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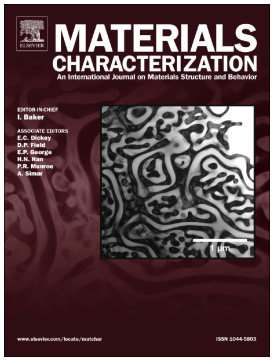

The effect of thermomechanical treatment and tempering on the subsurface microstructure and bendability of direct-quenched low-carbon strip steel

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TITLE: THE EFFECT OF THERMOMECHANICAL TREATMENT AND TEMPERING ON THE SUBSURFACE MICROSTRUCTURE AND BENDABILITY OF DIRECT-QUENCHED LOW-CARBON STRIP STEEL

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ABSTRACT

Recent results in the literature have shown that subsurface properties play a key role during the bending of steel plates. Now, for the first time, surface microstructure, surface texture, subsurface hardness and dislocation density have been studied to reveal the effect of tempering and thermomechanical treatment on the bendability of a direct-quenched strip steel. In the experiments, different thermomechanical treatments as well as non-isothermal tempering treatments were performed with slow heating to 570 °C and slow cooling to simulate the tempering of large steel coils in a batch annealing furnace. The results show that in addition to the improved production efficiency obtained through direct quenching and a single tempering process, tempering improves bendability by reducing subsurface dislocation density and hardness without a significant loss of strip yield strength. The subsurface microstructure and texture of the strip are the result of thermo-mechanical processing and transformation behaviour. Upper bainite containing elongated Martensite-Austenite (MA) islands in addition to an intense shear texture component $\{112\}\langle 111\rangle_{\alpha}$ leads to shear band formation, and therefore poorer bendability when the bend axis is perpendicular to the rolling direction. This texture is not affected by tempering. Therefore, tempering does not improve the bendability of steels with an unfavourable texture. When the subsurface layers comprise a softer ferritic microstructure, good bendability is obtained in the untempered direct-quenched condition with a modest improvement caused by tempering.