Contribution ID: **444** Type: **Oral Presentation**

Fungi-enhanced in-situ bioremediation of NAPL: A microfluidics study

Monday, 30 May 2022 14:40 (15 minutes)

Non-aqueous phase liquid (NAPL) trapped in stagnant regions such as dead-end fractures and rock matrix are hard to remediate because they are inaccessible by groundwater flow. Recent studies showed the potential of bioremediation technologies that utilize the chemotactic motility of bacteria [1-3]. However, such methods rely on diffusion and dissolution of contaminants from NAPL to an aqueous phase which is slow and limited by the oil-water interfacial area. Hyphae of fungi are known to generate a tremendous amount of turgor pressure (~ 10 bar) on its tip [4] and produce surfactants [5] that allow them to navigate through small pores and air-water interfaces in porous media. In addition, biosurfactants alter the balance of the capillary forces at the oil-water interfaces in-situ, opening new flow pathways with immediate impact on the NAPL removal. However, to the best of our knowledge, there has been no direct visualization of fungal hyphae's penetration into oil-water interfaces, and its implication on the bioremediation of NAPL has been unclear.

This study reports striking results showing the active removal of NAPL by fungi using microfluidic experiments. Naphthalene-degrading fungus isolated from a local coal-tar contaminated site was injected into the PDMS microfluidic chip with a flow channel surrounded by NAPL-saturated low porosity regions. Vegetable oil with 10 g/L of naphthalene was used as the model NAPL, and fungal suspension in minimal salt medium (M10) was injected into the chip using a syringe pump. Then, the growth of the fungus and the change of oil-water interfaces were recorded through a scientific CMOS camera at the pore scale. Our results showed the active removal of NAPL by fungi. Fungi hyphae effectively penetrated through water-oil interfaces and significantly enhanced the oil removal from low porosity regions compared to the control case where a sterile medium was injected. Moreover, we observed that the growth of fungi induced flow instability which dramatically mobilized the trapped NAPL phase. In this contribution, we will further discuss the detailed mechanisms behind the effective removal of NAPL by fungi.

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Time Block Preference

Time Block B (14:00-17:00 CET)

Participation

Unsure

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