The Use of Bioremediation for Treating Petroleum Contamination in Cold Weather Climates

Ryan Eisele

Abstract

The use of bioremediation to treat petroleum contaminated areas in cold weather climates has been recognized as an area of particular importance. The Exxon Valdez oil spill, along with several other large oil spills in cold-weather climates, has shown the importance of finding effective ways to clean up the contamination caused by petroleum hydrocarbons. Petroleum contamination of soils is not caused solely by large oil spills; it occurs through leaky tanks, ruptured pipelines, and natural seepage. The main source of pollution from oil spills are petroleum hydrocarbons. The bioremediation of oil spills is particularly challenging in cold weather climates. Cold temperatures slow down the activity of microbial hydrocarbon degraders, while affecting the physical nature and chemical composition of petroleum, making it more difficult for microorganisms to break down. Fortunately, there are many cold-adapted organisms that have proven to be efficient hydro-carbon degraders. There are large populations of these indigenous microbes present in nearly all cold-climate areas. To increase the efficiency of these indigenous hydrocarbon-degraders, biostimulation supplies them with oxygen and the necessary nutrients to grow, multiply, and break down petroleum hydrocarbons. Bioaugmentation, though not as successful in studies as biostimulation, involves the introduction of non-native strains of microbes to the treatment area to degrade petroleum hydrocarbons. Bioremediation has proven, both through real world use and experiments, to be an effective method which enhances the ability of indigenous microbes to break down petroleum hydrocarbons and clean up oil spills.

Key Words

Bioremediation, petroleum (oil), hydrocarbons, bioaugmentation, biostimulation, biodegradation, hydrocarbon-degraders, aromatics

Introduction

In the early morning hours of March 24, 1989, the supertanker Exxon Valdez ran aground in South Central Alaska on Bligh Reef. The spills released 20% of the tankers cargo, which came to 11 million gallons of Prudehoe Bay Oil, in only five hours (Gordon, 1994). Days later, a storm helped spread the oil to the west, contaminating the bays and islands of Prince Williams Sound, and eventually spreading to the Gulf of Alaska. By the time the oil spill stopped spreading, it covered 15% of the total shoreline in the Prince William Sound and the Gulf of Alaska (Gordon, 1994). The crash of the Exxon Valdez had resulted in the biggest oil spill in U.S. history.

Though the Exxon Valdez oil spill was the largest and most famous oil spill in U.S. history, it was not the first. In July of 1977, a failed valve on the Trans Alaska Pipeline sprayed over 80,000 gallons of Prudhoe Bay Oil over the Tundra. A year later, an act of sabotage on the Trans Alaska Pipeline caused over 500,000 gallons of crude oil to spill into Steele Creek just south of Fairbanks (Travis, 1989). These events underscore the importance of finding effective ways to clean up and remediate areas affected by oil spills and oil contamination. The discovery of new oil supplies in Arctic areas, coupled with future energy shortages and uncertainty over the future of our Mideast oil supply, means that there will likely be many challenges presented by oil spills in cold-climate areas in the future.