Lighth-weight Constructions

Welding of high strength steels for cranes or vehicles requires the use of a suitable welding consumables.

The influence of adjustments of alloying elements on the mechanical properties of a metal-cored filler wire was extensively studied.

In combination with thorough microstructural characterizations, it was possible to find an alloy design for a new generation of welding consumables with a minimum yield strength of 1100 MPa and a minimum impact toughness of 47 J at -20 °C.

While alloying with vanadium resulted in a severe strength improvement, the alloy contents of carbon, manganese and silicon were reduced to maintain an adequate toughness. This new welding consumable might enable the design of more energy efficient components with reduced weight and still improved load capacity.

New generation of welding consumables

By changing the chemical composition of high strength steel welding consumables, weld metal samples with a new level of strength could be produced by gas metal arc welding. This promising new generation of welding consumables could be used in the future for steel constructions, enabling the fabrication of stronger structures while using as little material as possible in the scope of lightweight components.

metal JOINing
K-Projekt Network of Excellence for Metal JOINing
Programme: COMET – Competence Centers for Excellent Technologies
Programme line: K-Projects
M2 – Ultra high strength welds, [09/2014 – 08/2018], multi-firm

Fig. 1: Application – Truck-Crane
### Alloying element Vanadium

Vanadium is frequently added to a variety of steels to improve the mechanical properties. Also in the case of the investigated welding consumables, vanadium proved to be a very potent element for increasing the strength. Small additions in the order of 0.2 wt% are enough to ensure 100 MPa more in yield strength. This strength increase can be facilitated to build new lightweight steel constructions more economically.

The behaviour of vanadium in the steel weld was studied by atom probe tomography. This method offers nearly atomic resolution combined with information on the chemical identity of the measured atoms.

Fig. 2 shows a reconstruction of a sample from a weld alloyed with vanadium. The small features in this image represent enrichments in vanadium, carbon and nitrogen, and therefore represent very small particles in the weld metal. Despite their small size (max. 10 nm), these particles impede the deformation of the material, therefore increasing its strength.

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<td>Vienna University of Technology</td>
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