WEAR REDUCTION IN LIGHT RAIL SYSTEMS THROUGH ASYMMETRICAL RAIL HEAD PROFILES

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ABSTRACT

Urban mass transit systems face specific wear problems especially on curved track sections with narrow radii. There, the sliding motion of the wheels on the rails, which is inevitable for conventional vehicle designs, not only leads to uniform rail flange and head wear which calls for repair when the geometrical limits for safe operation are reached, but also to ondulations, so called slip waves, which are accompanied by noise and vibrations damaging to the public acceptance of rail-bound transport systems and sometimes indeed intolerable in residential areas. Maintenance costs related to such wear phenomena place a heavy financial burden on transit systems, which are mostly depending on restricted public funding.

As in most cases, in this paper, too, measures to reduce wear in wheel-rail contacts start at the vehicle: at first, an attempt is made to design an optimised wheel profile for a homogeneous fleet of vehicles operating in an autonomous system. Furthermore, however, it is demonstrated that the wear and the forces acting in the contact surfaces of wheels and rails may be reduced by applying asymmetrical rail head profiles in curved track sections.

At first, the geometry and the mechanics of wheel-rail interaction on curved track are explained, followed by a description of the typical wear and damage patterns occurring in practical operation. Subsequently, based on tests performed by the Austrian Railways (ÖBB), the wheel-rail contact geometry is redesigned with regard to the conditions of a specific urban mass transit system.

![Figure 1: Proposed asymmetrical rail head profiles](image1)

The effects of the modifications are first simulated with the help of a computer programme and then verified by long-term testing in real operation. During those field trials, in particular the changes in the profiles, the development of ondulations and the sound emissions are monitored.

![Figure 2: Lateral forces and their variation for the conventional and the optimised contact geometry](image2)

Due to the reduction of the wheel/rail slip on the low rail the grinding intervals of the rail heads increase by more than a factor of two.

![Figure 3: Influence of railhead geometry on the development of ondulations](image3)

An additional effect is the reduction of the mean level of sound emissions. The mean reduction at a distance of 7.5 m from the track is about 1 dB(A).

![Figure 4: Mean level of sound emission](image4)