Improvement of a Radiochemical Laboratory by Fourteen Years Participation in an Intercomparison Program

Maria Helena Tirollo Taddei

Introduction

CNEN's radiochemistry laboratory in Poços de Caldas has been participating in the 14 year National Intercomparison Program (NIP) for the analysis of radionuclides in environmental samples. The program is coordinated by the Radiaprotection and Dosimetry Institute of CNEN. Three times a year, this program distributes simulated environmental samples which contain one or more radionuclides and the results of the analyses are sent for statistical and analytic performance evaluation. Each round, a report that allows performance to be evaluated and procedural or instrumental problems to be identified and corrected is sent to the participating laboratory. Participation in the program has improved analytical techniques in the determination of radionuclides and has introduced advancements in laboratory practices which have reduced many sources of uncertainty. Statistical parameters are applied to the analytical data in order to show the performance of the laboratory. The variable coefficient of three measurements that have been performed in related to standard deviation and the accuracy is related to the reference value. During the period of the study, various changes in analysis methods and the acquisition of new reagents were introduced, not just to achieve better performance in the exercises but also to develop methodologies for other radionuclides which are necessary for regulatory control of the nuclear fuel cycle and are offered during the intercomparison program rounds. The improvements have been pointed out in the graphs that are included here. The data base was made up of 43 runs from 1992 to 2005, with 726 radionuclide analyses, ^{226}Ra, ^{210}Pb, natural uranium and its isotopes, thorium, ^{90}Sr, ^{137}Am, total alpha and beta, approximately 10 gamma emitters ^{137}Cs and ^{134}Cs, in water, vegetation, soil and aerosol filter. The evolution of our results which were demonstrated by the results of the intercomparison allowed us to implement radiochemical analysis training programs for other CNEN laboratories and for research laboratories of both universities and private enterprises.

Methods and Results

EVOLUTION OF TECHNIQUES

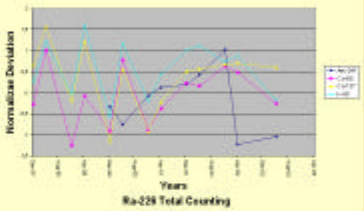
INTERCOMPARISON RUNS

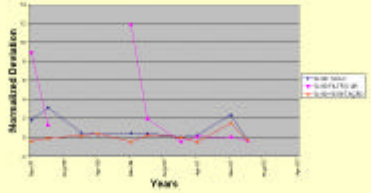
NORMALIZED DEVIATION

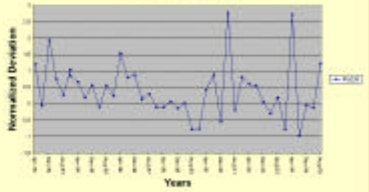
$$D = \frac{(\bar{X} - U)}{S_0\sqrt{n}}$$

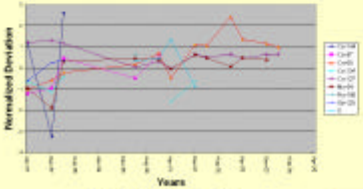
VARIATION COEFFICIENT

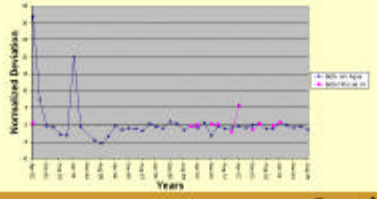
$$VC = \frac{S}{\bar{X}} \%$$

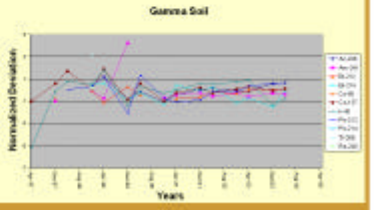


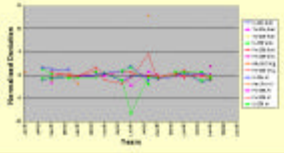












Conclusions

- For the samples that were analyzed through direct determination, that is, without the parts of the procedure that call for radiochemical separation, there was a notable improvement in the determination of total alpha and beta due to the introduction of low-background equipment, and for gamma radionuclide emitters due to the acquisition of more sensitive equipment.
- In the case of radionuclides that undergo radiochemical purification and separation, improvements were observed in the results due to the introduction of new purification methods, though it appears that a need to standardize operational procedures within the lab certification criteria in order to reduce sources of error in the analytical procedures.
- Even though some of the determinations weren't what was expected, figure 2 shows that participation in the program significantly improved the lab's analytical performance with a few small drops which were caused by lack of operational control, which needs to be improved.
- Participation in the intercomparison program made it possible to verify the weaknesses in the methods that were being used, introduce improvements in the procedures and improve the number of radionuclides that are being analyzed through the free distribution of reference standards by the coordinating body of the NIP. With these standards, it became possible to offer training to researchers and technicians for inspection agencies and companies involved in mining and processing of minerals that contain uranium and thorium.