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Building the Future with Biotech

Biotech for the Environment

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Emerging biotechnology enables many opportunities for a more vibrant environment, such as modifying microbes, like yeast, to upcycle waste for new materials or breeding crops that require fewer resources to grow. But what if we were also able to harness the power of living organisms to help clean up the environment? What if organisms could also absorb, store, and break down contaminants in our soil and water? In fact, using plants and microbes, bolstered by biotechnology, we already can through a process called ***bioremediation***. This paper offers three examples of how bioremediation plays a critical role in renewing our environment and how advancements in biotechnology are opening the door to even more effective solutions.

Photo courtesy of the Exxon Valdez *Oil Spill Trustee Council*

A new dawn of cleaning oil spills: In 1989, the Exxon Valdez oil spill dumped an estimated 11 million gallons of oil off the coast of Alaska, causing devastating effects on the ocean and the environment. Initial cleanup attempts using traditional methods, like physical barriers and chemical dispersants, were futile.[1] Therefore, the Environmental Protection Agency (EPA) and Exxon turned to the ocean's own microbial environment. Using microbes already in the ocean, which naturally break down certain compounds in oil, cleanup crews were able to improve efforts by supplementing the microbes with EPA-approved fertilizers, accelerating the breakdown of oil.[2] Efforts are currently underway to explore how biotechnology could improve microbial activity for use in future environmental disasters.[3]

Photo by Jeanethe Falvey, U.S. EPA

"Forever" no more: PFAS, short for per- and polyfluoroalkyl substances, is a group of chemicals found in a variety of products, from non-stick pans to fire-fighting foam. Known to cause negative health effects including causing cancer, these "forever chemicals" persist in the environment and in our bodies.[4] One study from the Centers for Disease Control and Prevention estimated that 98% of the U.S. population has some form of PFAS chemicals in their blood.[5] In 2024, the EPA took steps to curb the use of PFAS in new products, but there is still a need to remove existing PFAS in the environment.[6] Biotechnology and bioremediation offer such a solution, such as with sponges that promote natural microbial growth that can soak up and break down PFAS. One company's tests have shown that bioremediation could remove as much as 90% of PFAS from samples over a year.[7]

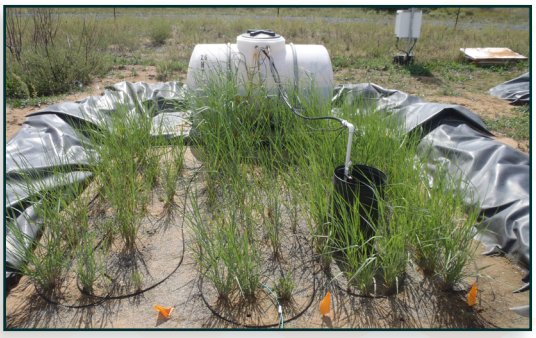

Photo by Timothy Cary, USACE

Safeguarding nature, using nature: While plants play a big role in cleaning the air by absorbing carbon dioxide and turning it into oxygen, plants also can clean the soil and water below our feet. When trees or grasses are planted near industrial plants or military demonstration sites, they can serve as a natural barrier to prevent toxic runoff. For example, the U.S. Army Corps of Engineers is growing modified switchgrass plants that can absorb explosive residues, like TNT, from their demonstration sites.[8] These grasses absorb explosive residues through their roots, neutralize them, and store them safely in roots and leaves. Biotechnology can increase the resilience of plants used in bioremediation, allowing enhanced plants to store more contaminants than unmodified ones.[9]

Sources

1 EPA. Response to Oil Spills.
2 Bragg et al. doi: 10.1038/368413a0.
3 Rebello et al. doi: 10.1080/21655979.2021.2004645.
4 White House. NSTC PFAS Report.
5 Calafat et al. doi: 10.1016/j.envint.2019.105048.
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