Enzymatic conversion of chemically pretreated subbituminous coal

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With more than 50% carbon (by weight), coal is a great source for hydrocarbons such as methane. Coal is recalcitrant and complex in structure. It is resistant to direct biological degradation. This study evaluated the influence of four chemical pretreatment agents (HNO_3, catalyzed H_2O_2, $KMnO_4$, NaOH) on the subsequent enzymatic conversion of subbituminous coal by a fungal manganese peroxidase (MnP) produced by the agaric white-rot fungus *Bjerkandera adusta*. The effects of the combined chemical and enzymatic treatments were analyzed by high performance size exclusion chromatography (HPSEC) and 3-dimensional excitation emission matrix fluorescence spectroscopy (3D-EEM). The nature of pretreatment agents and their applied concentrations had significant impacts on subsequent enzymatic conversion of coal. The 3D-EEM spectroscopic analysis provided new insight into the nature of the depolymerized and released coal constituents. Using the fluorescence spectra, it was possible to distinguish among humic-like, fulvic acid-like and aromatic/PAH-like substances. The fungal enzyme MnP had little effect on the untreated coal controls. Nitric acid (HNO_3) was the most effective pretreatment agent as indicated by the HPSEC profiles, followed by catalyzed H_2O_2 and $KMnO_4$. Low molecular weight aromatic fragments with sizes ranging from 1.1 to 6.2 kDa were released by all of the pretreatment agents used in combination with MnP. For $KMnO_4$ and HNO_3 pretreated coal, all four EEM regions increased after MnP treatment. Chemical and enzymatic combined treatments of subbituminous coal is appropriate for enhanced depolymerization and results in chemically heterogeneous and complex liquefaction products. In conclusion, this may have important ramifications in the generation of liquid and gaseous fuels from coals that is an important approach to the development of nonpetroleum-derived fuel alternatives.