INSTITUT DE RADIOPROTECTION
ET DE SÛRETÉ NUCLÉAIRE

POST DOCTORAL FELLOWSHIP
Investigation of the radiolytic properties of bitumens and synthesized bituminized waste

Site :	Fontenay aux Roses
Unité :	PSE-ENV/SEDRE/USDR
Durée :	18 month
Date de disponibilité :	**1 July 2023**

L'IRSN, Etablissement Public à caractère Industriel et Commercial (EPIC) – dont les missions sont désormais définies par la Loi n° 2015-992 du 17 août 2015 relative à la transition énergétique pour la croissance verte (TECV) – est l'expert public national des risques nucléaires et radiologiques. L'IRSN concourt aux politiques publiques en matière de sûreté nucléaire et de protection de la santé et de l'environnement au regard des rayonnements ionisants. Organisme de recherche et d'expertise, il agit en concertation avec tous les acteurs concernés par ces politiques, tout en veillant à son indépendance de jugement.

Environment: Coprecipitation sludges employed in the water treatment of effluent in the nuclear industry are immobilized in bitumen matrix. This mixture is known as bituminized waste, and it consists of long-lived medium and low-level waste. The structure of the bituminized waste will alter during storage due to self-irradiation, and radiolysis gases will occur. Because bituminous mixtures are opaque, direct visual observation of such occurrences is impossible. X-ray tomography is currently used to determine the distribution of radiolysis bubbles inside the bitumen matrix. However, this approach does not allow for a conclusion on the significance of the bubble coalescence phenomena or for direct observation of bubble production and migration in hot bituminized waste between 70 and 110°C (temperature range corresponding to the temperatures of triggering of the first exothermic chemical reactions). To overcome this technological challenge, the ARISE project seeks to investigate the viability of ultrasonic technologies for detecting the emergence of radiolysis bubbles and monitoring them in real time during a temperature rise. The project calls for the validation of this ultrasonic technology tried using X-ray tomography techniques. By overcoming the barrier posed by bitumen opacity, this innovative ultrasonic approach may eventually allow researchers to better understand the aging under irradiation of bituminized waste over several decades of storage and so increase their safety.

Duties:

- Bibliography and knowledge of work previously carried out at IRSN and IES
- Development of cells compatible with irradiation, measurement by X-ray microtomography and ultrasonic detection. This work will be carried out in partnership with IRSN PSN-RES/SCA in Saclay and IES.
- Following the irradiations which will take place in the first quarter of 2024, study by microtomography of the materials irradiated at the different doses and dose rates previously established at LUTECE.
- Study of the ultrasound response as a function of the dose and definition of a post-irradiation method. The work will consist in analyzing the ultrasonic signals after interaction with the cells according to the integrated dose. The analysis of the ultrasonic speed and the ultrasonic attenuation for example should lead to proposing a precise methodology for the detection of bubbles.

Profile of the desired applicant (theme, graduation level, behavioral abilities, etc.):

We are searching for a candidate with a doctorate in science who specializes in materials and/or sensors and has experience with cell design or radiolysis. Technical abilities in micro-tomography and/or ultrasonic sensors will be required to comprehend the project. Expertise in the design or implementation of experimental techniques is required. For the fellowship, the candidate must be self-sufficient and comfortable working in a group.

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