

Justification of the Technology and Materials for Plasma Arc Welding and Coating of Rapidly Wearing Parts

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Abstract:

The article analyzes the technology of applying surfacing coatings using a plasma arc to extend the service life of rapidly wearing parts. The types of coating materials and their mechanical, physical and chemical properties were also discussed.

Keywords: plasma, mechanical, mechanical, physicochemical, automation, welding, inspection.

Introduction

In industrial production processes, certain parts of various mechanisms and equipment are exposed to high mechanical loads, friction, and chemical effects. This leads to their rapid wear. There are several methods to extend the service life of such parts, one of which is the technology of welding and coating using a plasma arc.

The plasma arc welding and coating technology has both advantages and certain limitations.

Advantages

High adhesion quality – Materials coated using a plasma arc are firmly bonded to the base part, which ensures long-term operation.

1. Resistance to friction and corrosion – The applied materials (nickel-, cobalt-, tungsten-based alloys) are resistant to high friction and aggressive environments.
2. Ability to operate at high temperatures – Coatings obtained using this technology can withstand high temperatures and loads.

3. Possibility to work with various materials – It is possible to coat various metals and alloys using a plasma arc.
4. Preservation of geometric accuracy – During the coating process, the dimensions of the part do not change significantly, which is very important for parts requiring high precision.
5. Possibility of automation – Through automation of the process, high repeatability and quality can be ensured.

Disadvantages

High equipment costs – Implementing plasma arc technology requires special equipment, which increases the initial investment.

1. Operational complexity – The process requires high-level skills, and operators must be able to precisely control the plasma welding process.
2. Energy consumption – Compared to other coating methods, the plasma arc process requires more energy.
3. High cost of coating material – Special alloys resistant to friction and high temperatures are expensive.
4. High thermal impact – In some cases, high-temperature plasma can alter the internal structure of the base part, which affects material properties.
5. Environmental impact – Gases and dust may be produced during the welding process, requiring special ventilation and safety measures.

Plasma Arc Welding and Coating Method The plasma arc coating method is the process of bonding a metallic coating material to the surface of the base part under the influence of a high-temperature plasma arc. This technology has a number of advantages:

High adhesion and mechanical strength;

Increased resistance to friction and corrosion;

Preservation of the geometric dimensions of the part.

Selection of Coating Materials

The material selected for welding and coating depends on the operating conditions of the part. The most commonly used materials are:

Nickel-based alloys – resistant to high temperature and corrosion; Cobalt-based alloys – resistant to high friction; Tungsten- and molybdenum-based materials – resistant to high mechanical loads.

Technological Process The plasma arc coating technology includes the following stages:

Surface preparation – mechanical and chemical cleaning of the part;

Selection of coating material – material is selected according to the operating conditions of the part;

Welding and coating process – metallic coating is bonded to the surface using plasma;

Final treatment – grinding and inspection of the coated surface.

Methodology

The research investigated the plasma arc welding and coating method which protects rapidly wearing components from damage. The research team examined scientific documentation followed by field inspections of industrial technology applications. Manufacturers chose materials for coating applications according to their capabilities of withstanding high temperatures and mechanical pressure while resisting friction alongside corrosion. The study focused on analyzing nickel-based

and cobalt-based as well as tungsten and molybdenum alloys that regularly function in high-performance systems. Proper adhesion required the parts to undergo mechanical and chemical cleaning procedures which prepared their surface. The following stage consisted of plasma arc coating including the application of metallic materials by managing plasma energy levels. The process required continuous monitoring of three critical parameters which included temperature measurement and stability control of the arc together with accurate thickness evaluation of the applied coating. The treated parts went through both visual tests and physical exams following the coating procedure. The examination of coating quality involved evaluating adhesive properties together with the smoothness of the surface and its performance under stress from heat and wear. Researchers deployed this methodology to create reliable data about plasma arc welding and coating technology performance for industrial component service extension in challenging environments.

