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Rapid Radiochemical Methods for Asphalt Paving Material and Asphalt Shingles Matrices for Use during Environmental Remediation and Recovery

INTRODUCTION

In the event of a nuclear or radiological contamination event, the response community will require tools and methodologies to rapidly assess the nature and extent of contamination. To characterize radiologically contaminated areas (e.g., airport or urban center) and inform risk assessment, large numbers of samples will be collected and analyzed over a short period of time. The objective of this research is to develop robust analytical methods to enhance laboratories' ability to process and analyze large numbers of samples following a radiological/nuclear release. Improved laboratory capacity and capability will enable emergency response officials to more rapidly and accurately characterize contaminated areas.

A number of federal agencies have recognized the need to ensure adequate laboratory infrastructure to support response and recovery actions following an intentional or unintentional major radiological/nuclear incident. The Integrated Consortium of Laboratory Networks (ICLN), created in 2005 by ten federal agencies, consists of existing laboratory networks across the federal government. The ICLN is designed to provide a national infrastructure with a coordinated and operational system of laboratory networks that provide timely, high-quality, and interpretable results for early detection and effective consequence management following acts of terrorism and other events requiring integrated laboratory response. In response to this need, the Homeland Security Research Program (HSRP) established a relationship with U.S. Environmental Protection Agency's (EPA's) Office of Radiation and Indoor Air (ORIA) with regard to responsibilities in support of EPA's Environmental Response Laboratory Network (ERLN) and the ICLN. The HSRP and ORIA coordinate radiological reference laboratory priorities and activities in conjunction with HSRP's Partner Process. As part of the collaboration,

U.S. EPA's Homeland Security Research Program (HSRP) develops products based on scientific research and technology evaluations. Our products and expertise are widely used in preventing, preparing for, and recovering from public health and environmental emergencies that arise from terrorist attacks or natural disasters. Our research and products address biological, radiological, or chemical contaminants that could affect indoor areas, outdoor areas, or water infrastructure. HSRP provides these products, technical assistance, and expertise to support EPA's roles and responsibilities under the National Response Framework, statutory requirements, and Presidential Directives.

the HSRP worked with ORIA to publish rapid radioanalytical methods for selected radionuclides in building material matrices.

RAPID RADIOCHEMICAL ANALYTICAL METHODS DEVELOPMENT

Validated rapid radiochemical methods for alpha and beta emitters in solid matrices that are commonly encountered in urban environments were previously unavailable for public use by responding laboratories. A lack of tested rapid methods would delay the quick determination of contamination levels and the assessment of acceptable site-specific exposure levels. Of special concern are matrices with rough and porous surfaces, which allow the movement of radioactive material deep into the building material making it difficult to detect. This research focuses on methods that address preparation, radiochemical separation, and analysis of asphalt paving materials and asphalt roofing shingles. These matrices, common to outdoor environments, challenge the capability and capacity of very experienced radiochemistry laboratories. Generally, routine sample preparation and dissolution techniques produce liquid samples (representative of the original sample material) that can be processed using available radiochemical methods. The asphalt materials are especially difficult because they do not readily lend themselves to these routine sample preparation and dissolution techniques.

Development and use of these methods by ERLN-member radiological laboratories (federal, state, local, and commercial) fulfill the need for consistent, accurate analysis of large numbers of samples over a short period of time. These methods facilitate sharing sample load between laboratories, and improve data quality and comparability. They simplify the task of outsourcing analytical support to the commercial laboratory sector and improve the follow-up activities of validating results, evaluating data, and making risk-management decisions. The result of this research accelerates existing analytical throughput times so that each laboratory can process a larger number of samples per day.

This is the first issue of rapid methods for americium-241, plutonium-238 and plutonium-239/240, isotopic uranium, radiostrontium (strontium-90), and radium-226 in asphalt paving materials and asphalt roofing shingles. The methods have been single-laboratory validated in accordance with EPA and industry guidance documents. Single laboratory validation testing shows that the methods can achieve required quality objectives that are based on conservative risk or dose values for the intermediate and recovery phases of an emergency response. The methods also have been tested to determine the time required to process a batch of samples. For these radionuclides, analysis results for asphalt paving material samples can be available within 9 to 18 hours, and asphalt roofing shingles within 9 to 21 hours (range depends on count times). Tables 1 and 2 provide a summary of method performance information.

Table 1: Asphalt Paving Material Methods

Radionuclide	Analytical Action Level (AAL)	Minimum Detectable Concentration Tested (MDC)	Estimated Time to Obtain Sample Analysis Results
^{241}Am	1.5 pCi/g	0.20 pCi/g	9 - 16 Hours
$^{238/239+240}Pu$	1.5 pCi/g	0.20 pCi/g	10 - 17 Hours
^{226}Ra	5.2 pCi/g	2.1 pCi/g	11 - 18 Hours
^{90}Sr	2.4 pCi/g	0.40 pCi/g	10 - 11 Hours
^{238}U ^{234}U	13 pCi/g 12 pCi/g	2.0 pCi/g 1.9 pCi/g	9 - 16 Hours

Table 2: Asphalt Roofing Shingles Methods

Radionuclide	Analytical Action Level (AAL) as Tested	Minimum Detectable Concentration (MDC)	Estimated Time to Obtain Sample Analysis Results
^{241}Am	1.5 pCi/g	0.20 pCi/g	12 - 19 Hours
$^{238/239+240}Pu$	1.8 pCi/g	0.20 pCi/g	9 - 16 Hours
^{226}Ra	2.6 pCi/g	0.21 pCi/g	14 - 21 Hours
^{90}Sr	4.7 pCi/g	0.27 pCi/g	12 - 13 Hours
^{238}U ^{234}U	12 pCi/g 12 pCi/g	0.21 pCi/g 0.20 pCi/g	12 - 19 Hours

These new methods will accelerate the analytical turnaround time necessary leading to quicker sample processing while providing quantitative results that meet measurement quality objectives. The methods are designed to be used during the intermediate and recovery phases of the emergency response to a nuclear or radiological incident of national significance, such as the detonation of an improvised nuclear device or a radiological dispersal device. It should be noted that these methods were not developed for drinking water compliance monitoring and should not be considered as having EPA approval for that or any other regulatory program.

LINK TO ASPHALT PAVING MATERIALS METHOD

Rapid Method for Sodium Hydroxide Fusion of Asphalt Matrices Prior to Americium, Plutonium, Strontium, Radium, and Uranium Analyses, EPA- 402/R16-001, Revision 0, August 2016. https://www.epa.gov/radiation/rapid-radiochemical-methods-selected-radionuclides

LINK TO ASPHALT SHINGLE METHOD

Rapid Method for Sodium Hydroxide Fusion of Asphalt Roofing Material Matrices Prior to Americium, Plutonium, Strontium, Radium, and Uranium Analyses, EPA -402/R16-003, Revision 0, August 2016. https://www.epa.gov/radiation/rapid-radiochemical-methods-selected-radionuclides

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