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Quenched and tempered steel welded with micro-alloyed based ferritic fillers

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ABSTRACT

Quenched and tempered steel welds were made using one ferritic and two different micro-alloyed based ferritic fillers using shielded metal arc welding process. Variable metallurgical compositions in the weld zones of these joints resulted into wide variation in the microstructural phases and microhardness across different zones of these welds, which consequently influenced their tensile and impact toughness performance significantly. Joint welded using filler containing Cr and Mo with Nb, Ti, Al, V, Cu and N as micro-alloying additions resulted into weld metal where martensitic refinement occurred and thus showed highest microhardness of more than 400 HV_1. So this joint exhibited highest yield and ultimate tensile strength but gave least percentage elongation and showed the highest joint efficiency, whereas the other two joints welded using ferritic and less micro-alloyed (containing small additions of Ni, Mo and Cu) fillers fractured in their respective weld zones. High matching index (ratio of yield strength of weld joint to base metal) shifted the plastic strain from the weld metal to the HAZ during tensile loading. High micro-alloyed weld metal also showed the highest Charpy impact toughness value followed by low micro-alloyed and conventional ferritic weld metal. Weld metal with microalloying additions made to the weld metal via using suitable filler resulted into microstructural refinement of the weld metal which improved the tensile and impact toughness performance of quenched and tempered welded joints.

Keywords: Quenched and tempered low alloy abrasion resistant steel; Shielded metal arc welding process; Microhardness; Tensile properties; Impact properties; Fractography.

1. Introduction

Quenched and tempered low alloy abrasion resistant steels (few trade names like JFE-EH400, Sumihard 400, Fora 400, Hardox 400, Bisalloy 400, Hardox 500 etc.), have been developed to meet the industrial applications, where high wear resistance and strength is required by the components. These steels are typically characterized by their high tensile strength of around 1200 MPa or greater, besides possessing high hardness in the range of 400-600 BHN, which is