How 1,4-Dioxane Went from Widely Used to Wanting to be Removed: The Presence and Biodegradation of Emerging Water Contaminant, 1,4-Dioxane

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1,4-Dioxane is a compound that had seemingly endless uses and value. However, years after its wide dispersion to industrial companies and households, its prevalence became a concern to human and environmental health. 1,4-Dioxane has been historically used as a solvent for raw commodities such as, plastics, paints and dyes, solvent stabilizer for methyl chloroform, and component in antifreeze products used for military aircrafts. Due to improper storage and disposal methods, 1,4-dioxane has leaked into ground and surface water across the United States. Its miscibility with water and high heat capacity has allowed it to readily travel while remaining stable, thus impacting significant sources of drinking water. Currently, the United States Environmental Protection Agency has classified 1,4-dioxane as a likely human carcinogen due to its toxicity to the liver, kidney, and central nervous system. Several chemical and physical treatment strategies have been developed for removing 1,4-dioxane from water such as advance oxidation processes and adsorption. However, these methods can be costly, less targeted, and energy intensive. Biological treatment technologies such as bioremediation, which utilizes native and engineered microorganisms to break down environmental contaminants to benign end-products, is seen as an attractive alternative. Among the many microorganisms present in the sub-surface, very few contain the genes responsible for 1,4-dioxane transformation. Contrastingly, our research focuses on the unique aerobic bacterium, *Pseudonocardia dioxanivorans* CB1190 (CB1190), which is able to mineralize 1,4-dioxane. Our results show that CB1190 is a versatile microorganism that can grow on 1,4-dioxane and initiate degradation via a monooxygenase enzyme. Additionally, CB1190 can maintain its activity and ability to degrade 1,4-dioxane even in presence of inhibitors such as limited oxygen and co-contaminants. These characteristics make CB1190 an ideal candidate for removing 1,4-dioxane from groundwater. Ultimately, using microorganisms to remove drinking water pollutants, such as 1,4-dioxane, is an innovative approach that can reduce the cost, energy, and inputs required.