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# Wear and fatigue resistance of mild steel components reinforced by arc welded hard layers

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Abstract

This work investigates the wear and fatigue resistance of arc welded hard layers for structural steel applications. Herein, a mild steel S355 is utilized as base material and a metal-cored and solid wire are applied as filler metals for the hard facings. The results of the wear experiments show a mean volume reduction by 64 % in case of the metal-cored and by 69 % operating the solid wire compared to the base material as beneficial effect. Accompanying hardness measurements and microscopic analysis of the local microstructure basically substantiate these findings. On the contrary, cyclic four-point-bending tests at a stress ratio of  $R=0.1$  reveal a decrease in fatigue strength by 43 % in case of the metal-cored and by 46 % using the solid wire in relation to the base material fatigue resistance. In addition to this basic research study, the effect by adding tungsten carbides in the solid wire weld matrix is experimentally analyzed. Thereby, the mean wear volume reduces by 91 % compared to the base material. Cyclic bending tests also indicate an enhanced drop in fatigue strength by 78 % compared to the base material, and by 67 % in relation to the solid wire without tungsten carbides. A final application study incorporating a representative weld specimen for the presented industrial application reveals that the impact of wear layers on the resulting fatigue resistance can be fundamental with a decrease of more than 50 %. However, to reduce wear of structurally loaded steel components, an application of the presented hard facing techniques is favourable considering the effect on the fatigue strength within the design process.

Keywords: Arc welded hard layers; Wear; Fatigue strength; Tungsten carbides, Structural steel components.

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