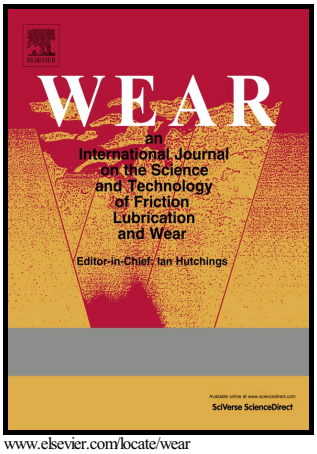

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Material concepts for top of rail friction management – classification, characterization and application.

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Abstract

The concept of managing and adjustment of friction between the wheel and rail has a long history within the operation of railways systems. In the past, adjustment/management has been limited to gauge face lubrication and the use of sanding equipment. The introduction of the top of rail (TOR) friction modifier (FM) over the last 20 years now allows for the modification of the friction at the top of rail – wheel tread interface. This paper focusses on the concept of TOR friction adjustment. Recent developments have led to a new generation of products, defined here as, TOR lubricants (oil and/or grease-based) and hybrid materials (oil/water mixtures), which are non-drying or slow drying. Definitions and functional difference are detailed and contrasted with that of the water-based drying FM. The water-based TOR FM once applied rapidly dries, mixes with the existing third-body layer, and allows for the accommodation of shear displacement. TOR lubricants and hybrid materials rely on mixed boundary layer lubrication, contrary to application of the water-based TOR FM. It has been shown that the adhesion level is highly influenced by the lubricant application rates. The risks and benefits (lateral force reduction, corrugation mitigation, and impact on energy consumption and influence on rolling contact fatigue) are discussed for all product classifications. However, a lack of data exists for the TOR lubricants especially in the area of rolling contact fatigue where laboratory studies have identified the possibility of crack interaction. Whilst it can be seen that TOR lubricants have the ability to provide similar benefits to that of a water-based FM, they exhibit a strong dependency on the application rate which may lend itself to adhesion and RCF issues. Further work is recommended in this area.

Keywords:
friction management, friction modifier, TOR material, friction, lateral forces, adhesion, wear, RCF

1. Introduction

The concept of managing and adjusting friction between the wheel and rail has been applied to the railway system since the early days of steam engine operations. Depending on the location of the wheel relative to the rail, different functional targets have to be achieved. On the gauge face (GF) / wheel flange contact, the main target is to reduce wear of both partners. Consequently, a GF lubricant or grease will be applied. On the top of rail (TOR), effects like squealing noise, damage development (corrugation, rolling contact fatigue – RCF, wear) and energy consumption are addressed by friction