**MCHM Chemical Properties, Transport, and Fate in Coal Preparation Plants**

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**Abstract**

4-methyl cyclohexane methanol (MCHM) is a flotation reagent often used in fine coal beneficiation and notably involved in the January 9, 2014 Elk River chemical spill in Charleston, WV. To assess the environmental fate and partitioning of MCHM, plant-wide water sampling surveys were conducted at two Appalachian coal preparation plants. Samples were recovered from various streams within the coal preparation plants as well as environmental discharges, including impoundment drains and groundwater monitoring wells. The sample data along with in-plant measurements were used to construct plant mass balances for the solid, liquid, and reagent partitioning within and around the coal preparation plant. The results from both cases indicate that measurable MCHM concentrations are only found immediately around the flotation circuit (feed, concentrate, and tailings). Samples from downstream units, including thickeners, impoundments, and discharge points show no concentration of MCHM above the detection limit of 2 ug/L. These measurements indicate that under normal operating condition, negligible amounts of MCHM leave the site in the discharge water, thus implying that other non-aqueous transport mechanisms such as volatilization strongly influence the measurable concentration.

To further investigate the transport mechanisms and explain the results from the field testing, a laboratory testing program was conducted using crude MCHM procured from Freedom Industries. Processes such as volatilization, sorption, and leaching were evaluated using material samples of fine coal and fine tailings. The results indicate volatilization and sorption are important mechanisms which influence the removal of MCHM from water, with sorption being the most significant removal mechanism over short time scales (< 1 h). The sorption data was found to best fit a pseudo-second order model, with the initial rate constant being four times larger for tailings than for coal. Alternatively, the volatilization data showed that under quiescent conditions, the first order decay half-life is 96.3 hours. This measured value varies significantly from calculations made from estimates of Henry’s law reported in TOXNET, which may produce a half-life as high as 51 days. Finally, leaching experiments show both coal and tailings have high affinity for MCHM, and the reagent does not desorb readily. Overall, the results bolster the findings from the plant study and suggest that the use of MCHM in coal preparation is not likely to pose a threat to either surface or groundwater under normal operating conditions.

Current Publications:

He, Y.T. Thomas, A. Noble, and P. Ziemkiewicz. "Investigation of MCHM transport mechanisms and fate: Implications for coal beneficiation." Chemosphere 127 (2015): 158-163.

Noble, A., Y.T. He, and P. Ziemkiewicz. “Partitioning Behavior of 4-Methyl Cyclohexane Methanol in Two Appalachian Coal Preparation Plants.” International Journal of Coal Preparation and Utilization (in review).