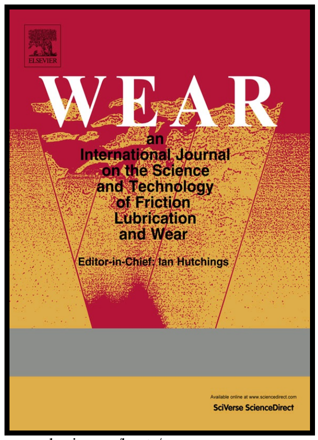

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Application of Grinding to Reduce Rail Side Wear in Straight track

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ABSTRACT： A stretch of straight rail on the Jing-Hu railway in China has been suffering from unacceptable levels of side wear. This phenomenon has not previously been investigated. This paper reports on work to analyse the causes using actual wheel and rail profiles from the track where it has occurred and a novel contact assessment approach and possible mitigations. By running a range of dynamic multibody simulations, it was shown that static calculations are adequate to represent the contact conditions that cause the wear. Almost 7000 wheel profiles were measured and their contact with the relevant rail profile calculated. It was predicted that freight trains whose wheels have a large rolling radius difference, would rub on the gauge corner and gauge face, thus causing the wear. This finding was consistent with field measurements.

Two grinding strategies were developed that could reduce the number of damaging contacts. These were, grinding the gauge shoulder, and grinding the field side of the top of the rail. Calculations predicted that the largest improvement would result from combining both strategies. This approach was adopted to reduce the side wear on rail in straight track. It was found that the distribution of wheel/rail contact points on the rail surface agreed well with the calculation results, and the proposed grinding regime did reduce side wear.

Key words： wheel/rail profile; side wear; rail grinding; rolling radius difference

1 Introduction

Wheel/rail wear is a normal phenomenon, and becomes more serious as vehicles' running speed and axle load increase. In most railways, wheel and rail life are limited by wheel flange wear and rail side wear. In order to reduce wheel/rail wear, many studies have been performed worldwide.

Managing the contact conditions between wheel and rail is key to controlling rail defect initiation and growth [1], and the major influences on wheel and rail wear can only be understood by analysing the contact between them. A number of different applications of contact mechanics to reduce damage problems have been reported. In order to improve rolling contact fatigue and wear performance, Magel et al. applied a quasi-static curving analysis combined with Hertzian normal contact and a linear wheel/rail lateral contact model to optimize wheel and rail profiles [2, 3]. Choi et al. employed a genetic-algorithm-based optimization method to design an asymmetric rail head profile that can reduce rail wear (predicted by post-processing results from commercial software) on curved tracks [4]. Shevtsov et al. [5] used static geometric contact analyses to design a wheel profile; they used an optimality criterion based on a rolling radius difference (RRD) function, but ran commercial software to verify that the profiles satisfied stability, wear, and dynamic contact stress requirements. Zhai et al. developed a design methodology for asymmetrically ground rail profiles to reduce side wear on heavy-haul railway curves [6]. Their contact calculations used Hertzian theory and with lateral forces given by a nonlinear heuristic model. No studies though have used actual profiles as an input and assessed the impact of proposed changes through track trials.

There has been significant progress in the simulation of wheel/rail wear evolution in recent years. Braghin developed a fast and reliable mathematical model to predict wheel profile evolution caused by