Sunflower pollen sponge could be used to absorb oil spills

By E&T editorial staff

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Scientists at Singapore's Nanyang Technological University have developed a reusable, biodegradable sponge which can soak up oil and other organic solvents from contaminated water, making it a promising candidate for helping tackle marine oil spills.

Oil spills are difficult to clean up and result in severe long-lasting damage to marine ecosystems and communities. Conventional clean-up methods, such as absorbing oil with expensive and unrecyclable materials, can worsen the damage.

The Nanyang Technological University scientists developed an eco-friendly alternative to these materials; the sponge is derived from sunflower pollen and coated with a fatty acid to repel water.

"By fine-tuning the material properties of pollen, our team successfully developed a sponge that can selectively target oil and contaminated water sources and absorb it," said Professor Cho Nam-joon, the Nanyang researcher who led the study. "Using a material that is found abundantly in nature also makes the sponge affordable, biodegradable and eco-friendly."

Pollen not used for plant pollination is often considered biological waste. Professor Cho and his colleagues aim to find new uses for this renewable, abundant and biocompatible resource.

The researchers first transformed the tough sunflower grains into a gel-like material through a chemical process similar to soap-making. They then freeze-dried the material, resulting in the formation of pollen sponges with porous architectures. After briefly being heated to 200°C, they gained stability of structure after repeatedly absorbing and releasing liquids and doubled resistance to deformation.

The researchers ensured that the sponge selectively targets oil and does not absorb water by coating it with stearic acid – a natural fatty acid – which renders it hydrophobic while retaining structural integrity.

In laboratory-based testing, they demonstrated that it can absorb oil contaminants of various densities, such as petrol and engine oil, at a rate comparable to commercial oil absorbents, which are petroleum-derived. They also tested the sponge for durability and reusability by repeatedly soaking it in silicone oil and squeezing the oil out, finding that this process could continue for at least 10 cycles. In a final experiment, they tested the ability of the sponge to absorb engine oil from a contaminated water sample, finding that it absorbed the oil in less than two minutes.

“Collectively, these results demonstrate that the pollen sponge can selectively absorb and release oil contaminants and has similar performance levels to commercial oil absorbents, while demonstrating compelling properties such as low cost, biocompatibility and sustainable production,” Cho said.

So far, they have engineered sponges up to 5cm in diameter. In the future, the researchers aim to scale up the size of the sponges to meet industry needs and to partner with NGOs to conduct pilot tests in real-world environments.

“We hope our innovative pollen materials can one day replace widely used plastics and help to curb the global issue of plastic pollution,” said Cho.

MATERIAL INNOVATION OIL AND GAS WATER MANAGEMENT INFRASTRUCTURE
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