

## HSS rolls: from research investigations to the mill

Massimo Pellizzari<sup>1, a</sup>, Alberto Tremea<sup>2, b</sup>

<sup>1</sup>Dept. of Materials Engineering and Industrial Technologies, Via Mesiano 77, 38050 Trento (Italy)

<sup>2</sup>INNSE Cilindri, Via Franchi 30, 25100 Brescia (I) (Italy)

<sup>a</sup>Massimo.Pellizzari@ing.unitn.it, <sup>b</sup>Alberto.Tremea@innsecilindri.com

### Abstract.

In the last years a wide research activity was devoted to the investigation of high speed steels for hot rolls. Many efforts were made to replace conventional Hi Chromium Irons with more performing high alloyed steels. The development of a new grade requires a careful analysis of the service conditions involving wear, thermal fatigue and oxidation. The microstructure, constituted by a martensitic matrix strengthened by a coarse dispersion of primary and eutectic carbides, has to provide the proper compromise between strength and toughness. In cast rolls, the choice of the chemical composition is of paramount importance, since they are not subjected to further thermo-mechanical treatments permitting modification of the solidification structure. The use of thermodynamic modelling, to forecast the solidification structure has then become a cost-saving methodology to implement the development. Thermo-Calc software was used to evaluate the influence of alloying elements on the amount and type and distribution of eutectic carbides. The systematic validation with thermal analysis and metallography has allowed to define very useful criteria for the production of rolls. In the case of bimetallic rolls modelling also resulted very important to promote adhesion between the outer shell and the nodular iron core.

The success of a new grade for hot strip mills requires a quite long time to be verified. From the birth of a new grade until the first results about the “rolled tons” several months can pass. In this view, the need of laboratory tests aimed at evaluating the properties of the new alloy has become a quite important topic. Customary wear and thermal fatigue tests were developed to reproduce the damage mechanism during rolling. The results of laboratory tests shows a fairly well correlation with the service performance of rolls, even if important differences remains due to scale factor and other instrumental limits of the equipment. In the case of tribological test at high temperature the complex interaction between the roll surface and the oxide scale developing on the rolled product represents the most difficult factor to be reproduced. With minor differences, thermal fatigue tests give very interesting results about the influence of carbides type and distribution on crack nucleation and propagation. This paper summarizes the most important results in the field of HSS rolls obtained by the University of Trento and INNSE Cilindri.

**Keywords:** High Speed Steel (HSS), microstructure, wear, thermal fatigue, rolling mill