NEWSPAPER COLUMN

Hydrocarbon Contamination and Bioremediation

A big problem in today's age is hydrocarbon contamination that has resulted from the activity of the petrochemical industry. Hydrocarbons are compounds composed of carbon and hydrogen, and are common elements found in crude oil, or natural gas (fuels). Consumption of these help maintain the economies of countries, however, when these activities result in oil spills or fuel combustion, it can lead to severe detrimental effects of wildlife and the environment. It threatens the extinction of several plants, and has already harmed many land, air, and sea animals. The use of bio-remediation technology is a promising technology in ridding areas of hydrocarbon contamination. This is simply the use of microorganisms to break down toxic, cancer-causing hydrocarbons into waste, and has been proven to be cost effective. Over the past several years, there has been research showing the bioremediation of petroleum hydrocarbons by microorganisms in saline environments, however, this method of decontamination proves difficult for microorganisms in environments of high salinity.

Dr. Babu Fathepure is an Environmental Microbiology associate professor at Oklahoma State University, whose research is primarily focused on aerobic and anaerobic biodegradation of petroleum hydrocarbons in hypersaline environments, such as those containing up to 10%, 20%, or 30% salt content. When asked why this research is important, Dr. Fathepure stated “it is critical for understanding the fate of hydrocarbons at oil and natural gas production sites, since these sites are highly contaminated, as well as highly saline.” His research in this area began in 2002, when him and his colleagues began questioning whether there were microbes capable of degrading hydrocarbons in hypersaline environments. They took five different crude oil-contaminated samples from Oklahoma production sites, and set up microcosms to look for degradation evidence. After a few months, they saw evidence of degradation, and began to enrich the environment for microorganisms with hydrocarbon degrading abilities. Dr. Fathepure stated that his team was one of the first few that showed microorganisms are fully capable of degrading toxic and carcinogenic hydrocarbons as their source of carbon in different salinities ranging in up to 35% salt content environment. After this discovery, they began isolating pure cultures of the microbes to study their physiology, genetics, and degradation pathways, and succeeded in isolating several bacteria and archaea.

Dr. Fathepure also studies the degradation of lignin in plant material. Plants are composed of cellulose, hemicellulose, and lignin. Cellulose and hemicellulose are sugar polymers, or a large compound made up of smaller molecules bonded together, and can be converted into biofuels. Lignin, however, is not a sugar polymer, but rather a complex aromatic structure that can become a major roadblock for efficient conversion of plant waste into ethanol. His team has recently made the discovery of *Rhizobium* species strain YS-1r’s that can degrade lignin. Dr. Babu stated that this is important because “*Rhizobia* are important soil microorganisms that convert atmospheric nitrogen into ammonia (fertilizer) that plants can happily grow on.” Dr. Babu continues his research at Oklahoma State University, and is currently aiming his research towards the study of anaerobic degradation of hydrocarbons in a saline environment, and the role of fungi and bacteria for lignin degradation.

Although petroleum hydrocarbon contamination by the petrochemical industry proves a major problem in areas all over the world, there are still solutions that can aid in maintaining this contamination and reducing its effects. Through the utilization of microorganisms in bioremediation, petroleum hydrocarbon contamination can be properly taken care of in a safe, cost effective way.

References

1. Fathepure, Babu Z. “Recent Studies in Microbial Degradation of Petroleum Hydrocarbons in Hypersaline Environments.” *Frontiers in Microbiology* 5 (2014): 173. *PMC*. Web. 13 Apr. 2017.
2. Nilanjana Das and Preethy Chandran, “Microbial Degradation of Petroleum Hydrocarbon Contaminants: An Overview,” Biotechnology Research International, vol. 2011, Article ID 941810, 13 pages, 2011. doi:10.4061/2011/941810
3. Jackson, C.A., M.B. Couger, M. Prabhakaran, K.D. Ramachandriya, P. Canaan, and B.Z. Fathepure. "Isolation and Characterization of Rhizobium Sp. Strain YS‐1r That Degrades Lignin in Plant Biomass." *Journal of Applied Microbiology*. Journal of Applied Microbiology, 27 Feb. 2017. Web. 13 Apr. 2017.