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REMEDIATION URANIUM POLLUTED SOIL BY WASHING METHOD

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ABSTRACT

Global concern for environmental protection and reintroduction of radioactive contaminated soils in rehabilitating land circuit of decontamination program of polluted areas; is an important and perpetual task. For remediation of radioactive soils the following systems were used; a) water, b) HNO_3, c) $C_6H_7O_8$, d) NaOH, contact time 4 hours, temperature 80^OC. Experimental investigations were performed on 5 soil samples which have been characterized in terms of activity concentration. It was established the remediation degree for each type of soil and reagent. Results show successful remediation to U-238 of radioactive contaminated soil using the system above and the highest efficiency clearly using $C_6H_7O_8$ as extraction material than HNO_3

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INTRODUCTION

The soil is every unique part of the natural and agricultural aspects mineral components of soils often consists of weathering products of rock parent materials and secondary minerals as clay, sand, silt and mineral oxides of Fe, AL, Mn and sometimes carbonates such as $CaCo_3$. Uranium is a common naturally occurring and radioactive substance. It is a normal part of rocks, soil, air, and water, and it occurs in nature in the form of mineals, but never as a metal. Natural uranium is a mixture of three types of isotpes the same chemical properties but have called U-234, U-235, and U-238. All have the same chemical properties but have different radioactive properties. The isotope U-235 is useful in power plant and weapons. Uranium enters by leaching from soil and rocks or in releases from processing plants. Soil could be polluted with uranium through human activates to accidents of different nature. Uranium has demonstrated toxic effects on human kidneys leading kidneys inflammation and changes in urine composition (Aura, 2013). Consequently, an environmental protection goal is to develop a process for uranium rescuing of the soils. In recent years , there is an increased interest in finding new, and innovation solutions for efficient removal of contaminates in order to save ground water and soil. Many conventional techniques for soil washing are based on the principle of adsorption of pollutants on soil fine particles such as mud, clay, and hemic material. These tend to adsorb sand and gravel particles on largely grain size, (Taken, 2001). The primary purpose of soil washing is to separate theses fine comports from the bulk mass of soil ground. If polluting materials can be detached from the majority of a soil "concentrate" polluted soil is detained any optimization of solvent penetration involves increasing the removal of soluble substances which are trapped inside solid particles. Several studies regarding removal of contaminants from polluted soils were collaborated (Popov, 2005; Panturu, 1991) A method for soil decontamination is based on extraction with citrate (acids). Citrate is an extracting substance that does not alter the environment and is successfully used in decontaminate soil with heavy metal, (Furmkawa, 2004). The effect of washing method was established that microorganism catalyze redox processes which result metal precipitation; the reduction of uranium form its hexavelent state (U^{6+}) which is very soluble to its tetravalent state (U^{4+}) insoluble and essentially imobile, lead finally to precipitate in the form of UO_2. The goal of water –chemical

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washing remediation process is to limit the extraction of contamination at hazardous waste soils; to prevent for their deteriavation of the environment and to prevent exposure by humans and other life forms to hazardous chemical and radiation risks (Anderson, 1993).

Experimental

Laboratory tests were performed on 5 soil types characterized in terms of activity concentration to Uranium radioactive contamination. The soil have been previously artificially contaminated in the same conditions with uranium from the same spote of decommissioning facility site. The soil particle size distribution were obtained by sieve analysis method which reached (<0.5mm). Measuring soil texture was made using a validated method (simplified pipette method), thus obtaining the approached distribution of soil particles in three classes range sand (50%), silt (40%), and clay (10%). The Method to established the soil composition consists in the treatment of a soil sample dried at 80 ^{O}C, with 2000 ml water and HNO_3 with molitratty (5-12 %); once $C_6H_7O_8$ (24%), and NaOH with (25%) and PH at ranged (6 - 9). The mixture has been homogenized for 3 hours; then, the sample was filtered and the settelment time has expired, the fraction containing clay settled and the silt particles within the sedment was dried 35 ^{O}C and silt fractions were directly calculated and expressed as sample mass. Clay fraction was dispred between the sample mass and the by product water waste. Fig. (1) represent the operational stages of the decontamination method of soil sample from uranium pollutions. Organic content of the soil is important, because uranium and a series of other pollutants have a certain affinity to bind to organic substances. The experimental results for organic matter content of the soil established by dry combustion method (Anderson, 1993), and the mass difference was so rare (less than 0.00293).

