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Reaction of lignite with dilute hydrogen peroxide to produce substrates for methanogens at *in situ* subsurface temperatures

Shuji Tamamura [a,*], Takuma Murakami [a], Noritaka Aramaki [a], Akio Ueno [a], Alam AKM Badrul [a], Shofa Rijalul Haq [b], Toshifumi Igarashi [b], Katsuhiko Kaneko [a]

Affiliations

[a] Horonobe Research Institute for the Subsurface Environment, Northern Advancement Center for Science & Technology, 5-3 Sakae-machi, Horonobe-cho, Teshio-gun, Hokkaido, 098-3221, Japan

[b] Division of Sustainable Resources Engineering, Faculty of Engineering, Hokkaido University, North 13 West 8, Kita-ku, Sapporo, Hokkaido, 060-8628, Japan

* Corresponding author. Tel: +81-1632-9-4112; Fax: +81-1632-9-4113
E-mail: shuji-tamamura@h-rise.jp

Abstract

Since the beginning of the 21th century, various works have sought to enhance coalbed methane (CBM) production by stimulating indigenous microbes in coal seams. This concept of microbially enhanced coalbed methane (MECBM) generation relies greatly on the solubilization of the coal, which determines the rate of microbial conversion of the coal into biogenic methane. This study examined the potential of using dilute hydrogen peroxide (H_2O_2) (0.3%) to solubilize lignite at common subsurface temperatures (10–50 °C) via batch experiments at a solid/liquid ratio of l g/150 mL. Dissolved organic carbon (maximum 450 mg C/L) and organic acid (formic, acetic, oxalic, malonic, and succinic acid, maximum total of 145 mg C/L) concentrations reached their maximum levels within periods of 1.2 days (at 50 °C) to 45 days (at 10 °C). H_2O_2 consumption was a first-order reaction with respect to its concentration, and the linear (r = 0.998) Arrhenius plot for the rate constants yielded its activation energy to be 73 kJ/mol. If the methanogens convert acetic and formic acids to methane, under the current experimental conditions they can produce about 6.0 m^3 of methane per ton of lignite. Dilute H_2O_2 would thus be useful for effective MECBM