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THE LASER WELDING FEATURES OF STAINLESS STEELS AND GALVANIZED STEELS

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Abstract. This paper is about the most important investigation result process of laser welding thin stainless and galvanized plates. The feature of this issue was the need to preserve the appearance of side reversed side of welding.

Laser welding is a widespread and effective technology. The popularity of this technology is growing because continuous improvement of laser sources has already provided 25-40 percent efficiency.

Process welding of stainless steels with using laser has been well studied but the requirement such as preservation the appearance of side reversed side of welding leads to necessity of additional investigation.

For this study, next equipment was used: fiber laser (power P=1kW, min spot diameter 0,16mm, wavelength λ=1,06μm), 3-axial coordinate system, welding head, microscope "Micro-200", tensile machine. All samples had 40x250mm size. AISI304 thickness 0,8mm, 1,2mm and 2mm were used. Argon was used for welding joint shield from oxidation.

Previously, it was supposed that main problem would be oxidation the side reversed the side of welding, but the destruction of the polymer protective film was more important problem. Temperature is destructing film and products of film decomposition are deleted badly. This is unacceptable at industrial production. This problem was resolved by regulating of thermal contribution for few thin pair. The results of these studies are shown in table 1.

Table 1 – The results of welding stainless plates

Thickness of top plate, mm	Thickness of bottom plate, mm	Welding speed mm/min	Laser power, W	Shift focus, mm	Destructing film
0,8	0,8	5700	800	+1	No
0,8	1,2	5000	1000	+1	No
0,8	2,0	3500	1000	-1	No
1,2	0,8	3000	1000	-1	insignificant
1,2	1,2	2700	1000	-2	No
1,2	2,0	2300	1000	-2	No
2,0	0,8	1200	1000	-3	Yes
2,0	1,2	1000	1000	-3	insignificant
2,0	2,0	700	1000	-4	No

The speed in column "welding speed" is speed which corresponds to maximum strength of joint and minimal destruction film. For all samples which shown in table 1 breaking load had value 9,94 - 11,74kN on length 40mm. The table shows that the majority of results are positive and the film is not damaged. From this it can be concluded:

- this technique is effective when the ratio of the thickness of the top plate to the thickness of the bottom plate less than 2 mm
- for fiber laser with a power 1 kW and min spot diameter 0,16 mm, maximum thickness of top plate is 2 mm. Welding of thicker sheets require the use of more powerful sources.

It should be noted, shield gas should be supplied such to zone front of laser beam as to zone back from laser beam.

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During the study, authors have met with next problem. The edges formed from side reversed side of welding as a result of residual stresses activities. For solving this problem several ways were used:

- decreasing deep welding and increasing joint length (for compensation loss of strength);
- different trajectories joint (circle, zigzag, snake, dotted line).

All ways have had positive result, but most of them lead to decreasing welding speed. Only dotted line could resolve problem with preserve welding speed. Authors were established that using short lines eliminate edge if their total length is less of 30 percent of the welding trajectory length and length of one line is less of the certain value (for example, this value for stainless steel of 1,25mm thickness is 10mm).

In this study also the issue of welding galvanized plates with 1 and 1.5 mm thickness with stainless steel plates of the same thickness addressed. This problem occurs if there is a need to increase the rigidity of stainless steel sheet.

The welding scheme is shown in Figure 1.

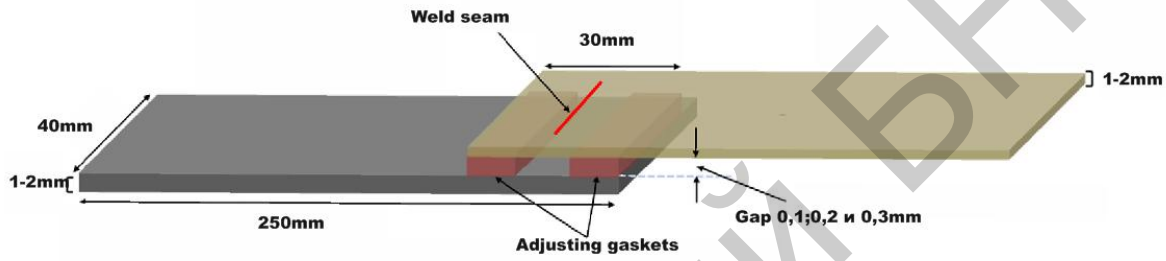

Fig. 1- Scheme of the welding process

The feature of this scheme is the presence of gaskets. They provide a constant gap between welding plates as result zinc vapor can escape, not only through the keyhole channel.

The welding modes are presented in table 2.

Table 2 – Welding modes

Thickness, mm	Gap, mm	Welding speed mm/min	Laser power, W	Shift focus, mm	Shield gas flow, l/min
1	0	3300	1000	-0,7	20
2	0	2750	1000	-1,2	30
1	0,2	2800	1000	-0,7	10
2	0,2	2100	1000	-1,2	10

Increase the gap over 0.2 mm was led a partial lack of the joint fusion.

From this it can be concluded:

1. The use of argon as a shielding gas is sufficient when welding galvanized steel is handled by fiber lasers, there is no need to add helium (as CO2).

2. When welding stainless and galvanized steel overlap, the only effective tool to combat the formation of defects is to provide a constant gap between the welded parts.

3 When welding stainless and galvanized steel overlap without gap with full penetration it is possible to avoid in the joint defects by great increasing the pressure of the shielding gas. However, this leads to blowing the metal from the bath and external defects.

The results of these studies can be used in different fields of industry, for example, at the railway/subway wagon and elevator manufacturing and etc.

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