

Reuse of Material Containing Natural Radionuclides - 12444

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ABSTRACT

Disposal of and use of wastes containing natural radioactive material (NORM) or technologically enhanced natural radioactive material (TENORM) with excessive natural background as a building material is very important in the supervision body activity.

At the present time, the residents of Ochyabrsky village are under resettlement. This village is located just near the Priargunsky mining and chemical combine (Ltd. «PPGHO»), one of the oldest uranium mines in our country.

The vacated wooden houses in the village are demolished and partly used as a building material. To address the issue of potential radiation hazard of the wooden beams originating from demolition of houses in Ochyabrsky village, the contents of the natural radionuclides (K-40, Th-232, Ra-226, U-238) are being determined in samples of the wooden beams of houses.

The NORM contents in the wooden house samples are higher, on average, than their content in the reference sample of the fresh wood shavings, but the range of values is rather large.

According to the classification of waste containing the natural radionuclides, its evaluation is based on the effective specific activity.

At the effective specific activity lower 1.5 kBq/kg and gamma dose rate lower 70 μ R/h, the material is not considered as waste and can be used in building by 1 - 3 classes depending upon A_{eff} value.

At $1.5 \text{ kBq/kg} < A_{\text{eff}} \leq 4 \text{ kBq/kg}$ (4 class), the wooden beams might be used for the purpose of the industrial building, if sum of ratios between the radionuclide specific activity and its specific activity of minimum significance is lower than unit.

The material classified as the waste containing the natural radionuclides has A_{eff} higher 1.5 kBq/kg, and its usage for the purpose of house-building and road construction is forbidden.

As for the ash classification and its future usage, such usage is unreasonable, because, according to the provided material, more than 50% of ash samples are considered as radioactive waste containing natural radionuclides.

All materials originated from demolition of houses in Ochyabrsky village are subjected to the obligatory radiation control. The decision to use the wooden beams shall enter into force after agreement with the State Sanitary and Epidemiological Supervision bodies.

INTRODUCTION

With the development of the Priargunsky mining and chemical combine (Ltd. «PPGHO»), Octyabrsky village was in the area of the mining lease of this facility and within its health protection zone, in close proximity of the uranium ore management and mining and milling facility. Near the residential area of the village, the ventilation shafts and boreholes appear on the surface, stowing complexes and dumps of off-balance rocks are located, and the tailing dump of the hydro-metallurgical plant for the uranium ore milling is in 4 km from the village. The technical road from the uranium mines is near the village too.

The registered gamma dose rates at the most part of the village are typical for the uranium-bearing areas. Inside dwellings, on private lands and in the streets those parameters vary over the ranges 0.09–0.4, 0.2–0.8 and 0.1–2.5 $\mu\text{Sv/h}$, respectively.

The soil cover in the village is subject to different degree of man-made contamination induced by the contents of natural radionuclides (NORM). On the most part of Octyabrsky area, the specific activity of NORM, in particular, Ra-226 concentration in soil is a bit higher than the similar parameter in the reference region. In some parts of the streets the man-made change of the NORM specific activity results from unauthorized import of rock from mining facilities into the territory of the village for the purpose of road pouring (Ra-226 specific activity in soil is 200 – 400 Bq/kg).

Maximum concentrations of Sr-90 and Cs-137 in soils are 2.6 and 30 Bq/kg, respectively, similar to Suktuj village; this is typical for the global contamination.

Octyabrsky village is entirely in the health protection zone of Ltd. «PPGHO» and is to be re-settled to Krasnokamensk city.

The vacated wooden houses in the village are demolished and partly used as the building material.

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Optionally, in the residential area of Octyabrsky, gamma level has been measured in-situ, soil sampling has been carried out and NORM and Cs-137 concentrations have been determined in those soil samples (Table 1).

Table 1. Measured gamma EDR and NORM contents in soil samples in the residential area of Octyabrsky village

Address	EDR, $\mu\text{Sv/h}$	Determined parameters in soil samples, Bq/kg				
		K-40	Th-232	Ra-226	Cs-137	A eff.
Mendeleeva	0.22 ÷ 0.25	527±179	40.4±13.7	31.9±11.5	≤3.65	132±45

street, 9/1						
Kurchatova street 26/1	0.18 ÷ 0.20	500±165	37.2±11.9	27.9±9.8	≤6.17	121±40
Stepnaya street 22/1	0.21 ÷ 0.25	330±132	68.7±19.9	71.8±20.1	≤3.22	191±70
Soktuj - Milozan	0.15	800	67.0	37	2.5	196±60

To address the question on potential radiation hazard of the wooden timber originated from the house demolition in Octyabrsky village, the NORM contents was being determined in samples of the wooden beam of houses. Table 2 shows the NORM concentrations.

