BEHAVIOR OF WELDED JOINTS FROM SOME STAINLESS AUSTENITE STEEL TYPES DURING NITRIDING PROCESS

Ovidiu DIMA
"Dunarea de Jos" University Galati
email: dima.ovidiu@ugal.ro

ABSTRACT

Researches made on welded and nitrided samples from stainless austenite steel types show that nitriding thermo chemical treatment can be applied also for welded joints. As a result of the treatment, a diffusion layer with austenite dendritic layer was obtained, max hardness of 500 HV_{005}- The layer's depth depends on the finishing degree of the structure. The finer the dendritic structure is the slower the diffusion process and smaller the layer depth.

KEYWORTS: welded joints, austenite stainless steel, nitriding process

1. Experimental conditions

For the analysis of welded joints behavior during nitriding process, some samples welded end to end by electric manual procedure EM, from steel types code 3, 4, 5, have been subjected to fluidized bed nitriding process in identical conditions as the analysed stainless austenite steel types.

The samples are from plates 3mm thick and they were welded with electrodes of 2.5 mm in diameter. The type of electrode is in accordance with the chemical composition of the steel. The type of electrodes and chemical composition of the material are presented in table 1.

Table 1

Steel type	Code	Electrode	%C	%Si	%Mn	%Cr	%Ni	%Mo
X2CrNil8.9	3	18/8 with low %C	<0.04	<1	<2.5	18-21	9-11	-
X2CrNiMo17.11.2 X6CrNiMoTil7.12.2	4 5	18/12/3Mo with low % C	0.04	<1	<1.5	18-19	11-12	2.5-3

The welding was made in direct current, reverse polarity c, and the electric parameters have the following values: U=24V, 1=55A. Taking into consideration the base coating of the electrodes, maybe they have been dried for two hours before using them, at a temperature of 250°C. The seam was thread-shaped, in one line, without oscillation, on a copper skid. Before welding the edges have been straightened. The analysis of the seam before the nitriding treatment shows that this presents a fine austenite dendritic structure for all steel types which is accompanied by a relative big ferrite (Fe_δ) quantity due to quick cooling and determined by welding on copper skid. The ferrite quantity in the seam was determined by means of a ferrite-meter and it is presented in table 2. The bigger quantity of ferrite Fe_δ in the steel types code 4 and 5 is determined by ferrite activity of molybdenum.

Figure 1 presents the welding seams microstructures made on steel types code 3, 4, and 5, at an increase of x200.

Table 2

Steel type	Code	% Fe_δ
X2CrNil8.9	3	4.5
X2CrNiMol7.11.2	4	6
X6CrNiMoTil7.12.2	5	9.5

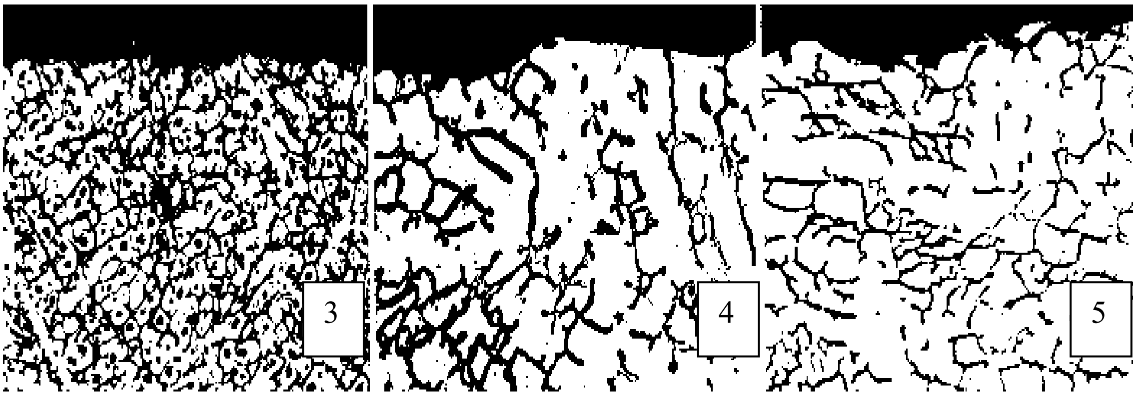

Fig. 1. *The welding seams microstructures made on steel types code 3, 4, and 5, at an increase of x200.*

