Quirks and Quarks

Oil sands tailings ponds are toxic. Canadian-made nanotech could help fix that

Tiny floating solar-powered beads can break apart the worst of the tailings pond toxins

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Tailings drain into a pond at the Syncrude oilsands mine facility near Fort McMurray, Alta. on July 9, 2008. Syncrude Canada now estimates at least 350 birds have died after landing on one of its toxic tailings ponds in northern Alberta. (Jeff McIntosh/Canadian Press)

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Oil sands tailings ponds are toxic. Canadian-made nanotech could help fix that

Tiny glass-like bubbles developed at the University of Waterloo show a lot of promise for dealing with the most toxic components of oil sands tailings ponds.

Large numbers of the bubbles could be dropped into the ponds and, powered by the sun, would chemically break down some nasty organic wastes.

Tailings ponds store water used in oil sands extraction, and contain a complex mixture of wastes that are toxic to vegetation and animals.

A recent report by the Commission for Environmental Cooperation described "scientifically valid evidence" that Alberta's oil sands tailings ponds are leaking and contaminating groundwater.

- **Environmental watchdog report says Alberta oilsands tailings ponds are tainting groundwater**

Tiny floating beads could help remove toxins

Diane Orihel, an aquatic toxicologist from Queen's University wanted to evaluate the technology developed at Waterloo University to see if potential releases of the treated water would be safe. "Are they actually going to be safe for the aquatic life downstream?"

- **Research paper in the journal *Facets***

She worked with Frank Gu, a chemical engineer — now at the University of Toronto — who developed the technology. The target of their concern was what has been identified as the worst of the tailings ponds toxins: naphthenic acids.

Gu's technology consists of tiny glass bubbles coated with titanium dioxide nanocrystals that can float on the surface of the tailings ponds. The energy of the sun drives chemical reactions on the surface of these bubbles that generate highly reactive free radicals that can, according to Orihel, "blast apart" naphthenic acids.

Orihel tested the treated naphthalene-spiked water on fathead minnow eggs. (NOAA Great Lakes Environmental Research Laboratory)

Important to break down toxins all the way

Orihel told *Quirks & Quarks* host Bob McDonald that she and her students tested the titanium dioxide treated water on fathead minnow embryos.

In lab experiments 72% of of the fish eggs from the untreated naphthenic acid water solution died before they had the chance to hatch, and in field experiments it was even worse — 84% died.

"However, if we applied the titanium dioxide technology to the exposure solutions, we saw that we could almost eliminate what we call "acute mortality" — the death that happened right away."

But there's a catch.

To reduce toxicity, the titanium dioxide nanotechnology had to break down 90 per cent or more of the naphthenic acids, otherwise the solution becomes even more toxic. If they're not completely broken down, the byproducts are actually more toxic than the parent naphthenic acid compounds.

This suggests that application of this technology on a large scale in the field will have to come with careful monitoring to make sure that it doesn't make a toxic situation worse

Produced and written by Sonya Buyting

Corrections

- A previous version of this article stated that all of the fish eggs in the untreated naphthenic acid solution died. In fact, between 72 and 84 per cent died before hatching. In addition, the degree to which the acids need to be broken down to avoid risk of increased toxicity is 90 per cent, not 80 per cent as previously reported.
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