A Comparative Characterization of Produced Water from Conventional and Unconventional Fossil Fuel Resources

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Produced water can be an asset when properly characterized and treated for reuse. Waters associated with oil and natural gas production are often generated in large volumes and may contain constituents of concern (COCs) that require treatment prior to reuse. The initial steps toward reuse involve careful characterization of produced water followed by comparison of constituents in the water with criteria for reuse purposes, such as irrigation, livestock watering, drinking, and discharge to support aquatic and terrestrial life. In this study, sources of information regarding constituents in produced water included peer-reviewed and published information, data provided by industry, and analysis of produced water samples. Produced waters associated with the following types of oil and natural gas were characterized: coal bed methane, shale gas, tight sand gas, conventional oil, and conventional natural gas. COCs for these five types of produced waters were identified by comparing the constituents from each of the waters to water reuse criteria. COCs identified among the produced waters varied, with some being Cu, Pb, Zn, Cd, Ni, and Se in specific waters. Several mean constituent concentrations were found to be significantly different among the five types of produced water by statistical analysis using SAS 9.2. Produced waters range from fresh to hypersaline with chloride concentrations ranging from 286 to 212,700 mg/L. From data used in this investigation, mean chloride concentrations of produced waters were 55,493 mg/L (shale gas), 855 mg/L (coal bed methane), 9,433 mg/L (tight sand gas), 4,358 mg/L (conventional oil), and 40,155 mg/L (conventional natural gas). The mean iron concentrations among these waters also differed significantly: 112 mg/L (shale gas), 2.74 mg/L (coal bed methane), 0.015 mg/L (tight sand gas), 0.064 mg/L (conventional oil), and 0.142 mg/L (conventional natural gas). The barium concentration in shale gas produced water was significantly different from that in the other waters. Differences in constituent concentrations among the various produced waters examined can be attributed in many cases to geologic origin and composition of the strata from which the waters were produced. Treatment of the constituents identified in the produced waters can provide opportunities for their reuse. We are investigating the potential for using hybrid constructed wetland treatment systems to renovate produced waters for reuse.