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To the question of the development of welding electrodes using meted minals

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ABSTRACT: This article presents a study of the composition of the electrode coating containing potassium hexafluorozirconate (VI), which increases the impact-plastic properties of the weld metal by grinding its structure by creating additional crystallization centers, refining the weld for sulfur and phosphorus.

KEY WORDS: arc welding, flux, low alloy steel, ceramic flux, slag, gas phase

I. INTRODUCTION

Welding production is one of the leading industries, thanks to which more than half of the gross national product of industrialized countries is produced. At present, we can talk about the stability of the domestic market of welding consumables. [1].
However, it retains a high proportion of imported electrodes, especially for special purposes, which is largely due to the lack of traditional welding materials, deteriorating product quality, high prices, the need to transport raw materials to electrode factories, including imports of raw materials from near and far abroad. The determining factor in the quality of the weld is the correct selection of welding materials and raw materials for their production. [2].

II. LITERATURE SURVEY

The general principles for selecting electrodes for manual arc welding are determined by the following conditions [3,4]:
- the absence of pores and slag inclusions or their minimum dimensions and quantity per unit length of the weld, acceptable for specific products or operating conditions;
- absence of hot and cold cracks;
- a certain complex and level of mechanical properties of the weld metal in combination with the metal of the welded parts;
- obtaining a complex of special properties of the weld metal;
- the required manufacturability of the electrodes, i.e. their versatility, suitability for use in given climatic conditions, etc.;
- satisfactory sanitary and hygienic characteristics of the electrodes (labor protection for welders).

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The fulfillment of these conditions is achieved by appropriate selection of the electrode rod and the components of the electrode coating. Modern electrode coatings are complex multicomponent systems. The materials included in them perform a variety of metallurgical and technological functions. Traditional components of coated welding electrodes have heterogeneity of charge particles in terms of fraction, morphology, fusibility and viscosity during melting, which does not allow achieving the required parameters of arc burning stability, slag and gas function.
In the light of the search for new sources for the production of traditional components of welding consumables, as well as the development of new original formulations for welding electrode coatings, it is necessary to take into account the requirements for the quality of raw materials for such materials. [5,6]

III. METODOLOGY

For the production of electrode coatings for manual arc welding, a raw material base is used, which is conditionally divided into: mineral raw materials, ferroalloys, metals for deoxidation, alloying and modification of the deposited metal, organic substances and artificial chemical materials.
It is known that the mineral resource base is divided according to the purpose of the components that make up the welding consumables into the following groups: stabilizing, slag-forming, deoxidizing, alloying, gas-forming, plasticizing and binding.
Slag-forming components - components that serve to protect the molten metal from the effects of oxygen and nitrogen in the air by forming slag shells on the surface of drops of the electrode metal and the molten weld metal.
Slags are called melts of non-metallic compounds - oxides, halides, sulfides.
The main oxides in welding slags are Na_2O, K_2O, CaO, MgO, MnO, FeO
Acid oxides often found in welding slags are SiO_2, TiO_2
The predominance of acidic or basic characteristics of the slag is estimated by the coefficient of basicity:

$$B = \frac{CaO + MgO + BaO + Na_2O + K_2O + Li_2O + CaF_2 + 0{,}5(MnO + FeO)}{SiO_2 + 0{,}5(Al_2O_3 + TiO_2 + ZrO_2)}$$

The melting temperature range of the slag system is determined on the basis of melting diagrams for binary and ternary systems.
In the case of the predominance of acidic oxides in the slag, the electrodes are of the acidic type.
In the case of the predominance of basic oxides in the slag, the electrodes are of the basic type.
Alloying components - components that serve to impart special properties to the deposited metal - wear resistance, heat resistance, corrosion resistance.
According to the criteria for choosing mineral raw materials for the production of welding consumables, the components of the charge are limited by the content of sulfur and phosphorus impurities, and the content of iron.
The use of ultrafine components in the composition of welding consumables can contribute to the formation of optimal structures of electrode coatings, which will ensure more efficient use of the components of welding consumables. The optimal temperature regime in the manufacture of electrodes using nanomaterials will make it possible to control the content of water and hydroxyl groups in the composition of welding consumables, which affect the hydrogen content in the weld metal and the strength performance characteristics of welded products and the porosity of the weld metal. The presence of hydroxyl groups in the precursors of nanosized components based on natural and synthetic sols, hydrogels, and oxyhydroxides allows us to hope that they can be used as new binders in the production of electrodes.
One of the problems solved in this work is the introduction of small amounts of alloying elements into the components of welding materials, such as rare earth elements, zirconium, etc., to improve the welding and technological characteristics of the weld. In this case, the distribution of these elements should be as uniform as possible throughout the entire volume of the coating of the welding electrode. In practice, such a distribution could not be achieved with the introduction of small additives of the necessary elements directly into the coating composition, therefore, the transition to the composition of the weld metal is also not uniform.
The introduction of alloying elements into the composition of the coatings was carried out by the method of obtaining fused components - minals containing, among others, alloying elements. During the melting of the minals, the purified

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components recommended by us were used, as well as oxides of rare earth elements as a source of alloying elements. This method ensures obtaining homogeneous products, their low reactivity with respect to liquid glass, ease of dosing small amounts of alloying additives.

The developed composition of the electrode coating contains, weight %: marble - 52-60, quartz sand - 8-11, fluorspar - 17-21, enriched kaolin – 3,8-5,4, soda - 1.5-1.9, electrode cellulose 0,8 - 1,6, potassium hexafluorozirconate (VI) – 12,5–18,9, ferromanganese – 1,9–2,1, ferrosilicon 3,2–3,8, ferrotitanium – 11,0–15,0.

The mechanism of the positive effect is the refining of the weld metal for sulfur and phosphorus, by binding them into harmless compounds of zirconium phosphorus and zirconium sulfide, which floats into the molten slag.

Introduction to the composition of the electrode coating less than 12,5 weight % of potassium hexafluorozirconate (VI) does not increase the impact strength of the weld metal, since this amount is not enough to achieve the desired level of activity of the welding slag, at which its refining is observed. An increase in the content of K_2ZrF_6 above 18,9% sharply worsens the welding and technological properties of the coating.

According to the geometry of the surface state, coated electrodes are even, smooth, without defects. When determining the strength of the coating by the method of impact of electrodes from a certain height on the concrete surface, no spalling of the coating was observed. Thus, the manufactured welding electrodes have the required quality for coating, the uniformity of the distribution of components, the absence of defects, all this indicates the quality of the mineral raw materials used in the mixture of electrode coatings.

IV.CONCLUSION

The composition of the electrode coating containing potassium hexafluorozirconate (VI) increases the impact-plastic properties of the weld metal by grinding its structure by creating additional crystallization centers, refining the weld for sulfur and phosphorus.

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