Research of a laser welding of thin-shit construction steels by continuous laser radiation

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Research of a laser welding of thin-shit construction steels by continuous laser radiation

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Abstract. The results of the laser welding by continuous radiation of thin-sheet low-carbon steels on the example of steel 08U presented in this paper. Metallographic studies of the laser weld were conducted. Tensile tests were carried out as a result of which it was determined that the nature of the fracture is adhesive, and after cohesive failure of the specimens, it is show the high quality of the welded joints at the beginning of the weld.

1. Introduction

Of the modern methods of welding is considered more effective the laser welding. The laser welding is an innovative method of metal processing [1-5]. This technology has a very wide scope of application, as it has many advantages. It can be used when working with the same and different metals, is actively used in electronic engineering and radio electronics. The convenience of the method is that such welding is carried out by partial or complete melting, in any position, at any angle. It is suitable for working with thin sheets of metal, and for large parts [6-10].

2. Experimental studies

The welding was performed using a LS-2 serial laser unit with a power of 2 kW manufactured by IRE-Polus with an IPG d38 f100W-150-200 optical head with a focal length of 150mm. The speed of movement of the instrument varied from 5 to 30 mm/s.

The object of the research was a cold-rolled steel 08U, structural carbonaceous quality with the addition of aluminum to give a steel elasticity. The steel 08U is used in the manufacture of car body parts, for example, in the production of KAMAZ trucks. The chemical composition of steel 08U was determined on a spark-meter spectrometer 100. The results are presented in Table 1.

Table 1. Chemical composition of steel 08U

C	Si	Mn	Ni	S	P	Cr	Al	Cu
0.052	0.011	0.139	0.006	0.007	0.007	0.024	0.031	0.022

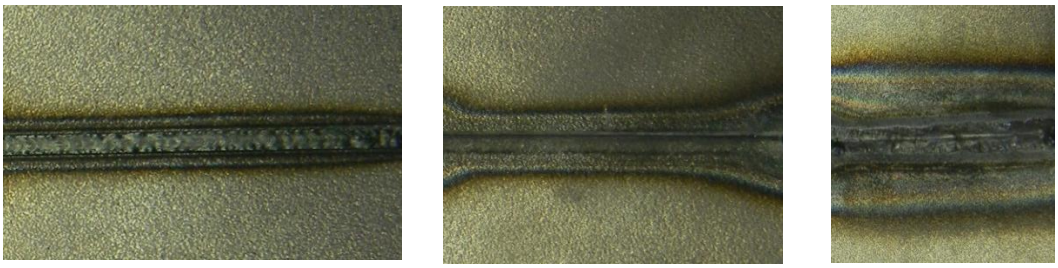
The obtained results of the chemical composition of steel 08U correspond to GOST 9045.

The modes of laser welding are presented in table2.

Table 2. Modes of laser complexes for laser welding of steel 08U.

Mode	Laser power, W	Speed, mm / s	Focus, [mm]
1	800	30	-30мм
2	1200	30	-30мм
3	1500	30	-30мм
4	1500	30	-20мм
5	2000	30	-20мм
6	1200	10	-20мм

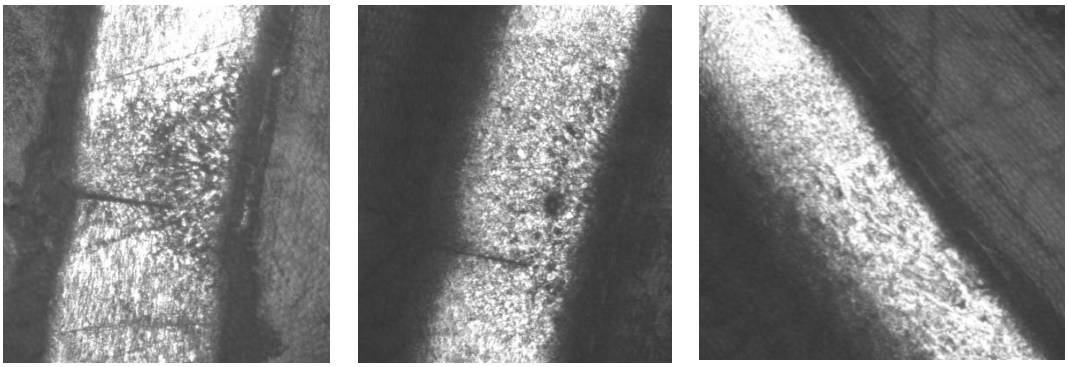
The appearance of the samples is shown in Figures 1-2:



Sample No. 1 x20 Sample No. 3 x20 Sample No. 5 x20

Figure 1. Appearance of samples with laser welding

The quality of the laser weld is evaluated by geometrical parameters, microhardness, tensile tests.
The measurement of the geometric parameter of the laser weld is carried out over the cross section of the sample. Using the measuring scale of the microscope Altami MET 3M, the geometrical parameters of the laser welds were obtained. Figure 2.



