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Cast Iron (GS 38-15) Behavior to Welding and Blowtorch Loading

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Abstract: The metal loading is sometimes regarded as a means of curing the manufacturing defects or the damage of the cast parts. In this direction and taking into account the high percentage of carbon, the parts out of pig iron and cast iron with graphite spheroid constitutes a rather difficult case. The principal objective of this study is the influence of the parameters of the annealing of softening on the mechanical characteristics and structure transformations of the samples into nodular cast iron, subjected to an assembly by welding with the oxyacetylene torch.

Key words: Cast iron, welding, loading, mechanical characteristics

INTRODUCTION

Many castings out of nodular cast iron are prone to defects appearing on the surface. One cures either by a metal loading or by a welding when it is a question of giving a separated part.

But as a part has quality only when it has a continuity of the properties in all its points, it is preferable to know the behavior as well principal mechanical characteristics as of the metallurgical evolutions when it undergoes a repair.

In general when there is contribution again metal passing by the liquid state, as it is the case of the assembly by welding or by loading one clears 3 zones, namely:

- A nonaffected zone where the basic structure is observed.
- A thermically affected zone where structure transformations of the base metal have took place.
- A zone consisted the metal lately brought, which is the weld bead. In this zone the structure can have a morphology different from those of the 2 preceding zones.

A suitable heat treatment can equalize, if not reduce the structural inequalities, by homogenizing the structure as a whole.

In this research, we study the behavior, with the favor of the heat treatment, the samples obtained with cast iron GS a 38-15 having undergone welding with the oxyacetylene torch.

The heat treatment selected to this end is an annealing at high temperature which consists of a heating until temperatures determined, in a maintenance according to defined durations, follow-up of one cooling at the ambient temperature.

The purpose of this treatment is also to transform the coarse structure of cast into a cellular ferritic structure with fine grains.

The means of characterization implemented are, inter alia, the microhardness, the tensile strength and optical microscopy.

OPERATING PROCEDURES AND ALLOY STUDY

The samples of cylindrical form were obtained starting from outlines run out of cast iron GS whose chemical composition is represented in Table 1.

Each outline was divided in its medium, then assembled by welding with the blowtorch. With each operation of assembly by welding the outline underwent a pre-heating with 200°C. The welding was carried out under neutral atmosphere with the blowtorch.

The rod having been used for welding of the outline with the blowtorch is run in same cast iron GS in order to carry out a loading with a of the same material chemical composition as initial alloy.

Table 1: Chemical composition in percent weight of material of study

% C	% If	% Mn	% S	% P	% Mg	% Cu
3.45÷3.90	2.45÷2.80	0.6÷1.0	< 0.02	< 0.06	< 0.06	<0.2

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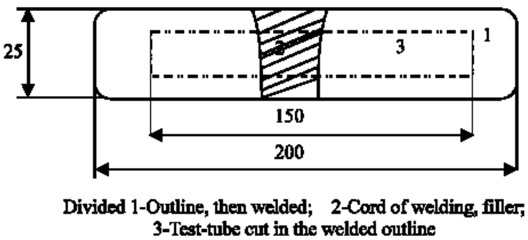


Fig. 1: Preparation of the outline for welding

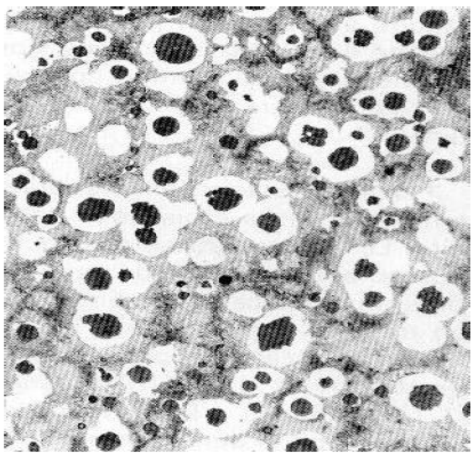


Fig. 2: Cast iron GS of pearlite matrix G×200. Nital 4%

Table 2: Mechanical characteristics of the cast iron used

HB	Rm, daN mm^{-2}	K, J cm^{-2}	With (%)
130-180	38	1.5	15

The samples having been used for the metallography and microhardness, tensile tests, were taken in these outlines according to identical geometrical conditions', (Fig. 1).

