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INFLUENCE OF PARAMETERS OF WELDING REGIME ON METALLOGRAPHIC STRUCTURE OF MATERIALS FROM A JOINT WELDED IN CORNER IN „T" FORM

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To achieve metal constructions with high importance, it can be used different steels, but steel OL 52.4k has a very wide use due to technological properties and mechanical they present. Metallographic structure of materials of a welded joint is influenced by conditions that occur in the process of welding. In the researches there have been studied the influence of parameters of welding regime on the system of metallographic structure of materials from a welded joint in corner in "T" form. There was taken into account welding process MAG using three welding regimes and using steel plates from OL 52.4k steel with a thickness of 10 / mm.

Key words: parameters of welding regime, metallographic structure, joint welded in corner in „T" form, welding process MAG

INTRODUCTION

Extending life for welded constructions is possible through constructive improvements and optimization of parameters of welding regime so as to obtain metallographic structure as homogeneous as possible in welded joints. Welded metal constructions generally shows in the welding joints area significantly deteriorations higher in comparison with other areas of the construction, all of these are determined by the properties and inhomogeneous structure of the weded joint area [1, 2].

Obtaining superior functional characteristics of welded joints is possible by realizing constructive and technological changes which have result, removal and prevention of nonconformities raised up during application of various assembly processes by welding. During exploitation of welded metal constructions, it can suffer some plastic deformations which lead to the appearance of cracks, whose size depends on the effort and their application mode [3].

For welded structures, execution temperature generates conditions for certain modes of decay by tearing due to inhomogeneous metallographic structure that is obtained during the application of various welding processes. The life of welded structures is very much influenced by the evolution of the material properties of their structure, and these properties are greatly influenced by structural constituents of the material of welded joint [4].

Steels for general use for constructions, compared with carbon steels, have become widely used in realizing welded constructions with great importance, due to the characteristics they have and allowing proper behavior at combined requests, respectively mechanical corrosive environment.

In conditions of technological exploitation of welded structures, breaks or disposals by tear are due to obtaining a patchy metallographic structure for welded joints or extend the size of a defect occurred during the welding process.

Welded constrcutions became increasingly used in the last two decades due to the advantages they have in comparison with other structures obtained by other technological processes, but by its specificity, the technological process of achieving products in welded construction presents and a number of disadvantages resulting primarily from working with a liquid material [5].

Choice of welding processes and filler material primarily participate of provisions of the draft the subassembly and technical conditions available to the contractor. In general, for weight and large-sized assemblies made of profiles, tables and other machined components, manual welding process with coated electrode is the most common, but in recent decades process MAG has greatly expanded for welding of steels.

A welded joint must have minimum thermal tensions because they negatively influence the whole welded assembly. The order of the layers involved in the welding point must be such that the tensioned fields to shrink by successive stress relief between layers [6].

In the case of welding in corner in «T», the deposition of material layers is successively realized, and this enables the regeneration of the microstructure whereas at the melting of a layer is heated the earlier one over the transformation point Ac3, resulting at the steel OL

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52.4k after cooling air, predominantly pearlitic structure, finer, stress relieved. The only layers that remain unregenerate, are those which are deposited last. Also an important role in achieving welded joint it is the preparing of the welding and in this way it is considered balancing of tensions and avoiding deformation in the assembly area [7].

MATERIALS

Research undertaken to establish optimum parameters of welding so as to obtain an uniform metallographic structure in a welded joint realized of steel OL52.4k. The use of this steel is indicated in the fabrication of resistance elements (beams, columns, sections, rails, brackets, etc.). In the experimental research it was taken into account the achieving of welded joints of tables with thickness of 10 / mm. Production technology of welded joints from steel OL 52.4k recommended that until a thickness of 10 / mm not to preheat base material due to welding linear energy realize a sufficient preheating operation. To achieve desired results in the research, there were established initially for steel OL52.4k mechanical characteristics which are shown in Table 1, and chemical composition is shown in Table 2.

