THE DETERMINATION OF THE FERRITE CONTENT IN THE WELDED JOINS STRUCTURES OF THE AUSTENICALY STEELS 10TiMoNiCr175 WITH ELECTRODES STAINLESS 19.12.2.Nb USING THE STRUCTURAL DIAGRAM WRC 1992

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1. INTRODUCTION

The presence of a certain quantity of ferrite in the welded join of the austenicaly stainless steels prevents the fissure on a high temperature of this.

The specification of the ferrite content, due of the chemical composition of the welded metal in the case of austenitic stainless steels, began in 1949 with the help of Anton Schaeffler's diagram.

The Schaeffler's diagram is considered a very important work instrument for the welding specialists, to establish the prospective microstructure of the welds made of austenitic CrNi steels. The section of the diagram belonging to more than 18% of chromium equivalent have been verified and specified many times, thus it can be valued reliable.

The following diagram that fixed the chemical composition and the ferrite content was DELONG diagram, published for the first time in 1956. It admits the importance of the nitrogen element as a strong austenitic element and it added this element to equivalent Ni as a term of multiplication of 30. This diagram, because of the lesser division and of the larger scale, improved the accuracy of the calculating of ferrite for series of stainless steels.

In 1973 DELONG diagram changed in order to show FERRITE NUMBER (FN). Using of FERRITE NUMBER instead of the percentage of ferrite, indicate the using of the standardized method of measuring the ferrite, included in ISO 8249. During the using of this diagram some of the limits of the DELONG diagram becomes not real. It is not fit the using of this diagram to the stainless steels with a high content of manganese, because these give content of ferrite as if they contain only 1% Mn. In order to remedy this situation in 1986 in Welding Research Council (WRC) – USA for stainless steels, was developed a diagram of predicted content of improved ferrite, which goes on in the scale: 0 - 100% FN.

In 1992 at the determination of equivalent Ni was added a term for Cu and this diagram was known as WRC 1992, represented in figure 1.

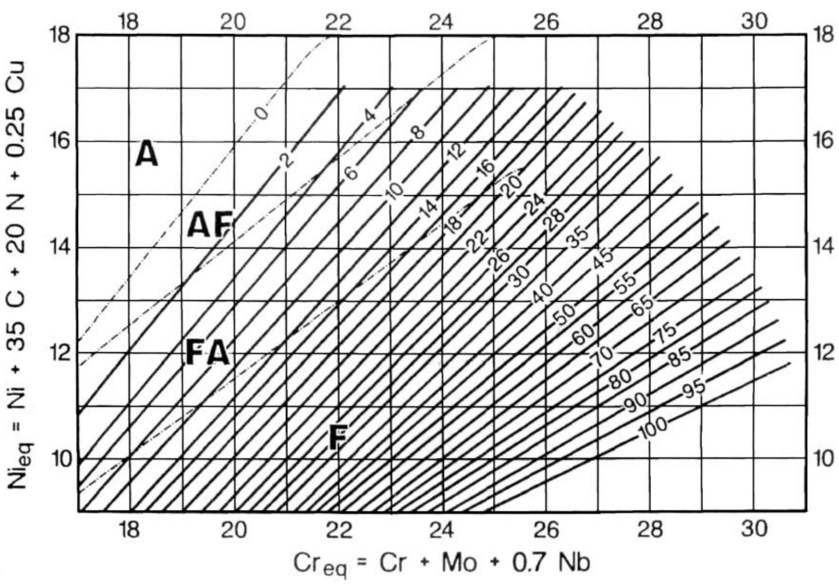

Figure 1. The WRC-1992 reference diagram Koteki & Siewert

The extra polarization outside the area of the lines from diagram is not recommended, because the isoferitical lines become unlinear at the larger contents in alloyed elements.

Where it is possible, it is necessary, for the practical cases, the magnetically measuring of ferrite content, as being the most exact method of determination.

The evaluation of ferrite content in the welded join in the case of heterogeneous welding begins with the chemical compositions of welded basics elements and chemical composition of additional elements.

In case of a welded joints, must be calculated the equivalent Ni and Cr of the basis metal and of the additional metal beginning with their chemical composition, with helping of the relations (1), obtaining two points A and B, in WRC 1992 diagram, figure 2:

