

Development of improved rail and wheel materials

S. Marich
(*BHP Melbourne Research
Laboratories, Australia*)

Recent developments in rail-steel technology are summarized in this paper. These developments have been motivated by the economic need to operate at higher axle loads and/or speeds. Various laboratory techniques used to assess new steel types and appropriate field trials are presented in detail. Based on these studies, fully pearlitic rail steels have been developed with yield strengths greater than 900 MPa (130 ksi) and good balance of other mechanical properties.

Concurrent with new rail developments, new wheel materials have been tested and commercially produced. Because of their improved fracture-toughness characteristics, these new wheel materials show a higher resistance to catastrophic brittle fracture.

INTRODUCTION

Among the numerous components used in the railroad industry for high axle load operations, wheels and rails give rise to a major source of running expenditure. Indeed the wheel/rail interaction is the main technical factor determining design procedures and maintenance and replacement schedules for both vehicles and track.

The degradation of rails in track is due to (a) wear, (b) fatigue and (c) plastic flow.

(a) Wear

Wear occurs primarily in the high rails of curves due to wheel/rail flange contact. Fig. 1(a) illustrates the extensive loss of material that can occur from the gauge corner of rails subjected to 30 tonne axle loads, unit train operations and situated in a relatively shallow curve of 873 m radius (2 degrees). The effect of curve radius on rail wear is shown in Fig. 1(b).

As mentioned in a previous report¹, the problem of rail wear can be reduced by the adoption of various approaches including: rail lubrication, the use of rail steels exhibiting higher hardness levels and modifications to wheel and rail profiles to improve the bogie tracking characteristics and therefore reduce the occurrence and the magnitude of flanging.

(b) Fatigue

Fatigue occurs in the form of transverse defects, shells and horizontal split heads (see Figs. 2(a), (b) and (c), respectively). All of these defects, if not detected in time, can result in rail failures and therefore derailments.

(c) Plastic flow

Plastic flow leads to mushrooming of the head of low rails in curves (Fig. 3(a)) and, more importantly, to corrugations on the running surface (Fig. 3(b)). Work previously reported²⁻⁴ has shown that the corrugation problem can be minimised by the development and use of rail steels which

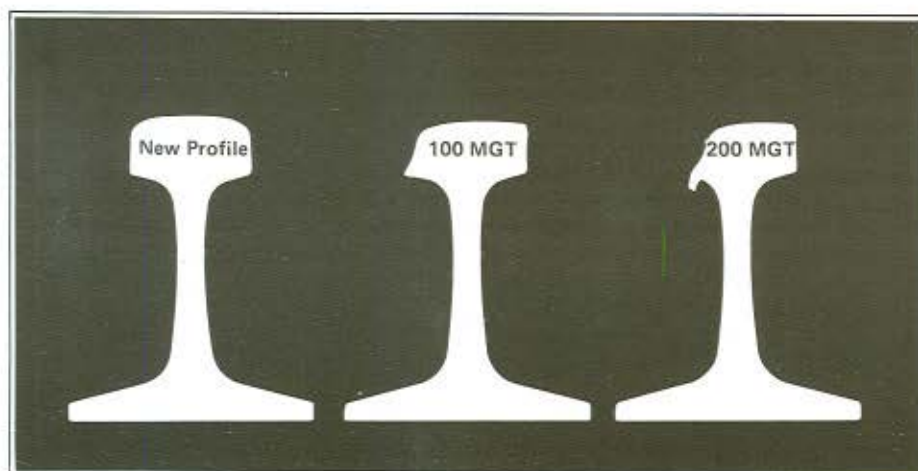


Fig.1(a) Standard rail profiles in 2 degree (873 m radius) curve