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Mineral resources of the Republic of Uzbekistan for the production of ceramic flux

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ABSTRACT: This article presents the features of the composition and properties of ceramic fluxes for automatic arc welding and the mineral resources of the Republic of Uzbekistan for their production

KEY WORDS: automatic arc welding, flux, low alloy steel, marble, quartz sand, dolomite, kaolin, fluorspar

I. INTRODUCTION

Submerged arc welding - fusion arc welding in which the arc burns under a layer of welding flux. In submerged arc welding, the arc burns between the workpiece and the end of the filler wire. Under the influence of the arc, the wire melts and, as it melts, is fed into the welding zone. The arc is covered with a layer of flux. The welding wire (and with it the arc) is moved in the direction of welding using a special mechanism (automatic welding) or manually (semi-automatic welding). Under the influence of the heat of the arc, the base metal and the flux also melt. The molten wire, flux and base metal form a weld pool. Flux in the form of a liquid film covers the weld area, isolating it from the air. The arc-molten filler wire is dripped into the weld pool where it mixes with the molten base metal. As the arc moves away, the metal of the weld pool begins to cool, as the supply of heat to it decreases, and then solidifies, forming a seam. The molten flux (slag) solidifies, forming a slag crust on the weld surface. The excess unmelted part of the flux is sucked off and reused.

II. LITERATURE SURVEY

It is customary to subdivide fluxes according to the following criteria:
1. By the method of their manufacture:
a) fused;
b) ceramic;
c) flux paste.

2. By appointment [2,3]:
a) for a specific welding method (fluxes for arc welding, for electroslag welding);
b) for welding certain metals (fluxes for welding steel, for welding aluminum, for welding titanium, for welding copper, for welding magnesium, etc.).

3. By chemical composition [4,5]:
a) oxidizing fluxes containing MnO and SiO_2. The more MnO and SiO_2 is contained in the flux, the more the flux can alloy the metal with silicon and manganese, but at the same time, the more it oxidizes the metal. Oxidizing fluxes are mainly used in welding carbon and low-alloy steels.

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b) non-oxidizing fluxes that practically do not contain oxides of silicon and manganese or contain small amounts. Mainly they contain oxides CaO, MgO, Al_2O_3, and calcium fluoride (CaF_2). They are mainly used for welding high-alloy steels.
c) oxygen-free fluxes, consisting of fluoride and chloride salts of alkali and alkaline earth metals, as well as other components that do not contain oxygen. They are used for welding chemically active metals (aluminum, magnesium, titanium).

Ceramic fluxes are a mechanical mixture of various natural materials and ferroalloys [1].

Advantages of ceramic fluxes:
- the technology of manufacturing ceramic fluxes allows to introduce alloying additives into the composition;
- high versatility of ceramic fluxes, the possibility of application for welding high alloy steels and alloys, as well as for surfacing surface layers with special properties.

Disadvantages of ceramic fluxes:
- the difficulty of obtaining uniform chemical composition due to different densities of the individual components;
- low mechanical strength of the flux and low moisture resistance.

III. METODOLOGY

Ceramic fluxes are used in automatic arc welding of low-carbon and low-alloy steel structures. The use of mineral resources of the Republic of Uzbekistan for the development and industrial production of ceramic flux for automatic arc welding is an urgent task. Deposits of mineral resources of the Republic of Uzbekistan are unusually rich, diverse and have significant potential.

Taking into account the above noted features and requirements for the composition and properties of ceramic flux for automatic arc welding, this work provides an analysis of ore-mineral raw materials of the Republic of Uzbekistan, which can be used as components of the flux charge. This analysis made it possible to identify objects that are most favorable for the production of ceramic flux for automatic arc welding.

The most promising deposits of quartz sands include Akmurdskoye, Kulantayskoye, Kermeninskoye (Navoi region), Yakkabag (Bukhara region) [6]. At present, quartz sands of the Kulantayskoye and Kermeninskoye deposits are widely used as a source of silicon oxide. SiO_2 content = 87.2 - 98.7%. Table 1 shows information on the reserves of some deposits of quartz sands of the Bukhara and Navoi regions.

