Properties of MIG/MAG brazed joints in zinc coated steel sheets

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Abstract

Arc welding of zinc coated steel sheets faces a number of difficulties, such as spatter and porosity. These problems are caused by zinc being vaporised during the welding process. In two prior projects at SIMR - JTC, MAG welding of zinc coated steel sheets has been studied, where improved weldability has been shown. A literature study indicated that another method had further potential when joining zinc coated sheets of steel - arc brazing.

In this master thesis, at the Department of Solid Mechanics, KTH, Stockholm, methods and possibilities for arc brazing and laser brazing were studied. A literature study was performed in order to compare arc- and laser brazing processes with corresponding fusion welding processes. A special focus was set on thin zinc coated steel sheet materials and automotive applications.

The results from the literature study showed that both arc brazing and laser brazing could be a good alternative to conventional fusion welding of thin steel sheets. Brazing is reported to be advantageous when joining zinc coated steel sheets, where the use of conventional fusion welding can be limited and/or costly.

Welding and brazing trials were performed on lap joints with zero gap between the plates both to connect to prior projects and to be able to compare MAG welding and MIG/MAG brazing. Base material DOGAL B500 with both 7 \( \mu \)m and 20 \( \mu \)m zinc coating was used.

Initial MIG/MAG brazing trials showed that pulsed arc transfer was preferable and further trials were performed with pulsed MIG/MAG brazing to investigate the influence of shielding gas and gap widths.

Four different shielding gases were evaluated: MISON Ar, MISON H2, FOGON 2 and a mixture of Ar + 1% O2. MISON Ar showed the best results regarding spatter, arc-stability and internal porosity closely followed by Ar + 1% O2.

The filler metal wire used, OK Autrod 19.30 (SG-CuSi3), showed good results and was able to bridge gaps up to 1 mm. The travel speed for the evaluated case
of MIG/MAG brazing was equal to the welding speeds (corresponding trials) in earlier SIMR-JTC projects.
Mechanical tests were performed on both welded and brazed joints. Tensile-shear tests showed varied results on both the welded and the brazed joints. The welded specimens all fractured above the tensile strength of the plate, regardless the fraction location. The brazed specimens with different shielding gases on zero gap had a scattered result and most of them fractured in the braze metal and fusion line. The brazed specimens on different gap widths fractured around the tensile strength of the base material with a majority in the base metal.
It can be concluded that the MIG/MAG brazing process can be an alternative to the MIG/MAG welding process when joining coated steels. However, the choice of joining process should be dependent on the application requirements.