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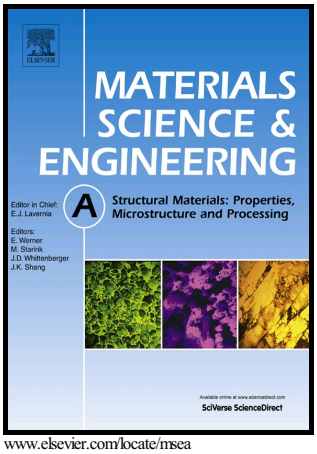

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Superior mechanical properties of microalloyed steels processed via a new technology based on austenite conditioning followed by warm deformation

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Abstract

In this paper we introduce the AC^{2}WD-technology, which stands for Austenite Conditioning – Accelerated Cooling – Warm Deformation. This technology was tested in laboratory conditions using a Gleeble thermomechanical simulator. Two microalloyed steels processed via this technology have shown a superior combination of mechanical properties, compared to those obtained via the conventional thermomechanical processing routes.

Key words: microalloyed steel, thermomechanical processing, microstructure, mechanical properties

Manufacturing of high strength steels is usually performed on multi-stand rolling mills using continuously cast slabs of up to 250 mm thickness. Due to high energy consumption, this technology is economically viable at high production capacity (millions of tons per year). With growing competition on the global steel markets the companies are searching for opportunities to reduce manufacturing costs, broaden the product nomenclature and keep the quality high. To reduce the product cost two major solutions can be suggested: (i) simplify a steel chemical composition; in the case of high strength steels this would mean a decrease in number and contents of microalloying elements; and (ii) simplify a processing route, in particular, decrease the number of hot deformation stages. Significant steps in this direction have been made during last 20 years. Compared to the conventional 15-20 pass rolling of ≈250 mm thick continuously cast slabs, the Compact Strip Production (CSP) technology utilises 5-6 rolling passes of ≈50 mm thick slabs, and in the Strip Casting technology only 1 rolling pass is applied to the 2-3 mm thick cast strip. Although the CSP technology allows manufacturing of various steel grades [1-4], the strip casting technology is currently limited to commercial manufacturing of plain carbon, silicon steels and stainless steels [5,6]. Recent experiments conducted in laboratory showed a possibility to produce thin cast dual phase and TRIP steels completely eliminating the hot deformation stage and applying only a short heat treatment procedure [7,8]. However, a decrease in amount of hot deformation increases the prior austenite grain size and grain size of low temperature phases (ferrite, bainite, martensite). These may result in decreased ductility, in particular, with increasing strength [9]. Thus, we suggest that hot deformation strain must be kept above certain limits. These limits will vary with steel grade, chemical composition, expected phase balance and a required combination of mechanical properties.

In this work we propose a new processing technology, which consists of 2-3 deformation stages and has a potential to produce steels of a simplified chemical composition with simultaneously high strength and ductility. The first and second deformation stages will assure the "**Austenite Conditioning**". On the first stage, deformation should be carried out at