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Mineral resources of the Republic of Uzbekistan for the production of covered electrodes for surfacing a layer of low-alloy steel

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ABSTRACT: This article describes the features of the composition and properties of electrodes for surfacing a layer of low-alloy steel and mineral resources of the Republic of Uzbekistan for the production of electrode of this type of coating.

KEY WORDS: manual arc surfacing, electrode, low alloy steel, marble, quartz sand, kaolin.

I. INTRODUCTION

In the world at the present stage, modern industrial production aimed at improving product quality, reducing material consumption and energy consumption is of particular importance. In this regard, the development of resource-saving technologies and the creation of new materials through the complex processing of mineral raw materials is one of the urgent tasks. In this regard, in developed countries, including the USA, Germany, Spain, China and Russia, special attention is paid to the development of industry based on the creation of new surfacing materials with high physical, mechanical and technological properties, as well as the development of economical and environmentally friendly technologies for their receiving.

II. LITERATURE SURVEY

Research and development work is being carried out around the world to develop economical and environmentally friendly technologies for producing new welding consumables. In this direction, among other things, special attention should be paid to the problem of using ore and mineral raw materials without deep technological processing in the development of the composition of the charge for the coating of surfacing electrodes. In particular, it is considered important to create new, better surfacing materials, optimization of the slag base of electrodes for manual arc surfacing, development of methods for reducing the content of sulfur, phosphorus, oxygen and other harmful impurities in the weld metal in order to achieve increasing requirements for welding and technological characteristics [1].

The composition of the electrode coating is determined by a number of functions that it must perform: protection of the welding zone from oxygen and nitrogen in the air, deoxidation of the metal of the weld pool, alloying it with the necessary components, and stabilization of the arc discharge. The production of electrodes is reduced to the application of an electrode coating of a certain composition to a steel rod. Electrode coatings consist of a number of components, which can be conditionally divided into ionizing, slag-forming gas-forming, deoxidizers, alloying and binders. Some components can perform several functions at the same time, for example, chalk, which, when decomposing, releases a lot of gas (CO_2), calcium oxide is used to form slag, and calcium vapor has a low ionization potential and stabilizes the arc discharge, CO_2 serves as a gas shield. [2]

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Ionizing components - compounds containing alkali metal ions: Na_2CO_3, K_2CO_3 (Potash). Pairs of these connections reduce the resistance of the arc gap and make the arc discharge stable. Calcium and barium vapors also ionize the arc discharge atmosphere well. [3]

Slag-forming components are minerals: feldspar O. Marble, chalk $CaCO_3$, magnesite $MgCO_3$, alumina $A1_2O_3$, fluorite CaF_2, rutile TiO_2, quartz sand SiO_2 and sometimes hematite Fe_2O_3. When melted, these components form slags of various compositions and different basicities. [4]

Gas-forming components - substances that decompose with the release of a large volume of gas - marble, chalk or organic substances: dextrin, starch, cellulose, which, burning in an electric arc, give a lot of gaseous products - CO_2; CO; H_2; H_2O [5].

Deoxidizers and alloying components - metal powders or ferroalloy powders - ferromanganese ferrosilicon, ferrochrome, ferrovolfram, etc. Ferroalloys are master alloys that quickly dissolve in liquid steel. Only nickel is introduced in the form of a metal powder, since it hardly oxidizes during welding. Deoxidizers, in addition to ferromanganese and ferrosilicon, can be ferrotitanium and ferroaluminum. [6]

The binders can be either water glass or (more recently) polymers. They combine the powders of the above-mentioned components into a batch, which is pressed onto a prepared metal rod in special presses. It is also possible to prepare electrodes by dipping in a liquid batch, the uniformity of which is maintained by stirring or sonication. All materials used for the manufacture of coatings must be strictly controlled for the content of such harmful impurities as sulfur and phosphorus. [2,3]

III. METODOLOGY

The use of mineral resources of the Republic of Uzbekistan for the development and industrial production of electrode coatings for surfacing a layer of low-alloy steel is an urgent task.

Analysis of marble deposits in the Republic of Uzbekistan showed that in terms of 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)) according to the content of standardized components, it is suitable for the production of welding consumables (Tables 1 and 2). The results of mineralogical analysis showed that fine and coarse-grained marble in the thin section consists of xeno-blast 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, areas of small grains in the thin section range from 80 to 85%, the rest is large grains.

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

№	Field	Location	Release volume, thousand m^3 per year	Characteristic
1	Zarband	Samarkand region	40,0	Gray with dark banded spots, medium-grained, massive structure.
2	Aksakata	Tashkent region	10,0	Small-block, cream-colored with shell-like patterns, coarse crystalline
3	Tomchi ota	Kashkadarya region	40,0	Dark gray, medium-grained, solid structure, mottled texture
4	Nurata	Navoi region	30,0	White, light gray, large crystalline.

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Table 2. Chemical composition of marble (wt%)

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

At present, quartz sands of the Dzheroyskoye and Mayskoye deposits are widely used as a source of silicon oxide (Table 3). The most promising deposits of quartz sands are Kulantayskoe (Navoi region), Yakkabag (Kashkadarya region) Contents SiO_2 = 87,2 - 98,7 %. Table 4 shows information about the reserves of some deposits of quartz sands.

Table 3. Average chemical composition of some quartz-containing raw materials of the Republic of Uzbekistan

Field name	**Content, %**						
	SiO_2	**Fe_2O_3**	**Al_2O_3**	**CaO**	**MgO**	**K_2O**	**Na_2O**
Djeroyskoe	97,16	0,16	1,1	0,36	0,24	0,18	0,1
Mayskoe	94,2	0,18	2,8	0,3	0,2	1,2	0,2

Table 4. Known deposits and estimated reserves of quartz-bearing resources of the Republic of Uzbekistan

№	**Field name**	Location	Characteristic	Reserves, million tons
1	Mayskoe	Tashkent region	Quartz	2,5
2	Djeroyskoe	Navoi region	Quartz	13,5

3	Kulantayskoe	Navoi region	Quartz	30,0
4	Yakkabag	Kashkadarya region	Quartz	4,0
5	Obruchevskoe	Syrdarya region	Quartz	3,0
6	Yangiarik	Khorezm region	Quartz	30,0
7	Tabakumskoe	Republic of Karakalpakstan	Quartz	20,0

Primary kaolins with a high potassium oxide content 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; NaO-0.1-1.0; loss on ignition -3.5-10%. The color of kaolin is gray, it can change to pale, yellow and brown due to admixtures of iron and titanium oxides. Sintering temperature 1350-1450 ° C, melting point 1730-1820 ° C. The chemical composition of Angren secondary kaolin is shown in Table 5.

Table 5. Chemical composition of secondary kaolin

Field name	Location	Content, %						
		SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	K_2O+ Na_2O	TiO_2
Angrenskoe	Tashkent region	59,39	26,7	1,52	0,4	0,27	1,32	0,3

The material of the electrode rod is Sv-08A welding wire in accordance with GOST 2246-70 (Table 6).

Table 6. Average chemical composition of the electrode rod material,%

Wire grade	C	Si	Mn	Cr	Ni	Al	S	P
Sv-08 A	≤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 required for the production of electrodes for surfacing a layer of low- alloy steel.

IV.CONCLUSION

The developed electrodes for cladding a layer of alloy steel provide:
- increased productivity;
- gas protection against nitrogen and oxygen ingress of the air;
- easy removal of slag from the surface of the cooled seam.

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