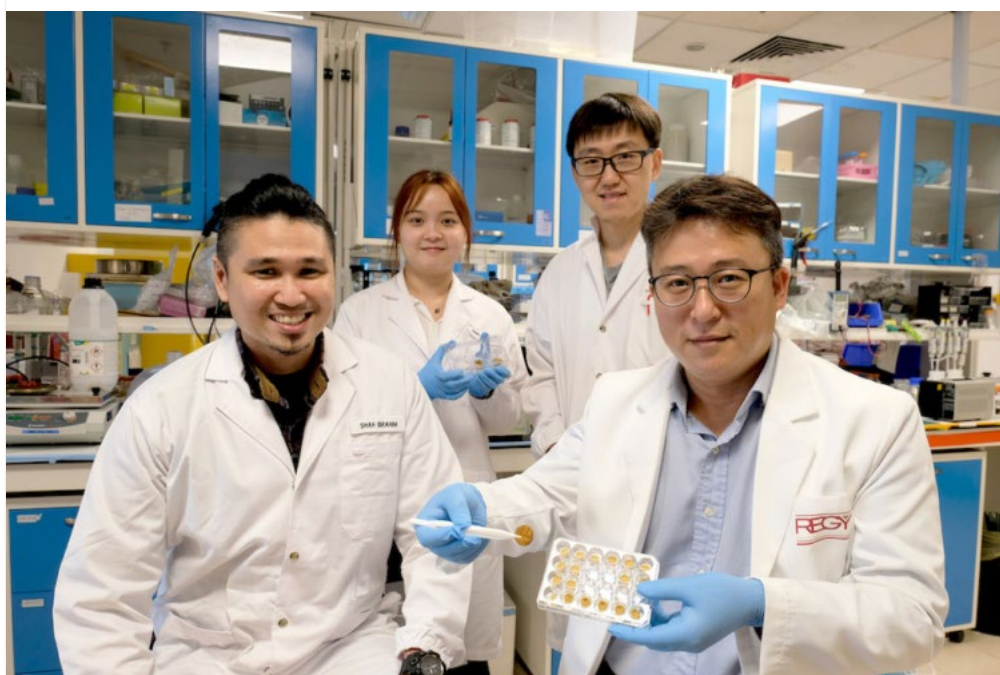


News Energy & environment Materials

New pollen sponge could tackle water contaminants

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A team led by Nanyang Technological University, Singapore has developed an eco-friendly pollen sponge that could help to tackle water contaminants.



(L-R) NTU PhD student Mohammed Shahrudin Ibrahim, NTU Masters student Deng Jingyu, NTU research fellow Dr Zhao Ze, and NTU Prof Cho Nam-Joon. Credit: NTU Singapore

The reusable, biodegradable sponges measure 5cm in diameter and can soak up oil and other organic solvents, making them a promising alternative for tackling marine oil spills when scaled-up, researchers said.

Made of sunflower pollen, the sponge is hydrophobic

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thanks to a coat of fatty acid. In lab experiments, scientists showed the sponge's ability to absorb oil contaminants of various densities at a rate comparable to that of commercial oil absorbents.

Oil spills are difficult to clean up and result in severe damage to the marine ecosystem. Conventional clean-up methods, including using chemical dispersants to break oil down into small droplets or absorbing it with expensive, unrecyclable materials can worsen damage.

Smart sponge selectively soaks up oil in water

Sponge speeds up removal of oil from wastewater

The research **builds on NTU's work** finding new uses for pollen by transforming its tough shell into microgel particles. This soft, gel-like material is then used as a building block for a new category of environmentally sustainable materials. The team behind the new study is made up of researchers from NTU Singapore and South Korea's Sungkyunkwan University.

"Pollen that is not used for plant pollination is often considered biological waste," said Cho Nam-Joon, project leader and professor at NTU's School of Materials Science and Engineering. "Through our work, we try to find new uses for this 'waste' and turn it into a natural resource that is renewable, affordable, and biodegradable.

"Pollen is also biocompatible. It does not cause an immunological, allergic or toxic reaction when exposed to body tissues, making it potentially suitable for applications such as wound dressing, prosthetics and implantable electronics."

To form the sponge, the team transformed the pollen grains from sunflowers into a pliable, gel-like material through a chemical process akin to soap-making. The process involves removing the sticky oil-based pollen cement that coats the grain's surface, before incubating the pollen in alkaline conditions for three days. The resulting material was then freeze-dried.

This resulted in the formation of pollen sponges with 3D porous architectures. The sponges were briefly heated to 200°C, which makes their form and structure stable after repeatedly absorbing and releasing liquids. Heating also led to two-fold improvement in the sponge's resistance to

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deformation, researchers found.



Scientists coated the sponge in a layer of stearic acid to ensure it selectively targeted oil and did not absorb water. Oil-absorption tests were then carried out on the sponge with solvents including gasoline, pump oil and n-hexane.

Findings showed that the sponge had an absorption capacity in the range of 9.7 to over 29.3g/g. This is comparable to commercial polypropylene absorbents, which are petroleum derivatives and have an absorption capacity range of 8.1 to 24.6g/g.

Researchers also tested the sponge for its durability and reusability by repeatedly soaking it in silicone oil, then squeezing the oil out. This was able to continue for ten cycles, they confirmed.

In a final proof-of-concept experiment, the team tested the ability of a sponge 1.5cm in diameter and 5mm in height to absorb motor oil from a contaminated water sample. According to researchers, the oil was absorbed in less than two minutes.

Next, the researchers plan to scale up the size of the sponges to meet industry needs and hope to collaborate with non-governmental organisations to conduct pilot tests with the sponges in real-life 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 Professor Cho.