Development and validation of off-line analytical methods used for detection of Radionuclides in deposits occurring in water distribution networks

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Background

As water resources, treatment and distribution systems can be used as delivery vehicles to cause violence to a human population (Gleick, 2006) the necessity to deal with deliberate contamination and its outcome is given. Therefore it is among other information important to know the condition precedent how to analyze the contaminant accumulation.These information will be the basis for a successful sanitization of a e. g. drinking water distribution system.

Aim of the study

To develop and validate off-line analytical methods used for detection of radionuclide threat agents in water and following adsorption to materials, biofilms and other deposits occurring in water distribution networks is one of the tasks in the European project SecurEau (http://www.secureau.eu). IWW Rheinisch Westfälisches Institut für Wasserforschung (www.iww-online.de) is one of the partners in this ongoing research project. The methods developed should not be sensitive to matrix effects such as deposits and biofilms known from distribution systems.

Method development

Adaptation and development of off-line, rapid detection methods in material, biofilms and deposits on the surface of metal and plastic network pipes are under development at IWW.

In this publication we are focusing on two types of analytical methods:

- Liquid scintillation for screening on radioactive contaminants by determining gross alpha and beta activities.
- Alpha spectroscopy for the specific determination of selected radio nuclides (e. g. Ra-226 and Po-210)

These two methods are well established for water samples such as drinking or mineral water but up to now there are no methods available for analyzing deposits in the distribution system. Several deposits (approx. 50) were sampled from different distribution systems. Therefore pipes have been cut and deposit removed in the laboratory, area and volume were documented. First step for both methods is homogenization of a representative sample by gently morting.

- For liquid scintillation two different sample preparation methods have been applied: (1) direct mixing of dried (1 – 10 mg) or original sample with the liquid scintillation cocktail, (2) filtration of the sample, transfer of the covered filter in the vial and adding liquid scintillation cocktail.
- For alpha spectrometry the second step is concentration on a filter (pore size 0.45 µm) with the necessary geometry for the measurement. After drying the filter is ready for alpha spectrometric measurement.

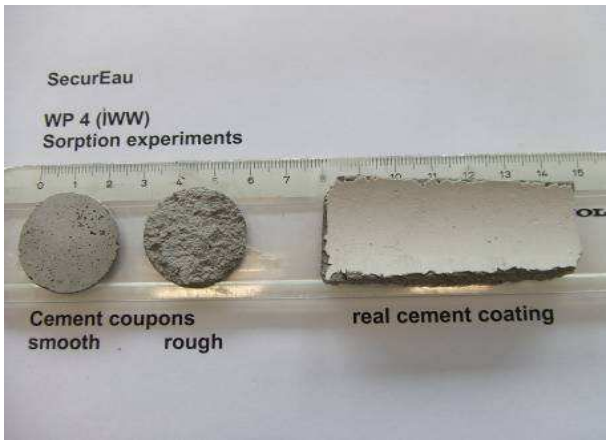
Method validation

Methods will be tested (validation) for their applicability with different types of deposits in order to evaluate matrix effects. Deposits from several drinking water pipes have been sampled and characterized chemically and microbiologically.

First experiments with high iron containing deposit showed that counting efficiency was quenched by the sample (matrix) and therefore these results will be compared with those from other type of deposit.

Fig. 1: Cast iron pipe with manganese containing deposit in a drinking water pipe

Fig. 2: Cement coating with deposit



Further aim:

Different materials used in drinking water distribution systems have been selected as well and prepared for measurement. Materials have been cut in disks in order to fit in the alpha measurement device with total area/coupon of 9.8 cm^2 as shown in Fig. 3. Experiment will focus on method development but also on sorption behavior.

Fig. 3: Material from distribution system

Literature:

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