THE INFLUENCE OF DAMAGES ON CRACK INITIATION IN THE OVERHEATING ZONE OF WELDED JOINTS

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An elevated level of damage cumulation usually impairs the material plasticity thus contributing to brittle fracture occurence. Because of this, when studying welded joints of structural steels, of a particular interest is the overheating zone where the greatest decrease in fracture toughness takes place. Tests to determine K_{IC} in 3 zones of a 14X2ГMP steel weld showed that at above-zero temperatures the K_{IC} values for these weld zones were about the same but with a test temperature decreasing there was a more rapid lowering in K_{IC} value for the overheating and transition zones as compared to the base metal (Fig. 1).

When testing welded notched specimens it was found that in the joint transition zone thre were rather important crack pop-ins (from 2 to 18 mm deep in 16 mm thick specimens) going over the overheating zone, which indicates that the ductility there is not as good as in other regions of weld. It was established that the depth l_c and the area S_c of crack pop-ins depend upon the welding procedure and testing temperature (Fig. 2). It turned out that the most sensetive to crack pop-ins were weldments in the 09Г2D steel executed following technological variants 1 and 2 (see Table 1).

The fracture surface of welded notched specimens in the weld transition zone was studied by a scanning electron microscopy method using an electron probe microanalyser JXA-50A (JEOL), and an analysis of image obtained with the help of secondary electrons showed that in the overheating zone there were some hardening microcracks $11 \cdot 10^{-6}$m ÷ $36 \cdot 10^{-6}$m in size that contribute to brittle fracture occurence (Fig.3)(2).

Hardening microcrack formation in the overheating zone during the 14X2ГMP steel welding takes place under conditions of intensive cooling after the first run deposition. The temperature range of these cracks formation corresponds to that of martensite transformation. As a result, the stress level in regions adjoining the overheating zone is 500-560 MPa (2).

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Therefore, characteristic features of deformation and fracture process in low-alloy steel welded joints depend on the extent of damage cumulation and determine their resistance to brittle fracture.

TABLE 1 - Technological Variants of 09Г2D Steel Welding

No.	Welding Procedure	Type of Wire & Flux	Wire Diam.	Welding Conditions		Gas Flow Rate l/min	Welding Speed m/hr
				A	V		
1.	Semi-automatic in CO_2	СВ08Г2С	1.2	200-220	28	10-12	-
2.	- " -	СВ08Г2С	1.6	330-340	31-32	15-16	-
3.	Semi-automatic in CO_2+ O_2 (23-25%)	СВ08Г2С	1.6	300-320	34	14-17	-
4.	- " - (32-35%)	СВ08 А	3.0	470-500	32-34	22-25	57.1-50.0
5.	Automatic submerged arc welding	СВ08 А АН-60	4.0	630-650	34-35	-	62
6.	- " -	СВ10 2 АН-65	3.0	500-550	35-36	-	50

REFERENCES

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(2) Larionov, V.P., Ammosov, A.P., and Moskvitina L.V. "Formation of Hardening Microcracks in High Strength Steel Welding", Information papers, COMECON, v.2(30), Kiev, Naukova dumka, 1986, pp. 30-35 (in Russian).

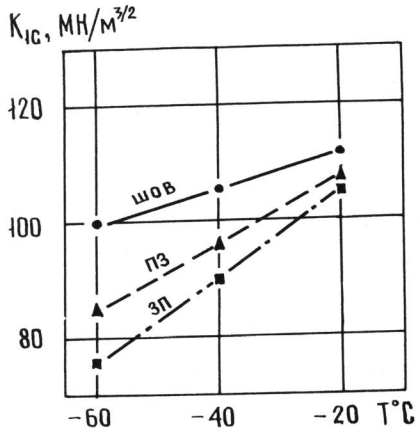

Figure 1 K_{IC} values in a 14X2ГMP steel weld

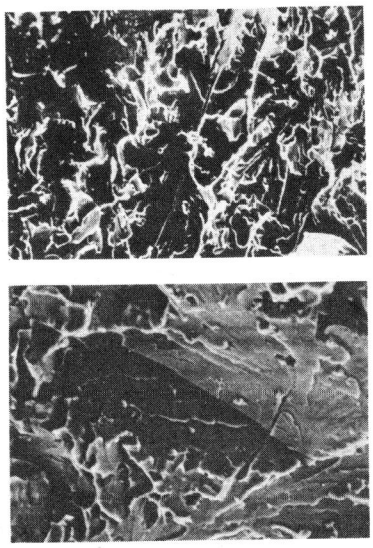

Figure 3 Fractographs of the 14X2ГMP steel weld overheating zone

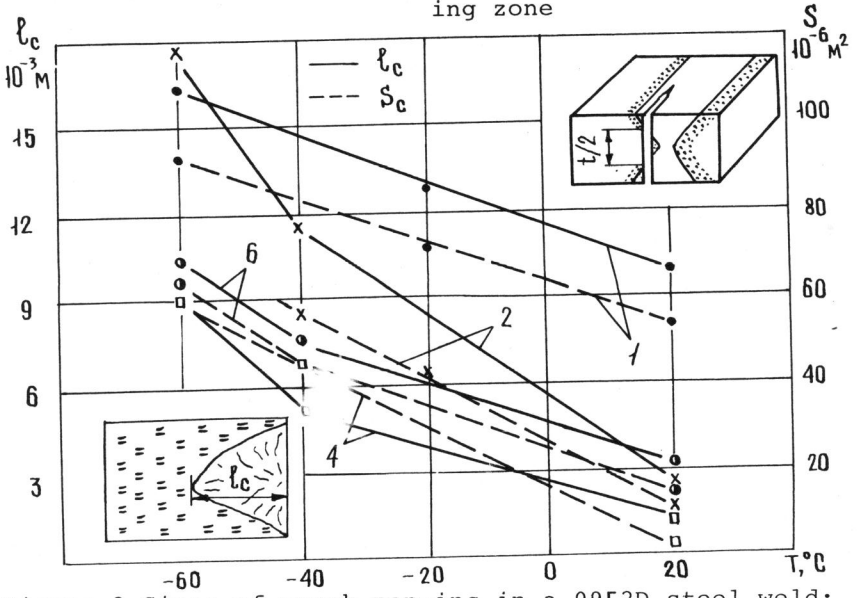

Figure 2 Sizes of crack pop-ins in a 09Г2D steel weld; 1...6 - welding technology number