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APPLICATION OF AUTOMATIC ARC INJECTION MOLDING TECHNOLOGY IN PIPE PRODUCTION AND REPAIR

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Abstract
The essence of this article is the construction structures in the production enterprises of all industrial sectors in our country, the constructions for the delivery of oil and oil products to the places, the drinking water and water-waste complexes in the territories of the Republic, the above-ground and underground main pipelines, the equipment brought from foreign companies and used. Problems arise in the production, repair and maintenance of all kinds of pipes, tubes and pipes in parts and mechanisms. This article explains how important such a problem is in the machine-building industry and how the technology of automatic flux-cored arc welding is carried out.

Keywords: Fluxes, slag, arc welding, non-ferrous metal, powders, sheet plates, chemical alkalis, spray mechanism, pipe, non-metallic materials, pipes, electrode, metal layer, alloys.

Introduction

The application of Automatic Arc Injection Moulding (AAIM) technology in pipe production and repair represents a significant advancement in the realm of industrial manufacturing. Traditional methods of pipe fabrication and repair often involve manual processes that are time-consuming, labour-intensive, and prone to inconsistencies. In contrast, AAIM technology offers automated capabilities that promise to revolutionize these processes by significantly improving efficiency, precision, and quality control. This introduction sets the stage for exploring the integration of AAIM technology into pipe manufacturing and repair workflows [1-3]. It outlines the challenges inherent in traditional methods and highlights the potential benefits of adopting AAIM technology to address these challenges. Additionally, it provides an overview of the key components and principles underlying AAIM technology, laying the groundwork for a detailed examination of its applications in the context of pipe production and repair. Through this exploration, we aim to showcase the transformative potential of AAIM technology in optimizing pipe manufacturing and repair operations. By harnessing the power of automation and advanced injection moulding techniques, AAIM technology promises to usher in a new era of efficiency, reliability, and sustainability in the field of industrial pipe systems [4-7].

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Materials and methods

For welding, to protect the arc and welds with an electrode, uncoated wire coils, a mechanism for spraying molten flux-metal powders, and a current flow are used. The scheme of initial processes of welding under automatic flux is shown in Fig. 1.

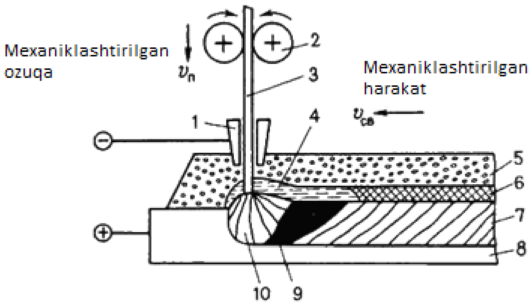

Figure 1. Scheme of arc welding under automatic flux

The supply and movement of the electrode wire is mechanized. Arc ignition and crater welding processes at the end of the weld are automated. The arc (10) burns between the wire (3) and the base metal (8), the arc column and the liquid metal (9) metal pool is tightly (5) covered on all sides with a flux layer (30) ... (50) mm thick. Part of the flux melts and forms a liquid slag (4) that protects the liquid metal from air. The protection quality is better than manual welding. As the electrode moves forward, the metal and slag baths solidify (6) with the formation of a weld (7) covered with a hard slag shell. Wires are transferred to the arc using mechanisms (2). The current is supplied to the electrode through the conductor (1).

Flux welding is characterized by deep penetration of the base metal. Compared to manual welding, the advantages of automatic flux welding include a 5...20 times increase in the productivity of the welding process, improvement of the quality of welded joints, and a reduction in the cost of 1 m of welding seam.

The workpieces to be welded are installed in 1 vertical position. The flux is poured into the closed space between the water-cooled copper coils 6 and the vertically installed edges of the products, and the electrode wire (2) is fed using a special transmission mechanism.

At the beginning of the process, the arc is ignited, the current melts and an electrically conductive slag 3 is formed. The slag conducts an arc, which is extinguished, and the output circuit of the power source is closed through the slag. The current passing through the slag heats it, which causes the base metal and the edges of the electrode to flake off. The melt flows down and squeezes the slag up, forming up to 4 welds and solidifying.

Defects are formed in the first and last parts of the seam: at the beginning of the seam - the absence of defects at the edges, at the end of the seam - a shrinkage gap and non-metallic inclusions. Therefore, welding begins and ends on special lead strips, which are then removed by gas cutting.

