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Oil spills could be cleaned up by bacteria from underground petroleum reserves

Bacteria taken from underground petroleum reserves could be used to effectively break down crude oil from spills at sea, new research has found. The study measured the breakdown of crude oil components in simulated seawater by four bacterial strains that had been isolated from petroleum reservoirs, as well as by four genetically modified stains. The findings raise the possibility of tailor-making organisms to clean up specific types of contamination.

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Some microorganisms are equipped with enzymes that allow them to degrade, and even live on, chemicals that other species find toxic. For example, many bacteria in the genus *Rhodococcus* are able to break down polychlorinated biphenyl (PCB), an industrial chemical and environmental pollutant linked to cancer in humans. In a process called 'bioremediation', humans can use these micro-organisms to break down hazardous chemicals and clean up contaminated environments.

This research examined the potential of a number of different microorganisms derived from petroleum reservoirs to break down crude oil in artificial seawater. The researchers used four bacterial strains isolated from petroleum reservoirs in the wild, as well as four types of genetically modified (GM) microorganisms known as 'metagenomic clones'. These GM microorganisms contained DNA fragments that had been cloned from the DNA of microbes extracted from petroleum.

Three of the metagenomic clones analysed use metabolic machinery derived from both aerobic (oxygen consuming) and anaerobic (non-oxygen consuming) bacteria. Thus they combined metabolic pathways in ways not typically found in nature.

The researchers used flasks of artificial seawater — with no other microbial contamination — dosed with 1% crude oil to simulate an oil spill. Flasks were prepared for all eight different bacterial strains, and dosed with around 1 million microbial cells each. The flasks were sampled on the first day and then at 7, 14 and 21 days.

A range of chemical analysis techniques were used to measure the degree of breakdown of petroleum components in different chemical classes, including 'aromatic hydrocarbons' and 'saturated hydrocarbons'.

After 21 days, two metagenomic clones were able to biodegrade saturated hydrocarbons by 31% and 47% respectively, while two reservoir-derived bacterial species reached rates of 99%. Chemicals in other groups, such as the aromatic hydrocarbons, were degraded up to 94% by metagenomic clones after 21 days, while reservoir-derived bacterial species degraded between 63% and 99%.

The bacteria used in this research have previously been shown to break down individual crude oil components in the laboratory. However, this is the first time that metagenomic clones have been shown to do so in a simulated seawater environment with a mixture of crude oil components, i.e. conditions similar to where they may be usefully applied to control crude oil contamination.

This finding illustrates that bacteria naturally capable of breaking down specific environmental contaminants could be used to clean up oil spills. While, at this point, no man-made bacteria were more effective than naturally occurring bacteria at breaking down crude oil components, the research does raise the possibility of designing bacteria to clear up specific types of contamination where natural options are not available or efficient, the study's authors say.