Table 1 **Mechanical characteristics of steel OL52.4k**

R_m / MPa	R_{02}/ MPa	Z / %	A / %	K_{CV} 20°C / J	K_{CV} 0°C / J	K_{CV} -20°C / J
568	402	23	31	79	64	52

Table 2 **Chemical composition of steel OL52.4k / wt. %**

C	Mn	Si	S	P	Al
0,217	1,6583	0,053	0,025	0,021	0,011

Obtaining welded joints was performed considering the welding process MAG using as the filler material a wire type SG2 with a diameter of ϕ 1.2 / mm, and the filler material characteristics are shown in Table 3, and Table 4.

Table 3 **Mechanical characteristics of filler material**

R_m / MPa	R_{02}/ MPa	K_{CV} 0°C / J
535	642	40

Table 4 **Chemical composition of filler material / wt. %**

C	Si	Mn
0,19	0,09	1,8

RESULTS AND DISCUSSIONS

To achieve welded joints was taken into account the welding process MAG because of the advantages of this method and namely that the rate of deposition according to the wire diameter of filler material can reach up to 10 / Kg / hour. Typically to this process is intensive use of filler material, and welded seam is glued to the clay.

Welding process can be realized in semi-mechanical version, mechanized, automated or robotic, in continuous current with reverse polarity when the welding source has external rigid feature. Research has been realized considering the three distinct welding regimes, namely a low, medium and respectively intense welding regime as shown in Table 5.

Table 5 **Parameters of welding regime used at the realization of welded joints**

No.	Sample type	U_{amed} / V	$I_{s\,med}$ / A	V_{med} / cm/min
1	With low welding regime	26	210	23
2	With medium welding regime	31	225	30
3	With intense welding regime	35	235	36

An initial analysis of a joint in corner in "T" form was performed by sectioning it and enlarging it 10 times after an attack with Nital and from this section it can be observed the area of base material, of filler material and the heat affected zone, Figure 1.

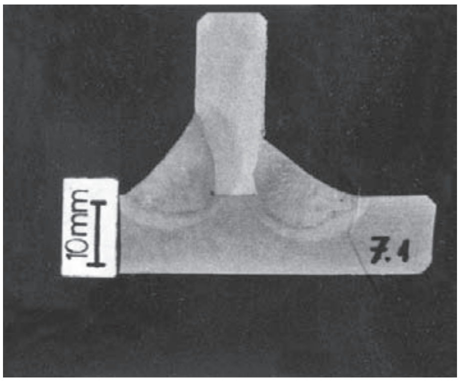

Figure 1 Welding in corner in T form, attack with Nital 2 / %; 10 x

The first set of samples was realized using a welding regime with low energy power. These samples were analyzed in terms of metallographic structure consisting of the following: metallographic structure of base material from the next of the weld seam, Figure 2, metallographic structure of filler material, Figure 3, and metallographic structure of the material from heat affected zone, Figure 4.

From the analysis of metallographic structures of materials is observed: the filler material, Figure 3, in addition to ferrite and pearlite with acicular ferrite appears fine sorbitan; same constituents occur in the heat affected zone at a rate between 60 / 40 to 35 / 65 and it is observed an increase in the real grain size from 5 - 6 to 8 - 9 per as we move away from the deposited material, Figure 4; the base material, Figure 2 shows ferrite

Figure 2 Base material – sample 1, attack with Nital 2 / %; 100 ×

Figure 3 Filler material – sample 1, attack with Nital 2 / %; 100×

Figure 4 Heat affected zone, – sample 1, attack with Nital 2 / %; 100×

and pearlite in rows with the proportion 30 / 70, with grain size 8 - 9 but with some intercalations of acicular ferrite.

The second set of samples was realized using a medium welding regime as power energy and in this case the samples were analyzed in terms of metallographic structure consisting of the following: metallographic structure of base material in the immediate vicinity of the welded seam Figure 5, metallographic structure of filler material, Figure 6, and metallographic structure of material of heat affected zone, Figure 7.

In Figure 5 is shown the metallographic structure specific to base material of set 2 of samples and in this are structural constituents by type of pearlite and acicular ferrite with the grain size of 8 - 10 in a ratio of 50 / 50. Metallographic structure of the filler material Figure 6, is characterized by rows of pearl in ferrite clouds with report ferrite / perlite 40 / 60 and a grain size 8 - 9. In the heat affected zone is present ferrite and pearlite with a report ferrite / perlite of 50 / 50 and then decreases drops to 35 / 65 to the periphery of the heat affected zone, Figure 7.

