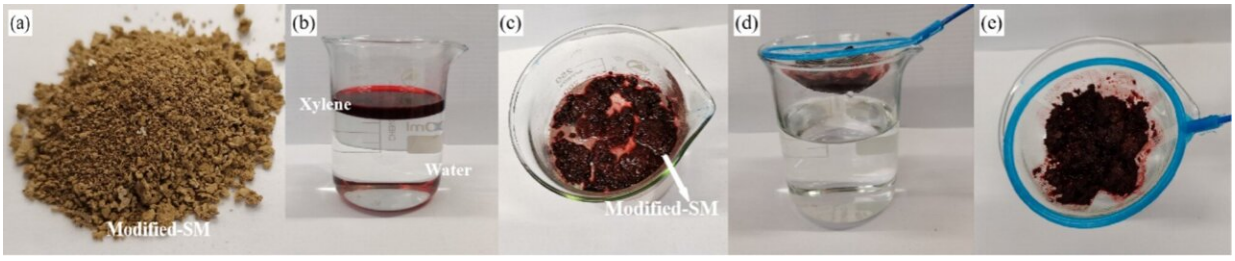
Reusable moss-based adsorbent can help clean up oil spills

April 18 2025, by Sanjukta Mondal



Oil pollution adsorption by modified sphagnum moss(modified-SM): (a) Macroscopic morphology of the modified sphagnum moss, (b) Oil-water mixture before adsorption, (c) Adsorption process showing adsorbed material, and (d, e) Separation of the material after adsorption. Credit: *Scientific Reports* (2025). DOI: 10.1038/s41598-025-96059-7

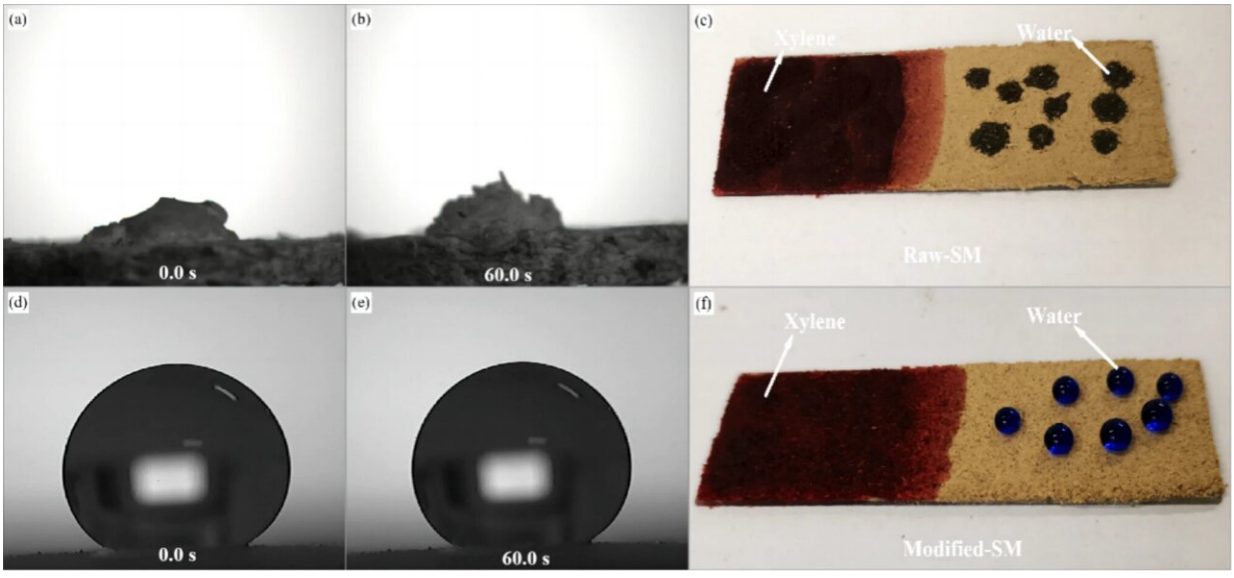
Hidden within sphagnum moss, commonly known as peat moss, is an adsorbent material that can help us combat oil spills. A study by researchers from China presents a new bio-based oil adsorbent derived from sphagnum moss that can selectively soak up oil.

Chemically modifying the peat moss resulted in a potential oil sponge with the ability to maintain over 90% of initial adsorption capacity even after 10 cycles of usage, according to the findings published in *Scientific Reports*.

Every year, hundreds of tons of oil get spilled into water bodies as a result of oil drilling gone wrong, pipeline leaks and big oil transportation ships sinking. Such oil and chemical spills can have devastating effects on aquatic wildlife, poisoning habitats and disrupting the food chain, among other serious consequences. Humans aren't immune to the impact of these oil spills either, as exposure can affect the lungs, heart and the immune system.

The growing urgency to deal with deadly oil spills has driven scientists to explore bio-based materials that can effectively separate oil from water. However, current natural bio-based adsorbents derived from fruit peels or cotton often suffer from low capacity, poor reusability, and their inherent hydrophilic nature makes selective adsorption of oil from oil-water mixtures rather difficult.

