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WELDING PROCESS OF AUSTENITIC CHROME-NICKEL STEELS.

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ABSTRACT Austenitic chromium-nickel steels (stainless steels) are corrosion-resistant, high-mechanical properties materials that are widely used in various industries. These steels usually have a content of 18% chromium and 8% nickel, which gives them high strength, heat resistance and corrosion resistance. The welding process of austenitic steels has its own characteristics, and the processes and difficulties that arise during the welding of these steels require special knowledge and technologies. This article discusses the welding process of austenitic chromium-nickel steels, its properties and the processes that occur during welding

Keywords : Austenitic steels, coefficient of expansion, chromium carbides, Melting temperatures.

Annotation. Austenitic chrome-nickel steels (inox steels) are corrosion-resistant materials with high mechanical properties and are widely used in various industries. These steels typically contain 18% chromium and 8% nickel, which gives them high strength, heat resistance, and corrosion resistance. The process of welding austenitic steels has its own characteristics, and the processes and difficulties that arise during the welding of these steels require special knowledge and technologies. This article describes the process of welding austenitic chromium-nickel steels, its characteristics and the processes that occur during welding.

Key words. Austenitic steels, coefficient of expansion, chromium carbides, Melting temperatures.

INTRODUCTION Austenitic steels contain 15 to 25% Cr and 8 to 35% Ni with a carbon content of up to 0.14%. Two groups of chromium-nickel steels are distinguished.

a) 18-8 type steels (1X18H10T, X18H11B, X18H12M2T)

b) 25-20 type steels (X25 N 20 S 2, X23 N 18, X23 N 13)

18-8 steels are rustproof and resistant to oxidation, 750 °Cretaining their properties at temperatures up to 700 degrees.

Steels of types 25-20 are resistant to metal burnout and heat-resistant, and can withstand temperatures up to 1100 in a gas environment. – 1150 °Ccan be operated at low temperatures. When assessing the weldability of austenitic steels, it should first be taken into account that they are not subject to spatial changes, therefore, during welding there are no difficulties associated with the occurrence of structural changes in the heat-affected zone and the risk of cold cracks is reduced.

The main factors that make welding these steels difficult are:

1. Low resistance of the weld metal to the formation of crystalline hot cracks;
2. Possible loss of corrosion resistance of the metal;
3. Increased brittleness of the weld metal during use.
4. Formation of pores in molten metal.

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Prone to hot cracks .

The high tendency of a metal with an austenitic structure to crack formation is explained by the following reasons:

a) with the thermal physical properties of austenitic metal;

b) with a transcrystalline structure of the weld metal;

c) with the presence of easily soluble constituents located at the boundaries of columnar crystallites;

g) with the phenomenon of polygonization.

The thermal properties of austenitic steels allow the formation of hot cracks. For example, the low thermal conductivity and high coefficient of thermal expansion of chromium-nickel steels increase the stresses in the weld metal that affect its crystallization and ultimately lead to their uneven distribution.

For example, comparative data on austenitic steels and low-carbon steels.

Table 1

Properties of steels	St. 3	18-8	25-20
Melting point, ^{0}C	1535	1400-1430	1390-1410
Heat o'tkavchan cal/cm*sec ° C λ	0.096	0.039	0.03÷0.04
Chiziqli keng a yish koef-ti λ *10 6			
Pri n a strike ot 0 ^{0} to 100 ^{0} S pri n a strike ot 0 ^{0} to ^{5000} S	12	17.3 18.5	15.0 18.0

b) The transcrystalline coarse dendritic structure of the primary structure is due to the absence of structural changes in the solidified metal; therefore, regardless of the number of layers in the weld, the crystals of each subsequent layer are considered to be a continuation of the crystals of the previous layer.

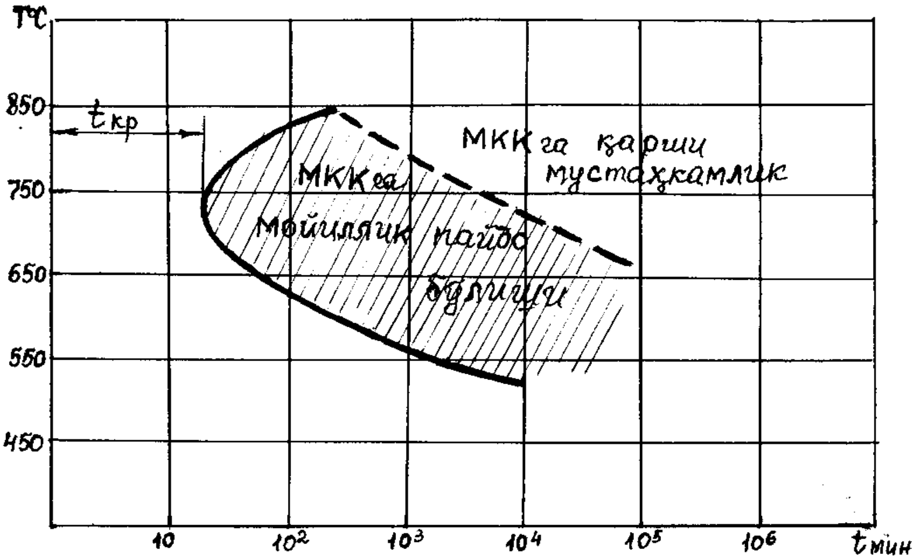

Figure 1. Scheme of the tendency of the heating duration to the occurrence of MCC.