Initially the matrix of alloy of study, the FGS38-15 is mainly ferritic with which a rate of pearlite coexists bordering the 10% and one quantity of cementite not exceeding 2% (Fig. 2).

The mechanical characteristics of material in the state of reception are presented in Table 2.

The test-tubes thus obtained, cut in the beforehand welded outlines, were subjected to an annealing at high temperature with 850, 900 and 950°C.

The times of maintenance appointed for this study, (Fig. 4), at these three temperatures are respectively 1 am, 2 and 3 h.

The cooling which follows the various maintenances at high temperature is made out of closed furnace, in order to ensure a cooling as slow as possible.

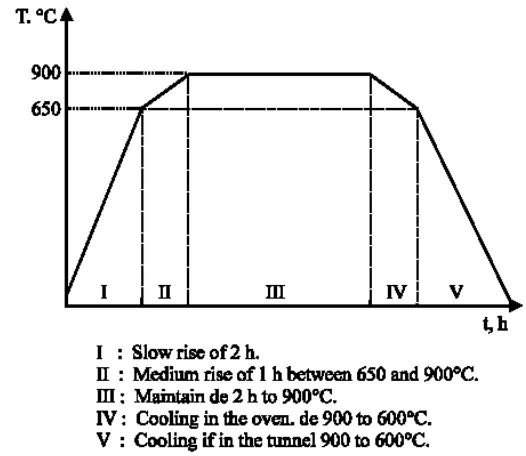


Fig. 3: Traitement cycle of ferritisation

RESULTS

Figure 4 has the results of the microhardness obtained according to the loading at the blowtorch.

This characteristic is traced according to the temperatures of annealing, the duration periods and according to the length of the sample.

The results show that one attends a variation of hardness as moves away from the edge of the test-tube towards the weld bead. Indeed the behavior of the curve of Fig. 4 shows for the samples untreated thermically three distinct zones:

It base metal where hardness is about 200 Hv units. Over the length this zone is spread out between 0 and 3 mm.

It affected metal thermically represented by a stage where the values increase with 220 units. The part occupied by this zone extends between 3 and 6 mm (Harrison and Farrar, 1993).

It metal charged with the blowtorch and coming from the rod, constituting the weld bead, occupying an extent beyond 6 mm, is harder and the property reaches a hardness of a value of about 350 units (Henri, 1993).

These three zones constituting three levels of stage of hardness show the difference in behavior mechanical which exists within the sample.

One clearly sees on the curves corresponding to the tests thermically treated that an annealing with 850°C during 1 h of time improves considerably the homogeneity of the sample; this property varies between 190 and 200 Hv units over the entire length of the test-tube.

For temperatures and higher duration periods hardness evolves moves in the same way with however a fall up to 140 units.

Table 3 has the results of the tensile specimens. We note a rather consequent loss in value of the properties

Table 3: Variations of the principal mechanical characteristics

		Time of maintenance	Resistance to traction (Mpa)	Limit of elasticity (MPa)	Lengthening with rupture (%)
Temperature of	Without welding		430	288	9
maintenance (°C)	With welding		315	227	1.37
850°C		1 h	271	164	3.2
		2 h	179	142	4.6
		3 h	195	144	4.6
900°C		1 h	250	163	3.2
		2 h	202	143	4.6
		3 h	230	150	4.4
950°C		1 h	241	152	3.6
		2 h	213	141	4.2
		3 h	224	147	4.3

