1.4.11. RADIOLOGICAL EXAMINATION OF WOOD WITH NEUTRONS, DIFFERENT PERSPECTIVES

Osterloh K., Jechow M., Fratzscher D., Wrobel N., Zscherpel U., Ewert U.,
BAM Federal Institute for Materials Research and Testing, Berlin, Germany;
Bücherl Th., Lehrstuhl für Radiochemie, TU München, Germany;
Tannert Th., Berner Fachhochschule, Biel/Bienne, Switzerland;
Hasenstab A., Remmers Fachplanung GmbH, Löningen, Germany

The unique property of neutron radiation is to penetrate easily heavy metals while giving contrast to light materials such as hydrocarbons, quite the other way round as with X-Rays and gamma radiation. As a consequence, hydrogen containing features are giving more contrast to a radiological image than heavy metals. This is of advantage in two respects: in identifying heterogeneous distribution of hydrogen rich materials such as glue in gluelam or when interrogating specimens consisting of both, wood and heavy metal plates. Such a combination of materials occurs in construction parts where wooden beams are hooked to each other or anchored at base plates. Particularly if large and thick steel plates are inserted into a cleft at the end of a girder the wooden part is barely accessible to X-Ray inspection, if at all.

Radiological examination with neutrons is capable to provide a solution to these problems. However, since wood by nature contains substantially hydrogen it an effectively moderating material to neutrons in itself. If they do not have sufficient “kinetic” energy, as it is the case with thermal neutrons, they cannot penetrate wooden layers of more than several centimetres of thickness. The only way to overcome this obstacle is to take neutrons of sufficient energy, i.e. fast neutrons. In the NECTAR facility of the FRM II research reactor of the Technische Universität München, they are available in the form of fission neutrons in an energy range between 1.5 and 2 MeV. It has been shown that they have the capability to penetrate up to some 50 cm wood. The results of two tomography studies will be presented; one on a girder made of gluelam focussing on possible distributions of glue inside the specimen and on a part of a beam with a metal plate inside removed from a wooden bridge. In the first case, density distributions were different as they occur in X-Ray inspections indicating the higher sensitivity of neutrons to the material composition. In the other case, neutrons even enabled an insight into the “weak” wooden structures in front of and behind the metal shielding.

This kind of studies will be extended on specimens of cultural heritage that are difficult to interrogate with X-Rays or gamma rays and should not be dismantled by preservation reasons. The radiological examination with fast neutrons offers a way to study structures of light materials such as wood shielded by plates of heavy metals. A further application is studying the distribution of moisture within the inside of wooden specimens since the hydrogen of the water gives a better image contrast with neutrons than with X- or gamma rays.