RADIOACTIVE WASTE CHARACTERIZATION

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Characterization of ion exchange resins and activated charcoal

Radioactive waste characterization program includes radioanalyses of wastes generated at IPEN and, in some cases, a proposition for their treatment. Our program follows the procedures outlined in CNEN-NN 6.09, about intermediate and low level waste acceptance criteria and some procedures are currently being implemented. The main subjects under development are characterization of ion exchange resins and activated charcoal generated at the research reactor water treatment system. Immobilization assays with ordinary Portland Cement have already been performed for both wastes including setting time, bulk density, porosity and compressive strength. We also tested silica fume as an admixture. For resins, the use of silica fume has improved the characteristics of the product with 10-15% wt. of resin, 2% wt. of the admixture and water/cement ratio of 0.4. For charcoal, we have observed good performance of the samples with 15% wt. of the material, water/cement ratio of 0.35, without silica fume. Next step will include leaching and durability tests. This study will cover the period 2003 - 2006.

Optimization of the radioactive waste storage

Radioactive waste storage is the practice adopted in countries where the production of small quantities of radioactive waste does not justify the immediate investment in the construction of a repository. Accordingly, institutional radioactive wastes have been stored at the Institute for Energy and Nuclear Research (IPEN), in São Paulo, Brasil, for more than 20 years. Most of these wastes are solid waste compacted in 200-litre drums, containing radionuclides with half-lives shorter than the storage period. Taking into account that a fraction of these wastes has decayed to a very low level and considering that "retrieval for disposal as very low level radioactive waste" is one of the actions suggested to radioactive waste managers, the Radioactive Waste Management Laboratory of the IPEN started a project to apply the concepts of clearance levels and exemption limits to optimize the radioactive waste storage capacity. This study has been carried out by determining the doses and costs related to two main options: either to maintain the present situation or to open the packages and segregate the wastes that may be subject to clearance, using the national and three international clearance levels. These doses and costs have been evaluated by using the technique to aid decision making known as cost-benefit analysis.

Preliminary results point out that to maintain the present situation is not the better option, even though some parameters of each scenario may vary. The sensitivity analysis for these parameters is still being done in order to determine the stability of the results concerning these variations.

The final results will enable to conceive an optimized radioactive waste management at the IPEN or in other countries with similar nuclear programs. This study will cover the period 2001 - 2005.

Artificial neural network applied to isotopic characterization of radioactive waste drum

One of the most important aspects for the development of the nuclear technology is the safe management of the radioactive waste, generated at all stages of the nuclear fuel cycle, as well as in the production and use of radioisotopes in medicine, industry and research.

Radioactive wastes are generally conditioned in a 200 L drum and should be characterized before final disposal; it is not a simple task, due to the diversity in isotope composition, plus heterogeneous mass density and spacial distribution. One of the difficulties is to determine the detector counting efficiency, since the infinity of possible combinations between activity and radionuclides position in the drum makes the preparation of suitable calibration standards impracticable. In most cases, this kind of problem could be solved through mathematical modeling and experimental validation.

In this study, the Monte Carlo method and artificial neural network approach have been applied for waste isotopic characterization in a 200 L drum . A system with 10 detectors and 5 cross sectioned drum layers was designed, with the detectors positioned parallel to the vertical axis of the drum. Situations where the drum layers are filled with a Co-60 source are created and the responses in each of the detectors are simulated using the MCNP-4C computer code. The Co-60 source can assume 10 relative intensities between 0 and 74 and the detector responses are combined to generate a data file, containing all the possible situations in which the sources can occupy the layers of the drum. The data file is separated in input and output files and then used for training a neural network, where the inputs are the detector responses and the outputs are the position and relative intensity of the sources in the radioactive waste drum.

Preliminary results of this study show that the neural network, in the training condition, is able to evaluate satisfactorily the activity of the radioactive waste contained in the drum. This study will cover the period 2000 - 2005.