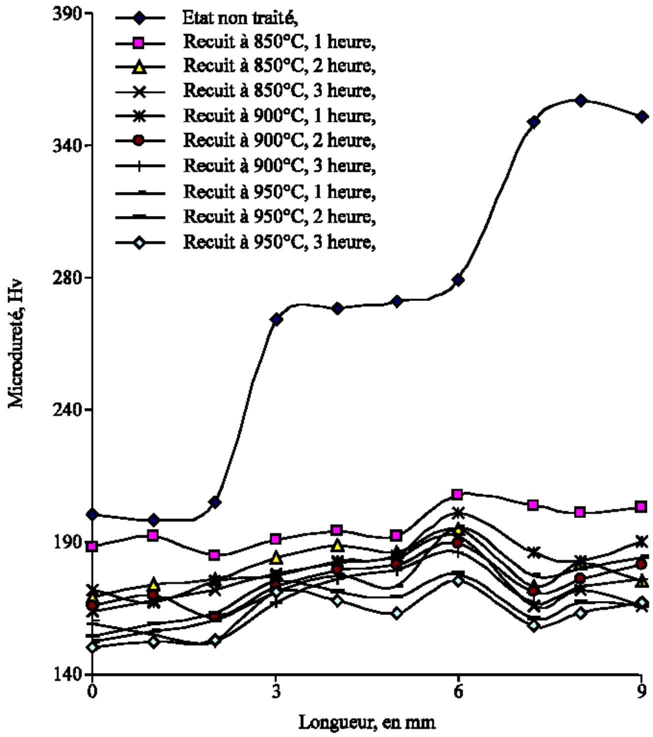


Fig. 4: Evolution of the microhardness for the various samples annealings

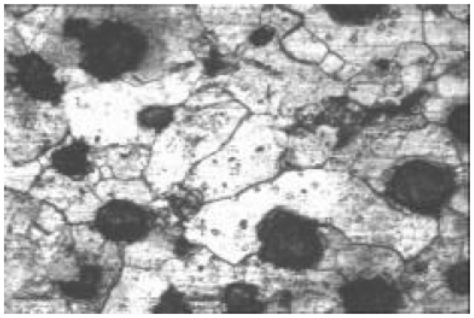
when one passes as of the test-tubes not welded to the welded test-tubes: The tensile strength passes indeed from 430 to 315 units and the lengthening from 9 to 1% (Rybakov, 1986).

This fall is more important with the thermically treated test-tubes and the rise in the temperature as well as duration periods. The tensile strength is better with the test-tubes treated during one hour with 850°C; the value is 271 units (Karsay, 1972). As for the lengthening, certainly improved by the treatment of annealing compared to the untreated welded test-tube, it is only 4% and does not vary in a significant way.

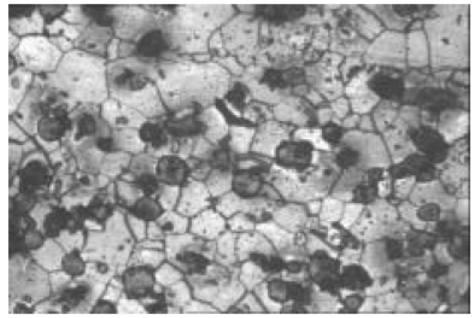
Micrographiquement one notes that the annealings carried out at the various temperatures according to various times of maintenance, with the image of the cycle 850°C/1 h represented on (Fig. 5), revealed:

- A structural zone corresponding to (Fig. 5a) where it is observed that the base metal does not have undergoes deep modifications, with a wholesale ferrite grains (Karsay, 1972).
- A zone presenting a difference with the preceding structure in the size of the ferritic grains become finer (Fig. 5b), as well as the size of the graphite spheroids (Forest, 1983).
- A zone where the size of graphite did not change, (Fig. 5c), but the importance of the ferritic grain is not any more équiaxe like that of the preceding structure.