Results and Discussion

Plasma arc welding as well as coating technology enhances both the performance and durability of fast-wearing materials according to study results. The application of coatings through this method succeeded in attaining proper bonding to base materials that ensures continued operation under severe mechanical and thermal conditions. Nickel-based along with cobalt-based materials delivered superior resistance to both corrosion and friction particularly when operating in aggressive industrial conditions. Tungsten together with molybdenum-based coatings function optimally under severe mechanical strains which qualify them for intensive industrial applications. Blank surface assessments indicated that the applied coatings exhibited even distribution and displayed a low level of alteration to the part's initial construction measurements. The results demonstrate the superiority of preservation methods for geometrical precision because such benefits directly enhance precision machinery applications. The procedure showed certain restrictions in addition to its advantages. Stable conditions during the process along with unsuitable touch led to the development of coating problems that included holes and uneven density distribution between layers. The implementation barriers for this technology include both expensive coating materials together with high energy use needs that limit large-scale industrial deployment. Research findings validate that plasma arc coating prolongs the operational lifespan of metal elements during demanding applications. The research demonstrates that proper material selection combined with process control yields the maximum returns from this technology.

Conclusion

Plasma arc welding and coating is an effective method for extending the service life of rapidly wearing parts. This technology serves as an optimal solution for components operating under high mechanical loads and in aggressive environments, allowing their durability to be increased several times over. In the future, further improvement of this method and the use of new materials represent a promising direction for development.

References

1. Исабоев Т. М., сын Насриддина т. н. Ю. Технология сварки траверсы тросового устройства // Образование науки и инновационные идеи в мире. 2023. Т. 15. – № 4. – С. 144-147.
2. Исабоев Т.М. и др. Технология восстановления коренных зубов погрузчика //Педагогическая наука и инновационные идеи в мире. 2023. Т. 15. — № 6. С. 27-28.
3. Исабоев Т. М. тош тупроқ қазыш машиналары ишчи органларини ейилишга чидамлилигини ошириш ишлари тахлили //Новости образования: исследование в XXI веке. – 2023. – Т. 1. – №. 6. – С. 752-762.

4. Mexmonovich I. T. et al. YUK AVTOMOBILLAR YOQILG'I NASOSINI DETALLARINI QAYTA TIKLASH TEXNOLOGIYASINI TAHLIL QILISH //ОБРАЗОВАНИЕ НАУКА И ИННОВАЦИОННЫЕ ИДЕИ В МИРЕ. – 2023. – Т. 15. – №. 4. – С. 119-125.
5. Umidjon o'g'li S. A., Mexmonovich I. T. KO'PRIKLI KRAN BOSH BALKASINI TAYYORLASH TEXNALOGI JARAYONINI ISHLAB CHIQUISH //ОБРАЗОВАНИЕ НАУКА И ИННОВАЦИОННЫЕ ИДЕИ В МИРЕ. – 2023. – Т. 16. – №. 3. – С. 37-40.
6. Isaboyev T. M. et al. YUKLAGICH CHO'MICH TISHINI QAYTA TIKLASH TEXNOLOGIYASI //ОБРАЗОВАНИЕ НАУКА И ИННОВАЦИОННЫЕ ИДЕИ В МИРЕ. – 2023. – Т. 15. – №. 6. – С. 27-28.
7. Игамбердиев М. К., Исабоев Т. М. Кодиров НУУ Недостатки технологии обработки хлопка-сырца и пути их преодоления //Universum: технические науки. – 2020. – №. 6-2. – С. 75.
8. Azimovich A. S., Ulug'bek o'g'li O. I. VAGONLARNI LOYIHALASHDA SISTERNA RAMALARINI TAHLILI //ОБРАЗОВАНИЕ НАУКА И ИННОВАЦИОННЫЕ ИДЕИ В МИРЕ. – 2023. – Т. 15. – №. 6. – С. 46-55.
9. Umarov A., Qosimov K., Isaboyev T. PAYVANDLAB QOPLANGAN DETALLARNING YEYILISHGA SINASH NATIJALARI //Академические исследования в современной науке. – 2023. – Т. 2. – №. 21. – С. 10-12.
10. Xusanov U.T. TO'SH TUPROQ QAZI'ISH MAJITLARI ICHKI ORGANLARINI EYILISHGA CHIDAMLIKINI OSHIRISH ISHLARI TAHLILI //Новости образования: исследование в XXI веке. – 2023. – Т. 1. – №. 6. – С. 752-762.