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A fundamental study of microbial attachment and transport in porous media for the design of MEOR

Yan-Guo Yang[1)], Yuichi Niibori[2)], Chihiro Inoue[3)] and Tadashi Chida[3)]

1) Graduate School of Environment Study, Tohoku University
2) Graduate School of Engineering, Tohoku University
3) Graduate School of Environment Study, Tohoku University

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Abstract: Generally, the cell number of the microbes attaching to the solid phase is large rather than that of microbes floating in the pores. For more reliable MEOR (Microbial Enhanced Oil Recovery), such attachment microbes should be distributed efficiently in the target zone of reservoir. In order to understand the attachment behavior of microbes in the flow system of porous media, in this study the relation of the attachment amount and the fluid flow velocity has been examined using a vertical, two-dimensional packed bed (plate-type packed bed).

Lactobacillus casei (IFO 15883) was used as the test microbe in this study. The microbe exhibits no motility or chemotaxis and does not produce gas. In the experiments, the growth rate of the microbe was negligible small by controlling the nutrients. The concentration of the cell suspension out of the bed was traced by the turbidity of the suspension. Then, the change of the concentration was analyzed by two-dimensional, advection-dispersion model with the attachment/detachment rate of microbes.

For the experimental results, this study evaluated W_{out}/W_{in} as the cell recovery, where W_{out} is the cell number flowed out of the packed bed, and W_{in} is the total cell number inputted into the packed bed. Also the maximum attachment amount based on the Langmuir type equation was estimated through the analysis by the two-dimensional mathematical model. The cell recovery and the maximum attachment amount strongly depended on both the injection concentration of the cell suspension, c_{bin}, and the injection flow velocity into

the packed bed, v_{in}. The experimental results showed an optimal value of the ratio of c_{bin} to v_{in}, for both the maximum attachment amount and the cell recovery. The optimal value does not always agree with that obtained from one-dimensional packed bed.

Key words: MEOR, Cell recovery, Cell attachment amount, Two-dimensional porous media

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