DEVELOPMENT OF NEW ADSORBENT MATERIALS AND TECHNIQUES

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Magnetic adsorbent/biosorbent. Modified magnetic particles have been investigated for metal adsorption. These particles are able to adsorb metals and organic compounds and may be easily removed from waste streams using a magnet due to their superparamagnetic properties. Two types of modified magnetic particles, mse05 and mse06, were prepared using magnetite nanoparticles as core and two organosilanes. They were characterized, and their values of saturation magnetization and adsorption behaviors for U^{6+} and Th^{4+} were evaluated. The maximum absorption capacities were estimated according to the Langmuir model. Recovery of 99% U from the mse06 by desorption process was obtained. Cobalt ferrite was also investigated as magnetic core. It was prepared as a fine powder containing nanometer-sized particles, and exhibited the superparamagnetism. Another important study is been conducted for obtaining of magnetic biosorbent. Magnetic biosorbent of chitosan was prepared by in situ precipitation, and was characterized. It exhibited a superparamagnetic behavior. In adsorption isotherms, quantitative removals of Cr^{6+} were obtained. Futhermore, magnetic biosorbent is been investigated for oil spill cleanup applications on both land and water, due to their relatively high sorption capacity, biodegradability and cost-effectiveness in comparison to the synthetic sorbents that are normally used. This material readily absorbs the oil and remains in a form that can be easily attracted by a magnet to remove it from places in which is involved (FIG.1). Natural fibers used in the study had undergone little processing, which enhanced oleophilicity and hydrophobicity. The preliminary studies shown that magnetic biosorbent can be used effectively in the area of oil spill cleanup. The majority of the sorbed oil was removed from the oil-saturated biosorbent by a simple mechanical compression suggesting that the biosorbent can be used repeatedly in oil spill cleanup. This study provided preliminary data for investigating other biomass with improved oil sorption properties. Further investigations on a more detailed analysis of the preparation of magnetic biosorbent by different methods and their application to the removal of heavy metals, dyes and pesticides are in progress.

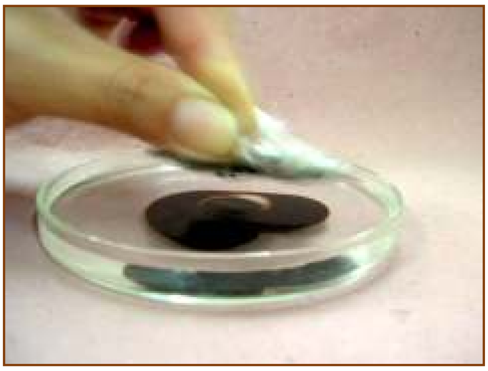

FIGURE 1 - Shows oil-saturated biosorbents being attracted by a magnet.

DEVELOPMENT OF NEW TECHNOLOGIES FOR TREATMENT OF NUCLEAR FUEL CYCLE WASTES

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Thorium of nuclear grade was obtained by solvent extraction purification. An impure thorium nitrate solution is submitted to an extraction using tributyl phosphate (TBP) diluted in varsol. The solubility of thorium nitrate in TBP is explored to purify the salt in a continuous counter-current mixer-settler unit. The mechanical basis of the process is that continuously flowing aqueous and organic phases are stirred vigorously in a mixing chamber whence flow is possible to a larger settling chamber. Two distinct layers are formed in the settler, the organic phase being the upper one. At the far end of the settler, an orifice at a low level allows the aqueous phase to flow into an adjacent mixer and a weir allows the solvent phase to flow into an adjacent mixer in the opposite direction. At the end of the process was obtained a thorium nitrate with purity higher than 99.9%. Preliminary Project on Decommissioning of Nuclear Fuel Facilities at IPEN (Brazil) Agency's Co-ordinated Research Project The pilot plants of nuclear fuel cycle at IPEN/CNEN-SP in 70-80 years were used to promote human resources, scientific research and development on several fields to reach the understanding of fuel cycle technologies, mainly to obtain high purity nuclear compounds. After the conclusion of these activities, it has been a constant concern the decommissioning of these pilot plants. In this work we will propose a study of a detailed dismantle plan for each part of deactivated facility of the fuel cycle, evaluating the risks and studying the necessary procedures to make operations in complete safeness, encompassing the segregation and the decontamination and finally the storage of nuclear material and equipments, including soil and buildings according to the criteria of radioprotection for storage and release of any material and equipment. Experts in beneficiation of uranium compose the staff. There are no experiences at all in actual decommissioning. However, this team have already dismantled two pilot plants, one of uranium cycle (dissolution and purification of ADU) and one of nuclear pure thorium nitrate (mantled grade). In this work we have proposed a study of a detailed dismantle plan for each part of deactivated facility of the fuel cycle, based on international standards on decommissioning of nuclear facilities. The main steps are the risks evaluation and the planning for the necessary procedures to make operations in complete safeness, encompassing the segregation and the decontamination and finally the storage of nuclear material and equipments, including soil and buildings according to the criteria of radioprotection for storage and release of any material and equipment. Magnetite coprecipitation process. Magnetite is an effective material to remove metal contaminants from aqueous systems. In the 2002-2004 period, the removal of Th^{4+} from nitric solutions by in situ coprecipitation of magnetite was investigated. Decontamination factor of 10^5 and a removal capacity equal to 4.06 g Th/g of magnetite were obtained. Magnetic property for the magnetite carrier of Th was estimated. Influence of a variety of complexing agents and cations on the coprecipitation process was investigated. In situ coprecipitation of magnetite is a practical process for treating Th waste without the production of secondary waste streams. The greatest advantage of this technology is the combination of chemical separation and magnetic separation resulting in a highly efficient system.

Natural adsorbents. Biomass from natural wastes or byproducts has been studied as alternative to existing commercial adsorbents. The aim is to develop inexpensive, highly available and effective biosorbents. Adsorption isotherms of U^{6+} and Th^{4+} by coir, a waste product from a renewable resource, were investigated. The biomass allows the reuse in subsequent adsorption-desorption cycles.