Sorption study of u^{+6} in brazilian soils

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ABSTRACT

The uranium mining is one of the main activities of the nuclear fuel cycle that can contribute to the increased exposure to radioactive materials and is one of the main routes of contamination of soil by natural radionuclides. This study investigated the sorption of uranium in brazilian soils, through sorption isotherms performed in batch. In this study, two types of soils were selected: Ferralsols Red and Nitosol. The adjustment of the experimental data to the kinetic models were evaluated by two approaches: the traditional, based on the coefficient of determination (R^2); and the theoretical and informative, based on Corrected Akaike Information Criteria (AIC_C). The coefficient of determination (R^2), revealed that, although empirical, both the kinetic model,
Freundlich and Langmuir, describes satisfactorily the experimental data, showing R^2 values higher than 0.9, while the partition constant model was not suitable for describe these sorption data. The AIC_C model analysis showed that the Langmuir model fit the U sorption curve well for Ferralsols Red, while the Freundlich model fits better to Nitosol. This study has highlighted the role of organic matter on the sorption of uranium in highly weathered soils, rich in oxyhydroxides and low activity clays. The Kd values reported in this study differ from those recommended by the United States Environmental Protection Agency, therefore must be considered as reference values for highly weathered soils, since it refers to Brazilian pedoenvironmental conditions. The low Kd values obtained in this study allowed us to evaluate the high vulnerability of highly weathered soils to uranium contamination [1-4].

OBJECTIVES

This work aimed to study the kinetic behavior of uranium in two Brazilian soils, with an Ferralsols Red of tropical climate and Nitosol subtropical climate. Specifically this study aimed to:

- Perform testing in batches to establish the time of balance-ground solution.
- Perform testing in batches to establish the behavior of adsorption isotherms and fit the models of Langmuir, Freundlich and constant partition in highly weathered soils.
- Perform multimodel analysis based on the Akaike Information Criterion corrected (AICC)

CONCLUSION

This study has highlighted important sorption characteristics of the studied Brazilian soils. The fit of the kinetic model to the experimental data, evaluated based on the determination coefficient (R2); found that, though empirical, both the kinetic model Freundlich as Langmuir satisfactorily describe the experimental data, with R2 values higher than 0.9, while the constant partition of the model is not adequate description of sorption data. Already multi model assessment undertaken in AICC function, showed that the Langmuir model was the best fit to the U sorption curve in Rhodic, while the model Freundlich adjusted better to Nitosol.

The Kd values reported in this study differ from those recommended by the United States Environmental Protection Agency (20 mL / g for soils with pH <5), so should be considered as benchmarks for highly weathered soils because they relate to the conditions Brazilian pedoenvironmental.

The low Kd values obtained in this study allowed us to evaluate the high vulnerability of soils studied contamination of uranium. Therefore, it is evident the need to generate regional parameter values to subsidize environmental radiation protection in mining and tailings that result in contamination of highly weathered soils with uranium.

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