To design a natural material that could overcome these issues, the scientists chose sphagnum moss as the base material and then treated it with hydrogen peroxide and sodium hydroxide, sequentially.

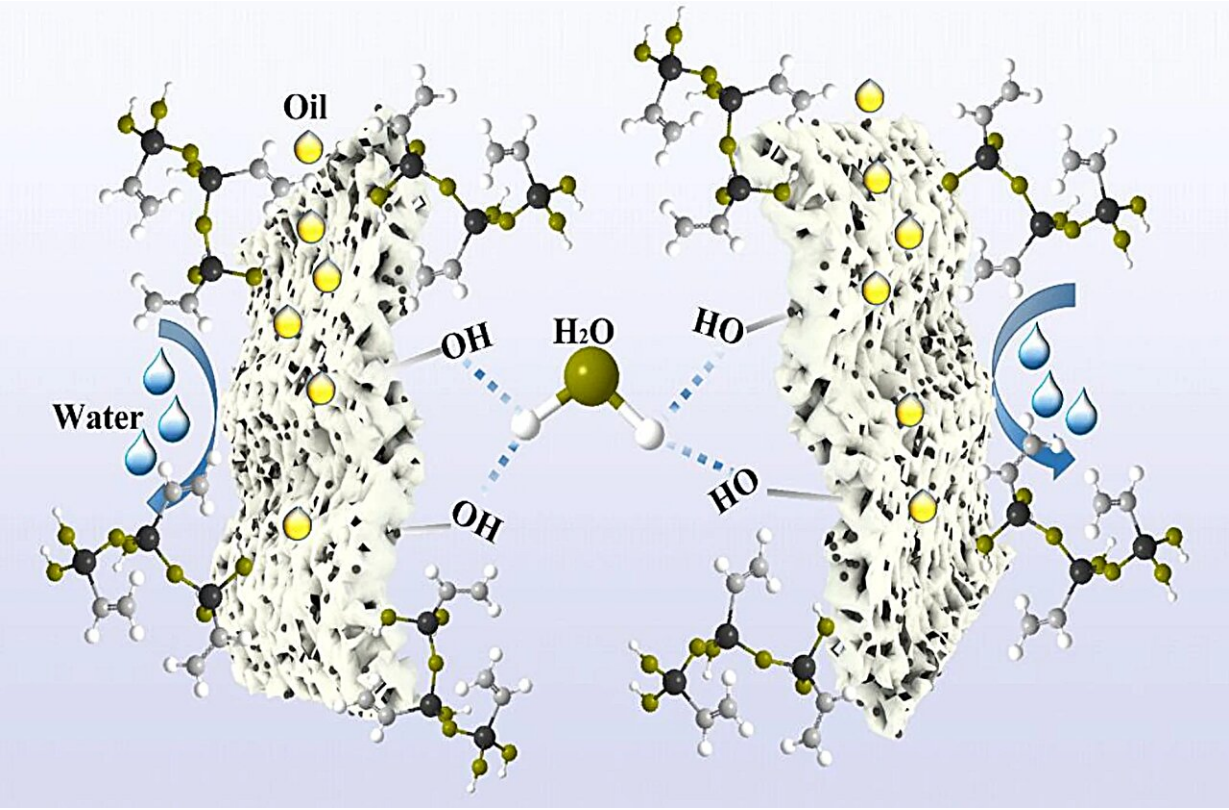


Hydrophobic and oleophilic properties of original sphagnum moss (a-c) and modified sphagnum moss (d-f). Credit: *Scientific Reports* (2025). DOI: 10.1038/s41598-025-96059-7

These chemicals increased the porosity of the moss surface and exposed the hydrophilic functional groups that make the moss surface water-loving. The obtained material was then treated with silane, a popular silicon-based surface modifier, which formed a thin polymeric layer on the moss surface, making it more attracted to oil by introducing oleophilic groups and covering up the hydrophilic ones.

A closer look at the modified moss using scanning electron microscopy and spectroscopic techniques revealed a rough surface, successfully grafted with water-repelling groups, creating a contact angle of 157° for water to roll off easily.

This resulted in enhanced selectivity towards oil, which was evident from the adsorption tests, where the modified sphagnum moss exhibited an adsorption capacity of 22.756 g/g for motor oil, outperforming many popular bio-based adsorbents, whose capacities range from 1.69 to 18.2 g/g.



Mechanistic diagram of oil-water separation adsorption. Credit: *Scientific Reports* (2025). DOI: 10.1038/s41598-025-96059-7

The researchers also discovered that chemisorption—the process of adsorption formation of strong chemical bonds between oil molecules and the functionalized surface—was the dominant mechanism which contributed to enhanced adsorption efficiency and oil affinity.

The modified moss-based oil adsorbent presents itself as a promising and eco-friendly tool for combating oil spills, thanks to its excellent adsorption performance and reusability.

More information: Junpeng Ren et al, Sustainable hydrophobic bio-based adsorbent from modified sphagnum moss for efficient oil-water

separation, *Scientific Reports* (2025). DOI: 10.1038/s41598-025-96059-7