

Bacteria used to clean diesel-polluted soil in Greenland

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Landfarming works by distributing contaminated soil in a thin layer, which is then plowed, fertilized and oxygenated every year to optimize conditions for bacteria to degrade hydrocarbons. Credit: Anders Christian Vestergaard

Diesel-polluted soil from now-defunct military outposts in Greenland

can be remediated using naturally occurring soil bacteria, according to an extensive five-year experiment in Mestersvig, East Greenland, to which the University of Copenhagen has contributed.

Mothballed military outposts and stacks of rusting oil drums aren't an unusual sight in Greenland. Indeed, there are about 30 abandoned military installations in Greenland where [diesel](#), once used to keep generators and other machinery running, may have seeped into the ground.

This is the case with Station 9117 Mestersvig, an abandoned military airfield on the coast of East Greenland. Forty tons of diesel fuel contaminated the [soil](#) at Mestersvig. As a result, Danish Defence and NIRAS, an engineering company, initiated an experiment to optimize the conditions for naturally occurring soil [bacteria](#) to break down soil contaminants.

Bacterial populations and the biodegradation of diesel compounds were continuously monitored by scientists from the University of Copenhagen's Department of Plant and Environmental Sciences and the Geological Survey of Denmark and Greenland (GEUS). After five years, the researchers found that the bacteria had bioremediated as much as 82 percent of the 5,000 tons of contaminated soil.

"The bacteria have proven extremely effective at breaking down the vast majority of the diesel compounds. As such, this natural method can be applied elsewhere in the Arctic, where it would otherwise be incredibly resource-intensive to remove contaminated soil by way of aircraft or ship," explains Professor Jan H. Christensen of the University of Copenhagen's Department of Plant and Environmental Sciences. Christensen has been responsible for analyzing the chemical fingerprints in the diesel-contaminated soil.

Never thoroughly studied and documented

The method, known as landfarming, is most often associated with [warmer climates](#) around the world. Prior to this project, landfarming had never been tested on a large scale under Arctic conditions. Nor had the method ever been as thoroughly studied and documented as in this experiment.

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Watering the field

Landfarming works by distributing contaminated soil in a [thin layer](#), which is then plowed, fertilized and oxygenated every year to optimize conditions for bacteria to degrade hydrocarbons. Photo: Anders Christian Vestergaard

According to Anders Risbjerg Johnsen, a microbiologist and senior research scientist at GEUS, the landfarming work resulted in regular explosions of soil bacteria, which he was able to keep track of from Denmark using advanced samples of soil bacteria.

"Having a wide variety of hydrocarbon-degrading bacteria is essential as the 10,000 various diesel compounds contaminating the soil require different degradation pathways to be broken down," explains Johnsen.

Ability to clean up abandoned bases

Warmer 'summer' temperatures of between 0 and 10 degrees only last about three months in Mestersvig. For the rest of the year, the soil is frozen. Thus, it was uncertain whether Greenlandic [soil bacteria](#) could break down the leaked diesel as effectively as bacteria in warmer conditions.

Fortunately, the study demonstrated that the bacteria could easily degrade diesel contaminants in the soil, despite the frigid temperatures. In the future, the researchers hope that naturally occurring bacteria can be used to remediate contamination in the Greenlandic environment at

roughly 30 other deserted installations. The lack of infrastructure has made it extremely expensive and resource-intensive to move soil around as, for example, might be done in Denmark.

"Some degree of diesel pollution can be found at nearly every Arctic site where there was once a [weather station](#), research station or military installation. It is likely that the approach used in our experiments can be used at many of these sites," say Jan H. Christensen and Anders Risbjerg Johnsen.

The researchers are returning to Greenland this year to conduct new studies on the experiment. They hope to find that the bacteria have successfully degraded all remaining diesel contamination.

More information: Anders R. Johnsen et al, Full-scale bioremediation of diesel-polluted soil in an Arctic landfarm, *Environmental Pollution* (2021). [DOI: 10.1016/j.envpol.2021.116946](https://doi.org/10.1016/j.envpol.2021.116946)

Provided by University of Copenhagen

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