Figure 5 Base material – sample 2, attack with Nital 2 / %; 100 ×

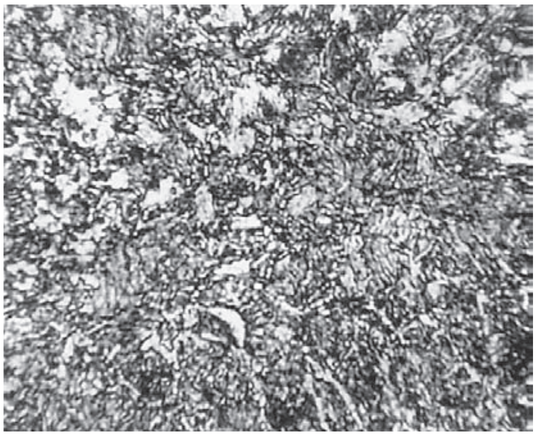

Figure 6 Filler material – sample 2, attack with Nital 2 / %; 100 ×

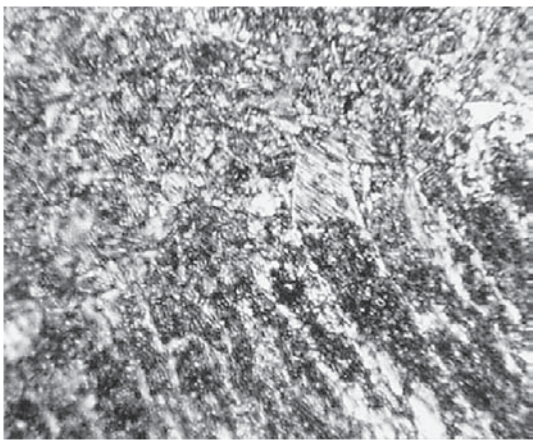

Figure 7 Heat affected zone – sample 2, attack with Nital 2 / %; 100 ×

Table 6 **Synthesis of structural constituents of the analyzed samples**

No. sample	Metallographic constituents – Observations	Metallographic constituents – Proportion	Size of real grain	Structure Wildmann-Statten		Analized zone	Figure
1	ferrite, pearlite of fine granulation and fine sorbitol	Structură de răcire cu grăunți alungiți pe direcția flxului termic				Filler material	2
	ferrite, pearlite, acicular ferrite	≈ 60 / 40	7 - 8	1 - 2	subarea of over-heating	Heat affected zone	3
	ferrite, pearlite of fine granulation	≈ 50 / 50	≈ 10	-	subarea of nor-malization		
	ferrite, pearlite	≈ 30 / 70	≈ 9	-	subarea of incom-plete transforma-tion		
	ferrite, pearlite, acicular ferrite	≈ 30 / 70	≈ 9	≈ 1		Base material	4
2	ferrite, pearlite, acicular ferrite	Structură de răcire cu grăunții alungiți pe direcția fluxului termic				Filler material	5
	ferrite, pearlite, acicular ferrite and in grid	≈ 65 / 35	5 - 6	2 - 3	subarea of over-heating	Heat affected zone	6
	ferrite, pearlite of fine granulation	≈ 55 / 45	≈ 10	-	subarea of nor-malization		
	ferrite, pearlite	≈ 35 / 65	≈ 9	-	subarea of incom-plete transforma-tion		
	ferrite, pearlite and acicular ferrite	≈ 35 / 65	≈ 8	≈ 1		Base material	7
3	ferrite, pearlite and fine sorbitol	Structură de răcire cu grăunții alungiți pe direcția fluxului termic				Filler material	8
	ferrite, pearlite, acicular ferrite	≈ 80 / 20	3 - 4	≈ 3	subarea of overheat-ing	Heat affected zone	9
	ferrite, pearlite of fine granulation	≈ 60 / 40	≈ 10	-	subarea of normal-ization		
	ferrite, pearlite	≈ 40 / 60	≈ 9	-	subarea of incom-plete transformation		
	ferrite, pearlite, acicular ferrite	≈ 40 / 60	≈ 7	≈ 1		Base material	10

Set 3 of samples was realized considering the intense welding regime considerably increasing both voltage and welding current, and welding speed. The samples were analyzed in terms of metallographic structure with consideration of: metallographic structure of base material next to the weld seam, Figure 8, metallographic structure of filler material, Figure 9, and metallographic structure of the material of heat affected zone Figure 10.