Table 2. NORM contents in samples of the wooden beam of houses in Octyabrsky, Bq/kg

Material	K-40	Th-232	Ra-226	U238
samples of the wooden beam of houses	545 (80-1500)	89 (12-300)	78 (18-330)	285 (92-300)
Reference samples	396	38	49	180

The NORM content in the wooden samples is, on average, evidently higher than their content in the reference sample of fresh chips of wood, but the range of values is very large.

Therefore, when addressing the question on potential radiation hazard of the wooden beam originated from demolition of houses in Octyabrsky, the requirements of the relevant Sanitary Rules were taken into account: SP 2.6.1.758-99 (NRB-99) p.5.3.4., SP 2.6.1.799-99 (OSPORB-99) p.p.3.11.4, 3.11.12, SP 2.6.1. 1292-03 p.p.4.2, 4.3., SP 2.6.6. 1168-02 (SPORO-2002) p.p.3.5, 3.8 [1, 2, 3, 4].

According to the classification of industrial waste containing the natural radionuclides, its assessment is made on the basis of the effective specific activity index $A_{\text{eff}} = A_{226\text{Ra}} + 1.3A_{232\text{Th}} + 0.09 A_{40\text{K}}$.

At effective specific activity lower 1.5 kBq/kg and gamma dose rate lower 70 µR/h, the material is not considered as the industrial waste and may be used in the building operations by 1 - 3 classes depending on A_{eff} level.

The industrial control is introduced to verify the compliance with the current regulations [1, 2]. The procedure for determination of the specific radioactivity of the production (evaluation of the homogeneity of a lot, procedure of selection, preparation and measurements of samples) is being implemented according to GOST R 50801-95 and GOST 30108-94 [5, 6].

The wooden beam originated from the house demolition in Octyabrsky village may be used as the construction material only in case when the effective specific activity index complies with the requirements of NRB -99 pp.9.3.4.

At $1.5 \text{ kBq/kg} < A_{\text{eff}} \leq 4 \text{ kBq/kg}$ (4 class), the wooden beams might be used for the purpose of the industrial building, if sum of ratios between the radionuclide specific activity and its specific activity of minimum significance is lower than unit. [4].

The material classified as the waste containing the natural radionuclides has A_{eff} higher 1.5 kBq/kg , and its usage for the purpose of house-building and road construction is forbidden [2].

If the material belongs to III category of industrial waste containing natural radionuclides, according to p.4.3. SP 2.6.2.12292-03, its management is similar to that of low level radioactive waste [3].

As for the ash classification and its future usage, such usage is unreasonable, because, according to the provided material, more than 50% of ash samples are considered as radioactive waste containing natural radionuclides.

All materials originated from demolition of houses in Octyabrsky village are subjected to the obligatory radiation control. The decision to use the wooden beams shall enter into force after agreement with the State Sanitary and Epidemiological Supervision bodies.

CONCLUSIONS

1. The wooden beam originated from the house demolition in Octyabrsky village might be used as the construction material only in case of compliance with the requirements of the regulatory documents, as well as under approval of the authorities responsible for the state sanitary and epidemiological supervision in this area.
2. The industrial control is introduced to verify the compliance with the current regulations.
3. The material originated from the house demolition might be used only if such usage does not cause increasing radiation exposure to the public.

REFERENCES

1. Radiation safety standards NRB-99/2009. SanPiN 2.6.1.2523-09 Official edition, Minzdrav of Russia, 2009.
2. SP 2.6.1.2612-10 (OSPORB -99/2010). The main sanitary Rules for Radiation Safety. Minzdrav of Russia. 2010. 82pp.
3. SP 2.6.1. 1292-03 Hygienic requirements for restriction of the public exposure due to natural radiation sources. Minzdrav of Russia. 2003.
4. SP 2.6.6. 1168-02 (SPORO-2002). Sanitary rules for radioactive waste management. Minzdrav of Russia. Moscow. 2003.61p.
5. GOST R 50801-95 . «Wood raw materials, timber, semi-finished products and goods from wood and wooden materials». Gosstandard of Russia. M.1995. 12pp.

WM2012 Conference, February 26 – March 1, 2012, Phoenix, Arizona, USA

6. GOST 30108-94 «Building Materials and Products. Determination of the effective specific activity of natural radionuclides». Gosstandard of Russia. M.1994. 12pp.
7. Research report «Comprehensive study of the environmental conditions and health of workers from uranium mining and milling facilities» (code «Rehabilitation-2») Burnasyan FMBC under FMBA of Russia, 2009, 60 pp.
8. Research report «Environmental monitoring and occupational health nearby Priargunsky Priargunsky mining and chemical combine » (code «Rehabilitation -3») Burnasyan FMBC under FMBA of Russia, 2010, 59 pp.