Ilmiy tadqiqotlar va ularning yechimlari jurnali
Aoka guvohnoma № 323759 ISSN: 3060-4818

WELDING TECHNOLOGY OF AUTOMOBILE WHEELS IN A SHIELDING GAS ENVIRONMENT

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Doi: https://doi.org/10.5281/zenodo.20592442

Abstract

This article examines the technology of welding automobile wheels in a shielding gas environment. Automobile wheels are important structural components that operate under dynamic loads, vibration, impact forces, and changing road conditions. Therefore, welded joints in wheel components must have high strength, reliability, and resistance to deformation. Shielded gas welding, especially MIG/MAG welding, is widely used in modern mechanical engineering due to its high productivity, stable arc formation, and ability to produce quality welds. The article analyzes the technological features of welding automobile wheels, the role of shielding gases, welding parameters, joint quality control, and methods for improving weld reliability.

Keywords: automobile wheel, shielding gas welding, MIG/MAG welding, welded joint, welding technology, weld quality, mechanical strength, automotive industry.

Introduction

Automobile wheels are one of the key components of a vehicle’s running system. They support the vehicle load, transmit driving and braking forces, and ensure stable movement on different road surfaces. During operation, wheels are exposed to cyclic stresses, impact loads, vibration, corrosion, and temperature changes. For this reason, the manufacturing and repair of automobile wheels require highly reliable joining technologies.

Welding is one of the main technological processes used in the production and repair of metal wheel components. Among modern welding methods, welding in a shielding gas environment has become especially important. This method protects the molten weld pool from atmospheric oxygen, nitrogen, and hydrogen, preventing defects such as porosity, oxidation, and weak fusion.

MIG/MAG welding is commonly used for steel and alloy components because it provides high productivity, good weld penetration, and stable weld quality. The use of shielding gases such as carbon dioxide, argon, or argon-based mixtures improves arc stability and weld formation. Therefore, studying and improving shielding gas welding technology for automobile wheels is an important scientific and practical issue.

Literature Review

Scientific and technical literature shows that shielding gas welding is one of the most effective methods for joining automotive metal components. Researchers emphasize that the quality of welded joints depends on the correct selection of welding current, voltage, wire feed speed, shielding gas composition, welding speed, and surface preparation.

According to welding technology studies, carbon dioxide shielding is widely used for welding carbon steels due to its availability and economic efficiency. However, argon-based gas mixtures provide smoother arc operation, lower spatter, and better weld appearance. In automobile wheel welding,

weld quality is particularly important because even small defects may reduce mechanical strength and service life.

Modern studies also highlight the importance of automated and semi-automated welding systems. These systems reduce the influence of the human factor, improve repeatability, and increase production efficiency. In addition, non-destructive testing methods such as visual inspection, ultrasonic testing, and radiographic inspection are recommended for evaluating weld quality.

Materials and Methods

This study is based on a theoretical and analytical review of shielding gas welding technology used for automobile wheel components. The analysis focused on steel wheel elements, welding materials, shielding gases, welding parameters, and weld quality control methods.

The main technological stages considered in the study include surface preparation, selection of filler wire, adjustment of welding current and voltage, selection of shielding gas flow rate, welding process control, cooling, and post-weld inspection.

Special attention was given to MIG/MAG welding because this method is widely applied in automotive manufacturing and repair. The influence of welding parameters on weld penetration, strength, deformation, porosity formation, and surface quality was analyzed.

Results

The analysis showed that welding automobile wheels in a shielding gas environment provides several important advantages. First, shielding gas protects the weld pool from atmospheric contamination, which improves weld density and reduces defects. Second, stable arc formation allows uniform weld bead formation and better penetration. Third, semi-automatic and automatic MIG/MAG welding increase productivity and ensure stable weld quality.

It was found that proper surface preparation is essential for obtaining high-quality joints. Rust, oil, paint, dust, and oxide layers must be removed before welding. If the surface is poorly prepared, defects such as porosity, lack of fusion, and weak bonding may occur.

The correct selection of shielding gas also has a significant effect on weld quality. Carbon dioxide is economical and suitable for many steel parts, while argon-carbon dioxide mixtures provide improved arc stability and reduced spatter. Welding current and voltage must be selected according to material thickness and joint type. Excessive heat input may cause deformation, while insufficient heat input may lead to incomplete fusion.

Discussion

Shielding gas welding is highly effective for automobile wheel components because it combines strength, productivity, and technological flexibility. In comparison with manual welding methods, MIG/MAG welding provides more stable weld formation and better control of process parameters.

However, the quality of welded automobile wheels depends on strict observance of technological requirements. Incorrect welding parameters may lead to overheating, distortion, residual stresses, and internal defects. Since automobile wheels operate under dynamic loads, weld defects can become sources of fatigue cracks during service.

To improve welding technology, it is necessary to use optimized welding modes, high-quality filler wires, appropriate shielding gas mixtures, and modern quality control methods. Automated welding systems and digital monitoring can further improve weld consistency and reduce defects.

Post-weld inspection is also an important stage. Visual inspection helps detect surface defects, while ultrasonic or radiographic testing can identify internal defects. Mechanical testing may be used to evaluate weld strength and reliability.

Conclusion

Welding automobile wheels in a shielding gas environment is an effective and reliable technology for producing and repairing wheel components. MIG/MAG welding provides high productivity, stable arc formation, good penetration, and strong welded joints. The use of shielding gases prevents oxidation and porosity, improving the overall quality of the weld.

The study shows that weld quality depends on surface preparation, welding current, voltage, wire feed speed, shielding gas composition, and cooling conditions. Proper control of these parameters reduces defects, improves mechanical strength, and increases the service life of automobile wheels.

Therefore, the use of modern shielding gas welding technology is important for improving automotive safety, reducing repair costs, and increasing the reliability of vehicle components.

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