

Introduction to Practical Environmental Radiochemistry course

Held : 11-15 June 2007, Meiringen, Switzerland

Course Programme : PDF file 64 kb
Course outline

This is a novel course for the ITC on the practical aspects of environmental radiochemistry. The 5 day programme for 2007 features:

- Lectures on the fundamentals of radiochemistry, including case studies on natural radionuclides as environmental indicators. Advances in radiochemical methods will be presented, as will appropriate environmental sampling protocols, something of interest to all professionals involved in radiochemical monitoring in and around power plants (nuclear and thermal). Sufficient time will be allocated for questions and discussions in each presentation module.

- One field day will be allocated to the hands-on demonstration of appropriate environmental sampling in and around nuclear installations at PSI (Paul Scherrer Institute). A range of environmental samples with different sample matrices will be collected and different sampling strategies will be examined.

- The remaining two field days will be spent in the Grimsel Test Site (GTS; www.grimsel.com) looking at in situ radiochemical analytical techniques and the protocols behind the use of radioisotopes in the open environment. Appropriate field radioprotection and handling techniques will be presented and the participants will be involved in a simulated radiochemistry field experiment. Further to this the participants will work-up their own datasets using computer codes used to analyse the transport of radionuclides in the environment.

The course is ideal for a wide range of professionals with some interest or responsibility in the field of environmental radiochemical analysis and surveillance. It will be particularly useful to those in the nuclear power industry who require an understanding of the basic concepts of environmental monitoring, but will also be of interest to students and professionals in environmental protection who require knowledge of specific radioanalytical tools which can be utilised to assess mechanisms and processes in environmentally sensitive areas.

Course Organiser

The course is organised by the ITC-School, supported by a range of organisations and individuals who have been active in the field of radiochemistry for many years. In particular, the support of the Radioanalytical Laboratory of PSI (Paul Scherrer Institute; http://www.psi.ch/forschung/forschung_e.shtml) is greatly appreciated.

Teaching

The course will be held in an informal, workshop atmosphere and participants will be encouraged to interact and question at all times. Each course topic will be taught by highly qualified and internationally recognised specialists from a range of organisations active in the field of environmental radiochemistry. They will provide the most up to date and comprehensive information and discussions. Course materials will be provided for each topic. Modules will generally be taught throughout the day but there will also be three, hands on, field days where the participants will be introduced to the practical aspects of environmental sampling and encouraged to develop their own appropriate sampling protocol. They will also be directly involved in an exercise in the Grimsel Test Site (GTS) explaining the use of radioisotopes as indicators of environmental processes.

Course Programme

Monday 11TH June

Morning session: Theory and practise of radiochemistry

0900-0915

General introduction, course organisation, structure

Dr.R.Alexander

0915 - 1030

Types of radiation and interaction with matter

Radioactive decay, concept of half life, properties of radiation, radiation exposure (internal and external) and the concept of dose. Interaction of radiation with matter and radiation protection.

Dr C. Biggin

1030-1045

Coffee break

1045-1200

Radionuclides in the environment

Origins and fate of radionuclides in the environment (man-made pollutants, natural terrestrial and cosmic radionuclides). Use of radionuclides to assess environmental processes and mechanisms

Case study 1: Natural decay series disequilibrium in environmental studies. Case study 2: Pb isotope dating over a range of timescales, in rocks and atmospheric emissions.

Dr. J. Eikenberg

1200-1300

Lunch

Afternoon session: Overview of methods 1

1300-1415

Spectrometric radionuclide detection techniques

Gamma spectrometry: Instrumentation, detection concept, calibration and samples geometry, common applications, QA

Alpha spectrometry: Instrumentation, detection concept, calibration, samples geometry, interferences, common applications, QA

Liquid scintillation spectrometry: Instrumentation, detection concept, calibration, alpha/beta separation, sample preparation, interferences common applications, QA

Radiation background and shielding

Gas detectors, track measurements, whole body counters

Dr Cristoph Wilhelm

1415-1530

Advanced methods for radionuclide analysis and speciation

Development of alternative detection techniques. Overview and application of different techniques (eg ICP-MS; TIMS, LA-ICP-MS, SIMS, PIXE, autoradiography etc).

Case study: in situ actinide speciation, theory vs measurement.