In the case of these samples, metallographic structure of the base material consists of elongated grains of ferrite and pearlite besides appears fine sorbitan which consist of grains formed by intense cooling, Figure 8. In the filler material, Figure 9, there occur structural constituents by ferrite and pearls type that are in proportion

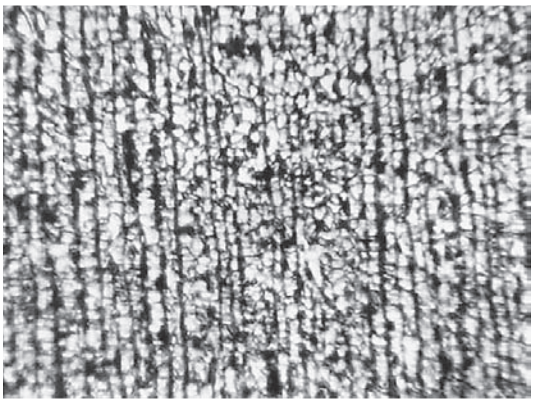

Figure 8 Base material – sample 3, attack with Nital 2 / %; 100 ×

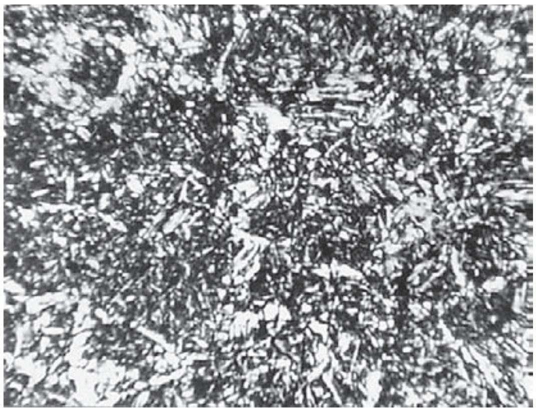

Figure 9 Filler material – sample 2, attack with Nital 2 / %; 100 ×

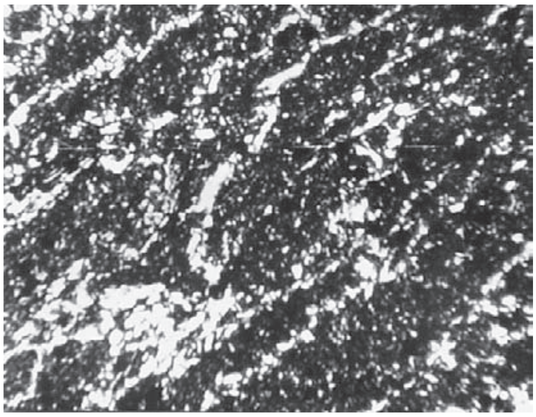

Figure 10 Heat affected zone – sample 3, attack with Nital 2 / %; 100 ×

25/75 with real grain 8-9, and in some areas appears acicular ferrite. The heat affected zone has a metallographic structure which presents structural constituents of the type of ferrite and pearlite that occur at different rates from 20/80 to 70/30 with a real grain size of 3-4 to 8-9 or even 10 and in the metal bath zone it occur an acicular ferrite, Figure 10.

A summary of metallographic structure for the three types of samples is shown in Table 6.

CONCLUSIONS

- research has shown the presence of ferrite-pearlitic type constituents in principle with a fine grain in case of ralizing a welded joint with a low welding regime and establishing a growth of granulation with increasing of intensity of parameters of welding regime;
- small amount of sorbates and the few areas of overheating occur only in the heat affected zone when appling to an intense welding regime;
- the proportion of ferrite in comparison with pearlite, from the overheated zone, increases with intensification of parameters of welding regime;
- filler material structure is a cooling structure of elongated grains on the direction of thermal flow.

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Note: The responsible translator for English language is S.C. PUR-TRAD S.R.L., Targu Jiu, Romania