THE WELDABILITY OF THE STAINLESS AND HEAT RESISTANT STEELS USED IN MANUFACTURING OF AGABARITIC VESSELS

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The weldability of the 10TiNiCr180 and 10TiMoNiCr175 stainless steels is analyzed. Welding technology and mechanical tests and corrosion resistance tests results of welded joints, made with Romanian electrodes, are shown.

Stress relieving at 500 - 550°C/air, according to the Romanian method IPT-TAGCEMERIC, is recommended after welding for spherical vessels produced of these steels.

INTRODUCTION

In the chemical and oil-chemical industry, for the storage of some fluids, agabaritic spherical vessels produced by welding of corrosion resistant steel, are used. They are made of special steels, by welding in workshops and on-site. The vessels reliability in service depends on the material used and on the quality of the welded joints. To manufacture these agabaritic vessels of 1000 m^3 the 10TiNiCr180 (W1.4541) and 10TiMoNiCr175 (W1.4571) steels 20 mm thick plates had been used. The weldability of these steels has been studied in laboratory and on-site conditions.

TESTS AND RESULTS

Plates 20×140×250 mm have been cut from 10TiNiCr180 and 10TiMoNiCr175 steels sheets, and their but welded joints, simulating welding of vessel rings. The plates have been exposed to solution hardening (1070 ± 10/2h/water) to achieve an increasing corrosion resistance of the material.

The sheets were prepared by welding with groove angle 60° and gap of 2 mm. The welding was made in dc with inverse polarity, using 19.9 Nb and 19.12.2 Nb electrodes, made in Romania. The thickness of each layer was 4 mm maximum. Some welded joints were exposed to stress relieving (500 - 550°C/2h/air).

All the welded joints were tested in tensile, impact bending, guided bend, and hardness tests, as well as in intercrystalline corrosion resistance tests. These tests were made upon requirements of Romanian standards, corresponding to the European ones.

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The tensile test results of base metal (N), as-welded (S) and stress-relieved (D) welded joints specimens, expressed through ultimate tensile strength, are presented in Fig.1. All tested specimens had been fractured in base metal. No significant effect of stress-relieving was found.

The fracture energy in impact tests was influenced by the welding process, as shown in Fig.2. In all cases the fracture was typically ductile (Fig.3).

In guided bend tests on plunger with d=40 mm in welded joints even at 180° no cracks or microcracks occured.

The maximum Vickers hardness of 225 - 238 HV5 had been found in welded joints in comparison with the 200 HV5 in the base metal.

The intercrystalline corrosion test was made on samples of 5x20x50 mm from welded joints, exposed to the STRAUS test, STAS 7114-80. The samples were exposed to bending at 90° and no microcracks or cracks initiated, that means that intercrystalline corrosion did not act.

Additional corrosion test results according to DIN 509/4-80 are expressed in corrosion pits depth, presented in Fig.4. For all tested samples good corrosion resistance was found.

The results of laboratory tests were checked also in building site conditions, with conclusion that a stress-relieving had been applied to that vessel after the welding.

The stress-relieving of vessel was made by the IPT-TAGCEMERIC method. This method requires methane-gas heating at the temperature (500 - 550°C).

CONCLUSIONS

The welding of the 20 mm thick plates of 10TiNiCr180 and 10TiMoNiCr175 steels with stainless 19.9 Nb and 19.12.2 Nb electrodes was made applying presented technology.

The weldability of these steels is acceptable and welded joints properties are close to those of the base metal.

After the welding of the spherical vessels made of these steels, stress relieving at 500 - 550°C/air is recommended.

REFERENCES

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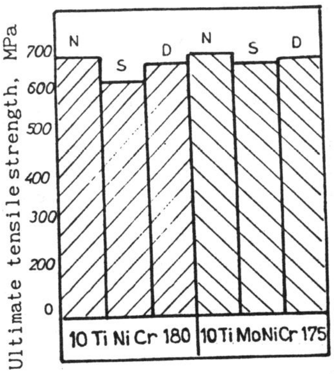

Figure 1 Ultimate tensile strength, base metal (N), as-welded (S) and stress relieved (D) welded joints.

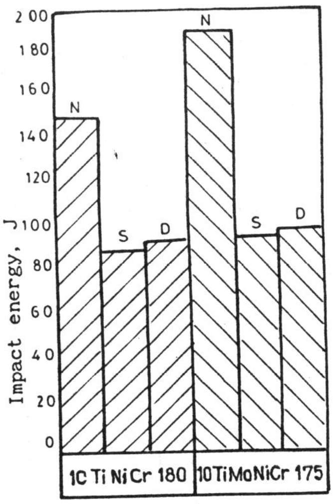

Figure 2 Impact energy, N-base metal, S-as-welded and (D)-stress-relieved welded joints.

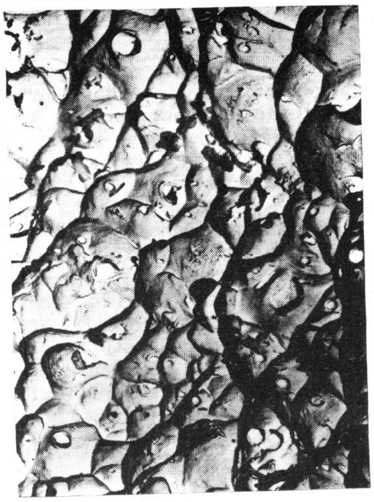

Figure 3 Ductile appearance of impact specimen fracture surface (4700:1).

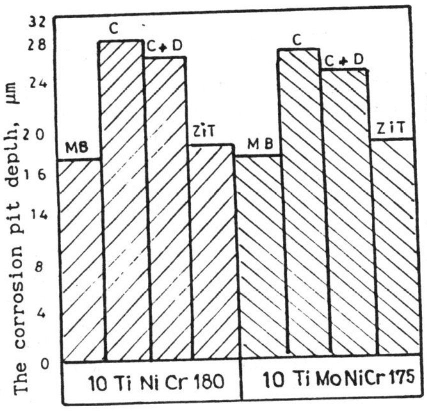

Figure 4 Depth of corrosion pits according DIN 509/4-80 HAZ -heat-affected-zone.