Dr Horst Geckeis

1530-1545

Coffee break

1545-1700

Uncertainties in radiochemical analysis

Introduction to statistics, uncertainty in radiochemical analysis, sources of errors, reporting of errors, detection limits

Dr Ian McKinley

1700-1715

Open discussion on the day's presentations

Tuesday 12th June

Morning session: Overview of methods 2

0900-1030

Radiochemical separation methods

The need for separation in radiochemistry. Ion exchange, extraction chromatography, solvent extraction techniques, electro-deposition, precipitation techniques

Case study : Purification of Pu

Dr. J. Eikenberg

1030-1045

Coffee break

1045-1200

Workshop: calculations: from cpm to Bq

A series of calculation commonly used in radiochemistry. Decay correction, determination of counting efficiencies, interpretation of gamma spectrometry results.

Dr. J. Eikenberg

1200-1300

Lunch

Afternoon session: Methods in action

1300-1545

Sampling in the vicinity of nuclear installations, in the vicinity of incineration plants, coal or oil-fired power stations, etc

What are the key factors of sampling, how to plan a good sampling strategy, sample size, sample preservation techniques, number of samples, the benefit of blanks, establishing the natural background.

Overview of tomorrow's activities.

Dr C. Biggin and Dr P. Dale

1545-1600

Coffee break

1600-1700

Food chain sampling

Dr P. Dale

Wednesday 13th June

Morning session: Practical applications: Field sampling and analysis

0800-1000

Travel to PSI

1000-1230

Field work instruction in and around a nuclear site

The practical aspects of environmental sampling and the common pitfalls will be demonstrated in the field. A range of environmental samples are available around this nuclear research site (including a reactor undergoing decommissioning) and different sampling techniques will be tested.

Dr J. Eikenberg, Dr C. Biggin and Dr. R. Alexander

1230-1330

Lunch

Afternoon session: Environmental Sampling

1330-1800

Visit to an Environmental Monitoring Radioanalytical Laboratory at the Paul Scherrer Institute (PSI)

This laboratory is the key link in the national environmental monitoring programme of Switzerland and specialises in low-level, routine monitoring techniques.

Lab visit and presentations from lab staff on various analytical techniques.

Begin analysis of the samples collected around the field site.

Dr. J.Eikenberg and his staff, Dr. C. Biggin and Dr. R. Alexander

1800-2000

Return to Hotel

Thursday 14th June

Morning session: Analysis of samples

0930-1000

Travel to the Grimsel Test Site

1000-1100

Introduction to the test site

Dr R. Alexander and Dr. C. Biggin

1100-1200

Theory and practise of in situ tracer testing

Why examine radionuclide migration/retardation in situ? Historical overview, advantages/disadvantages, integration with laboratory experiments, pitfalls to be avoided. Shallow vs deep testing. Where are we now?

Dr. R. Alexander

1200-1300

Lunch at the test site

Afternoon session: Theory and field set-up

1300-1400

In situ analysis of radionuclides: an introduction to various methods

Dr. J.Eikenberg

1400-1600

Set up of field equipment, start of tracer test.

The students will gain hands on experience in the preparation and checks required for the following days field work under expert guidance.

Mr T. Fierz

1600-1700

Case study: Preparation and application of radionuclides in the pharmaceutical industry.

An example of radiochemistry in industry will be presented. The background of the isotope production, its application and initial results will be presented.

Dr C. Biggin

Friday 15th June

Morning session: Analysis of samples

0830-0900

Travel to the Grimsel Test Site

0900-1200

Field work at the test site

Visit active handling and analytical facilities

Train (under simulated conditions) in active handling techniques

Observe an ongoing in situ tracer test (depending on the status of ongoing field work: see www.grimsel.com for details)

Mr T. Fierz

1200-1300

Lunch at the GTS

1300-1400

Raw data handling, analysis and uncertainties

The data from the morning's experiment will be examined and analysed. The raw data will be processed and plotted to serve as a foundation for the afternoon's discussions and modelling.

Dr R. Alexander and Dr C. Biggin

1400-1500

Modelling of students own data

A variety of modelling tools will be available to process the results of the tracer testing.

Dr. R. Alexander

1500-1520

Coffee

1520-1615

Application to long term monitoring

Nuclear sites are monitored continuously but monitoring of deep geological repositories will require a whole new approach to the problem – examples and practical solutions.

Dr J. Skrzyppek

1615

Closing comments, discussion and Aperero

All