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Duke graduate student Laura Ruhl collects samples from a site affected by the TVA coal sludge spill. | Avner Vengosh

Analysis shows exposure to ash from TVA spill could have 'severe health implications'

Nicholas School's Avner Vengosh leads tests in eastern Tennessee

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DURHAM, NC -- A report by Duke University scientists who analyzed water and ash samples from last month's coal sludge spill in eastern Tennessee concludes that "exposure to radium- and arsenic-containing particulates in the ash could have severe health implications" in the affected areas.

"Our radioactive measurements of solid ash samples from Tennessee suggests the ash has radiation levels above those reported by the Environmental Protection Agency (EPA) for typical coal ash," said Avner Vengosh, associate professor of earth and ocean sciences at Duke's Nicholas School of the Environment. "Preventing the formation of airborne particulate matter from the ash that was released to the environment seems essential for reducing possible health impacts."

More than a billion gallons of sludge coal waste spilled from a holding facility at the Tennessee Valley Authority's Kingston coal-burning power plant on Dec. 22. The ash-laden waste flooded more than 400 surrounding acres and spilled into a tributary of the Emory River, which converges with the Clinch River and flows into the Tennessee River, a major source of drinking water for many communities in the region. The spill was so large it partly dammed the tributary of the Emory River, turning it into a standing pond.

Vengosh's team found that the combined content of radium-228 and radium-226 – the two long-lived isotopes of radium – in the solid ash samples they collected from the TVA spill measured about 8 picocuries per gram. That's higher than the average 5-6 picocuries per gram reported by the EPA in most bottom and fly ash samples. The curie is a standard measure of the intensity of radioactivity.

Radium is a naturally occurring radioactive element that decays from uranium and thorium elements in coal. When the coal is burned, it is concentrated in the ash. The EPA classifies radium as a Group-A carcinogenic material, which means exposure to it could cause cancer.

Water samples collected and analyzed by Vengosh and Duke graduate student Laura Ruhl found high levels of arsenic, measuring 95 parts per billion, in water from the dammed tributary where coal ash has accumulated. Only low concentrations were found in the Emory and Clinch rivers. The EPA has set the arsenic standard for safe public drinking water at 10 parts per billion.

Arsenic is a toxic metal that can occur naturally in the environment or as a by-product of some agricultural and industrial activities. According to the EPA, the effects of long-term chronic exposure to arsenic can include increased risk of certain types of cancer, as well as skin damage and circulatory problems.

"The good news is, we detected only trace amounts of arsenic in waters beyond the dammed tributary," Vengosh said. "The data suggests that in less than three weeks since the spill, river flow has diluted the arsenic content. The river is clean, but the water from areas like the dammed tributary, where the coal ash has accumulated, still contains high arsenic levels."

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He and Ruhl collected the water and solid ash samples at sites affected by the TVA spill on Jan. 9. Duke research scientist Gary Dwyer analyzed the water samples for trace metal content using inductively coupled plasma mass spectrometry. Following preliminary analysis, the solid ash samples were incubated and underwent more detailed analysis of their radioactive content using gamma spectrometry.

Vengosh's team collected the samples from the TVA spill after being contacted by United Mountain Defense, a nonprofit environmental group based in Tennessee. The Duke researchers received no funding from the group or any other external party. All funding was provided by the Nicholas School, Vengosh said, "to maintain total impartiality in our analysis."

"The TVA spill is one of the largest events of its kind in U.S. history. It raises questions concerning the safety of storing coal ash and the potential effects of coal ash on environmental and human health," Vengosh said. "We hope our analysis will help provide some answers."

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