BIOREMEDIATION

MORE CONFIDENCE ABOUT DEGRADING WORK

ANAHEIM, Calif.—Bioremediation, once figuratively and often literally a backwater for microbiology, is steadily gaining the high ground (*Bio/Technology* **8**:283, Apr. '90). The annual meeting of the American Society for Microbiology (ASM, Washington, DC) held here in May, yielded new details about practical achievements, including efforts to harness microbes in the clean-up of the Exxon oil spill in Alaska. Researchers also described promising results using microbes to help degrade complex synthetic organic compounds, such as polychlorinated biphenyls (PCBs).

The clean-up of crude oil along the Prince William Sound in Alaska surely ranks as the grandest implementation of a bioremediation scheme to date. Last August, near the end of the abbreviated Alaskan summer, teams of workers began spraying microbe-enhancing oleophilic fertilizers along 70 miles of rugged, oil-contaminated shoreline (*Bio/Technology* **7**:852, Sep. 89). The fertilizer supplies nitrogen and phosphorous nutrients to indigenous hydrocarbon-degrading microorganisms, thereby accelerating microbial growth rates and the consequent disappearance of pollutants.

The spraying program had "a dramatic visual impact," says Hap Pritchard of the Environmental Protection Agency (EPA, Gulf Breeze, FL), who is part of the federal, state, and corporate consortium that has focused on the Alaskan clean-up project. Although less startling, other more objective measures of oil disappearance at such sites also are encouraging. Under "optimal conditions," the addition of fertilizers led to a "two-fold increase in the [hydrocarbon] degradation rate," he says. "In the 6–8-week period [last summer], there was 4–5 times more oil consumed than on untreated beaches."

The oleophilic fertilizer, made by a subsidiary of the petrochemical company Elf-Aquitaine (Paris), is "the French cuisine" that whets the microorganisms' appetites for the less appetizing American crude oil main course, according to Steve Hinton of Exxon Research and Engineering (Annandale, NJ). The mix of nutrients in the fertilizer, including its hydrocarbon chains, is all helpful in coaxing indigenous microbes to digest most of the complex ingredients in the spilled crude oil. The role of the fertilizer thus is unequivocally to enhance microbial growth and biodegradation, he says, "not a physical or a chemical effect."

In general, the microbial populations at shore sites in Alaska seem to adapt to environmental nutrients, including hydrocarbon contaminants, by changing population composition and function rather than overall population size, says Joan Braddock of the University of Alaska (Fairbanks). Some of the bioremediation sites that were sampled, Braddock says, "appear to have higher numbers of cells." Moreover, the oxidative process of hydrocarbon breakdown is more rapid and efficient at exposed, wave-washed sites than in sediments that are several feet away.

Contaminated sediments in other settings often furnish microbiologists with the organisms that serve as workhorses in novel bioremediation schemes. For instance, anaerobic microbes that can dechlorinate PCBs were found in pond sediments several years ago, and subsequently in other marine and freshwater aquatic environments, according to Donna Bedard of General Electric (Schenectady, NY). However, at Woods Pond in western Massachusetts, which is heavily contaminated with two PCB products, there is "little or no natural dechlorination...despite activity in [nearby] ponds," she says. Moreover, even in sediments where some degradation occurs, "We still haven't found microbes to remove [particular] chlorines and to break the ring anaerobically. The option is to use aerobic strains to complete the process, which we can do in the lab. This hasn't been tried in nature."

Bioremediation works, most experts in this field of research now are saying. Each site and event, however, seem to dictate different approaches. Fortunately, the "versatility of microbes is astounding," notes Bedard. But, she cautions, "It's important to understand metabolism and...to show there is [biochemical] destruction of contaminants." Nonetheless, adds Ronald Atlas of the University of Louisville (KY), who has played an active role in developing the technology used in the Alaskan clean-up, often it is necessary "to begin a bioremediation before all the data are in, much like a physician begins medicating before the diagnosis is complete."

—**Jeffrey L. Fox**