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Mineral-Raw Resources of the Republic of Uzbekistan for the Production of Acidic Type of Electrode Coatings

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ABSTRACT: In this article is given the characteristics of the composition and properties of electrodes with an acidic coatings and mineral-raw resources of Republic Uzbekistan for the production of electrode for this type of coatings.

KEYWORDS: Manual arc welding, electrode, acidic coating, dolomite, feldspar, kaolinite

I. INTRODUCTION

For the beginning of 2019, the volume of world sales of welding technologies and equipment varies about 56 billion dollars, welding materials –7,4 billion US dollars. Nowadays demand for welding electrodes comprises 18,5 thousand tons in Uzbekistan. Their imports exceeded 14 million US dollars.

The main manufacturers of electrodes in Uzbekistan are JV LLC “Tashkent Pipe Plant named after V.L. Galperin” (production volume 2 thousand tons), JSC “Uzmetkombinat” (1,2 thousand tons), “Navoi Machine-Building Plant” State Enterprise “Navoi Mining Metallurgical Plant” (0,5 thousand tons).However, the lack of scientific support in the manufacturing of electrodes and high-quality materials for coating are not only reduces the quality of produced products, but also leads to a decrease in its share in the domestic and foreign markets. The main reason for this is a scientifically unreasonable approach to the development of blend composition for coating electrode wires, which necessitates the purchase of raw materials and technologies from abroad.

II. LITERATURE SURVEY

Slags in manual arc welding are introduced artificially to protect the metal from the effects of gases. Slags are called melts of non-metallic compounds - oxides, halides, sulfides, etc. They can be free or are form complex compounds.

The electrode coating applied to the metal rod of welding wire consists of slag and gas-forming, alloying, stabilizing, deoxidizing and binding components.

Electrodes are classified by type, depending on the composition of the slag-forming components of the coating. The main objective of these components in the composition of electrode coatings is to protect the molten metal in the arc and weld pool from the harmful effects of the atmosphere. Slag coating reduces the rate of cooling and hardening of the weld metal joint, contributing to the exit of gas and non-metallic inclusions from it. Slag-forming components are mainly minerals and ore concentrates, for example, titanium concentrate, feldspar, mica (muscovite) and others [1].

Slags are liquid phases of complex composition, which are welding on the surface of the molten metal and create prerequisites for the mutual transition of elements from slag to metal and vice versa [2, 3]. Depending on the composition of the weld pool, the components can either be removed from the metal, binding into compounds and passing into the slag composition, or, when recovering, can be transferred from the slag to liquid metal. The components of the slag are divided into four main categories: acidic (TiO_2, SiO_2, P_2O_5, etc.), basic (CaO, MgO, MnO, K_2O, etc.), amphoteric (Al_2O_3, Fe_2O_3, etc.) oxides and neutral salts (Na_3AlF_6, KCl, CaF_2, etc.). The nature of the slag is determined by the ratio adopted by the International Institute of Welding [4, 5]:

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$$B = \frac{CaO + MgO + BaO + Na_2O + K_2O + Li_2O + CaF_2 + 0,5(MnO + FeO)}{SiO_2 + 0,5(Al_2O_3 + TiO_2 + ZrO_2)} \quad (1)$$

Fluxes are acidic components, if the basicity coefficient is less than one, because acidic oxides that chemically reacts with the molten metal are present in excess. Fluxes are basic if the basicity coefficient is greater than one, and the basic oxides present in excess enter a chemical reaction with the molten metal. In neutral fluxes, the basicity coefficient is equal to one.

The coating, which is based on acid fluxes, is called acidic or mineral acid. The composition of such coatings usually include ores containing oxides of iron and manganese (hematite, manganese ore) and various alumina silicates (feldspar, granite, etc.). Coatings of this type during melting emit free oxygen into the welding arc, which causes their oxidative character. The high oxidizing ability of acid coatings leads to large losses of doping elements during the welding process, which makes their use for welding high-alloy steels unacceptable. Also, when using electrodes with an acidic coating, the weld metal tends to form hot cracks when it contains more than 0,15% carbon. Therefore, for the welding carbon and low alloy steels (containing more than 0,3% carbon), this type of electrodes is not used. In addition, these electrodes are not suitable for welding steels with a high sulfur content, as they have a low desulphating capacity. It should be noted that the metal deposited with acidic-coated electrodes always has a high concentration of hydrogen. Priming of the weld metal, and due to diffusion and the base metal, is a significant disadvantage of acid coatings, which prevents their apply for welding hardening carbon and alloyed steels, lead to prone to the formation of cold hydrogen cracks [6].

III. METODOLOGY

Acidic coated electrodes are applied for welding metal structures from low carbon low alloy steel. They provide a reduced content of pores when welding with a long arc at high speeds. The developed composition of the electrode coating of the acidic type for welding structures made of low-carbon steels contains the following components, wt%: feldspar – 21-24; dolomite – 13-15; kaolinite – 2-4; rutile – 32-35; ferrosilicamanganese – 20-23; cellulose – 5-6.

