

論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	Study on dissolution mass transfer from trapped gas bubbles to water in porous media
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出典(和文)	学位:博士(工学), 学位授与機関:東京工業大学, 報告番号:甲第11590号, 授与年月日:2020年9月25日, 学位の種別:課程博士, 審査員:末包 哲也,肖 鋒,野崎 智洋,伏信 一慶,齊藤 卓志
Citation(English)	Degree:Doctor (Engineering), Conferring organization: Tokyo Institute of Technology, Report number:甲第11590号, Conferred date:2020/9/25, Degree Type:Course doctor, Examiner:,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	要約
Type(English)	Outline

Dissertation summary

Dissolution mass transfer of trapped phases to water in porous media is important in various hydrogeology processes, such as groundwater contamination, groundwater in-situ bioremediation, and geological carbon sequestration. It is pointed out that the mass transfer coefficient and the specific surface area in the case of dissolution mass transfer in porous media cannot be quantified independently due to limitation in visualization technology. In this work, this phenomenon was investigated using micro-tomography and a series of image processing techniques. Bottom-up investigation was then performed from pore-scale. First, porous media characteristics, i.e., porosity, pore size distribution, and throat size distribution, of several porous media were investigated. Second, the capillary trapping characteristics, i.e., trapped phase saturation, bubble size distribution, bubble morphology, and specific interfacial area, in these porous media were examined. Third, the initial fluid displacement patterns were investigated. Viscous and capillary fingering displacement pattern, which is the most likely displacement patterns that occur in hydrogeology, were investigated. Afterwards, the dissolution mass transfer processes were investigated under various conditions of porous media characteristics, fluid velocity, and trapped phase properties. At the end, a model of specific interfacial area and a mass transfer model for dissolution in porous media were developed.