Personnel neutron dosimetry thesis samples

Technology, Development



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Introduction

It is generally noted that the development of dosimeters to measure neutron exposures has been slow for many years in comparison to the development of gamma and x-ray dosimeters. Exposures to x-rays and gamma rays have been determined from glass dosimeters and film badges. By applying these dosimeters, personnel exposure to radiations caused by radioactive substances can be measured to standard accuracy. However, the uncertainty may arise due to variation in readings as a result of orientation of the wearer of the dosimeter to the source during exposure. On the other hand, NTA film has been the only neutron dosimeter available for many years. Nonetheless, there are other additional neutron dosimeters available such as fissionfragment track registration and albedo-neutron dosimeters.

Literature Review

lonizing radiations from gamma rays, X-rays, alpha and beta rays are undetectable by human senses. For this reason, it is important for people that are exposed to radiations such as workers in nuclear plants, doctors who use radiotherapy, radiographers and even the people working in laboratories that use radionuclides to wear dosimeters to keep record of the total dose of radiations exposed to. This enables these personnel not to be exposed beyond the legally prescribed limits. One problem about use of neutron dosimeters is that they are less sensitive to radiations than those that measure other rays such as gamma except the albedo-neutron dosimeter.

Personnel Neutron Dosimetry Techniques

According to the national regulatory requirements, neutron dosimeters ought to be worn whenever the minimum sensitivity of 300 mrems is exceeded in a quarter. It is also recommended that use of dosimeters with more sensitivity is encouraged so as to detect more radiations than the required standard measure. The dosimeters that are believed to be more sensitive than the required standards are the albedo-neutron dosimeters. It is also recommended that NTA film is not preferred to be used in nuclear power reactor neutrons since the energy of neutrons are less than the threshold energy of NTA film which is about 0. 7 MeV. NTA film dosimeter can therefore be used if humidity is controlled and if it can be indicated that the energy dispersal would offer a substantial fraction of the dose from neutrons that have energies greater than 0. 7 MeV (Pettengill, 2).

Another measure points out that if the exposure to the whole body does not exceed 10% of the gamma and that of X-ray dose equivalent, then the

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neutron dosimeters may be omitted and thus the neutron dose equivalent is regarded as being zero. Lastly, if the neutron dose equivalent is less than 30 milirems per quarter for persons under the age 18, it is stipulated that neutron dosimeters may be omitted and thus their dose equivalent assumed to be zero (Pettengill, 3).

Detectors

Film Badges

These are the earliest personnel doses evaluators from neutrons that were made with neutron film plates (also known as film badges). These film plates are said to have been expensive, inconvenient to read and easily broken. It is recorded that NTA film were preferred to film badges for they were more convenient to use than the film plates. However, it is noted that the NTA film had a disadvantage of energy dependence and fading of tracks. The problem of fading of tracks can be overcome by desiccation and sealing of the film. Though, the fore mentioned processes have born little success and hence the film badges are not commonly used nowadays (Schwartz 12).

Albedo-Neutron Dosimeters

On exposure to neutrons, the human body is said to backscatter some of the incident neutrons creating a flux of neutrons. The neutrons of this type are referred to as albedo neutrons. Therefore, a dosimeter that is placed on the body of a person in order to measure these flux of neutrons is called an albedo-neutron dosimeter. The most fundamental usage of the albedo neutron dosimeter is detection of thermal neutrons. As early as the era of atomic-energy programs, several dosimeters were designed to detect

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thermal neutrons but the response was not always relative to the dose for various neutron energies. This meant that the dosimeters were extremely energy dependent and therefore most of the studies on them were discontinued (Schütz R, et al 21).

Nonetheless, the introduction of Li thermoluminescent-dosimeters (TLDs) proved to be greatly sensitive in detecting thermal neutrons. This created a new interest in developing and improving the albedo-neutron dosimeters. It was also associated with cheap and easy to make dosimeters hence several of them were created. Various scientists studied these dosimeters on account of their accuracy, usefulness and sensitivity. Consequently, varied conclusions were made on the sensitivity, usefulness and accuracy of the dosimeters that were made mainly because there were no standard designs used. However, it was determined that the albedo-neutron dosimeters that were made with the inclusion of LTDs were more sensitive to thermal neutron radiations and therefore they could be used to produce personnel neutron dosimetry detectors (Hankins 519).

Fission-Fragmentation Track Registration

When a charged particle penetrates through a good insulating solid material, it is shown that electrons are dispersed, leaving a damaged region. If the solid material or substance is subsequently etched, this region is preferentially developed into a track or pit that can easily be seen through a microscope. The microscope is then used to trace and trace and count the tracks in order to determine the radiation levels. However, this process proves to be tedious and cumbersome and hence a spark counting technique was necessary to facilitate easy detection and improved sensitivity. This was made by a thin piece of polycarbonate foil and placing it together with a fissile material. Fission occurs when the fissile material is exposed to neutrons emitted with proper energy. Most of the radiated fission fragments have the ability to pass through this foil. Consequently, the foil etches forming holes which can be detected or registered. This is achieved through the application of high voltage across the two electrodes made of mylar foil and metal, where the foil is placed in between. A spark jumps amid the electrodes through one of the holes in the polycarbonate foil. The heat produced by the spark evaporates the aluminium layer from the mylar and this eliminates one electrode ensuring that no additional spark can take place through the same hole. The process goes on until a spark takes place at each hole (Harvey et al 392).

Conclusion

In summary, personnel neutron dosimetry entails the application of devices that detect and record radiations of neutrons in radioactive places. The dosimeters are vital for the protection of people from being exposed too much to emitted or backscattered neutrons that are dangerous to one's health. These detectors have been iomproved from time to time since the commencement of the era of atomic-programs.

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