

NEUTRON RADIOGRAPHY AND NEUTRON INDUCED RADIOGRAPHY

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Neutron Radiography(NR) is a non-destructive testing technique largely employed to inspect materials. Because of the differences between the interaction processes with matter, neutrons provide complementary information with respect to the ones obtained with X-rays. While X-ray attenuation is directly dependent on the atomic number, neutrons are efficiently attenuated by hydrogen rich substances as well as by some specific elements. The NR is mainly applied to inspect water, oils, plastics, explosives and other organic materials even wrapped by thick metal layers.

The radiographic equipment of IPEN is operational since 1992 and is installed at the beam line 08 of the pool type 2MW, IEA-R1 Nuclear Research Reactor. The NR services can be provided either by using conventional X-ray films or polymers. More recently, since 1998, we have also available a neutron radiography real-time system to inspect dynamic events. Recently the neutron radiography working group is developing a new radiography methodology which makes use of low-energy radiation beams to inspect low-thick materials, in the order of units of micra. In this methodology, named neutron induced radiation radiography, neutrons are employed to generate these beams which after attenuation by the material under study, will form an image either in conventional X-ray films or in polymers. This technique has demonstrated to be very useful to inspect, biological and medical samples as well as documents.

NUCLEAR METROLOGY SERVICES

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Since 1973 the Nuclear Metrology Laboratory (Laboratório de Metrologia Nuclear - LMN) at IPEN has been involved in the field of Neutron Metrology. The developments enabled the laboratory to provide the calibration of neutron fluences for users of the IPEN reactor or other neutron sources.

The neutron fluence measurements are performed by the activation method. For thermal and epithermal neutrons, capture reactions in ^{197}Au or ^{60}Co are used. For fast neutrons, the threshold reactions $^{58}\text{Ni}(n,p)^{58}\text{Co}$ and $^{27}\text{Al}(n,\alpha)^{24}\text{Na}$ are used.

The activity measurements are performed by means of a HPGe gamma-ray spectrometer. This spectrometer has been calibrated in the energy range from 59 keV to 1408 keV by means of standard sources that were supplied by the International Atomic Energy Agency (IAEA) or calibrated at the LMN using 4-pi-beta-gamma coincidence systems.

The LMN also offers other services related to sample weighting with analytical balances and to calibration of radioactive sources supplied by users (FIG.1).

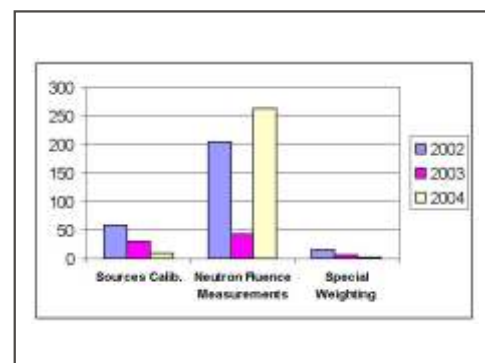


FIGURE 1 - shows the number of services performed in the 2002 to 2004 period.