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WELDING OF STRUCTURES IN A CARBON DIOXIDE ENVIRONMENT WITH THE ADDITION OF OXYGEN (CO2 + O2)

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Abstract
This article examines the technological features of welding structures in a carbon dioxide (CO2) environment with the addition of oxygen (O2). The advantages and disadvantages of this welding method, the influence of various parameters on the quality of the welded joint, and recommendations for choosing the optimal gas mixture ratio are highlighted. Special attention is paid to the application of this method in mechanical engineering, construction, and other industries.

Keywords: Welding, carbon dioxide, oxygen, gas mixture, arc welding, weld quality, welding mode, protective environment.

Introduction

Protective gas welding is widely used in various industries due to its high productivity, the availability of equipment, and the possibility of obtaining high-quality welded joints. One of the most common protective gases is carbon dioxide (CO2). In recent years, increasing attention has been paid to improving the technological characteristics of welding by introducing various additives, particularly oxygen, into the protective medium. A mixture of CO2 and O2 allows for optimization of the process, improved seam formation, and increased productivity.

The purpose of this article is to investigate the features and advantages of using the CO2 + O2 gas mixture in the welding process, as well as to determine the influence of various parameters on the quality of welded joints.

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Main features of welding in CO2 medium

Advantages of CO2 welding

Pure carbon dioxide gas welding is one of the most affordable and cost-effective welding methods. Among its advantages:

- High availability and low cost of CO2.
- Deep melting of metal.
- High welding speed.

Disadvantages of CO2 welding

Despite the obvious advantages, welding in pure CO2 has several disadvantages:

- Increased splash formation.
- Coarse seam structure.
- Increased probability of pore formation.
- The need for more thorough post-processing.

The effect of adding oxygen to the gas mixture

The role of oxygen in the welding process

Adding oxygen to carbon dioxide significantly improves arc stability, reduces splashes, and improves seam quality. Oxygen promotes more intensive oxidation, thanks to which wetting and seam formation improves.

Optimal CO2 and O2 ratios

The recommended amount of oxygen in the mixture with carbon dioxide is 2-10%. At low oxygen concentrations (2-3%), arc combustion stability improves and spraying decreases. When the oxygen content increases to 5-10%, the external appearance of the seam improves and a smoother surface is formed.

However, when the oxygen content is too high, increased oxidation is observed, which can lead to a deterioration in the mechanical properties of the welded joint.

Influence of welding modes

Arc current and voltage

Optimal welding modes in a mixture of CO2 + O2 depend on the thickness of the metal being welded and the type of joint. Usually, the following parameters are used:

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- Welding current: 150-350 A.
- Arc voltage: 18-30 V.

Increasing the welding current contributes to an increase in the melting depth, however, it can lead to an increase in spraying, especially if the gas mixture is chosen incorrectly.

Welding speed

The optimal welding speed ensures high-quality seam formation and minimizes thermal deformation. When using a CO2 + O2 mixture, the welding speed can be higher than when welding in pure CO2, due to improved arc stability.

Protective gas consumption

Gas mixture consumption depends on the diameter of the wire used, the type of connection, and welding conditions. Usually, it is 15-25 l/min.

Influence of additives on wire and material selection

Using alloyed welding wires containing manganese and silicon allows for improved seam formation and reduced pore formation. When welding in a mixture of CO2 + O2, it is preferable to use wire with an increased content of silicon to compensate for oxidation processes.

Quality of welded joint

Seam structure

Adding oxygen contributes to obtaining a finer-grained seam structure, which positively affects its mechanical properties. However, excess oxygen can cause oxidation of alloying elements and lead to a decrease in strength and impact toughness.

Mechanical properties

Welded joints made in a mixture of CO2 + O2 have the following characteristics:

- Increased strength.
- Good plasticity.
- Resistance to impact loads.

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Visual inspection and non-destructive testing

To assess the quality of the weld, the following are applied:

- Visual examination.
- Radiographic control.
- Ultrasonic defectoscopy.

Application in industry

Mechanical Engineering

In mechanical engineering, welding in a mixture of CO2 + O2 is used for the manufacture of housings, frames, and other critical structures, where high-quality welding is required while maintaining high productivity.

Construction

In the construction industry, the method is actively used in welding metal frames of buildings and bridges. The advantage of this method lies in the high speed of work execution and the reliability of the connections.

Shipbuilding

In shipbuilding, this method is used for welding ship hulls, which allows for good tightness and high mechanical strength of welded joints.

Automotive manufacturing

CO2 + O2 mixture welding has become widespread at automobile plants for welding body panels and vehicle chassis.

Safety of welding operations

When welding with gas mixtures, the following safety measures must be observed:

- Ensure good ventilation of the workplace.
- Use personal protective equipment (masks, gloves, work clothes).
- Control the oxygen concentration to eliminate the possibility of ignition.

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Economic efficiency

Adding oxygen to carbon dioxide allows for increased welding productivity, reduced processing costs, and reduced defects, ultimately increasing production efficiency.

Conclusion

Welding structures in a carbon dioxide environment with the addition of oxygen is an effective method for obtaining high-quality welded joints. This method allows for increased arc stability, reduced spray formation, and increased seam strength and plasticity. With proper welding regimes and optimal gas mixture ratios, this method can significantly increase the productivity and quality of welding work in various industries.

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