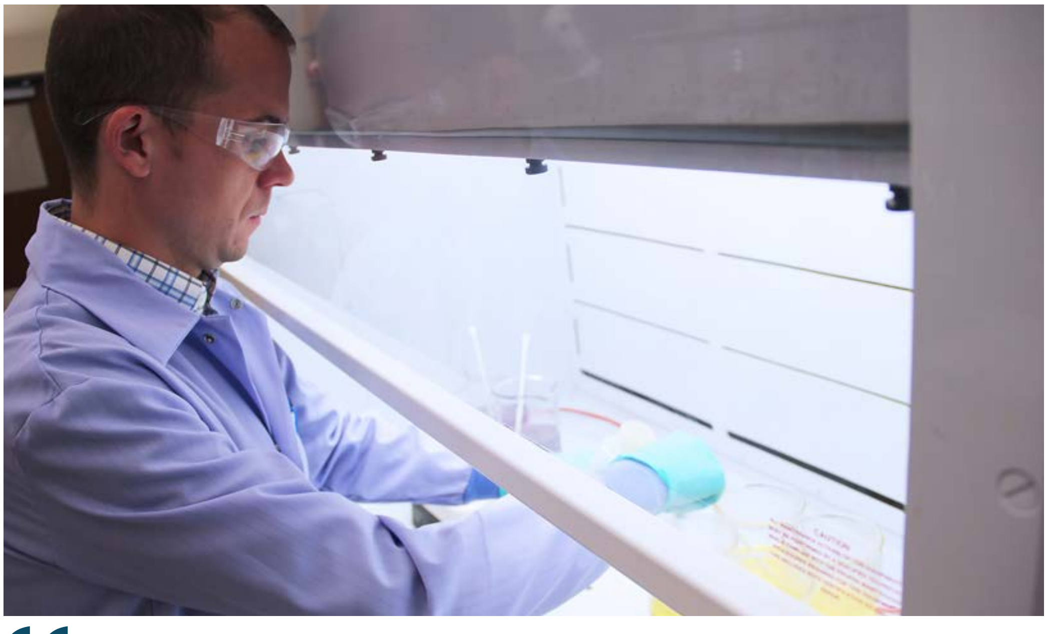
Iowa's State Hygienic Laboratory Tackles Radioanalytical Challenges for Lead-210

by **Dustin May**, radiochemistry supervisor and graduate researcher, State Hygienic Laboratory at the University of Iowa

Even though lead's adverse health impact on human health is commonly recognized, the health impacts of radioactive lead isotopes are often ignored and overlooked. Lead-210 (^{210}Pb) is a radioactive form of lead that can be found naturally in earth sediments, rocks that contain natural uranium, ground-derived water and in air as a decay product of radon gas. Radon is a cancer causing gas and is the second leading cause for lung cancer according to the American Cancer Association. Adverse health impacts of ^{210}Pb include the carcinogenic effects of its beta particle emission, as well the alpha particle emission of its decay product, Polonium-210 (^{210}Po), which is extremely hazardous when inhaled or ingested. It is, therefore, helpful to actively monitor for the environmental contaminant ^{210}Pb. However, the determination of ^{210}Pb in complex aqueous solutions, such as hydraulic fracturing flowback fluid, is a common radioanalytical challenge in environmental science.

Researchers at the State Hygienic Laboratory (SHL) and University of Iowa have developed a new alternative method to measure ^{210}Pb by using the electron-capture, gamma-emitting isotope Lead-203 (^{203}Pb) as a yield tracer. The new method takes advantage of the relatively short half-life (52 hours) of the ^{203}Pb isotope and its pure gamma emission to circumvent interferences from stable lead and alkaline earth metals in the chemical separation and enables the accurate measurement of ^{210}Pb in environmental samples at trace levels.

Laboratory supervisor Dustin May analyzes drinking water for gross alpha particles as part of community water system regulatory compliance. Photo: University of Iowa



"As with all science, and especially with environmental science, we must actively ask questions and do the work to determine the potential impacts of contaminants in the environment. Research on these potentially important environmental hazards is critical to developing evidence-based, common sense regulation to protect public health."

—Dustin May, radiochemistry supervisor and lead for research projects

Alpha-emitting radionuclides are co-precipitated with iron hydroxide using a color indicator, bromocresol purple, and a strong base, ammonium hydroxide. Photo: University of Iowa

Traditionally, yield for ^{210}Pb measurements is determined utilizing the recovered mass of a stable lead carrier. This approach, while very simple, is susceptible to interferences from endogenous stable lead and high levels of alkaline earth metals such as barium and strontium. Additionally, mass-based yield approaches limit the counting methodology to gas-flow proportional counting or require the use of inductively-coupled plasma-mass spectrometry (ICP-MS) analysis for yield determination. The new method developed at SHL eliminates the need for a stable lead carrier entirely, while allowing for the use of variable counting methodologies, including liquid scintillation counting. This additional flexibility can allow for simpler calibration and counting procedures utilizing liquid scintillation counting (LSC).

Besides offering the full spectrum of radioanalytical testing services to support the public health community, the SHL's radiochemistry department is leading research efforts to answer important questions such as hydraulic fracturing's impact on our environment, as well as the potential impact of less well-understood radioactive isotopes (such as ^{210}Pb and ^{210}Po) on public health in public and private drinking water. These radioactive isotopes are not routinely monitored in drinking water, and their prevalence in public and private drinking water has not been widely studied; SHL and the University of Iowa researchers are currently undertaking several studies examining the distribution of these radioactive materials in drinking water. ■