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

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**Abstract**

Since the beginning of the 21st 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<sub>2</sub>O<sub>2</sub>) (0.3%) to solubilize lignite at common subsurface temperatures (10–50 °C) via batch experiments at a solid/liquid ratio of 1 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<sub>2</sub>O<sub>2</sub> 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<sup>3</sup> of methane per ton of lignite. Dilute H<sub>2</sub>O<sub>2</sub> would thus be useful for effective MECBM

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