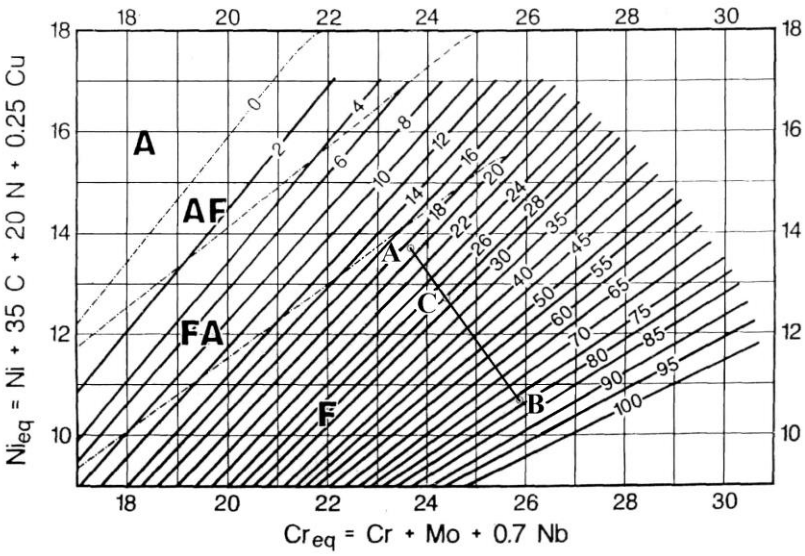

Figure 2. The determination of the ferrite content at the basis metal MB welding with the additional metal MA

$$Ni_{ech} = Ni + 35C + 20N + 0.25Cu$$
$$Cr_{ech} = Cr + Mo + 0.7Nb \qquad (1)$$

In order to estimate the ferrite content of the laid down metal by welding, it is drawing a line between the two points, line that represents all the possible combinations of the laid down metal, for different scales of its dilution. Attributing a certain dilution of welding (15 - 60%) it is obtained on the right line AB, the point C, which indicates the ferrite content.

2. THE DETERMINATION OF THE FERRITE CONTENT OF AUSTENICALY STEELS WITH ELECTRODES WITH WRC 1992 DIAGRAM

The basic material is austenically stainless steels with chemical composition: C = 0,04%; Mn =1%; Si = 1.0%; S = 0.03%; P = 0.035%; Cr = 18.5%; Ni = 10.5%; Mo = 2.5%; Ti = 0.6%. This steel has Cr and Ni with the following formulas:

$$Cr_{ech} = 18.5 + 2.5 = 21$$
$$Ni_{ech} = 10.5 + 3.5 \cdot 0.04 = 11.9 \qquad (2)$$

For the additional material the used electrode, Stain 19.12.2 Nb (E 19.12.2.Nb.B.2.0) contains: C < 0.1%; Mn = 1.5%; Si < 1.0%; Cr = 18.5%; Ni = 11%; Mo = 2.19%; Nb = 1%. The equivalent contents of Cr and Ni for the electrode are:

$$Cr_{ech} = 19$$
$$Ni_{ech} = 11.8 \qquad (3)$$

During the welding process it has been used material with almost similar chemical structure and symmetrically joints (I and X), so the dilution and participation degree it's been considered 50%.

In figure 3 can be observed two points: A and B corresponding to materials used during the analysis process.

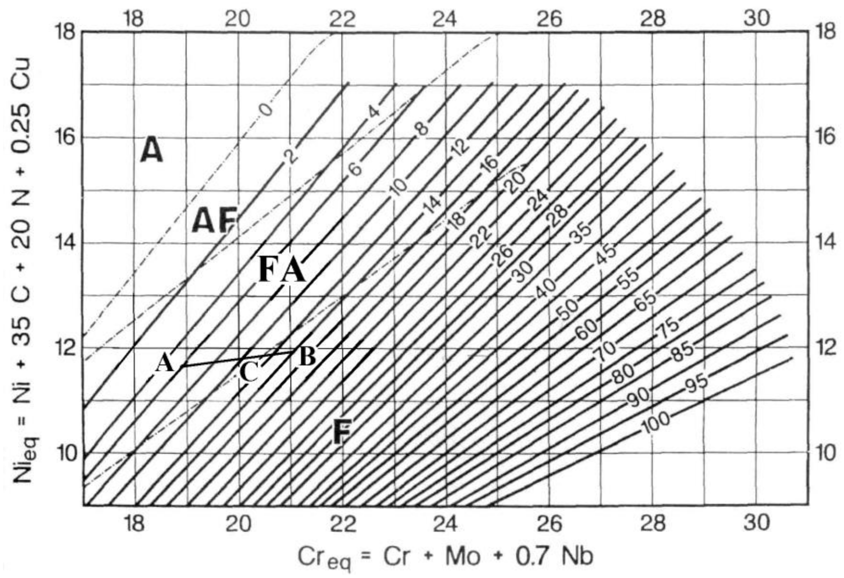

Figure 3. The determination of the ferrite content at the welded steel 10TiMoNiCr175 with stain 19.12.2 Nb electrodes

On the AB line (figure 3), point C corresponding the dilution and participation degree 50%, has the coordinates Cr_{ech} = 20.3 and Ni_{ech} = 11.8.

3. CONCLUSIONS

- In the studied case, the Ferrite Number with its value FN = 10, corresponds to a ferrite content in welded join of 7.6;
- The value FN = 10 is covering the fissuring avoidance in heat conditions. The branch literature recommends FN = 5;
- The analyzed diagram shows that no matter the value of dilution and participation degree, the metallographic structures are in ferrite-austenically area (FA);
- The experimental values of ferrite content, established in magnetic way, are between 7.3 - - 7.8, which proves that the analysis of structures from the welding girdle in the presented case are covering the area.

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