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Dimensionless analysis applied to bacterial chemotaxis towards NAPL contaminants

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Dimensional analysis applied to bacterial chemotaxis towards NAPL contaminants
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The use of chemotactic bacteria in bioremediation may improve the efficiency and decrease the cost of restoration, which means it has the potential to address environmental problems caused by oil spills. However, most previous studies were focused at the laboratory-scale and there lacks a formalism that can use these laboratory-scale results as input to evaluate the relative importance of chemotaxis at the field scale. Thus, dimensional analysis was adopted to solve this problem. First, the main influential factors were extracted according to the previous researches on bacterial chemotaxis and a set of dimensionless numbers were obtained according to Buckingham theory. After collecting basic parameter values from previous studies, we formulated a dimensionless equation shown as *BR*=1.987(P1^-0.0179)(P2^0.3235)(P3^0.0319), where BR (bacterial ratio) is the ratio of maximum bacteria concentration to its original value, and P1, P2 and P3 are combinations of the derived dimensionless numbers. For BR greater than one, the bioremediation strategy based on chemotaxis is expected to be effective in relative contaminated groundwater system, and chemotactic bacteria are expected to accumulate around non-aqueous phase liquid (NAPL) contaminant sources efficiently.

Keywords: Bioremediation; Bacterial chemotaxis; Numerical simulation; Dimensionless analysis

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References

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