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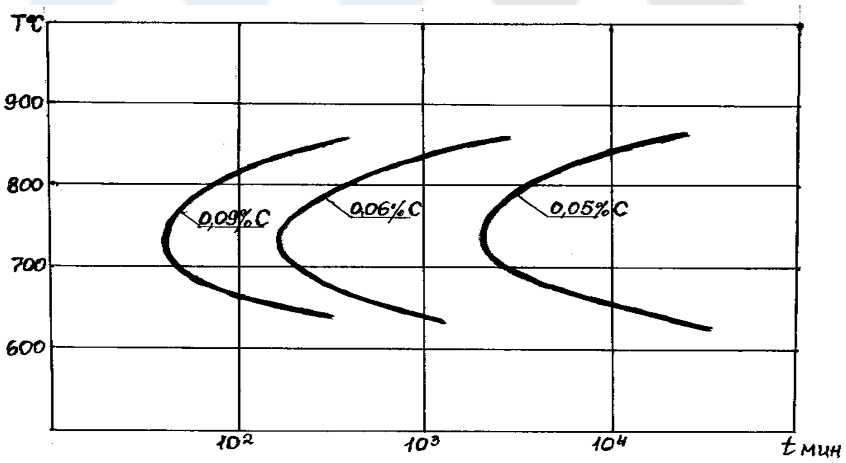
In the TCI (brittle temperature range), the transcrystallite structure is characterized by increased susceptibility to cracking.

c) The name of the intercrystalline layers that form a readily soluble eutectic, located at the crystal boundaries, is given to the eutectic properties. Their solidification temperature is usually lower than the solidification temperature of the metal. For example, easily soluble sulfide eutectics of the type Ni_3S_2+Ni have a melting temperature of about 600 ^{0}C, and easily soluble eutectics of niobium in the Ni-Nb system 1270 °Chave a melting temperature of about . Easily soluble eutectics with a melting temperature of NiS 644 °Ccan be formed. **Corrosion resistance** . Intergranular corrosion is also observed in the welding of austenitic steels. Unlike ferritic steels, in austenitic steels, chromium carbides are formed not by cooling the steel from high temperatures, but by repeatedly heating the steel. Such heating occurs in the area around the weld and when heat is applied to it from subsequent rolls. The critical temperature range for the precipitation of chromium carbides from the solution is 500. -800 °CAustenitic steels usually 1100 °Cexhibit their best properties after rapid cooling from about 1050 - 1050. After such treatment of the metal, a state of dissolved austenite is observed, which contains a very high carbon content for room temperature. Further heating of the metal in a certain temperature range allows the formation of carbides, which are mainly precipitated near the boundary. Here, the solution is not only depleted in carbon, but also loses chromium. Carbides, which are depleted at the boundaries and are normal in the grain center, and the non-uniformity of the solution composition, when exposed to a corrosive environment, allow corrosion to develop along the grain boundaries from the metal surface to the inside. The schematic connection of the formation of such a tendency to MCC as a result of the duration of exposure to the metal at different temperatures is shown in the diagram below:



2- drawing. The effect of carbon content in metal on intergranular corrosion and heating resistance.

As a result of diffusional alignment of the solution near the grain center and metal boundaries, the metal becomes resistant to MCC under the influence of high temperatures for a long time . The carbon content has a significant effect on the amount of holding time required until the metal acquires sensitivity to MCC, t_{cr}. The value of t_{cr} changes. Therefore, one of the means of combating MCC is to reduce the carbon content in chromium-nickel steels. If stronger carbide formers than Cr are added to the metal, for example, Ti, Nb, t_{cr} can also be increased due to the introduction of strong carbide formers. In this case, chromium depletion is not observed at the

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austenite boundaries, since mainly carbides of titanium or niobium are formed. 3. Embrittlement. In the austenitic welds of steels of types 25-20, 900 °Csigmatization occurs during prolonged heating of the metal at temperatures up to 650 ° C. Sigmatization is accelerated by V, Cr, Mn, W, Mo, Ni, Si, Nb, Cu. Carbon hinders this process. The composition of the σ -phase is very complex, especially in steels of the 25-20 type. After heating for 1000 hours, the σ -phase formed contained 51.8% Cr; 3% Ni; 1.1% Si; 0.61% Mn; 44.62% Fe in a ratio of Fe:Cr of 0.86. At the same time, the amount of Cr in the steel was 25%, and the amount of Ni was 18%. The second type of embrittlement of the weld metal 475 °Cis embrittlement, also associated with prolonged heating, but 525 °Cat temperatures above and especially around 325 ° C. 475 °CThis embrittlement can be eliminated by a similar method as sigmatization, that is, 1150 °Cby heating to 1000 ° C and then rapidly cooling.

Pores . The main reason for the formation of pores in the welding of austenitic steels is the presence of N_2, which is due to its high solubility in austenite and the low rate of diffusion in austenite.

CONCLUSIONS AND SUGGESTIONS In conclusion, it can be said that the processes occurring during welding are one of the most important areas of metallurgy and materials science. The changes between chemical, physical and mechanical processes in welding determine the quality of the joints and the strength of the materials. To properly control the welding process and create high-quality joints, it is necessary to take into account the necessary temperature, gas environments and the specific properties of the materials. These processes are important in ensuring the strength of materials in industry, construction, transport and other areas.

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