DATELINE/

LARGE-SCALE BIOREMEDIATION

NATIVE MICROBES' ROLE IN ALASKAN CLEAN-UP

WASHINGTON, D.C.—Use of microbes to help clean Exxon's (New York, NY) Alaskan oil spill from last March is surely not one of the most dazzling examples of biotechnology, but it may represent one of the largest operations undertaken to date. In August, following pilot studies conducted by U.S. Environmental Protection Agency (EPA) researchers, teams began spraying microbe-enhancing fertilizers on the oil-slicked beaches along Prince William Sound and the Gulf of Alaska. The cooperative bioremediation effort between EPA and Exxon teams is not relying on engineered microbes, but on native species already adapted to the Alaskan environment. The simplicity of the scheme provides a rare but refreshing example of virtually unopposed environmental biotechnology.

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Adding fertilizers does not appear to inflict any harm on the environment beyond that left by the oil spill, according to EPA tests. "Biomass is not being stimulated to a point where there is a visible slime," says James Clark of EPA (Valdez, AK and Gulf Breeze, FL). The microbial by-products of oil degradation become part of the food chain, with much of the partly degraded hydrocarbon materials being further metabolized by shellfish without accumulation of toxic materials.

Bioremediation is a follow-up step for the cleanup, one that comes after collection of bulk oil that is swept off the beaches by warm-water jets from fire hoses, according to Sam Hinton of Exxon. Such standard mechanical procedures leave residues, some of which can be eliminated by microbial action. The goal in adding fertilizers is to speed up the natural process of oil degradation, with the added nutrients expected to give native microbes a fast start and thus to cut time for the process roughly in half. "If we let nature degrade the oil, we would be looking at [the process taking] from five to ten years because of the cold, clear waters with low nutrient content," says Clark. Although not "a magic cure," adding nutrients to enhance the process could reduce that time to three to seven years.

During the late spring and summer, EPA researchers conducted tests to evaluate several formulations containing nitrogen and phosphorus, which are the nutrients that limit microbial growth because of their short supply in coastal waters, Clark says. The favored formulation compounds these nutrients in an oleophilic carrier. The material collects at oil-water interfaces, presumably concentrating microbes in just the microenvironment where they are needed.

According to Clark, pilot tests on contaminated beach plots indicate that bacterial populations increase while spilled oil compositions "change dramatically, with some components disappearing rapidly." However, because the spilled oil is so heterogeneous in its distribution, "the test plots show lots of variability." Nonetheless, contrary to the claims of skeptics, the cleansing action does not appear to be attributable merely to detergent effects of the oleophilic fertilizer, Clark says. In lab tests on sterilized specimens, the fertilizer by itself has "little effect" on oily surfaces. "The detergent-effect explanation is unlikely, but even if it's true, the oil is still in a more degradable form."

Exxon has purchased 500 metric tons of the oleophilic fertilizer, which is supplied by Elf-Aquitaine (Paris, France), at a cost of $1.65 million, Hinton says. Plans call for spraying the material over two miles of contaminated beaches per day during the late summer, racing against the arrival of early winter storms that will retard microbial activity.

—**Jeffrey L. Fox**