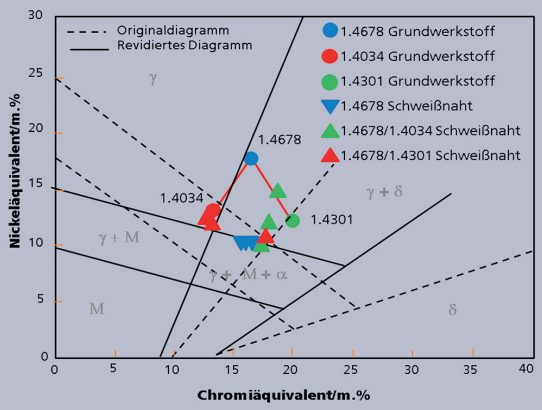

STRENGTH OF WELDED JOINTS OF DISSIMILAR ULTRAHIGH-STRENGTH MANGANESE STEELS

Task

With appropriate process parameters, laser beam welding can reliably join thin high-strength sheet metal. Not only does the industry have a demand for connections of similar materials, but it also requires, increasingly, connections between different steel material combinations. In this context, the properties of welded joints of 1.4678 (FORTA H100) with 1.4301 (X6CrNi 18 10) and press-hardened 1.4034 (X46Cr 13) shall be determined and appropriate process parameters and strategies presented.

Method

After systematic welding tests were conducted, EDX analyses were used to determine the local composition of the alloy in the fused metal. The composition was then recorded so that the microstructural components could be specified according to the Schaeffler diagram. Transverse tensile tests were carried out at room temperature to determine the strength of the joints. In addition, the fracture behavior was analyzed with a fractographic analysis.

1 Welding structure of 1.4678/1.4301.

2 Welding structures of 1.4678/1.4034.

3 Arrangement of the composition according to the Schaeffler diagram.

Results

According to the classical Schaeffler diagram, all welding materials solidify austenitically. In the revised diagram, which takes into account the influence of manganese, the welded metal of the compound with 1.4301 can have up to 40 percent ferrite. The high carbon content causes a shift to martensite. In the joint with 1.4301, the component fails in the chrome-nickel steel due to the lower strength of this material. The joint with the press hardened 1.4034 shows a reduced elongation which leads to fracturing in the weld area. With a yield strength of 900 MPa and a tensile strength of 1200 MPa, the strength of the press-hardened material is not achieved in the weld. The seams have a strong notch effect due to their hardness distribution. Future studies will show whether the properties can be improved by welding and heat treatment.

Applications

Applications can be found where the advantages of the combination of high elasticity and high strength need to be used with predominantly static loads. For example, hollow-chamber plates made of steel with improved damping can be constructed. Due to the narrow weld seams, there are further constructive possibilities which allow new designs in steel construction.

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