POSSIBILITY OF USING SLUDGE FROM DRINKING WATER TREATMENT PLANT AS FERTILIZER IN AGRICULTURE AFTER E-BEAM TREATMENT: EFFECTS OF AGING

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Using accelerators in treating waste sludge from a drinking water treatment plant is a well-known technique. Ionizing radiation is an effective method for neutralizing microorganisms from waste sludge [1]. Sludge treated in this way can be used as fertilizer in agriculture [2]. Sludge can increase the humus content of the soil [3], the physical condition of soils [4], can enrich the soil with micronutrients such as phosphorus, potassium, sulphur, calcium, magnesium, and micronutrients [5].

However, if it is not used as a fertilizer immediately, but after a storage period, the content of microorganisms and mold in the sludge can increase. It is also necessary to examine whether the polyacrylamide present in the sludge degrades.

In this paper, the effects of aging on the physicochemical characteristics (Table 1), the content of microorganisms and mold (Table 2), heavy metal concentration (Table 3), and total nutrient content (Table 4) in waste sludge treated with e-beam and were investigated.

TABLE 1. PHYSICOCHEMICAL CHARACTERISTICS OF SLUDGE SAMPLES COLLECTED FROM A DRINKING WATER TREATMENT PLANT

Parameter	Measured immediately after e-beam treatment	Measured after 15 months	Permitted values for sludge to be used as a soil improver*
pH	5.98	5.32	4-7
electrical conductivity	1486	1488	<3000
cation exchange capacity	108	107	>25
volatile solids	46	29	-

TABLE 2. TOTAL NUMBER OF MICROORGANISMS ANALYZED IMMEDIATELY AFTER IRRADIATION, AS WELL AS AFTER 15 MONTHS

Dose	0 kGy	1 kGy	3 kGy	5 kGy	10 kGy	25 kGy
Total number of microorganisms ($cfu \cdot ml^{-1}$)	24500	12500	1700	80	0	0
Total number of microorganisms ($cfu \cdot ml^{-1}$) After 15 mounts	5200	1000	500	0	0	0

TABLE 3. THE CONTENT OF HEAVY METALS BEFORE AND AFTER IRRADIATION WITH A DOSE OF 10 KGY

Heavy metal	Limit values, mg/kg dry matter	Irradiated with a dose of 10 kGy e-beam irradiation, measured after treatment mg/kg dry matter	Irradiated with a dose of 10 kGy e-beam irradiation, measured after 15 mounts mg/kg dry matter
Cadmium	20 to 40	19	19
Copper	1000 to 1750	388	390
Nickel	300 to 400	54.8	55.0
Lead	750 to 1200	123	120
Zinc	2500 to 4000	170	170
Mercury	16 to 25	8.20	8.19
Chromium	100	38.5	39.1
Arsenic	29	9.70	9.70
Selenium	0.7	0.0682	0.0672

TABLE 4. THE CONTENT OF TOTAL NUTRIENT IN SLUDGE IMMEDIATELY AFTER IRRADIATION WITH A DOSE OF 10 KGY AND 15 MONTHS AFTER IRRADIATION

Nutrient	Irradiated with a dose of 10 kGy e-beam irradiation, measured after treatment %	Irradiated with a dose of 10 kGy e-beam irradiation, measured after 15 mounts %
Nitrogen	1.9	2.0
Phosphorous	1.9	1.8
Potassium	0.19	0.18

The possibility of using treated sludge as a fertilizer in agriculture was evaluated. It has been shown that the content of acrylamide in treated sludge after 15 months of storage does not exceed the limits for sludge to be used as fertilizer. If the sludge is stored in closed bags in a dark place, aging does not increase total microorganisms and molds. The research also showed that the sludge's physicochemical characteristics treated in this way do not decrease under the influence of aging. Finally, it has been shown that aging does not change the concentration of heavy metals and total nutrients in sludge treated by ionizing irradiation. It can be concluded that waste sludge from drinking water treatment plants, treated with e-beam, has excellent potential to be used as fertilizer in agriculture

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