Nano-sponges for toxic metals

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Microscopic particles honeycombed with holes only nanometers wide soon could help purify industrial runoff, coal plant smoke, crude oil and drinking water of toxic metals, experts told UPI's Nano World.

The particles, made of glass or natural diatomaceous earth, are 5 millionths to 50 millionths of a meter wide and filled with holes a thousand times smaller. The surfaces of these particles can bear a variety of flavors or coatings that soak up specific toxic metals -- for instance, sulfurous organic coatings attract mercury, while coppery organic coatings bind to arsenic and radioactive metals known as actinides. The particles' spongy nature gives them an incredible 6,400 square feet to nearly 11,000 square feet of surface area per gram of material with which to draw in toxins.

Physical chemists at Pacific Northwest National Laboratory in Richland, Wash., developed the particles, known as SAMMS -- or self-assembled monolayers on mesoporous supports -- to remove mercury from oil in nuclear facility pumps last decade. Over the past three years, the scientists have vastly broadened the potential applications of the particles and partnered with companies to bring them into greater use.

"We have a technology that can be used to address a large number of emerging water treatment problems, with arsenic and mercury as just a couple of examples," said Richard Skaggs a civil engineer at PNNL. "For example, in Washington, D.C., and certain other parts of the country, radium in the water is a problem, and many existing conventional technologies really cannot move it or other contaminants

down to acceptable levels. These nanomaterials offer a new opportunity."

The SAMMS particles can not only soak up toxic metals, but once disposed of in landfills, the particles also should prove too large for microbes to consume. Keeping microbes clean of toxins helps ensure the metals do not enter the ecosystem and become concentrated, for instance, in fish, Skaggs explained.

"We see a cost reduction of a factor of 10 when it comes to saving landfill space because only very, very small amounts of material are needed," Skaggs added.

The lab is partnering with Steward Advanced Materials in Chattanooga, Tenn., to help clean mercury from coal-plant exhaust gas emissions, to help meet Environmental Protection Agency requirements. The lab also is partnering with Perry Equipment Company, also known as PECO, in Mineral Wells, Texas, to remove naturally occurring mercury from the water found in offshore oil wells to ensure the water can safely get discharged back into the ocean.

Other projects the lab is collaborating with companies on include removing arsenic from drinking water and reducing the amount of mercury in crude oil to 5 parts per billion, because mercury concentrations as low as 25 parts per billion in oil can foul up the catalysts employed in oil refining.

The research with PECO is furthest along, Skaggs noted, and the lab hopes by next year to start engineering ways PECO can use SAMMS in products. Future research involves making production more efficient and testing other materials as potential SAMMS particles, such as carbon, which could prove durable in wide extremes of temperature and acidity.

The particles also could find use in ultra-sensitive toxin detectors, Skaggs said.

"We believe SAMMS provides a potential to implement a revolutionary change in the way we approach remediation of toxic substances," said Bob Jones, managing partner at Energy & Environmental Enterprises in Atlanta.