The actual task are applying of mineral resources of the Republic of Uzbekistan for the development and industrial production of coatings for electrodes. The deposits of mineral resources of the Republic of Uzbekistan are extremely diverse, rich and have significant potential. Considering the above mentioned features and requirements for the composition and properties of coatings welding electrodes of the acid type, in this paper represented an analysis of ore-mineral raw materials of the Republic of Uzbekistan, which can be used as components of electrode coatings. This analysis made it possible to distinguish among them objects that are most favorable for the production of acidic type welding electrodes.

As a result of the analysis of data on feldspar, the chemical composition of potassium, sodium, calcium and barium aluminosilicates revealed that in Uzbekistan the main sources of feldspar are mainly granite pegmatites. The Lolabulak headset pegmatite deposit is located in the Chirakchi region of the Kashkadarya region on the southern slope of the Lolabulok mountains, between the Karakiya streams in the west and Irail in the east. Five independent, contiguous manifested areas were identified: Sultansay, Arraband, Chikanchi, Uyshun.

The chemical composition of the pegmatite Lolabulak deposits are given in table 1.

Table 1.
The chemical composition of the pegmatite in Lolabulak field.

Area	Content of oxides (%)											
	SiO_2	Al_2O_3	Fe_2O_3+ FeO	CaO	MgO	K_2O	Na_2O	K_2O/ Na_2O	SO_3	P_2O_5	Other impurities	H_2O
Arraband	64,86	17,44	0,24+ 1,26	trace	0,10	9,8	3,74	2,62	0,01 1	0,19	0,22	0,39
Uyshun	67,00	19,15	0,06+ 0,47	0,28	trace	4,15	7,08	0,59	0,12	0,213	0,17	0,36
Chikanchi	64,34	18,16	0,37+ 0,55	0,14	0,05	11,74	2,74	4,28	0,13	0,18	0,55	0,02
Sultansay	64,84	18,06	0,11+ 0,81	0,07	0,05	11,52	4,66	2,47	0,20	0,14	0,50	0,06

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Primary kaolinites with a high content of potassium oxide are called alkaline. The chemical composition of secondary kaolinites depends on the ratio of the main rock-forming minerals (%): SiO_2– 50-75; Al_2O_3– 17-34; Fe_2O_3– 0,2-2,5; TiO_2– 0,2-2,0; CaO – 0,1-1,0; MgO – 0,1-0,5; K_2O – 0,3-8,5; NaO – 0,1-1,0; loss on ignition – 3,5-10%. The color of kaolinite is gray, can change to pale yellow, yellow and brown due to impurities of iron oxides and titanium. Sintering temperature 1350-1450 ºC, melting point 1730-1820ºC. The chemical composition of Angren secondary kaolinite is shown in table 2.

Table 2.
Chemical composition of Angren secondary kaolinite

Material	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O+ Na_2O	SO_3	P_2O5	H_2O	Other impurities
Angren secondary kaolinite	59,39	0,3	26,7	1,52	0,27	0,4	1,32	-	-	-	10,1

Dolomite deposits are also found in Uzbekistan, particularly in Tashkent, Bukhara, Samarkand, Navoi, Fergana, Namangan and Kashkadarya regions.

The chemical composition of dolomites from the Dekhkanabad fields (Kashkirin region), Chust (Namangan region) and Shorsuv (Fergana region) is given in table 3.

Table 3.
The chemical composition of the initial dolomite raw materials

Field name	**CaO**	**MgO**	**Fe_2O_3**	**Al_2O_3**	**SO_3**	**CO_2**	**H_2O**
Dekhanabad	37.55	13,57	0,214	0,366	0,80	44.43	0,56
Chust	38,90	12,83	0,202	0,15	0,70	43,08	1,73
Shorsuv	33,37	17,25	0,133	0,11	1,90	40,65	0,95

The elaboration, review and generalization of the results of the published literature reported of the prospects for obtaining cellulose in a finely dispersed state by the methods of hydrolytic and mechanical destruction, as well as their combination in various variants.

Despite certain shortcomings (inability to regenerate reagents due to contamination by hydrolysis products, the need to use acid-resistant equipment, a significant consumption of water or other solvent for washing), only acid hydrolysis makes it possible to obtain products with maximum crystallinity and high chemical homogeneity.

The method of hydrolysis makes it possible to vary the quality of the final product by changing parameters such as the concentration of the reactants, the reaction temperature and its duration, as well as the type of acid.

Mechanical grinding is now the most common method for producing powdered cellulose.

A significant disadvantage of the method of mechanical grinding is the high energy costs of the process and the possibility of contamination of the cellulose powder with metal or ceramics in the case of imperfect equipment.

A comparative analysis of the studied deposits allowed to identify among them objects with the most favorable raw materials for the production of welding electrodes, which confirms the possibility of industrial production in Uzbekistan of almost all types of mineral raw materials necessary for the production of acidic type welding electrodes.

IV. CONCLUSION AND FUTURE WORK

Developed electrodes with an acidic type of coatings, containing the following components, wt.%: Feldspar – 21-24; dolomite – 13-15; kaolin – 2-4; rutile – 32-35; ferro silico manganese – 20-23; cellulose – 5-6, provide:

- low tendency to pore formation in the weld with rust and scale not removed from the surface of the base metal to be welded;
- improved performance;
- high stability of the process when welding on alternating current;

- low content of pores when welding with a long arc in high speed;
- low no-load voltage of the power source of the welding arc.

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