International Journal of Engineering and Information Systems (IJEAIS)
ISSN: 2643-640X
Vol.5 Issue 5, May – 2021, Pages: 93-94

Duplex Stainless Steel Pipes

Narkulova Zokhida Tashbaevna,

Senior Lecturer, Jizzakh Polytechnic Institute, Republic of Uzbekistan
Email:norqulova196805@mail.ru

***Abstract**: Tests for strength and corrosion resistance of duplex stainless steels in solutions containing various aggressive agents have been carried out. As a result of the study, it was found that the most mechanical strength and corrosion resistance is characterized by steel C, which contains the minimum amount of carbon, phosphorus and sulfur.*

Keywords: duplex stainless steels, arc welding, crevice corrosion, sulfide cracking, impact strength, test solution

Introduction

Standart Oil 9 (USA) has begun testing various construction materials suitable for the harsh conditions of the north. Duplex stainless steels have proven to be the most suitable because they provide sufficient strength and corrosion resistance at a relatively low cost. The chemical composition of the steels and the dimensions of the tested samples are shown in the table. The proposed construction included several dammed pipelines that would connect the two bulk islands to each other and to the mainland. During the tests, three main characteristics were determined: weldability, resistance to various types of corrosion and impact toughness of the base metal and the metal of the weld zone. To study the weldability of steels, the pipes were cut into samples 18 ... 25 cm long, which, after appropriate preparation of the edges, were welded with tungsten electrodes in an inert gas medium (root weld) and arc welding (filling passages). The filler was a wire similar in composition to the main one. metal, with a slightly lower content of carbon, phosphorus and sulfur. Full-size V-notched specimens were cut from the weld, heat-affected zone and base metal for Charpy impact tests at temperatures of -29 and -46^{0}C. Steel C (seam, heat-affected zone) showed the best characteristics of the welded joint.

Tests for resistance to various types of corrosion (crevice; stress corrosion cracking, SCC) were carried out on specimens cut from welded pipes so that the seam was in the center of the specimen. The test program included long-term tests for resistance against SCC, which for 6 months. was carried out in four solutions containing CO_2 and other aggressive agents, at a temperature of 93^{0}C and a pressure of 0.69 MPa. Tests for resistance to crevice corrosion of samples with preliminary nucleated cracks were carried out in the same solutions under conditions of slow loading with subsequent examination on an electron microscope. All samples passed final impact tests and hardness tests. The test medium was a synthetic saline solution with additions of CO_2; CO_2 + 2ml / l O_2; CO_2 + 1750mg / l H_2S and CO_2 + 1750mg / l H_2S + 2mg / l O_2.

Such a composition of media is close to the actual operating conditions of pipes in neutral media. Small amounts of oxygen were injected to simulate air ingress. The amount of hydrogen sulfide in the test media is such that a partial pressure of the order of 1.2 kPa is created when a test pressure of 0.69 MPa is applied; this ratio simulates the actual operating conditions of the pipes. During the tests, the samples were kept in a closed vessel with an inner glass lining. The inner space of the vessel with the external environment is connected only by inlets for liquid and gas and a control device for measuring the temperature. The samples used for long-term tests for resistance against SCC were preloaded up to 80 ... 100% of the yield strength of steel, the permissible tensile level at which such a stress is created was determined for each material based on the results of testing samples on a stretching machine with an automatic plotter, build a stress-strain curve for each sample. The choice of the test voltage level determines the load under which the sample is placed. The test for resistance to crevice corrosion was carried out on samples mounted on holders representing a threaded rod, on which nuts were screwed on both sides so that the ends of the rods remained free, on which a sample cut from a pipe was put on.

The samples, together with the holders, are placed in an autoclave for 24 hours, where conditions simulating real ones are created. A pressure of 0.69 MPa (H_2S / CO_2) and then 0.71 MPa (O_2) is created in the autoclave when a corrosive gas is injected. At this pressure, O_2 in the salt test solution is 2 ... 3 mg / l.