Sample No 1 x100 Sample No 3 x100 Sample No 5 x100

Figure 2. Transverse microsections of samples with pulsed laser welding

When determining the geometric parameters of the laser seam, it was found that the samples were welded on an automated laser system-2 №1, №2, №3 there is no through seam. A microhardness determination is carried out on a PMT-3 microhever meter. The principle of operation of the device is based on pushing the diamond pyramid into the material under test under a certain load and measuring the linear magnitude of the diagonal of the print obtained.
The results of changing the microhardness across the width of the weld of sample No. 5 are presented in the form of a graph for greater clarity Figure 3.

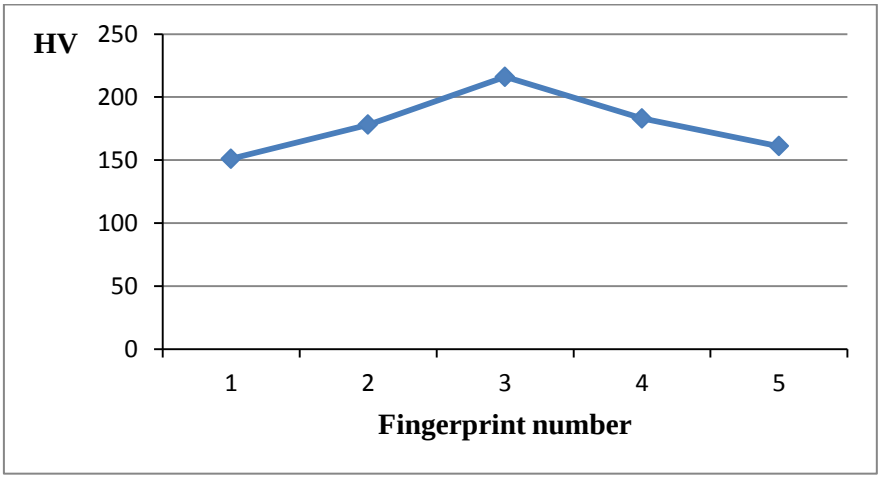


Figure 3. The change in microhardness across the width of the weld of sample No. 5

The determination of tensile strength was carried out according to the method “tensile test methods for thin sheets and tapes GOST 11701” and “tensile test methods GOST 1497-84”. Cutting blanks for samples and manufacture of samples carried out according to GOST 1497-84.
The tensile strength is determined by special equipment - Universal tensile testing machine MIM-7LR-010. According to tensile tests, charts were constructed (Figure 4).

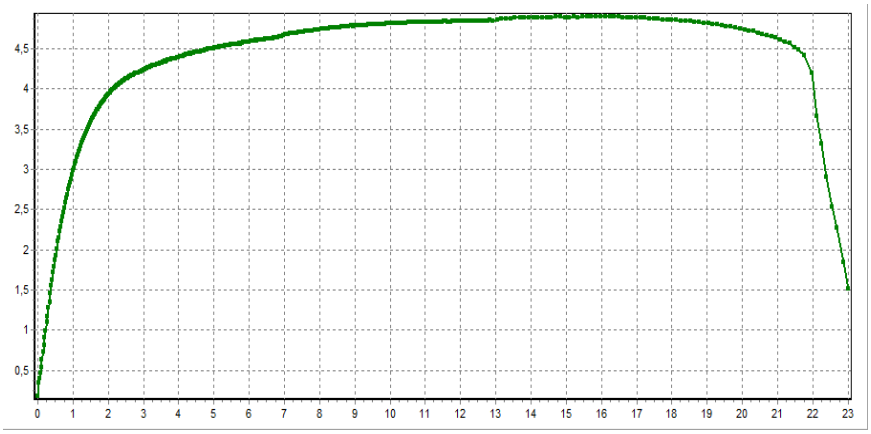


Figure 4. Graph - results on the gap sample number 5

In the process of tensile testing, adhesive and after cohesive failure of the specimens are observed, which shows the high quality of the welded joints at the beginning of the weld.

3. The conclusion

Experimental research on the effects of pulsed laser radiation on steel 08U shows the possibility of obtaining a weld with the required quality indicators. The localization of the welding zone ensures the rational design of the parts to be welded and minimizes permanent deformations.

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