The welded samples, like the steel nitrided samples, have been cut to the dimension of 20x60x3, and the seam arrangement is medial, frontal. The seam surface was polished and after that with granulated metallographic paper 280-320. Before being introduced in to nitriding installation, the samples have been washed, degreased with carbon tetrachloride and then dried with hot air.The fluidized bed nitriding process lasted for 3 hours.

2. Analysis of nitrided samples

Samples for metallographic analysis and for mechanical micro hardness tests have been taken from the welded and nitrided samples in order to point out the modifications inside the surface layer.

The metallographic analysis made by optical microscopy shows that nitrogen diffusion in the structure formed from austenite with ferrite separations Fe_δ , with dendritic aspect specific to welding seams has not produced visible changes in the aspect of the structure.

The nitrogen was diluted without producing complex nitrides separations, so without forming a composition layer with a distinct metallographic aspect. However it is possible for nitrogen diffusion to reduce very much the ferrite quantity Peg in the surface layer which will be transformed in austenite enriched with nitrogen.

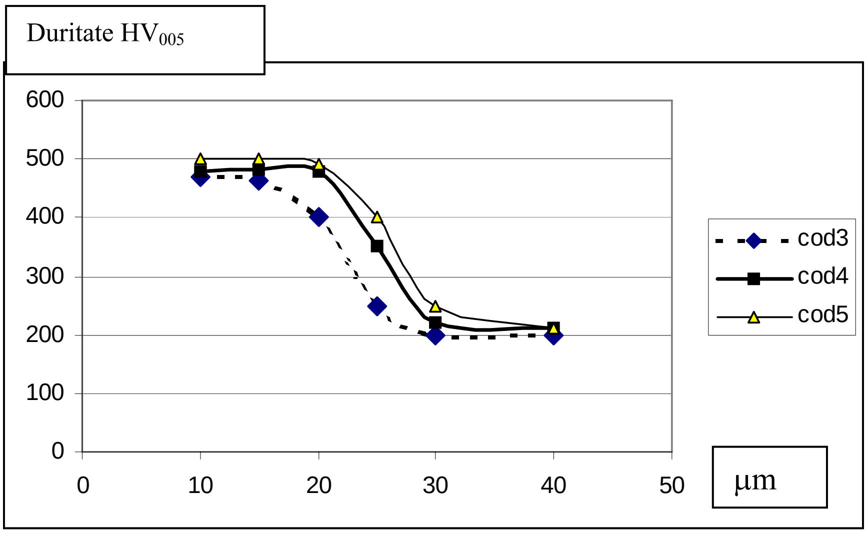

Fig.2*. Hardness variation in nitrided layer depth*

For the hardness test, Vickers trial with low loads was used and the pressure force was of 0,50N. The values of the three samples are presented in table 3. The analysis of hardness variation in the surface layer shows a two times bigger hardness, even bigger for molybdenum steel types and especially for the steel type which has a higher carbon content. Layer's depth is small enough 20-25μm because the dendritic structure is very thin and because the high density of grains limits suppresses the diffusion process.

Table 3

Code steel	Surface distance μm					
	10	15	20	25	30	40
	Hardness HV_{005}					
3	470	462	400	250	200	200
4	480	482	480	350	220	210
5	502	500	490	400	250	210

You may notice that layer's depth is smaller for steel type code 3 which has the higher structure finishing degree.

Fig. 2 presents the hardness variation in nitrided layer depth.

3. Conclusions

The researches made on welded and nitrided samples show that nitriding thermo-chemical treatment can be applied also to welded joints. After the treatment, a diffusion layer with austenite, dendritic structure having a hardness of max. 500 HV_{005} will be obtained. The layer's depth depends on finishing degree of the structure. More fine the dendritic structure is, more restrained the diffusion process and smaller the layer's depth are.

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