In accordance with NACE TMO177, which regulates the testing of metals for resistance to sulfide stress cracking, the tests with low strain rate in solutions, which were mentioned above, were also carried out. Polished samples (polishing in this case aims to remove the risks that appear during cutting and processing from the metal surface) were placed in an autoclave with a capacity of 250 ml, which was filled with a synthetic saline solution heated to 930 ° C. At the same time, the samples were subjected to tension at a rate of 10-6 and 5* 10-7 sec^{-1}. Loading at such a rate was carried out up to the creation of the calculated test stress, which is determined by the "deformation-stress" curve. The fractured samples were examined using an electron microscope to determine the degree of corrosion damage. In addition, to clarify the morphology of cracking, he carried out metallographic studies of the samples.

For comparison, samples tested in air were used in all cases. For all three steels, V-notch specimens were tested for Charpy impact toughness at -29 and -46^{0}C. Were also carried out measurements of the hardness of the base metal, heat-affected zone and weld and microstructure studies in order to determine the specific density of the ferrite component. The research results showed that steel C possesses the optimal combination of properties. The advantages of this steel can be explained by the reduced content of carbon and harmful impurities - phosphorus and sulfur. Tests for the resistance of stainless steels against sulfide stress cracking, which were carried out for 6 months, confirmed that the materials under consideration are not susceptible to this type of corrosion. However, on two samples of steel C and one of steel A, crevice corrosion was found under the scale spots.

In the course of tests for resistance against crevice corrosion, it was found that, from this point of view, environments containing oxygen are the most dangerous for stainless steels. Steel C turned out to be the most prone to crevice corrosion in these environments, and crevice corrosion was found on one of steel A under the scale spots. In the course of tests for resistance against crevice corrosion, it was found that, from this point of view, environments containing oxygen are the most dangerous for stainless steels. Steel C turned out to be the most prone to crevice corrosion in these environments, steel B was the most resistant (corrosion was found only on samples placed in test solution No. 4). In these cases, the corrosion depth was 250 ... 380 µm.

Testing samples with a low loading rate allows you to accurately set the time interval from the start of testing to failure. The criterion of material stability in this case is the ratio T / T_n, where T and T_n are the time required for the destruction of the sample in the test and neutral environment, respectively.

If $T / T_n = 0.8\text{-}1.0$, then the material is resistant to sulfide corrosion. During the tests, the ratio T / T_n was mainly within these limits. However, in two cases, there was a sharp decrease in this indicator on steels A and B - to 0.4b 0.25 (due to the existing welding defects). The fracture surfaces were examined using an electron microscope. This made it possible to establish that steel C has the highest elongation and high toughness. It is noted that similar results can be obtained at different loading rates within the considered range of values

Steel C also has the best performance in terms of impact toughness, which makes it less sensitive to changes in welding conditions. The hardness testing of the materials tested was carried out in accordance with the requirements of the NACE MRO 175 standard, which sets a hardness limit for duplex steels equal to 28HC. Only steel C withstood this test when testing the base metal, weld metal and heat-affected zone. As mentioned above, along with the base metal, the weld metal and the heat-affected zone were tested. As a result of the research, it was recommended to use welding with tungsten electrodes in a shielded gas environment. The welding wire should contain 7 ... 9% nickel, which guarantees sufficient impact toughness of the welds that are not subject to heat treatment after welding.

REFERENCES.

1. US 7074283D2 Low alloy steel. 7.12.2006

2.RU2322531C2 Сталь для холодной обработки и инструмент для холодной обработки.18.12.2008.

3. EP 2035593D1.Austenic parametic corrosion resistant material.11.08.2010.

4. RU2599936C2.Бесшовная труба из высокопрочной нержавеющей стали с высокой коррозионной стойкостью для нефтяной скважины и способ ее изготовления.20.10.2016.

5. ES 2658770T 3.Metodo para la fabrication de tubos de acero ino[idable dedos fases/3.12.2018.

6. EP2803742D1/Djlt and method for manufacturing bolt.25.12.2019.