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Aspects of the transitory deformations correlated with the cracking at heat in welding

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ABSTRACT

The cracking at heat is one of the main problems which appear at the austenitic steel welding, especially for the austenitics steel without delta ferite.

The susceptibility regarding the cracking at heat can be studied analitically by the correlation between two factors : the factor stress constituted by the tension and the deformations which appear in the welding process (FS) and the resistance factor constituted by the capacity of the material to take the stress and the deformations appeared (FR).

As a result of the interaction of the both factors is the possibility of cracking or not cracking into a concret case, named generally the susceptibility at the heat cracking.

The tendency at the cracking at heat can be apreciate with a quantitativ estimation, named critical speed of cracking (V_{cf}). The practical determination of these speed suposed for an concret exemple, the knowledge of real plastic deformation at the weld, which are determinated in this paper.

TRANSITORY DEFORMATION AT THE WELDING

The transitory stress and deformations in the welding process are represented by the stress and deformations which varied in time along the operation of welding in accordance with the termic cycles.

On the point of one on the cracking at heat that is intresting are the transitory deformations which are manifested on the high temperatures, at the solidification interval for the steels considered and less under the solidus point, on the heat fragilisation interval (IFT).

For the main aspects about the appearance of the welding transitory deformations, we'll consider the case of the precipitate of one row on a plate, in the situation when we analyse only the stress (S_y) and we don't analyse the three-dimensional tensions field. The thermic field form is presented in Fig. 1.

Fig.1. The thermic field form at the deposit of one row on a plate:

- 1-The liquid metal bath, resulted after the mouvement of the electric arch displacement with the welding speed, V_s ;
- 2-Maximum temperature izotherm (TM);
- 3-Thin material strip, breadth dx ;
- AB is measuring base, length $l=2y_o$.

Considering, as initial moment, that when liquid metal bath (1) leaves the thin material strip (dx), the temperature equalization process begins, thanks to the conduction to the colder parts of the plate and thanks to the heat elimination in the ambient average.

In this case, supposing like acquainted the temperature functions variation in time, the elasto-plastic real deformation of the measuring base AB is given by the relation:

$$\varepsilon_p(T) = \varepsilon_t(T) - \varepsilon_m(T),$$

$\varepsilon_t(T)$ -thermic relative deformation of AB base.

$\varepsilon_m(T)$ -measured relative deformation of AB base.

The practical application deficiency of this relation consists in experimental determination of the measured relative deformation. Considering this, we conceived a determination experiment of this deformation.

THE EXPERIMENTAL DETERMINATION OF THE RELATIVE MEASURED TRANSITIONAL DEFORMATION

On an austenitic steel plate, type 10TiNiCr180, 300x150x6 mm, were positioned wolfram electrodes, resulting the assembly presented in the Fig.2.

Fig.2. The elements of the test used to determine $\epsilon_m(T)$

The presented assay was fixed into a device and a welding cable was met on the axis of the plate, from the left to the right, interval during which it was filmed and photographed ultrarapidely the variation of the distance between the wolfram electrodes. The photography was taken before the beginning of the welding process and after the electric arch left the section where the wolfram electrodes were planted, the electric arch being screened by a screen.

The measurements realised on slides, based on these photos, are shown in the Table 1.

Table 1.

Time	Values of the measurement basis for the steel 10TiNiCr180, mm		Values of the measurement basis for the steel OL 37.2 K , mm	
0		$\varepsilon_m(T)$		$\varepsilon_m(T)$
2	6	0	5,87	0
4	5,9	0,016	5,812	0,01
6	5,837	0,027	5,775	0,017
8	5,812	0,031	5,725	0,025
10	5,775	0,047	5,687	0,032

CONCLUSIONS

Analysing the results of the Table1 we can stress the following:

- 1) The value of the deformation measured in the case of the sample in carbon steel , stressing the influence of different dilatation coefficients of the two materials.
- 2) The values of the deformation, measured in the temperature interval which presents interest from the point of view of the cracking at heat (1300-700) are of an order of some tenth of percentage, according to the speciality literature.
- 3) Given the conditions of the determinations, we can state that the values of the measured transitorial deformations are close to the thermic transitorial deformations in the considered thermic interval.
- 4) The experimental model we used does not correspond to the most practical situations of welding, where the phenomena are much more complex, but it demonstrates the possibility of practical determination of the measured transitorial deformations.
- 5) Although the considered transitorial deformations are relatively small comparatively to the extent of the deformations determining the cracking at heat, these can determine the cracking , because the transitorial plastic deformation can not be uniformly distributed on a measurement basis of about 6 mm, very great comparatively with the length of the zone where the material is in the interval IFT (0,5-1mm).

Admitting that the plastical deformation at a macroscopic scale is unevenly distributed, we obtain for real transitorial plastic deformations values of 6-12 times greater than the mentioned values and which are able to determine the cracking at heat.

REFERENCES

- 1.Welding metalurgy of stainless steel , E. Folkhart , New York 1988;
- 2.Cracking in the transverse restraint test, B.F.Dixon, R.H.Phillips; & J.C.Ritter, Metal Construction 1984;