Influence of laser parameters on laser brazed DX56 to DX56 galvanized steel joint

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Abstract

Galvanized steel finds application in the automobile industry for their excellent corrosion resistance. Joining of these steel is challenging with conventional fusion joining process such as Metal arc weld (MAW) and Tungsten inert gas weld (TIG) due to excessive zinc evaporation at the joint area and also formation brittle intermetallics at the interface. In order to minimize the problems laser brazing was tried out.

In the present study, the amount of zinc loss, intermetallic formation and corrosion properties of the joint area has been evaluated. Galvanized steel (DX56) of 1.5 mm thickness was laser brazed with 1.5 mm diameter solid Cu-Al filler wire. During laser brazing 3 m/min wire feed rate and 3 m/min laser scan speed were kept constant with varying laser power of 4.2, 3.8, 3.4 kW. The Microstructure of laser brazed joint reveals cast structure in the fusion zone and intermetallics formation at the steel interface. Intermetallic thickness decreasing with decreasing heat input. It was found that increase in wetting length improves the joint mechanical and electro-chemical properties.

Key words: Galvanized steel, Laser brazing, potentiodynamic study.
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Introduction

- Galvanised steel is widely used in auto-vehicle industry for corrosion protection.
- Conventional fusion Joining of galvanised steel is problematic due to vaporisation Zn at 906°C and leads to formation of defects in the joint.
- Formation of brittle intermetallics at the interface.
- Formation of weld cracks and distortion of specimen due to conventional brazing technique.

Remedies for joining of Galvanized steel
**Objective of the Study**

- To optimise the laser brazing parameters galvanised steel joints using CuSi$_3$ filler wire.
- In depth characterization of the reaction layer at braze seam/steel interface using EDs, for phase identification.
- To investigate the mechanical and corrosion properties of joints.

**Experimental work**

- **Laser**: 360 microns spot size
- **Joint configuration**: fillet joint
- **Material Used**
  - DX56 (1.5 mm thick sheet)
  - Filler wire – CuSi3 (1.5 mm thick)
- **Specimen size** (1.5 X 200 mm X 150 mm)

**Parameters of Laser brazing**

<table>
<thead>
<tr>
<th>Laser (kW)</th>
<th>Speed (m/min)</th>
<th>Wire Feed Rate (m/min)</th>
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<td>4.2, 3.8, 3.4</td>
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Experimental set up for laser brazing
Results and Discussion

Inference form graphs

• At higher power, bead width increases.

• With increasing the laser power, bead height has increased marginally.

Fillet joint Macrostructures

Bead Geometry Measurements
Microstructure of Fillet joint

- Microstructures have extremely fine dendritic features due to very high cooling rates associated with laser brazing.
- Next to the fusion zone there exists an intermetallic layer at the steel side and this zone width was varying with laser power.

Tensile Results

Inference
- Higher strength has shown at the 3.8 kW laser power.
- Corrosion is prominent at the joint interface in all the test conditions
Conclusions

- Laser brazing with different welding parameters were free from defects such as macro cracks and pores.
- Intermetallic layer thickness was found to be increased with increasing brazing power.
- At laser power 3.8 kW has shown better tensile strength compared to 4.2 kW power.
- Salt spray test of laser brazed joints changes marginally with laser power.

References