Greener processing makes novel material cheaper for water decontamination

Researchers show greener processing can reduce estimated production cost for novel materials that remove heavy metals from industrial wastewater.

BIRMINGHAM, WEST MIDLANDS, UNITED KINGDOM, August 20, 2026 /EINPresswire.com/ -- University of Birmingham scientists who used green chemistry to make a next-generation Metal Organic Framework (MOF) for capturing heavy metals from wastewater, have shown it is cheaper and more resource-efficient to produce than the similar MOF processed conventionally.

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> *Dr Swaroop Chakraborty, University of Birmingham, U.K.*

Water contamination caused by industrial wastewater leaching into the environment remains a persistent public health problem. Exposure to metals such as lead is particularly harmful to children and has lifelong effects.

While the challenge of treating chemically complex wastewater created by industrial processes such as mining, and electronics or chemical manufacturing is far from solved, MOFs are emerging as a technology with huge potential.

These advanced materials have metal nodes connected by organic linkers, resulting in a cage-like molecular structure with enormous internal pore networks providing huge internal surface area that acts like a sponge to selectively capture heavy metals dissolved in water.

However, many MOF manufacturing and post-processing routes are solvent- or energy-intensive. Moreover, the metals used in MOFs can leach into the water being treated, potentially causing secondary contamination. Both these issues have held back the use of MOFs as green materials for wastewater treatment and most are still at pilot or demonstration stage.

Researchers led by Dr Swaroop Chakraborty, a NERC Independent Research Fellow from the School of Geography, Earth and Environmental Sciences, are working on the safer and more sustainable design of these innovative materials.

He said: "For water-treatment materials, removing the pollutant is only half the story. We also

need to understand how materials like metal organic frameworks are manufactured and how they change during use in the environment. By redesigning one processing step, we were able to recover much more of the material, lower its estimated production cost while retaining its strong lead-capture performance under environmentally relevant conditions."

The team has already developed a novel method to make a green-synthesised MOF using a scalable water-based process.

University of Birmingham Enterprise has filed a patent application on the method, and the material, which was engineered to recover rare earth elements and heavy metals from industrial waste streams.

The material has been tested on real-world water samples, where it showed remarkable efficiency in removing lead from chemically complex solutions, with low copper leaching. It comes in the form of pellets rather than fine powder, which enables easier handling in real-world situations.

Dr Chakraborty's most recent research, which is now published in Green Chemistry, has further embedded green chemistry principles in MOF manufacturing techniques.

The paper details a freeze-drying technique that increases isolated yield more than threefold and reduces estimated electricity demand per gram by around 74%- lowering estimated lab-scale production cost from around $19/g to just over $5/g compared with conventional processing.

The research demonstrates freeze-dried MOF has a high capacity to rapidly remove lead from solution, with over 90% removal in the first hour, with high removal maintained across four consecutive treatment batches. It also showed that the material retained its principal structural features after seven days of exposure to air, freshwater-like conditions and artificial seawater.

The researchers are now looking for industrial partners in mining, e-waste, or water treatment who are interested in licensing the technology for a specific application or co-developing a pilot-scale trial in a real-world setting.

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