THE ESTIMATION OF RADIATION OF MINE DIAMONDS WASTES FOR WELDING MATERIALS MANUFACTURE

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Abstract

The estimation of radiation of mine diamonds waste of Udachninsky mountain-concentrating combine is made. The specific effective radioactivity of raw material is calculated. It is shown, the raw material has no restrictions on use in manufacture welding materials under the radiating factor. However, processes of enrichment rocks on a magnetic sluice lead to natural radionuclide concentration on the magnetic carpet both in the magnetic fraction at long period. A_{eff} can fall outside the limits admissible norms of radiation safety.

Key words: welding materials, diamond mining waste, radioactivity, natural radio nuclides.

Introduction

As is known, a leading industry of Republic Sakha (Yakutia) is diamond-mining. One of largest factory of diamond-minings is Udachninsky mountain-concentrating combine (UMCC). At extraction of diamonds the fertile soil layer is broken, the horizons containing heavy metals are open, the external dumps are collected. Undoubtedly, the further recycling and processing of diamond-mining waste is actual and significant problem. Presence of such minerals as rutile, ilmenite, dolomite, etc. in dump enables to use them as an additional raw resource for welding materials manufacture [Ref.1].

As a result of wind erosion and a filtration of waters through waste congestions of rocks with high natural radio nuclides content can be formed. The natural radio activity is caused by presence at rocks of natural radioactive elements [Ref.2].

The question of radiating quality of the present mineral raw materials as the raised radiation can essentially affect on health of the welders.

The objective of the given work was definition of radiating characteristics of various representative samples from mineral raw materials of Udachninsky mountain-concentrating combine dumps.

Samples of UMCC wastes have been subjected to research. The specific activity of natural radio nuclides in each granulometric fraction have been investigated. Each fraction has been passed on a magnetic sluice. The magnetic sluice is used as a trap of fine diamonds and represents a metal chute at the bottom of which magnetic tiles of the square form are covered. In a pulp of waste which passes on a trench, there are magnetic minerals in the sizes from 0,2 up to 3,0 mm. As a result of interaction with constant magnets of a chute bottom they form characteristic fibers in height up to 5 mm where the diamond crumb concentrating. Then products have been researched on consist of natural radio nuclides. All samples were analyzed by gamma-spectrometer "Canberra", USA.

Results and discussion

According to State standard 30108-94 and Radiation safety norms-99 all building materials and products should be certificated to a radiating attribute. Specific effective radioactivity of natural radio nuclides is calculated by equation:

$$A_{eff} = A_{Ra}+1,31A_{Th}+0,085A_K \qquad (1)$$

where A_{Ra} and A_{Th} - specific radioactivity of radium and the thorium, being balance with other members of uranium and thorium element groups; A_K - specific radioactivity of kalium-40.

Results of gamma-spectrometer analysis and the calculated specific effective radioactivity are shown in Table 1. Apparently from the given table, A_{eff} does not exceed 225 Bq/kg that is within the limits of Radiation safety norms-99 (see Table 2).

Table 1. Specific effective radioactivity of natural radio nuclides, calculated by equation (1).

Samples	**Fraction, mm**	**Specific radioactivity, Bq/kg**			**A_{eff}, Bq/kg**
		^{40}K	**^{226}Ra**	**^{232}Th**	
UMCC waste initial	_	167,5±10,7	25,8±1,1	37,4±1,8	89±5,8
UMCC waste	<0,2	168,3±13,0	31,6±1,5	55,8±2,9	119±7,7
Heavy concentrates of MF*	<0,2	85,2±12,3	68,8±3,2	102,1±5,4	209,8±13,6
UMCC waste	0,2-0,315	140,7±9,8	29,8±1,2	40,4±1,9	94,7±6
Heavy concentrates of MF*	0,2-0,315	94,7±9,1	45,8±1,9	41,8±2,4	108,6±7
Heavy concentrates of MF*	0,315-0,4	104,2±6,2	38,1±1,1	44,7±1,5	105,6±6,9
UMCC waste	0,4-1,0	158,6±15,0	26,1±1,7	35,7±2,7	86,4±5,6
Heavy concentrates on carpet	0,4-1,0	127,7±17,2	58,1±3,2	71,5±4,8	162,7±10,6
Heavy concentrates of MF*	0,4-1,0	233,9±14,6	53,6±1,9	115,6±4,2	224,9±14,6
Magnetic sluice waste, NMF**	0,4-1,0	154,3±11,7	22,5±1,2	36,7±2,1	83,7±5,4
UMCC waste	1,0 -2,0	190,2±12,1	25,6±1,1	36,7±1,8	90,1±5,9
Heavy concentrates on carpet	1,0-2,0	137,0±14,2	60,5±2,7	110,8±5,3	217,2±14,1
Heavy concentrates of MF*	1,0-2,0	158,8±15,0	25,4±1,7	41,0±2,9	92,6±6
Heavy concentrates of NMF**	1,0-2,0	202,6±16,0	25,6±1,6	40,7±2,7	96,1±6,2

*MF – magnetic fraction,
**NMF – nonmagnetic fraction

Table 2. Standard values of specific effective radioactivity according to Radiating safety norms-99

Material class	**Using area**	**A_{eff}, Bq/kg**
1	Public buildings	≤ 370
2	Road construction within the area of settlements,	≤ 740
3	Road construction outside of settlements	≤ 2800
4	In coordination with federal department of radioactive safety	> 2800

The distribution of natural radio nuclides in various fractions of samples is shown in the Fig.1. The content of ^{40}K rises with fraction size increasing. The content of the heavy radio nuclides ^{226}Ra and ^{232}Th is independent on fraction size.

The greatest contribution to specific effective radioactivity brings ^{232}Th (53-75 %), the contribution of ^{226}Ra and ^{40}K makes accordingly 22-30 % and 3-17 %. The radioactivity of samples is thorium-radium specificity.

Content of natural radio nuclides in any size class waste of UMCC is within the limits of effective standards of radiating safety (<370 Bq/kg).

The concentration of heavy natural radio nuclides occurs in heavy concentrates on magnetic sluice carpet and in magnetic fraction.

Thus, specific effective activity of samples on the given sites in comparison with initial UMCC heavy concentrates increases in 1,5-2,5 times and maximal A_{eff} values make 200-225Bq/kg.

Conclusions

In general, the raw material has no restrictions on use in welding materials manufacturing under the radiating factor - specific effective radioactivity of diamond mining UMCC waste makes less than 370 Bq/kg.

However, enrichment technologies of diamond rocks on a magnetic sluice lead to natural radio nuclides concentration in heavy concentrates on carpet both in magnetic fraction. A_{eff} on these sites can fall outside the limits admissible norms of radiating safety at long period operation. Carrying out of the periodic radiating control of waste from a magnetic sluice therefore is recommended.

References

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