LS COUNTING OF LEACHABLE Rn-222 AND Ra-226 FROM PHOSPHATE ORES

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ABSTRACT: Phosphate ores from different locations contain various concentration of uranium and its decay products. Local phosphate deposits of economic merit have been identified. Processing of phosphate ores results in aqueous and acidic waste waters that carry some of the radionuclides of the uranium decay series, which can contaminate surface or ground waters in the vicinity. Phosphate ore samples from ores in Sanam, Jalameed and Umh Waul regions have been leached with neutral and acidic waters. The leachates were found to contain Rn-222 and Ra-226 in varying amounts depending on type of ore and length of leaching time.

1. INTRODUCTION
Phosphate ores from different regions are known to contain different concentrations of radionuclides [1,2,3] that are leachable by aqueous or acidic solutions [4,5,6,7]. Phosphate ore processing involves treatment with sulphuric acid. This results in aqueous wastes which if released to the environment may contaminate surface and underground water resources. This potential problem has to be investigated since several phosphate ore deposits were found locally, some of economic value, and hence will eventually be processed.

2. MATERIALS AND METHODS
In order to assess the potentially leachable radioactivity during ore processing several representative phosphate ore samples were obtained from Sanam, Jalameed and Umh Waul regions. The samples were crushed to a particle diameter equal to 150 mm. Four hundred gram samples of each type of phosphate was then placed in air tight jars and four hundred ml. of either distilled water or 0.1N H2SO4 were added to each jar. The jars were closed, shaken well and the leaching was continued up to 20 days. Samples of water or acid leachates were obtained at various times during the leaching period.

Ten ml. samples of water and acid leachates were sampled at different times up to 20 days and transferred to the standard Liquid Scintillation (LS) counting vial, plus ten ml. of high efficiency mineral oil liquid scintillator (Du Pont). The vials were then closed tight and shaken vigorously and then kept for a period of about 4 hours, for secular equilibrium to be achieved between Rn-222 in the organic phase (top layer) and its decay products. Any Ra-226 that is in the water or acid leachate will remain in the bottom layer of the vial. Its decay will produce Rn-222 that diffuses to the organic phase. The activity concentration of Ra-226 in the leachates can be obtained from the activity of Rn-222 by graphically plotting the equation

\[ R_{n_t} = R_{a} + (R_{n_0} - R_{a})e^{-\lambda R_{n_t}} \]  

where \( R_{n_t} \) is Rn activity at time \( t \) and \( R_{n_0} \) is initial Rn activity and \( \lambda_{Rn} \) is decay factor.

Liquid scintillation counter LSC2 (NE Technology) connected to a scaler/ratemeter SR8 (NE Technology) was used. The system was calibrated using a certified standard Ra-226 source.
3. RESULTS AND DISCUSSIONS
Prolongation of leaching time resulted, for Rn-222, in an initial decrease in activity in the leachate samples, then the activity concentration progressively increased (Figure 1). For Ra-226 however there was a successive decline in its concentration with time due perhaps to adsorption of leached Ra ions on the glass surfaces of the container. Acid and water leaching of the three phosphate ores at 20 days (Figure 2) resulted in release of different amounts of Rn-222 and Ra-226. There was more released activity, in general, with acid than with water leaching. Greater concentration of Ra-226 in the leachate reflects perhaps higher concentration of uranium in the respective ore sample.

Figure 1: Effect of acidic leaching duration on extraction of Rn-222 and Ra-226 from SANAM phosphate

Figure 2: Ra-226 and Rn-222 in water and acid (0.1N sulfuric acid) leachates of phosphate samples from different regions after 20 days of leaching
It may be concluded then that aqueous and acidic waste waters from future phosphate ore processing operations in the Kingdom will have radionuclides in it that can contaminate surface or underground waters if allowed to reach it.

4. CONCLUSIONS
Phosphate ores are known to contain traces of uranium series decay radionuclides. Local phosphate deposits of economic value have been identified. Processing of phosphate ores involves treatment with neutral and acidic solutions that may leach some uranium series radionuclides. Local phosphate ore samples from Samand, Umm Waal and Jalarneed regions were leached with neutral and acidic solutions. Liquid scintillation counting of the leachates showed that Ra-226 and Rn-222 are present in the leachates in varying concentrations from the different ore samples. Also, the radionuclide concentration present in the leachates varied with duration of leaching. It is then deemed important in future processing of local phosphate ores to take precautions that waste waters from phosphate processing do not contaminate surface or ground water in the vicinity.

REFERENCES