New catalyst removes harmful perchlorate from groundwater

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Scientists at the University of Illinois at Urbana-Champaign have developed a new chemical catalyst that uses hydrogen gas to efficiently remove and destroy harmful perchlorate in contaminated groundwater.

Found in solid-rocket fuel, roadside flares and fireworks, perchlorate is a dangerous contaminant that can disrupt thyroid function by interfering with the uptake of iodine. Infants and fetuses are believed to be particularly at risk from the effects of perchlorate exposure.

Because perchlorate is readily soluble in water, it can be transported vast distances in groundwater or rivers. A plume of contaminated groundwater from a manufacturing plant near Las Vegas, for example, reached the Colorado River and spread throughout the Southwest. Cleanup could take decades. "Perchlorate has been recognized as a significant environmental contaminant in U.S. water supplies, and its physical and chemical properties pose a serious challenge for remediation," said John Shapley, a professor of chemistry at Illinois and co-developer, with graduate student Keith Hurley, of the new catalyst.

Efforts at remediation using naturally occurring microorganisms or existing pump-and-treat technology are too complicated, too energy intensive or too slow to be practical, Shapley said.

The new catalyst is composed of two metals – palladium and rhenium – supported on activated carbon. The catalyst operates at room temperature under normal atmospheric pressure, and does not dissolve in

water.

"In catalytic operation, the rhenium removes an oxygen atom from the perchlorate molecule in what is called an atom transfer reaction," Hurley said. "Meanwhile, the palladium activates the gaseous hydrogen atoms so they will react with the freed oxygen. What's left is harmless chloride and water." The catalytic reaction continues as long as there is both hydrogen gas and perchlorate contaminant present.

"While current technologies – such as ion exchange systems – can concentrate and remove perchlorate from water, they cannot destroy it," said Shapley, who will describe the new catalyst at the national meeting of the American Chemical Society. "Our catalyst would take a concentrated stream of perchlorate and get rid of it altogether."

Source: University of Illinois at Urbana-Champaign