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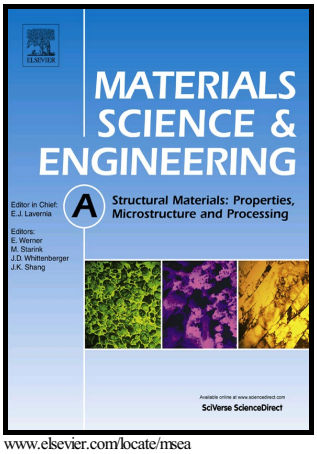

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Dynamic compressive behaviour of weld joints

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Abstract

Materials used in military applications have to withstand multiple threats like ballistics and explosions. Thus, high-strength low alloyed (HSLA) steels are used. The main joining technique for metals is welding. Therefore, analysing the dynamic impact behaviour of high-strength welds is very important to fulfil these demands. Investigation of welds at high strain rates has rarely been conducted in the past. To determine the dynamic impact behaviour of hybrid laser-arc welds, the Split Hopkinson Pressure Bar (SHPB) technique was used. The base material was a quenched and tempered fine-grained armour steel with yield strength of 1100 MPa.

First, a full hybrid laser-arc weld was investigated by extracting specimens consisting of weld metal and heat affected base material. The influence of two variables, the cooling time between 800 °C and 500 °C ($t_{8/5}$) and strength of filler material, on the impact behaviour was studied. The cooling time $t_{8/5}$ was varied by preheating to influence the microstructure in the HAZ and to analyse the effect on the hardness and dynamic compressive strength.

Subsequent analysis to detail the original investigation was carried out by dilatometer heat treatment of specimens to create homogenous subzones of the weld. These specimens have a homogenous microstructure of HAZ and were tested by SHPB to determine the stress-strain characteristics for the different microstructures of HAZ.

The results of the weld specimen showed the effect of preheating and filler material strength on the dynamic compressive behaviour. The analysis of the different microstructures of the HAZ indicated that especially the tempered microstructure caused a reduction in dynamic compressive strength.

Keywords: *SHPB; Hybrid laser-arc weld; armour steel; dilatometry*