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D9 - Biological contribution of composting and phytotechnologies to manage solid wastes of petroleum industry after chemical oxidation

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The generation of oily sludges with a high hydrocarbon content is an unavoidable problem for the petrochemical industry. These wastes are a complex mix of hydrocarbons, heavy metals, solid particles and water. The hydrocarbon fraction is classified as: aliphatic, aromatic, resins and asphaltenes, the latter two being those with the highest molecular weight and recalcitrance. Although chemical oxidation has been shown to be effective for removing complex hydrocarbons, its impact on the native microbiota can be unfavorable. One single remediation technology can hardly provide an effective treatment for petrochemical sludges.

In line with this problem, a sequential strategy was designed combining: chemical oxidation (alkaline activated persulfate), composting (goat manure and oat straw) and phytotechnologies (ryegrass) to treat the oily sludge originated in oil-water API separators of an oil refinery. Throughout the full process, a number of physical (pH, E°), chemical (total hydrocarbons, organic carbon, E4/E6 ratio), microbiological (hydrocarbon degrading bacteria, copy number of hydrocarbon degrading genes, enzymatic activities) and biological (plant growth) parameters were monitored. Persulfate was not longer detected after 19 days of oxidative treatment, and a 31% removal rate of total hydrocarbons was evidenced. Besides, after one year of composting, the oxidized compost did not show a higher hydrocarbon removal rate than the unoxidized compost. Nonetheless, a mature and stable product of improved microbial quality in terms of gene copy number and enzyme activity was generated, capable of sustaining ryegrass growth. Finally, after four months of plant growth, the oxidized-composted-planted microcosms showed a tendency to decrease total hydrocarbons and presented an active microbiota with characteristics comparable to the non-oxidized-composted control. These results show that combining chemical and biological strategies can transform a petrochemical waste into a material with added value, capable of sustaining plant growth.