Biogenic Methane Potential of Bowen Basin, Queensland Coal Preparation Plant Rejects

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Bowen basin coal (Queensland, Australia) must go through a process to remove rocks, minerals, and soil before it can be used in coking applications. Magnetite, fuel oil #2, methyl-isobutyl-carbinol (MIBC), and a proprietary coagulant and flocculant are added in this process to maximize coal recovery. The reject material still contains up to 80% coal as measured by fixed carbon and volatile matter. A coal-to-methane consortium enriched from a Surat basin coal seam water sample [1] yielded little or no biomethane when cultured with four different raw reject samples taken from two different coal preparation plants. But when the same rejects were first washed and dried under anaerobic conditions to remove any inhibitory compounds, biomethane yields were up to 5 times greater compared to the unwashed samples. After several enrichments on washed rejects, the Surat basin consortia yielded 103 μmol per gram of Jameson flotation cell rejects, matching or exceeding yields for pure Surat basin coal [1]. Magnetite, fuel oil #2, and MIBC additives were then screened for inhibition of methanogenesis. No inhibition was observed for fuel oil #2 or MIBC, and magnetite enhanced methanogenesis for multiple reject samples. Kato *et al* [2] also found that magnetite enhances methanogenesis on ethanol or acetate via an electric syntrophy. This leads to the hypothesis that either the proprietary flocculant and/or coagulant are inhibitory to the methanogenic consortia. Changes in the microbial community in response to coal rejects/associated additives will be discussed and compared to the Surat basin mother culture, along with implications for a commercial scale coal-reject-to-biomethane process.

[1] Papendick *et al* (2011) *Int. J. Coal Geol.* **88**, 123-134.
[2] Kato *et al* (2012) *Environ. Microbiol.* **14**(7), 1646-1654