Advantages: metal of any thickness can be welded (from 16 mm). Workpieces with a thickness of up to 150 mm can be welded with one electrode oscillating transversely in the joint plane,

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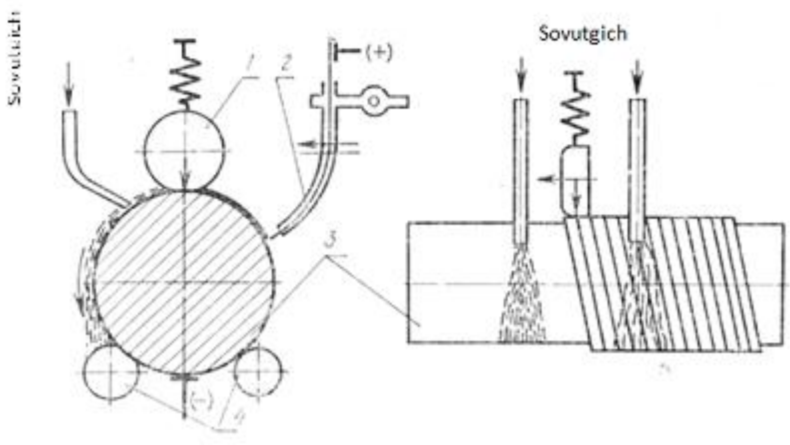
several wires with a thickness of more than 150 mm are used. The experience of welding up to 2 m thick has been increased.

The disadvantage of this method is the formation of large grains in the seam and heat-affected zone due to the delay in heating and cooling. It is necessary to perform heat treatment: normalizing or burning to clean the grain.

Electroslag welding is widely used for the production of forged-welded and cast-welded structures in heavy engineering; frames and parts of power presses and machines, crankshafts of marine diesel engines, rotors and shafts of hydraulic turbines, high-pressure boilers, etc.

In the process of melt casting, it is necessary to ensure a minimum dilution of the main surface metal with the base metal. Automatic flux coating allows not only to restore the original dimensions of worn parts but also to cover the deposited metal with an alloy through a current or electrode, to give the restored surfaces a set of required properties (hardness, corrosion resistance, fatigue resistance). At the same time, the under-flux arc coating has several disadvantages: due to rapid and deep melting, it leads to changes in the physical and mechanical properties of the parts and deformation, it makes it difficult for the molten metal flow and fluxes to be held on the surface of small parts, the diameter (50 ... less than 60 mm), significant flux consumption increases and the cost of the flux is affected [8-11].

In our country, the production enterprises of all industrial sectors create construction structures, the processes of pulling and transporting structures for the delivery of oil and oil products to places, the equipment used in the laying of above-ground and underground main pipes of drinking water and water-waste complexes in the territories of the Republic, brought from foreign companies, such mechanisms are relevant in preventing problems in the production, repair and maintenance of all kinds of metal and non-metal pipes, tubes and pipes in their parts and mechanisms.



1 - deforming roller; 2 - neck (fist) for pouring; 3 - detail; 4 - auxiliary rollers.

Figure 2. Scheme of combining thermomechanical processing with vibratory melt casting

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Semi-automatic and automatic welding heads of various designs are produced for welding parts under flux (PSh-5, PSh-54, PDShM-500, ABS, A-580M, A-874N, A-384MK, ADS-1000-4). The main parts of the melting head - there is a wire transfer mechanism with a device for gradually or smoothly changing the speed of wire transfer during automatic flux welding: a - longitudinal part through the weld; b - the equipment or scheme of metal-slag-gas interaction and elimination of unnecessary substances.

