LONGITUDINAL CHANGES IN POTENTIAL TOXICITY OF COAL BED NATURAL GAS PRODUCED WATER ALONG BEAVER CREEK IN THE POWDER RIVER BASIN, WYOMING[1]

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Abstract. In the Powder River Basin (PRB) in northeast Wyoming, coal bed natural gas (CBNG) is being extracted from coal seams at depths up to 500 m. Produced waters that are concurrently pumped from a coal seam by a CBNG operator commonly are piped to a central discharge point in or near the well field and sometimes are discharged into ephemeral drainages like Beaver Creek, a tributary to the Powder River. In the PRB, CBNG produced waters tend to be dominated by sodium bicarbonate ($NaHCO_3$), leading to regulatory concerns about potential toxicity to aquatic organisms in receiving streams. Additionally, CO_2 and total ammonia (NH_3) concentrations are high in produced waters from some of the deeper coal seams. Those elevated concentrations are a concern if degassing of the CO_2 causes the pH of the discharged water to increase high enough from the initially circumneutral pH values to convert large percentages of the ammonium ion (NH_4^+) to the more toxic NH_3 in the receiving stream. In this study, we evaluated the fate and effects of ammonia and $NaHCO_3$ in CBNG produced water that was discharged into Beaver Creek from August 2006 through March 2007. The study included (1) instream monitoring of the fish and amphibian population along a longitudinal gradient in the creek, (2) instream toxicity tests using caged fathead minnows (FHM; *Pimephales promelas*) along the same longitudinal gradient, (3) concurrent ambient-pH and CO_2-adjusted toxicity tests conducted in the laboratory with the same batch of FHM exposed to effluent water and to stream water collected along the longitudinal gradient, (4) analyses of water quality parameters in the effluent and the stream, and (5) a supplemental study to determine if ammonification occurs during transport and storage of stream-water samples, thus elevating the total NH_3 concentration from the stream to the lab. The results of this seasonal study provide additional data to evaluate the potential toxicity of CBNG produced waters, the biogeochemical changes occurring in the effluent that mitigate NH_3 toxicity, the appropriateness of standard laboratory toxicity tests for predicting instream effects, and the appropriateness of the current frequency of mandated toxicity tests. This information will help regulatory and management agencies, industry, and environmental-interest groups to more accurately assess the risk to aquatic life from CBNG produced waters.

Additional Key Words: ammonification, ammonium, fathead minnow, instream toxicity, $NaHCO_3$, *Pimephales promelas*, unionized ammonia

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