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# Results of mechanical, sorption and transport experiments on a German high volatile bituminous coal

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A high volatile bituminous coal (vitrinite reflectance: 0.93%, carbon content: 83%) from the Prosper-Haniel mine, North Rhine-Westphalia has been studied using a comprehensive set of measurements and experimental procedures at RWTH Aachen University and the University of Queensland.

Using the True Triaxial Stress Coal Permeameter (TTSCP) .....(Massarotto et al., 2003) of the University of Queensland, permeability and gas displacement tests were performed on an 80 mm cube of the Prosper-Haniel coal. Extensive data sets were recorded to assess the effects of stress changes on gas transport and the impact of nitrogen, methane and $CO_2$ sorption on the mechanical properties.

Figure 1: Permeability coefficients of an 80 mm cube of Prosper-Haniel coal measured with helium, nitrogen, methane and carbon dioxide as a function of net stress.

Figure 1 shows the permeability coefficients for helium, nitrogen, methane and carbon dioxide measured on this sample as a function of net stress. As expected, permeability values decrease with increasing stress. Methane and nitrogen have nearly identical permeability coefficients throughout the entire net stress range, while permeability coefficients measured with helium are higher and those measured with $CO_2$ significantly lower.

Figure 2: Displacement curves for nitrogen, methane and carbon dioxide on Prosper-Haniel coal cube

During the permeability measurements with $CO_2$ an anisotropic swelling of the coal cube by about 1.9% to 2.3% was observed. The volumetric effect (swelling) is 100 times slower than gas displacement. Simultaneous mechanical tests indicated a softening of the coal block upon exposure to $CO_2$. Thus, a decrease of Young's modulus (YM) of the coal cube during the $CO_2$ flow test was observed as compared to the methane and nitrogen tests.

Figure 3: Methane excess sorption isotherms at 1.6 and 3% moisture (318K)

High-pressure sorption isotherms with $CH_4$ and $CO_2$ were determined on different grain-size fractions of the Prosper-Haniel coal at 318K and different moisture contents (Figure 3). Methane sorption capacity decreases by 29% with increasing moisture content. Also, a decrease of sorption rate was observed with increasing moisture content. While sorption rates are generally faster for $CO_2$ than for $CH_4$, the sorption rates of $CH_4$ and $CO_2$ at a moisture content of 1.6 % were nearly identical. The results of this study are compared with those of similar experiments performed on a set of Chinese coals in our laboratory ...(Busch et al., 2006; Han et al., 2010; Li et al., 2010).

**References**

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