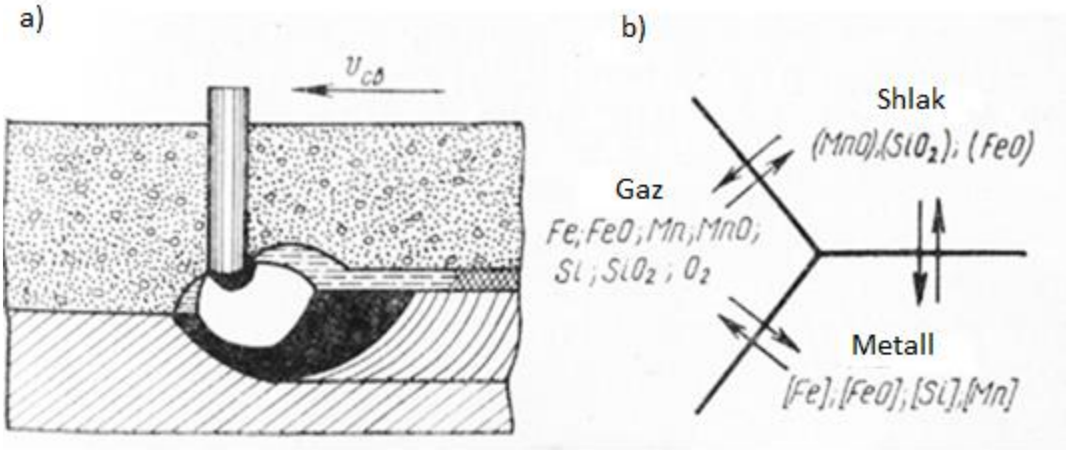

Figure 3.

The scheme of installation of automatic coating is shown in Fig. 2. 4. To change the speed of the part from 0.25 to 4 minutes, a surface coating is installed on the support of the lathe equipped with a reducer -1. Through copper-graphite brushes on the current part and a ringed copper bus installed on the machine, the electric current is transferred to the part installed on the machine tool cartridge. The metal is melted by the longitudinal support movement of the melting head. Power supply conductors from VDG-301, VDU-301UE, VDU-504, VDU-1001, VS-600, VSS-400, VKSM-500, VKSM-1000, direct current source generators (PSO 300/500, PSU - 300/530, PSU-530, /500) are used.

However, when the surface is laid in such installations, the flux slags fall on the surface of the table, causing it to wear out and corrode quickly; difficult absorption of undissolved flux; complex configuration melt casting has limited coverage options and other disadvantages. In addition, general-purpose machines with oscillating electrodes were developed: U-651 (for open arc coating of worn surfaces and spindles of parts with a diameter of 20-M 50 mm "and a length of 1300 mm. A diameter of 1 ... 2 mm a wire with an electrode or a current conductor, a wire with a diameter of 2 ... 3 mm is used);

U-652 (for underwater welding restoration of crankshafts with a neck diameter of up to 100 mm and a shaft length of up to 1300 mm with a solid (1 ... 2 mm) or flow conductor with a diameter of 2 wired) ... 2.5 mm); U-653 and U-654 (external, internal, cylindrical, conical and surface surfaces of parts with a diameter from 50 to 800 mm and a length of 8300 mm for underwater arc and internal flow, surface water and gas pipelines melt and powder coating by spray coating). Transverse vibration of the electrode allows for an increase in labour productivity and improves coating quality.

Conclusions

The integration of Automatic Arc Injection Molding (AAIM) technology into pipe production and repair processes offers significant benefits and represents a paradigm shift in industrial manufacturing practices. Through our exploration of AAIM technology, several key conclusions emerge:

1. Enhanced Efficiency: AAIM technology streamlines pipe production and repair workflows by automating key processes such as mould creation, material injection, and defect correction. This automation reduces production time, minimizes manual labour requirements, and improves overall operational efficiency.
2. Improved Precision and Quality: By leveraging advanced injection moulding techniques, AAIM technology ensures precise control over the manufacturing process, resulting in consistently high-quality pipes with minimal variations. This precision enhances product reliability and reduces the likelihood of defects or failures in pipe systems.
3. Cost Savings: The efficiency gains and quality improvements enabled by AAIM technology translate into tangible cost savings for manufacturers and end-users alike. Reduced production time, lower material waste, and fewer instances of rework contribute to lower manufacturing costs and increased profitability.
4. Versatility and Adaptability**: AAIM technology offers versatility in accommodating a wide range of pipe sizes, shapes, and materials, making it suitable for diverse industrial applications. Its adaptability allows manufacturers to respond quickly to changing market demands and customize pipe designs to meet specific requirements.
5. Sustainability**: By optimizing material usage and minimizing waste, AAIM technology supports sustainability initiatives within the manufacturing industry. The efficient production processes enabled by AAIM technology contribute to a more environmentally friendly approach to pipe manufacturing and repair.

In conclusion, the adoption of AAIM technology holds immense promise for the future of pipe production and repair. By combining automation, precision, and efficiency, AAIM technology enables manufacturers to achieve higher productivity, improved quality, and reduced costs. As industry stakeholders embrace this innovative technology, we anticipate continued advancements and widespread adoption in the years to come, driving positive outcomes for both manufacturers and end-users in the industrial pipe sector.

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