MARS-PCBs: Microbially Assisted Remediation of Stabilized Polychlorinated Biphenyls

Jabczun, Jozef (School: Saint Nicholas Grammar School)
Kanderka, Alex (School: Grammar School of Jan Adam Rayman)

Polychlorinated biphenyls (PCBs), highly toxic and carcinogenic compounds, constitute a significant threat to the environment and public health, both on local and global scales. Nevertheless, most nations are ill-equipped to adopt UNEP's mandate by 2028, calling for environmentally sound practices for their disposal. Moreover, the problem of PCB-contaminated soil is routinely overlooked. A significant barrier to addressing these problems is the absence of a remediation method that perfectly balances efficacy, affordability, and environmental friendliness. This led us to investigate and create a method of our own, MARS-PCBs. First, it stabilizes PCBs in soil (<1 mg/kg) by absorbing them into the roots of hyperaccumulating plants, namely Glycine max (BAF = 309%) and Medicago sativa (BAF = 189%). In addition, field measurements demonstrated plants' high degree of resistance to contamination with performance index (PI) over 600% higher than control. Furthermore, to effectively break down PCBs, we enriched activated charcoal exhibiting high sorption efficiency and capacity of 98.14% and 3.37 mg/kg, respectively, with selected bacteria. To achieve this, we isolated autochthonous soil bacteria from our study sites, using both TSA (non-selective) and liquid (selective) media. Bacterial strains were identified via MALDI-TOF MS and 16S rRNA sequencing, five of which were inoculated onto the sorbent and later subjected to a soil biodegradation experiment. The bacteria's efficiency ranged from 26% to 58%, with an exceptional efficiency of 86% by a novel species of Pseudomonas. Such sorbents can be applied directly to polluted soil, ensuring a regenerative, effective, and eco-friendly solution across globally contaminated sites.

Awards Won: