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Mineral resources of the Republic of Uzbekistan for the production of electrode coatings of cellulose type

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ABSTRACT: This article presents the features of the composition and properties of electrodes with cellulose coating and mineral resources of the Republic of Uzbekistan for the production of electrode of this type of coating

KEY WORDS: Manual arc welding, Electrode, Cellulose coating, Marble, Kaolin, Rutile, Cellulose

I.INTRODUCTION

At the beginning of 2020, global sales of welding consumables were $ 7.8 billion. USA. The demand of Uzbekistan for welding electrodes is 20.5 thousand tons. Electrode imports exceeded $ 16 million. The main producers of electrodes in Uzbekistan are JV “Tashkent Tube Works named after V.L. Halperin ” (production volume 2 thousand tons), JSC“ Uzmetkombinat ” (1.2 thousand tons), Production Association “ Navoyisk Machine-Building Plant ”GP NMMK (0.5 thousand tons). A scientifically unreasonable approach in the manufacture of electrodes reduces the quality of the products and leads to a decrease in its share in the domestic market.

II. LITERATURE SURVEY

When 30-40% cellulose and above are introduced into the rutilosilicate system, the electrodes acquire pronounced gas-shielding properties and belong to the cellulose type of coating [1].

Oxycellulose (the main component of cellulose coatings) dissociates when melting electrodes, forming a large amount of gases. When welding with cellulose-type electrodes, both hydrogenation and carburization of the deposited metal are possible due to the reduction of carbon by manganese or iron from CO oxide, which impairs the properties of the weld metal. Therefore, the technological feature of the considered electrodes, combining them with rutile, is the need to prevent excessively low humidity (“drying” of the coating) in order to avoid, in particular, the formation of pores: for a cellulose coating, the moisture content should be in the range of 1.5-5.0% [2].

The main advantage of cellulose electrodes is the deep penetration of the base metal. They provide welding in all spatial positions, including welding from top to bottom, with a high linear speed of up to 25 m/h [3].

Electrodes with a coating of this type are most widely used for welding joints of trunk pipelines [4].

Organic compounds make up most of the mixture - up to 50%. These include cellulose, flour and starch. The role of these compounds is to provide gas protection. A minor amount of rutile concentrate may be used. Marble, carbonates, as well as aluminosilicates and other substances are used to implement slag protection during welding. Metal powders and ferroalloys can also be added - for alloying the weld metal [5].

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Deposited metal corresponds to calm or semi-quiet steel. According to the mechanical properties of welded joints, the cellulose coating corresponds to electrodes of the type E42-50. Seams are obtained with a rough-flaky surface. Therefore, additional grinding of the weldment metal may be necessary. When preparing the electrodes for operation, they must be calcined strictly at the temperature specified by the manufacturer. It is impossible to overheat the electrodes during calcination, since the humidity level from 1.5 to 5.0% should be preserved in them. If the electrodes are calcined at temperatures above 170°C, they are significantly dried out. As a result, the deposited metal will be more saturated with carbon. Optimum calcination temperature - 120-130°C [6].

III. METHODOLOGY

Cellulose-coated electrodes are used for welding metal structures from low-carbon low-alloy steel. They provide welding in all spatial positions and deep penetration of the base metal at high speed. The developed composition of the electrode coating of the cellulose type for welding structures of low carbon steels contains the following components, wt.%: cellulose - 50-54, ferrosilicon manganese - 18-20; marble - 6-8; rutile - 16-18; kaolin - 4-6.

The use of mineral resources of the Republic of Uzbekistan for the development and industrial production of coatings for cellulose type electrodes is an urgent task.

Analysis of marble deposits in the Republic of Uzbekistan showed that the chemical composition (according to GOST 4416 - 73 “Marble for welding electrodes”) marble deposits Tomchi ota (Kashkadarya region), Nurata (Navoi region), Zarband (Samarkand region), Aksakata (Tashkent region) for the content of standardized components is suitable for the production of welding materials (table 1 and 2). The results of mineralogical analysis showed that finely and coarse-grained marble in the section consists of xenoblast calcite grains (99-100%), which have more or less isometric shapes and different sizes. The diameter of calcite grains varies from 0.3 to 1.5 mm, the sections of small grains in the section are from 80 to 85%, the rest are large grains.

Table 1. Deposits and estimated reserves of marble resources of the Republic of Uzbekistan

№	Name of the field	Location	Volume of output, thousand m^3 per year	Characteristic
1	Tomchi ota	Kashkadarya region	40,0	Dark gray, medium grain, massive texture, spotty texture
2	Nurata	Navoi region	30,0	White, light gray, large crystalline
3	Zarband	Samarkand region	40,0	Gray with dark banded spots, medium-grained, massive structure
6	Aksakata	Tashkent region	10,0	Small-block, cream-colored with shell-like patterns, coarse-crystalline

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Table 2. The chemical composition of marble (wt.%)

№	The chemical composition	Tomchi ota	Nurata	Zarband	Aksakata
1	SiO_2	1,59-1,9	0,18	1,9	1,53-9,44
2	Al_2O_3	0,21-0,57	-	0,9	0,03-0,89
3	TiO_2	-	-	-	0,02-0,03
4	Fe_2O_3+FeO	0,67-0,83	-	0,28	0,18-0,39
5	CaO	49,2	55,86	53,27	48,6-54,55
6	MgO	4,27-4,87	-	0,33	1,05-2,42
7	K_2O	-	0,05	-	0,1-0,13
8	Na_2O	-	-	-	0,1
9	P_2O_5	-	-	-	0,04
10	CO_2	41,62-44,36	43,23	42,75	39,57-42,9
11	SO_3	0,38-0,88	<0,1	<0,1	0,1

Primary kaolins with a high content of potassium oxide are called alkaline. The chemical composition of secondary kaolins 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; Na_2O-0.1-1.0; loss on ignition -3,5-10%. The color of kaolin is gray, it can change to yellow, yellow and brown due to impurities of iron and titanium oxides. Sintering temperature 1350-1450ºC, melting temperature 1730-1820ºC. The chemical composition of Angren secondary kaolin is shown in table 3.

Table 3. The chemical composition of secondary kaolin

Name of the field	Location	Content,%						
		SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	K_2O+ Na_2O	TiO_2
Angren	Tashkent region	59,39	26,7	1,52	0,4	0,27	1,32	0,3

Fine cellulose is obtained by mechanical and hydrolytic degradation methods.
Mechanical grinding is now the most common method of producing powdered cellulose. A significant drawback of the method of mechanical grinding is the high energy costs of the process and the possibility of contamination of the pulp powder with metal or ceramics in case of imperfect equipment.

The hydrolysis method makes it possible to vary the quality of the final product by changing such parameters as the concentration of the reagents, the reaction temperature and its duration, as well as the type of acid. Despite certain drawbacks (the inability to regenerate reagents due to contamination with 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, as well as high chemical uniformity.

The electrode rod material is Sv-08A welding wire in accordance with GOST 2246-70 (Table 4).

Table 4. The average chemical composition of the electrode rod material, %

Wire mark	C	Si	Mn	Cr	Ni	Al	S	P
Sv-08A	≤0,10	≤0,03	0,35-0,60	≤0,12	≤0,25	≤0,01	0,030	0,030

A comparative analysis of the studied deposits of the Republic of Uzbekistan confirms the possibility of industrial production of almost all types of mineral raw materials necessary for the production of cellulose-type welding electrodes.

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IV. CONCLUSION AND FUTURE WORK

Developed electrodes with a cellulose type of coating containing the following components, wt.%: cellulose - 50-54, ferrosilicon manganese - 18-20; marble - 6-8; rutile - 16-18; kaolin - 4-6, provide:
- welding in any spatial position in hard to reach places, since the electrodes are very thin;
- deep penetration to the root;
- high welding speed up to 27 m / h;
- gas protection against the intake of nitrogen and oxygen;
- slight formation of slag during welding, which allows welding of vertical joints, since the slag does not flow down and does not interfere with work;
- easy removal of slag from the surface of the cooled seam.

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