Table 1. Known deposits and estimated reserves of quartz-bearing resources of the Republic of Uzbekistan

№	Field	Reserves, million tons	Location	Characteristic
1	Yakkabag	4,0	Kashkadarya region	Quartz
2	Akmurdskoe	3,0	Navoi region	Quartz
3	Djeroyskoe	13,5	Navoi region	Quartz
4	Kulantayskoe	30,0	Navoi region	Quartz
5	Kermeninskoe	20,0	Navoi region	Quartz
6	Mashikudukskoe	3,0	Navoi region	Quartz

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Table 2. Average chemical composition of some quartz-containing raw materials of the Republic of Uzbekistan

Field	Content, %						
	SiO_2	Fe_2O_3	Al_2O_3	CaO	MgO	K_2O	Na_2O
Akmurdskoe	98,7	0,22	0,46	0,1	0,1	0,05	-
Djeroyskoe	97,16	0,16	1,1	0,36	0,24	0,18	0,1
Kermeninskoe	94,2	0,18	2,8	0,3	0,2	1,2	0,2

The analysis of marble deposits in the Republic of Uzbekistan showed that, in terms of chemical composition, marble from the Aksakata (Tashkent region), Zarband (Samarkand region), Gazgan, Nurata (Navoi region), Sovuk bulak, Tomchi ota (Kashkadarya region) deposits is suitable for production of welding consumables for both special and general purposes (Table 3). 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. Areas of small grains in the thin section make up from 80 to 85%, the rest is made up of large grains. The calcite grain diameter varies from 0.3 to 1.5 mm.

Table 3. Known deposits and estimated reserves of marble resources of the Republic of Uzbekistan

№	Field	Release volume, thousand m3 per year	Location	Characteristic
1	Aksakata	10,0	Tashkent region	Small-block, cream-colored with shell-like patterns, coarse crystalline
2	Tomchi ota	40,0	Kashkadarya region	Dark gray, medium-grained, solid structure, mottled texture
3	Nurata	30,0	Navoi region	White, light gray, large crystalline.
4	Zarband	40,0	Samarkand region	Gray with dark banded spots, medium-grained, massive structure.

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Table 4. Elemental and oxide chemical composition of marble (wt%)

№	Chemical composition	Field			
		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

Analysis of information on fluorspar showed the presence of the following industrial deposits on the territory of the Republic of Uzbekistan: Agata-Chibargata, Karaultash, Yangoly, Shabrez and others. From the above list of deposits, the largest is the Agata-Chibargata deposit, located in the Tashkent region and represented by a quartz-fluorite vein. The deposit's balance reserves are 3,932 thousand tons.

The analysis of the studied deposits made it possible to single out among them the objects with the most favorable raw materials for the production of fluxes for automatic arc welding of structures made of low-carbon and low-alloy steels, which confirms the possibility of industrial production in the territory of Uzbekistan of almost all types of mineral raw materials necessary for the production of ceramic fluxes.

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.

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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

IV.CONCLUSION

The developed composition of the ceramic flux provides:
- good arc stability;
- satisfactory seam formation;
- low tendency of the weld metal to form pores and cracks;
- satisfactory separability of the slag crust.

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REFERENCES

[1] Verkhoturov A.D. Methodology for creating welding materials: monograph - Khabarovsk: Publishing house of FVGUPS, 2009. - 128 p.
[2] Alloying elements in mineral and synthetic components of welding materials / Yu.V. Adkina, A.I. Nikolaev, V.B. Petrov, N.M. Putintsev // Zhurn. app. chemistry. - 2016. - T. 83, No. 12. - S. 1960-1964.
[3] Kuznetsov M.A. Nanotechnologies and nanomaterials in welding production (Review) / M.A. Kuznetsov, E.A. Zernin // Welding production. - 2010. - No. 12. - S.23-26.
[4] Boronenkov V.N., Salamatov A.M. Computational assessment of the kinetics of the interaction of multicomponent metal and slag in submerged-arc welding // Automatic welding. - 1985. - No. 8. - P. 19–23.
[5] Pokhodnya I.K. Metallurgy of arc welding of structural steels and welding materials // Welding production. - 2009. - No. 4. - P. 3–15.
[6] Khudoyov S.S., Dunyashin N.S. Mineral resources of the Republic of Uzbekistan for the production of fused fluxes for automatic arc welding // International Journal of Advanced Research in Science, Engineering and Technology - India, 2020. - No. Vol.7, Issue 5, - P. 13598-13601 ...

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