicating a free section of track. Surrounding signals

will hence show a green light. However, when a train is present in a section of track the track circuit will be shorted and thus no current will be seen at the detector. In this situation surrounding signals are automatically turned to a red light to avoid train collision.

2. Experimental details

2.1. Test equipment

Testing was performed using the Sheffield University Rolling Sliding (SUROS) machine and a technical schematic is shown in Fig. 2. This test rig consists of a Colchester Mascot lathe with an A. C. motor on the tailstock.

In this arrangement two 47 mm diameter discs are loaded against each other and independently driven. The discs are cut from sections of wheel and rail material (R8T and UIC60 900A respectively) with the rail disc attached to the lathe and wheel to the A.C. motor. Details of the disc specimens are shown in Fig. 3. The discs are independently driven allowing a certain amount of creep (difference between surface speeds) between the discs. A hydraulic jack forces the discs together to achieve a required maximum Hertzian contact pressure. The torque transducer on the lathe shaft allows tangential contact force to be measured and hence a calculation of traction coefficient can be made.

An electrical circuit representing the TI21 circuit used in the UK was used in conjunction with the SUROS machine. The circuit, shown in Fig. 4, represents the transmitter and detector of a TI21 track circuit with two $10\ \Omega$ resistors. The test discs are connected in parallel with the detector. This circuit has also been used in previous works [4,5,9].

When the test discs are brought into contact more current is drawn through them due to their lower resistance (between 0.5–0.6 Ω) compared to the detector ($10\ \Omega$). The current following through the contact can then be calculated by measuring the voltage across them. Using Ohm's and Kirchhoff's laws the impedance of the disc contact can then be calculated. It must be noted that this measured impedance is not only the impedance of the disc contact, but also the impedance of the machine bearings and attachment points of the circuit to the machine. However, the impedance due to the bearings and attachment points will remain relatively constant and thus any relative differences in impedance between separate tests can be taken as a reliable reflection of impedance due to changes at the contact if not the absolute impedance of the contact.

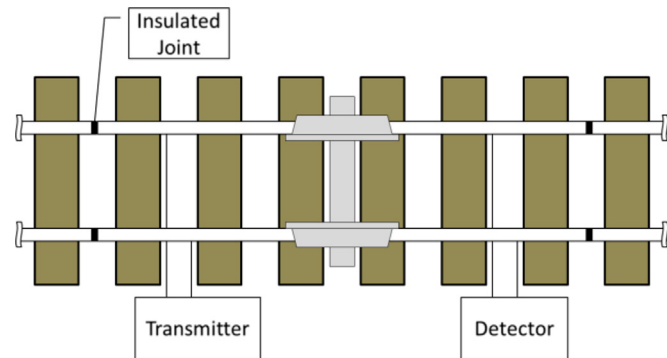


Fig. 1. Schematic of occupied isolated rail section and track circuit adapted from [5].

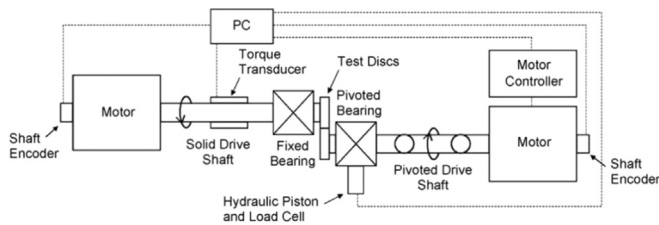


Fig. 2. Schematic of SUROS machine [9].

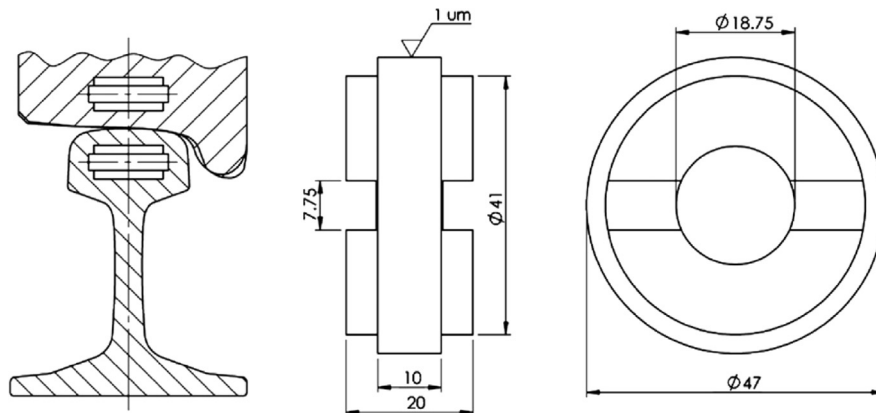


Fig. 3. Cutting positions and dimensions of SUROS specimens (dimensions in mm).

Download English Version:

<https://daneshyari.com/en/article/4986851>

Download Persian Version:

<https://daneshyari.com/article/4986851>

[Daneshyari.com](https://daneshyari.com)