FILIP VANHAVERE

NEUTRON DOSIMETRY

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Background

Neutron dosimetry is still a hot issue in radiation protection. The ICRP 60 publication of the International Commission on Radioprotection introduced new and increased quality factors and lowered the annual dose limits for radiation workers. Present neutron personal dosemeters still perform very poorly in view of these new demands.

Objective

- To improve the determination of neutron doses by studying neutron spectra, neutron dosemeters and shielding adaptations.

Programme

- To further investigate the bubble detectors type BD-PND and BDT, with respect to their sensitivity and temperature dependence
- To make the SCK•CEN criticality dosemeter up-to-date
- To investigate the characteristics of new themoluminescent materials for their use in neutron dosimetry
- To study neutron shielding with the Monte Carlo calculational code MCNP

Achievements

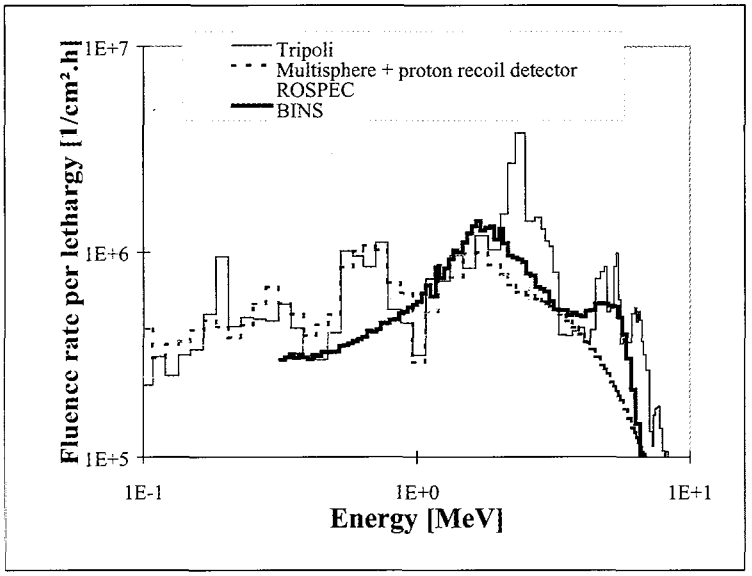
We continued the tests on the BDT bubble detector, which is specifically sensitive for thermal neutrons. The temperature dependence of these detectors is still not fully understood, nor is the evolution in time of the temperature compensation known. By systematically checking the temperature behaviour for thermal neutrons (irradiations at the BR1 reactor) this effect is investigated. Until now it is clear that a large temperature effect exists (up to factor 5 at 36°C), although it is difficult to find a consistent and systematic effect. In addition to this study, we determined the angular dependence of the BDT detector for thermal and ^{252}Cf neutrons in terms of the personal dose equivalent $H_p(10)$.

The criticality dosemeter of SCK•CEN is used in BELGONUCLEAIRE and FBFC International to give the neutron doses in case of a criticality accident. After a study, we introduced a new and improved algorithm for reconstruction of the dose in routine. The dosemeter consists of gold, sulphur and indium samples that will be activated by the neutrons. The whole system was incorporated in the quality assurance procedures and a yearly test will be done to keep the system operational.

We made an overview of the different neutron spectroscopic measurements that we performed in the previous years around the VENUS critical facility.

We tested newly developed crystals for their thermoluminescent (TL) characteristics. These materials are being synthesised in Russia and the different dopant materials are chosen for their neutron cross section (e.g. Gd). The usefulness as a TL-material depends among others on the sensitivity, the fading characteristics and the position of the glow curve peak. These things are investigated for materials with different concentrations of different dopants. At SCK•CEN a special emphasis will lie on the neutron detection characteristics of the crystals.

We performed Monte Carlo calculations to investigate two different neutron shielding problems: one around a small fuel transport case including a comparison with the Tripoli code and one around the MYRRHA accelerator driven system.



The neutron spectrum around the Venus reactor determined by four different methods.

Perspectives

- We will continue the experiments with the bubble detectors including the development of an acoustic read-out system and the tests on the new TL materials.
- We will study a neutron shielding problem at Nordion, using bubble detectors and MCNP calculations.

- A tissue equivalent proportional counter will be purchased so that we can perform neutron spectrometry in mixed gamma-neutron fields.
- Participation as a sub-contractor is foreseen in the project EVIDOS (Evaluation of Individual Doses in the Nuclear Fuel Cycle) of the 5th Framework Programme of the European Commission. Our part would be the organisation of neutron dosimetry and spectrometry measurements at the VENUS reactor and BELGONUCLEAIRE.

Partners

BN	BELGONUCLEAIRE (Dessel, Belgium)
-	Institute of General and Inorganic Chemistry (Moscow, Russia)
-	Aristotle University of Thessaloniki (Thessaloniki, Greece)
-	University of Pisa (Pisa, Italy)

Scientific Output

Presentations

F. Vanhavere, F. Vermeersch, J.L. Chartier, C. Itié, W. Rosenstock, T. Köble, F. d'Errico, "A Comparison of Different Neutron Spectroscopy Systems at the Reactor Facility VENUS", Int. conf. on neutron field spectrometry in science, technology and radiation protection, Pisa, June 4-8, 2000.

F. Vanhavere, "The BDT Bubble Neutron Detector for Personal Dosimetry", 20th International Conference on Nuclear Tracks in Solids, Portoroz, Slovenia August 28-September 1 2000.

F. Vanhavere, "The Bubble or Superheated Drop Detector: from a laboratory tool to a workfiekd dosemeter", One day meeting on calibration and use of neutron personal dosemeters, (invited), London, September 26, 2000.

F. Vanhavere, G. Eggermont, "Medical Applications in a Nuclear Research Centre", International Youth Nuclear Congress, Bratislava, April 9-14, 2000.

M. Coeck, F. Vermeersch and F. Vanhavere, "Neutron shielding evaluation for a small fuel transport case", Int. conf. on neutron field spectrometry in science, technology and radiation protection, Pisa, June 4-8, 2000.

M. Coeck, Th. Aoust, F. Vermeersch, H. Aït Abderrahim, "Shielding assessment of the MYRRHA accelerator driven system using the MCNP code" , MC2000 conference, Lisbon, October 23-26, 2000.