Neutron study of kinetic of absorption of nanoparticles of earth-alkaline hydroxides in ancient waterlogged wood

This project is based on the study by neutron scattering of nanoparticles (NPs) of earth-alkaline hydroxides and their use to innovative applications in conservation science, in particular in the treatment of acified ancient waterlogged wood. Severe acidification phenomena affecting organic materials such as paper and wet wooden archaeological objects have put into question current methods of treatment. The most symbolic case is represented by the famous Swedish warship Vasa (17th century-Stockholm): approximately 2 tons of acid are believed to be present within the ship. In collaboration with the CEA Lab ARC-Nucléart we studied the penetration of hydroxide Nano Particles into archaeological samples (acidified ancient wood of Gallo-roman shipwrecks, around 2rd century AD), representative in terms of availability, and both acidity and decay level of the archaeological composite wood. The hydroxide NP comes from the collaborative group of L'Aquila (Italy) and they are produced by a patented synthesis method and could be employed in extensive, compatible interventions on collections of works of art, as it is the case in the de-acidification treatments on wooden artifacts. However, it is very difficult from standard laboratories measurements to know the depth of penetration of the treatment on larger samples without the destruction of the sample so that neutron imaging is the perfect no-destructive technique to observe the penetration of the treatment in the core of the wood. We used neutron radiography and tomography to follow the kinetic of the penetration of hydroxide NP in suspension in D2O into the samples, and to measure the depth of penetration into the wood. The images produced by the experiment are still under analysis. We also characterize the suspension in term of size and morphology of the NP using SANS experiment.

Activities of the trainee: The student will be involved in the analysis of the neutron data concerning the absorption of the NP in several samples with different level of acidification and on different kind of woods used in the shipwrecks Furthermore, the student could also be involved in the analysis of neutron data from pervious SANS experiment on the suspension used in the wood treatment.