Study on Enhanced Coalbed Methane Recovery by Flue Gas Injection

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http://prelude.geosys.t.u-tokyo.ac.jp/index-j.html

Recently, the necessity to reduce greenhouse gas emissions has provided a dual role for deep unminable coalbeds: as a source of natural gas and as a repository for carbon dioxide (CO2), a greenhouse gas. In the process of CO2 sequestration in coalbeds, the injected CO2 is stored in the coalbed by adsorption at the coal surface. The mechanism is that CO2 displaces the sorbed methane (CH4) from the coal surface that results in the enhancement of the coalbed methane (CBM) recovery.

The primary enhanced coalbed methane (ECBM) recovery process was performed by pure CO2 or pure N2 injection. But several problems appeared, such as the high cost of separating CO2 from flue gas or the productivity of CBM. So it is necessary to understand the ECBM recovery by flue gas injection that may avoid the high cost or improve the productivity. In the case of flue gas injection, it must be the key that the effect of CO2 displacement until N2 breakthrough.

The purpose of this study is to find the effect of ECBM recovery by flue gas injection. It is the most significant purpose to predict the ECBM recovery performance by flue gas injection in this numerical model.

Numerical models are useful tool in the development of the CBM recovery technology. A full understanding of all of the process mechanism is essential to performing a numerical modelling of the process. Although existing numerical models are successfully used to predict field performance of the primary CBM recovery process, many researchers still report that the recovery process is extremely complex and not fully understood. Things become even more complex in the ECBM recovery processes with CO2 or any other gas injection, especially with mixed gas (flue gas). It is believed that existing numerical models do not correctly model the ECBM process mechanism. There are many problems for numerical modelling to correctly model the ECBM recovery process, such as: (1)multiple gas components for flue gas injection; (2)coal swelling due to CO2 sorption on coal; (3)mixed gas sorption; (4)mixed gas diffusion.

In this study, numerical model has been developed to model ECBM recovery process by flue gas injection with following assumptions such as: (1)a dual porosity system; (2)Darcy flow in the fracture system; (3)extended Langmuir adsorption at the matrix surface for modelling to mixed gas sorption; (4)diffusion in the matrix caused by the difference of density. These assumptions were taken into consideration in modelling.

Numerical model is used to predict the ECBM recovery performance in a 5-spot pattern. The results of simulation show that the cumulative production and production rate of CBM are the almost same tendency if N2 is injected more than 30%. It also shows if pure CO2 is injected, the tendency is quite different. Although it may depend on the simulation parameter such as permeability, porosity, Langmuir constant and so on, these features are shown in all cases. In any case the cumulative production of CBM is improved by gas injection. For better understanding the effect of flue gas injection, much more simulations must be performed and numerical model must be improved. Although economic study is not carried out in this paper, optimal injection gas component may depend on the cost of separating CO2 from flue gas before injection or separating N2 from production gas.

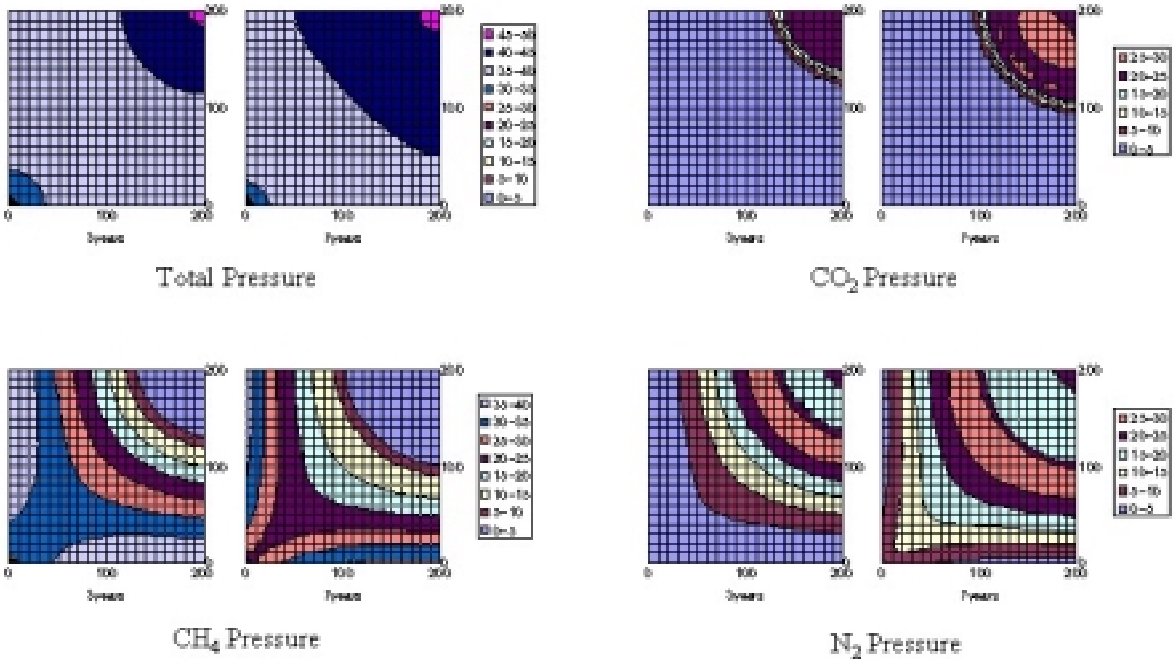

Figure.1 Pressure mapping by CO_2-50%:N_2-50% gas injection

(unit; Pressure [atm] x,y-direction [m])