Metal Mass Retention in Passive Treatment Systems at the Tar Creek Superfund Site[1]

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Abstract: The Tri-State Mining District (TSMD) was a major producer of lead and zinc concentrates in the 19th and 20th centuries. Upon cessation of mining operations, mine voids filled with groundwater and several dozen artesian discharges of metals-contaminated waters began flowing in late 1979. The U.S. Environmental Protection Agency identified four TSMD-related Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) sites in Oklahoma, Kansas, and Missouri. Due to topographic and hydrologic features, mine water discharges were especially pervasive in the Oklahoma portion of the TSMD, known as the Tar Creek Superfund Site. In the mid-1980s, impacts to surface waters were deemed to be due to "irreversible man-made damages" and action to address them was determined to be inappropriate. Since 2008, two full-scale mine water passive treatment systems (PTS) have been installed to address some of these waters, contaminated by elevated concentrations of iron, zinc, lead, cadmium, arsenic, and nickel. The Mayer Ranch PTS (since 2008) and Southeast Commerce PTS (since 2017) produce effluents which are circumneutral pH, net alkaline, and contain concentrations of ecotoxic metals meeting receiving water body in-stream criteria. On an annual basis, MRPTS and SECPTS respectively retain approximately 57000 and 27000 kg of iron, 3300 and 2200 kg of zinc, 290 and 120 kg of nickel, 18 and 12 kg of lead, 19 and 8 kg of arsenic, and 5 and 7 kg of cadmium. If these systems continue to function as designed throughout their 20-year design lifetimes, they will collectively retain approximately 1700 metric tons of iron, 110 metric tons of zinc, 8 metric tons of nickel, 600 kg of lead, 540 kg of arsenic and 250 kg of cadmium. Although considerable water quality improvement has occurred in the Unnamed Tributary into which these PTS discharge, additional artesian discharges and substantial tailings pile and pond runoff still pollute the main stem of Tar Creek.

Additional Key Words: Mass loadings, mass removals, iron, zinc, lead, cadmium, arsenic, nickel

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3. Work reported here was conducted near 36° 55′ 14″ N; 94° 52′ 11″ W