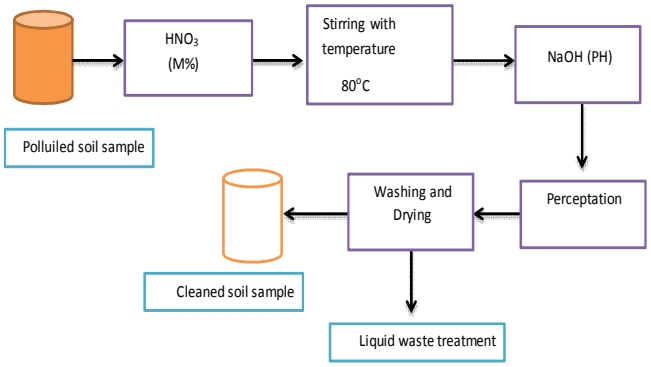

Fig. 1. Operational staged of the decontamination method of soil samplr fro, uranium pollutions

The soil samples were regardless of their content, gamma spectrometric method analysis with multichannel analyzer with pure Ge detector for gamma radiation (0-2 MeV) –type ORTEC with 60% efficiency resoulation for gamma ray energy (1333KeV) type of Co-60 gamma source was used. The five soil samples were treated during (6-8) woking hours with synthetic solutions which has the following chemical composition and moliarity percent shown in Fig. (2).

RESULTS AND DISCUSSION

Particle size distribution of soils has sand dominate class where partical size less than 0.55mm that lead to be decontataminat successfully where clay has small ratio in the samples. Soil sampls were placed in normal atmpshere for 24 hr. for final test (activity concentration).

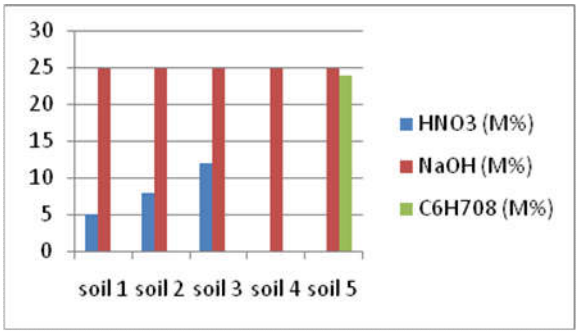

Fig. 2. Typical soil samples with remediation material

Remediation degrees of the soil samples ranged about (26-96 %) with the agents shown in Fig. (2), respectively, the reducing of uranium content in soil and efficiency of decontamination shown in Fig. (3).

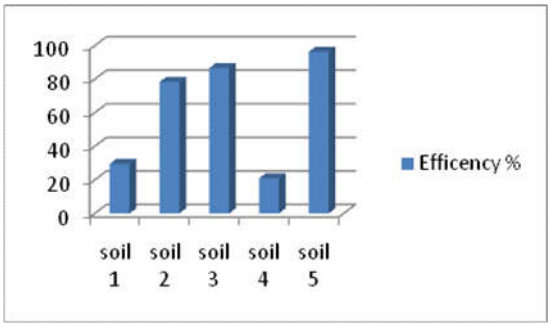

Fig. 3. Efficiency remediation ratios due to soil samples

As can be seen from Fig. (3), the most efficient remediation agent for all types of soil was ($C_6H_7O_8$). The degree of remediation is different with HNO_3 where depending on the molarity and PH value of the base NaOH. Soil sample (4) show low remediation degree due to washing with water only. The high degree of remediation with $C_6H_7O_8$ solution consists in fact that uranium was retained on soil samples through adsorption and complex formation processes and minimum ratio of clay. High degree of remediation with low cost was achieved as expected, for the samples (soil), which contain high ratio of sand and the reagents (HNO_3, $C_6H_7O_8$, NaOH) are very effective in washing method of uranium soil decontamination. The response to the extraction reagent is strongly dependent on molarity ratios and PH in addition to nature of the soil (Patent, 1991).

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