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Dual use fungi to remediate groundwater oil contamination and/or enhance oil and gas recovery

A method utilizing fungal hyphae to degrade non-aqueous liquid phase in contaminated soil and groundwater systems.

IP Status: Provisional Patent Filed

Applications

- Remediation of oil contamination in groundwater
- Enhanced oil and gas recovery

Key Benefits & Differentiators

- **Potential dual use of fungi to** 1) enhance oil recovery and 2) remediate oil contamination of groundwater
- **Fungi is isolated from the subsurface and can use oil as a food source** so it is potentially self-regulating to propagate and remediate oil as long as the oil is present
- **Fungi can access pores, fissures and even rock formations** using a unique mechanism not available from other oil remediation or recovery technologies

Value Proposition

The 2022 global markets for environmental remediation in the oil and gas market has been valued at $23.12 billion and the on-shore enhanced oil recovery market has been valued at $7.6 billion in 2022.

The potential value proposition for this technology would be application of naturally occurring fungi in both of these markets with the aimed-for benefit being remediation that continues with the growth of the fungi at the site using the oil as a food for propagation of the fungi. By utilizing the oil contaminant as a carbon source, the fungi population self-regulates and adapts to in-situ contaminant levels thereby maintaining contaminant remediation. In addition, utilizing the high pressure exerted at the tip of the growing fungal hypha, sites where contaminants are present in difficult to reach areas can be accessed and remediated. The oil displacement induced by branching fungi could also enhance oil recovery. Thus, at oil and gas drilling sites the same mechanism that enhances oil recovery can potentially reduce groundwater contamination.

Naturally occurring fungi provides unique oil remediation and recovery

Non-aqueous phase liquid (NAPL) that include petroleum-based oils, trapped in stagnant or low permeability regions, such as dead-end fractures or rock matrices, are hard to remediate or recover because they are mostly inaccessible by groundwater flow. Hyphae of fungi are known to generate a tremendous turgor pressure on their tips and produce surfactants that allow them to navigate through small pores, air pockets, and even rock matrices in porous media. While such properties can be exploited to target biodegradation of trapped NAPLs or recovery of oils, to the best of our knowledge, there has been no report on how fungal hyphae can

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Category
Engineering & Physical Sciences/Chemicals
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enhance the bioremediation or recovery of trapped NAPLs. University of Minnesota researchers, using microfluidic chip media, have demonstrated the active removal of NAPL by fungi and elucidated the bioremediation mechanism. Results show the active removal of NAPL by fungi within 40 hours. The fungal hyphae effectively penetrated water-oil interfaces and significantly enhanced the oil removal/recovery from low porosity regions via direct consumption and oil displacement induced by hydrophilic hyphae-aided push. The results of this study will provide insights into the use of branching fungi for the bioremediation and recovery of trapped NAPLs.

Phase of Development

TRL: 2
Lab demonstration and visualization of key processes in a simulated subsurface environment.

Desired Partnerships

This technology is now available for:

- License
- Sponsored research
- Co-development

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Researchers

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