

Radiochemical Analysis in Decommissioning of Nuclear Facilities

Xiaolin Hou

National Laboratory for Sustainable Energy (Risø-DTU), NUK-202, Technical University of
Denmark, DK-4000 Roskilde, Denmark,
E-mail: xiaolin.hou@risoe.dk

The decommissioning of a nuclear facility requires estimating the total inventory of radioactivity in various materials and its variation with time, which has to be carried out by the determination of the radioactivity of various radionuclides presented in the materials. Of all materials in the nuclear facilities, graphite, concrete, and steel are the main low-medium radioactive waste due to their large volume. The neutron activation products of components and impurity in the materials, such as ^3H , ^{14}C , ^{36}Cl , ^{41}Ca , ^{60}Co , ^{55}Fe , ^{63}Ni , ^{133}Ba , ^{152}Eu , ^{154}Eu , and some transuranics, are the main contributors to the total radioactivity. But some fission products, such as ^{90}Sr , ^{99}Tc , ^{129}I , and ^{137}Cs , may also exist in the materials due to the contamination of the leaked nuclear fuel. Of these radionuclides, the determination of gamma emitters is easier and can be directly carried out by gamma spectroscopy without any radiochemical separation. But the beta and alpha emitters including ^3H , ^{14}C , ^{36}Cl , ^{41}Ca , ^{55}Fe , ^{63}Ni , and some transuranics, have to be determined by radiochemical analysis including a completely separation of individual radionuclides from matrix and other radionuclides before measurement by beta counting, alpha spectrometry or mass spectrometry. This work presents various radiochemical analytical methods developed in the authors laboratory in the recent years for the determination of these radionuclides in various materials for the decommissioning of nuclear facilities, which includes: (1) rapid determination of tritium and ^{14}C in solid materials, such as graphite, concrete, steel, aluminium, paint, silica gel, soil, and dust; (2) determination of ^{14}C in high tritium samples, such as heavy water, waste water, and oil; (3) determination of ^{36}Cl and ^{129}I in graphite, steel, concrete, waste water, and dust; (4) determination of ^{41}Ca in concrete; (4) determination of ^{55}Fe and ^{63}Ni in graphite, concrete, steel, aluminium, sediment, sand, waste water, seawater, and lichens; (5) determination of ^{99}Tc in concrete, and waste water; (6) determination of ^{238}Pu , ^{239}Pu , ^{240}Pu , ^{241}Pu , and ^{241}Am in concrete, graphite, and steel samples.