



LASER WELDING OF STEELS WITH HIGH MANGANESE CONTENT

Task

Supra-ductile steels are able to absorb high energy under dynamic loads. This makes them ideal materials for the construction of components that provide impact protection in the automotive industry. In this context, twin-roll casting (TRC) is a cost-effective manufacturing process. High carbon content, segregation of manganese and inclusions are suspected, however, of limiting weldability of such steels. Therefore, the suitability for welding and mechanical properties of welded steels shall be tested using a butt joint.

Method

After the parameters and process guidance were set, the metallurgical effects and the mechanical properties were determined. The destructive test was carried out in a quasi-static and dynamic tensile test as well as in crash tests. The investigations were carried out on alloys with 17 and 30 percent mass fraction of manganese and 0.3 and 0.6 percent mass fraction of carbon.

Result

A study of 1.5 mm thick sheets showed that welding under the parameters for austenitic steels is possible. A root protection needs to be applied in order to achieve a high bead quality and to limit the burn-off of manganese. On the beam side, a local feed with inert gas is sufficient. Thus, the loss of

manganese could be absolutely limited to 1 percent. The inner segregation of manganese is about 2 percent, wherein the manganese tends to segregate at the dendrite boundaries.

In the tensile test aluminum-alloyed grades broke outside of the weld seam. An aluminum-free alloy broke in the weld seam, and while the tensile strength was reduced by 50 percent, the fracture strain was preserved at 40 percent. After deformation under crash conditions, the weld seams showed no failure.

Applications

High ductility steels are primarily used in vehicle construction when deformation and strength of the overall structure have to be adjusted. In this context, crash boxes are two examples in automobiles and railroad cars. Also in building construction, these materials can be used for collision protection, e.g. for bumpers and guard rails. In connection with twin-roll casting, a resource-saving and energy-efficient component production can be set up when forming and welding lines are integrated downstream.

Contacts

Dipl.-Ing. Martin Dahmen
Telephone +49 241 8906-307
martin.dahmen@ilt.fraunhofer.de

Dr. Dirk Petring
Telephone +49 241 8906-210
dirk.petring@ilt.fraunhofer.de

2 + 3 *Structure and distribution of manganese in the weld.*

4 *Deformed sample of Fe-0.3C-18Mn-1.5Al.*