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HOSSAM MAGHRABY

شبكة المعلومات الجامعية

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

HOSSAM MAGHRABY

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IMPROVEMENT OF SOLID WASTES FROM PROCESSED RADIOACTIVE MATERIALS TO STUDY THEIR EFFECTS ON AGRICULTURE AND ENVIRONMENT IN SOUTH WESTERN SINAI

By

ASHRAF MOHAMED REFAEI IBRAHIM
B.Sc. Agric. Cooperative Sc., Higher Institute for Agric. Cooperation, 1996
M.Sc. Agric. Sc. (Soil Science), Ain Shams, University, 2011)

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ABSTRACT

Ashraf Mohamed Refaei Ibrahim: Improvement of Solid Wastes from Processed Radioactive Materials to Study their Effects on Agriculture and Environment in South Western Sinai. Unpublished Ph.D. Thesis, Department of Soil Science, Faculty of Agriculture, Ain Shams University, 2021.

The acid processing of radioactive sedimentary rock material led to the production of huge amounts of milling solid radioactive wastes. These wastes represent environmental pollution of some heavy metals and radioactive elements in the areas surrounding the mining and milling area in Wadi Allouga and Wadi Nasab and their surroundings located the in south western Sinai, Egypt. The aim of this study was to decrease the grade of environmental pollution and permit the safe storage of milling solid wastes or to use them in agriculture in the study area. Moreover, studying heavy and radioactive elements effects on soil, herb weeds and water wells contamination in study area and surroundings. Additional, studying the ability of sunflower *(Helianthus Annuus)* to remediate some heavy and radioactive elements to decrease their effects on germination and growth characteristics of plant. The geochemical characteristic of the original ore material was chemically consisted of around 50% SiO_2, 10.6% Al_2O_3, 10.2 Fe_2O_3, 13% (CaO + MgO) and around 10% loss on ignition. This figure indicated high carbonate and total iron contents. The mineralogic constituents of milling solid wastes were consisted of Quartz, Kaolinite, Jarosite and Gypsum. The milling solid wastes contained 60.2% SiO_2, 6.8% Al_2O_3, 9.4% Fe_2O_3, 4.7% (CaO + MgO) and 14.8% loss on ignition. The picture of some trace elements was as follows; Cu was 2900 mg Kg^{-1} in original ore material and 359 mg Kg^{-1} in milling solid wastes. In the same order, Zn was 1865 and 92 mg Kg^{-1}, Th was 14 and 26 mg Kg^{-1}, U was 346 and 184 mg Kg^{-1}, The value of the main specific activity of radionuclides as ^{238}U, ^{232}Th, ^{226}Ra and ^{40}K in original ore material, milling solid wastes and mixed soil samples were 4527.63, 2385.72 and 6.23 Bq kg-1; 58.39,

56.44 and 5.93 Bq kg^{-1}; 5608.31, 5864.33 and 9.35 Bq kg-1 and 377.32, 385.51 and 1.10 Bq kg^{-1}, respectively. The optimum conditions of leaching efficiency of heavy metals and radioactive elements from milling solid wastes by agitation leaching were application of 40 g L^{-1} from sulfuric acid, with particles size; < 2.8 mm, solid/ liquid ratio 1/ 2 at room temperature 25^{o}C and agitation time 4 hrs. The leaching efficiency of U, Cu and Zn elements were 88.0, 58.1 and 37.3%, respectively. Application of 40 g L^{-1} from sulfuric acid, with flow rate of 1.2 ml min^{-1} particles size < 5.0 mm by column method achieved leaching efficiency of U, Cu and Zn elements as 69.91, 60.42 and 27.5%. While leaching efficiency of U, Cu and Zn elements were 52.8, 79.3 and 36.7% by application of 10 g L^{-1} from citric acid concentration, respectively, by column leaching method. Microorganisms were isolated from three representative samples of milling solid wastes after the previous chemical treatment with column method using tap water, sulfuric acid and citric acid and hence were tested under microscope to identify the types of fungi. All types of fungi were coming from one strain which is *Aspergillus strain.* The picture of original ore material and milling solid wastes was reflected on the soil after the flush flood. The degree of contamination was pronounced in the upstream of soil in Wadi Allouga and Wadi Nasab and decreased in the direction of downstream. Similarly, the degree of contamination was pronounced in the upstream of water wells and decreased in the direction of downstream. Copper ranged from 3637 to 1464 mg L^{-1}, Zn from 442 to 130 mg L^{-1}, Mn from 4702 to 422, Pb from 287 to 148 mg L^{-1}, Ni ranged from 257 to 130, Co from 178 to 41, U from 9 to 2 mg L^{-1} and Th from 13 to 4 mg L^{-1} in the downstream during the low torrential course in the valley. The contamination effect was also clear in the two types of herb weeds (*Zygophyllum siplex* and *Haloxylon salicornicum*) in Wadi Allouga and Wadi Nasab. Uranium in the roots of *Zygophyllum siplex* plant ranged from 4 to 6 mg Kg^{-1}, while in roots of *Haloxylon salicornicum* plant was not detected. Also, it was not detected in the vegetative part of the two herb plants and Th was not detected in the roots and vegetative part of the two

herb plants. On the other hand, the levels of heavy metals found in irrigation water from the three wells in the study area (i.e. Wadi Allouga, Wadi Nasab and Wadi Seih) were higher than the maximum permissible limits for drinking water and can cause toxic reactions in crop plants grown on soils of the study area. The degree of contamination was pronounced in the upstream of water wells and decreased in the direction of downstream, since, Cu ranged from 10.5 to 12.4 mg Kg^{-1}, Zn ranged from 0.02 to 0.03 mg Kg-1, Pb ranged from 0.7 to 0.9 mg Kg^{-1}, Co ranged from 0.1 to 0.3 and U ranged from 0.2 to 1.0 mg Kg^{-1}. The germination and growth characteristics of sunflower (*Helianthus Annuus*) plant when used as phytoremediation technology for milling solid wastes were higher in plants grown on milling solid wastes which were previously chemically treated by citric acid. The absorption efficiency of Cu, Zn, Mn, Ni, U and Th were higher in the roots than in the vegetative part of sunflower as compared to plants grown on soil taken from Wadi Allouga and Wadi Nasab and milling solid wastes treated with water tap.

Key words: Milling solid wastes, Heavy metals, Radioactive elements, Chemical processing, Environmental pollution, Phytoremediation, Sunflower**,** South western Sinai.

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