Coal Mining Waste Material More Than 90 Per Cent Effective at Removing Heavy Metal

2021-07-26
Nano humus works like a sponge that attaches to and holds cadmium, a common byproduct of mining, U of A research shows.

A low-value byproduct of the coal mining process is proving highly effective at helping reclaim the land and water used in mining, University of Alberta research shows.

Nano humus, a substance extracted from coal mine deposits and then crushed to a black, powdery material, has “outstanding physical and chemical properties” that remove heavy metals from contaminated water and soil, said researcher Yihan Zhao.

Zhao conducted the research to earn her PhD in land reclamation and remediation from the Faculty of Agricultural, Life & Environmental Sciences (ALES).

Made up of natural organic compounds, nano humus works like a sponge that attaches and holds heavy metals. Testing waste water containing cadmium—one of the heavy metals most commonly produced by industries like mining—Zhao found that at a high concentration, about 90 per cent of the toxic heavy metal was removed after just 15 minutes. After 24 hours, 93 per cent was removed.

“It’s rapid, safe and effective,” said Zhao, whose work is part of Future Energy Systems, a cross-disciplinary research and teaching network at the U of A working to develop innovations for energy transition.

“The fact that we can use a waste material to reclaim an area that produces it is exciting,” said project supervisor Anne Naeth, director of Future Energy Systems and professor of land

reclamation and restoration ecology in the Department of Renewable Resources in ALES.

Naeth predicts nano humus could be in widespread industrial use within the next five years.

The findings offer the potential option for a low-cost, more efficient way to remediate industrial waste water and soil affected by resource extraction and manufacturing processes, Zhao noted.

Conventional remediation treatments for heavy metals use large amounts of chemicals which, in turn, can produce further contaminants that require treatment. Some remediation methods also require large amounts of electricity or can take days or months to complete.

Materials such as nano humus can be used not only for remediation of contaminants but can also contribute to soil-building, Naeth noted, by partially or completely replacing the bulkier materials of manure and straw typically used to amend soil.

“The huge amounts of these standard materials we need to apply has always been an issue for their use in land reclamation. Using nano humus reduces the amount of material we need and makes it much easier to transport and apply.”

Next steps are to partner with Canadian industries in mining reclamation to field test the nano humus. Moving from the lab research to industrial-scale application will help to determine actual costs and efficacy under natural environmental conditions.

The research, if applied to large-scale reclamation projects, could be especially beneficial for developing countries with fewer available resources for remediating industrial waste water and soil, Zhao added.

“Using nano humus to treat their contaminated land and water means reduced health risks and makes their land available for agricultural production and food security.

“The research also contributes to developing long-term solutions to the environmental concerns of industries globally,” she added.

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