

Slag formation and internal oxidation during HFI welding of pipeline steels

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Abstract

Pipeline steels are basically ferritic-bainitic grades, containing Mn, Si and Al as alloying elements. This elements are necessary to achieve the required mechanical properties during service in arctic regions. In production, heavy plate steels are formed to tubes, which are line welded by the HFI process. Internal oxidation and slag formation during welding sometimes leads to a decrease in toughness of the welded zone and, therefore, not acceptable quality. Upon welding, Scheil separation of the liquid metal occurs during melting and a Mn-rich melt part is formed. FactSage simulation of the oxidation of the Mn-rich melt shows the formation of MnO- and SiO₂-rich slags, which dissolve FeO with increasing welding time. In parallel, viscosity calculation have shown that the early MnO-SiO₂ slags are quite viscous and are becoming more fluid with increasing FeO content. In conclusion, more fluid slags are much easier to remove during the process and, therefore, the welding time has to be adjusted.