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REPORT

Measurements of ambient equivalent dose rate of photon radiation on the surfaces of examination objects following the use of portable complex DVIN-1 (ДВИН-1) (NT.425199.001 (НТ.425199.001)) based on tracer neutrons technology for detection of explosive materials.

Measurements were made in compliance with accreditation area of Radiation Monitoring Laboratory of radiological Safety Department, Joint Institute of Nuclear Research, accredited at Rostechregulirovaniye and registered in Public Register under No. SARK RU.0001.441319 (САРК RU.0001.441319).

Measurement objective

Monitoring of radiological safety of examination objects caused by activation radiation after fast-neutron exposure as a result of DVIN-1 complex application.

Measurement method

The portable DVIN-1 complex (NT.425199.001) based on tracer neutrons technology for detection of explosive materials was applied in accordance with Operation Manual NT.425199.001 RE (НТ.425199.001 РЭ).

Examination object was placed at the distance of 40 cm from the wall of DVIN-1 examination module. Examination object used for the tests was a carryall with 27 articles referred to the following categories: foodstuff, domestic chemical products, radio electronic devices, tools and household articles. 80 % of the

maximal overall size of the examination object was located in the area of tracer beams. Exposure scheme is presented on Drawing 1. Exposure time corresponded to the maximal time for object examination by DVIN-1 complex (in accordance with Passport NT.425199.001 PS (НТ.425199.001 ПС)) and lasted 10 minutes. The level of neutron flux from the source was not less than $5x10^7$ neutrons per $second^{-1}$.

Ambient equivalent dose rate of photon radiation was measured by dosimeter DKS-AT-1123 (ДКС-АТ-1123) No. 5149, calibrated by the JINR metrological service on 17.10.2012 (metrological service is registered in the Register of accredited metrological services under No. 0031). All measurement results obtained have statistic error of 20 %.

Drawing 1. Exposure scheme

Measurement results

Ambient equivalent dose rate of photon radiation, μSv/h (± 20 %):

- examination object prior to exposure: 0.07 μSv/h
- examination object after exposure: 0.16 μSv/h
- in placement location of examination object after exposure: 0.10 μSv/h.

In order to characterize radiological safety of examination objects, we compared the value of Ambient equivalent dose rate of photon radiation on the surface of exposed articles within the examination object with the value obtained in placement location of examination object after the complex switching off (0.10 μSv/h).

Measurement results of ambient equivalent dose rate of photon radiation on the surfaces of exposed articles are presented in Table 1.

Table 1. Measured values of ambient equivalent dose rate for household articles:

Serial No.	Object	After exposure, μSv/h (± 20 %):
Foodstuff		
1	Cereals (600 g)	0.09
2	Sugar (1000 g)	0.09
3	Water (1 liter)	0.08
4	Peas (900 g)	0.08
5	Rock salt (1000 g)	0.09
6	Apple	0.08
7	Banana	0.08
8	Orange	0.07
Household chemical articles		
9	Cleanser (450 g)	0.14
10	Soda (500 g)	0.12
11	Toothpaste (“Ftorodent”)	0.12
12	Fertilizer – potassium sulfide, 1000 g	0.12
13	Chalk (1 pack)	0.07
Radio electronic devices		
14	Mobile PC	0.10
15	Lead-acid battery	0.12
Tools and household articles		
16	Copper wire	0.19
17	Silver (1 g)	0.12
18	Coins with yellow galvanic coating	0.08
19	Coins with white galvanic coating	0.11
20	Bunch of keys	0.11
21	Pliers (stainless steel)	0.11
22	Printing products	0.11
23	Electrical connectors – gold plated	0.10
24	Plastic	0.08
25	Tin (solder alloy 17 g)	0.10
26	Aluminum	0.11
27	Glass ashtray	0.14

The ambient equivalent dose rate of photon radiation measurements were performed the surfaces from engineering metals and alloys. The ambient equivalent dose rate in the measurement area before and after the complex switching on/off was 0.06 μSv/h. The results are presented in Table 2.

Dependence of measured ambient equivalent dose rate of photon radiation for the examined objects made from engineering metals and alloys on time passed since the exposure is presented on Fig. 2.

Table 2. Measured ambient equivalent dose rates of photon radiation for the examined objects made from engineering metals and alloys.

Serial No.	Object	After exposure, μSv/h (± 20 %):
1	Duralumin (395 g)	0.07
2	Brass (295 g)	0.10
3	Copper (1355 g)	0.14
4	Stainless steel (1020 g)	0.07
5	Bronze (Beryllium) (760 g)	0.14
6	Gold (10 g)	0.07

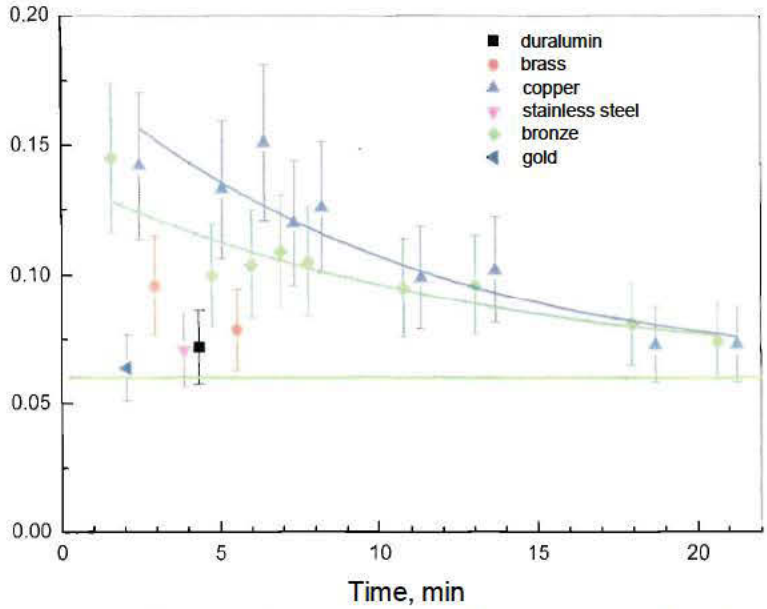

Figure 2. Time dependence of measured ambient equivalent dose rate of photon radiation for the examined objects made from engineering metals and alloys.

Conclusions

1. After fast neutron irradiation by complex DVIN-1 for a standard composition of examination object, comprised of foodstuff, domestic chemical products, radio electronic devices, tools and household articles, the ambient equivalent dose rate of photon radiation on the surface **does not exceed background values**.
2. In case the examination object contains materials from engineering metals and alloys (bronze, copper) the ambient equivalent dose rate of photon radiation on the surface **does not differ from the value of natural background in 20 minutes following the exposure.**
3. During operation of the portable complex DVIN-1 (NT.425199.001) based on tracer neutrons technology for detection of explosive materials applied in accordance with Operation Manual NT.425199.001 RE, induced activity in examination objects **does not pose any radiological hazard**.

Measurements were conducted by
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