

## CALIBRATION OF RADIATION MONITORS AND DOSEMETERS

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Keywords: radiation metrology; calibration; radiation therapy; radiation protection; diagnostic radiology.

During the last 25 years, instruments have been calibrated at the Calibration Laboratory of IPEN at radiotherapy and radiation protection levels. Since 2000 calibration service is being offered to users of diagnostic radiology instruments with the establishment of standard radiation quality at this level. At the radiation protection level there are special set-ups with gamma ( $^{60}\text{Co}$  and  $^{137}\text{Cs}$ ), beta ( $^{90}\text{Sr}$  +  $^{90}\text{Y}$ ,  $^{204}\text{Tl}$  and  $^{147}\text{Pm}$ ), alpha ( $^{241}\text{Am}$ ,  $^{233}\text{U}$ ,  $^{238}\text{Pu}$ ,  $^{244}\text{Cm}$ , etc.) and low energy X radiations (60 kV). Clinical dosimeters (radiotherapy level) can be calibrated, using gamma ( $^{60}\text{Co}$ ) or low and intermediate energy X radiation. As reference system, a secondary standard ionization chamber is used, traceable to the Physikalisch-Technische Bundesanstalt, PTB, Germany, and to the National Laboratory of Metrology of Ionizing Radiations, Brazil. Instruments utilized in diagnostic radiology measurements can be calibrated in X radiation qualities, using a diagnostic radiology system (125 kV) and two reference ionization chambers, traceable to the Center for Devices and Radiological Health, CDRH, FDA, USA and to PTB, Germany. The service is offered to the following types of instruments: kinds of ionization chambers, pen dosimeters, survey meters (including superficial contamination detectors), alarm dosimeters, activimeters, clinical dosimeters and others (FIG.1). The distribution in terms of levels of calibration is: 1% for radiation therapy, 2% for diagnostic radiology and 97% for radiation protection level. In this period, 5523 instruments were calibrated: 16% from IPEN, 21% from hospitals and clinics and 63% from industries. Besides this service, 33,000 samples including thermoluminescent dosimeters, alanina, blood and other samples, using beta, gamma and X radiation were irradiated.

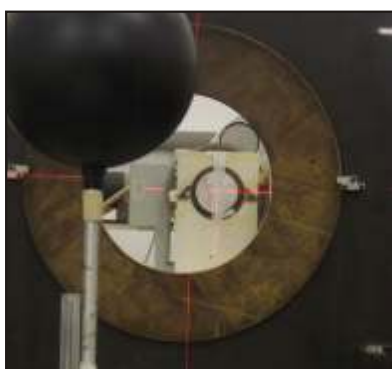


FIGURE 1 - Rigaku X ray system used to perform calibration of ionization chambers and portable survey meters.

## DETERMINATION OF RADIONUCLIDES IN ENVIRONMENTAL SAMPLES

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Keywords: natural radionuclides; artificial radionuclides; environmental samples.

Radioactivity is measured on a routine basis in environmental samples, by using alpha, beta and gamma spectrometry, gross alpha and beta counting and neutron activation analysis, in order to determine their contents of artificial and natural radionuclides.

The following analyses are available:

- Determination of gross alpha and beta activities;
- Determination of uranium, thorium and radium isotopes;
- Determination of  $^{210}\text{Pb}$ ,  $^{210}\text{Po}$  and  $^{222}\text{Rn}$ .

In the period from 2002 to 2004, 1400 analyses were performed.

## DOSIMETRIC PELLETS OF $\text{CaSO}_4:\text{Dy}$

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Keywords: radiation dosimetry;  $\text{CaSO}_4:\text{Dy}$ ; dosimetric materials; thermoluminescence.

The  $\text{CaSO}_4:\text{Dy}$  is a very sensitive thermoluminescent material. It is largely used in personal, environmental, space and area monitoring; high doses, accident, medical and biomedical dosimetry; geological and archeological dating as well as in research and development projects. The main dosimetric properties are high sensitivity for X, gamma, beta, electron, UV and laser radiation; low thermal fading (3% per month); simple glow curve; no significant light induced peaks; large useful dose range ( $2\ \mu\text{Gy}$  -  $10^3\ \text{Gy}$ ), as well as easy preparation and low cost. The crystals of  $\text{CaSO}_4:\text{Dy}$  are produced at Ipen by the Dosimetric Materials Laboratory according to established procedures to maintain the wanted and reproducible properties. Efforts have been spent to improve the production performance by controlling the process parameters. The TL properties of the  $\text{CaSO}_4:\text{Dy}$  dosimeter produced at Ipen are: Dy concentration: 0.1%mol - Atomic number: 15.3 - Dosimetric TL peak:  $210^\circ\text{C}$  - TL emission peaks: 480, 570 nm TL. The material is produced in powder and pellet form. Powder form: Grain size: 85 -  $185\ \mu\text{m}$  - Pellets: Diameter: 6mm - Thickness: 0.2mm and 0.8mm Binder material: Teflon. During 2002 - 2004 60,000 pellets were produced to fulfill the solicitations from several Research Institutions and Individual Monitoring Services.