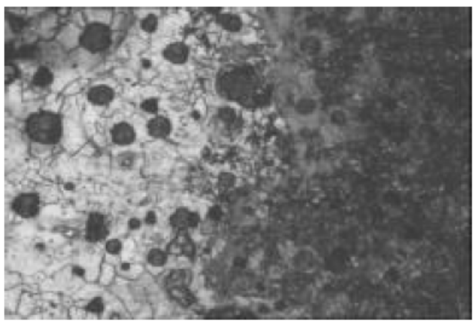
Figure 5d annealing with 900°C shows during one hour when one observes the appearance of the spheroids of shredded graphite and a finer ferritic grain.



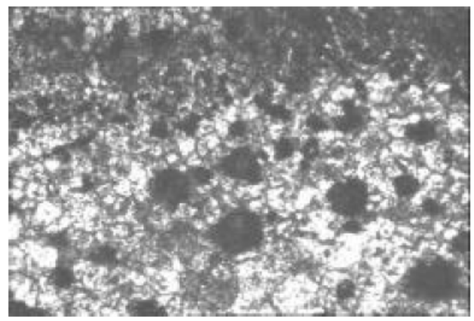
Basic A-metal



Affected B-metal thermicall



C Annealing with 850°C/1 h



D Annealing with 900°C/1 h

Metal lately brought (weld bead)

Fig. 5: Structures developed by alloy during annealings

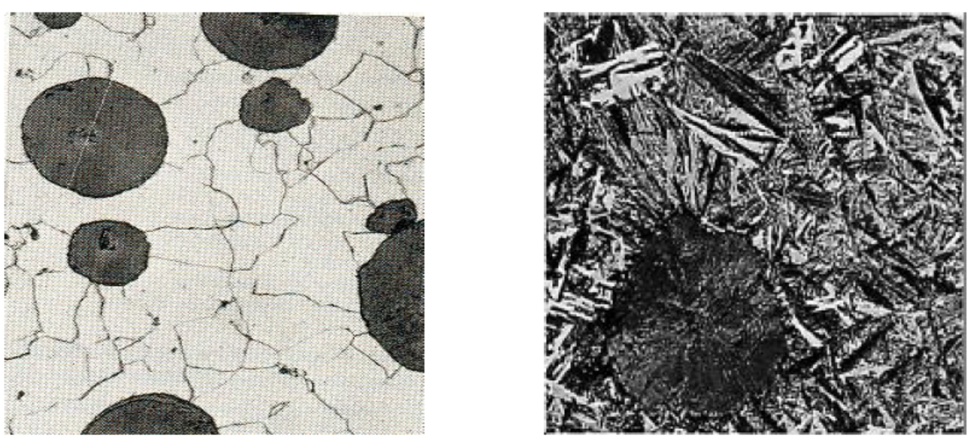


Fig. 6: Cast iron GS completly ferritique G×500. Nital 4%

CONCLUSION

The results developed with the favor of annealing show that nodular cast iron GS 38-15 can be charged or welded (Fig. 6a, b). The adjustment of the thermal cycle makes it possible to obtain a considerable corrective measure and can restore with the base metal and the filler the required structure.

However within the limits of our research presented here, the initial properties of the crude state are not reached. The study can be extended to higher temperatures of pre-heating, going until 600°C, of the test-tubes charged out of metal or assemblies by welding with the blowtorch.

REFERENCES

Forest, R.D., 1983. Ductile Welding Iron Castings, Casting Engineering and Foundry World Spring.

Harrison, P.L. and R.A. Farrar, 1993. Influence of inclusions rich in oxygen on the transformation of phase γ into α in the molten metal of a FGS, technical Editions of industries of the foundry, Paris.

Henri, L., 1993. Pig iron and cast iron and their heat treatments, structural metallurgy T2.

Karsay, S.I., 1972. Ductile Iron II, Quebec Iron and Titanium Corporation.

Rybakov, V., 1986. The welding and the cutting of metals, edition MIR. Moscow.