**2022 Americas Site Solutions Technology Transfer Conference**

**Title: Bioremediation of Perchlorate using Hydrogen**

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**Key Topic: Innovative Remediation Technologies**

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**Client Name: Confidential**

**Project Name: Remedial Investigation and Feasibility Study**

**Project Location: Henderson, Nevada**

**Primary Ramboll Project Staff (Office): Emeryville, California**

**ABSTRACT**

**Background/Objectives:**

Hydrogen is considered a universal electron donor because of the wide variety of bacteria that utilize it to support reductive bioremediation. Hydrogen may be a more sustainable alternative for bioremediation of perchlorate and other contaminants. While organic substrates are effective in stimulating biological perchlorate reduction, they require frequent reapplication and result in growth of non-target, heterotrophic bacteria competing for electron donors. In contrast, dissolved hydrogen specifically enhances the activity of autotrophic bacteria that use hydrogen as an electron donor and inorganic carbon (e.g., $CO_2$) as a carbon source. Here, we share results from multiple treatability studies aiming to develop more sustainable options for bioremediation of perchlorate.

**Approach/Activities:**

Three treatability studies were performed to evaluate bioremediation of perchlorate using hydrogen: 1) bench-scale batch microcosm tests using zero valent iron (ZVI); 2) column tests and an intermediate-scale sand tank study using bioelectrochemical treatment; and 3) an ex-situ pilot plant using membrane biofilm reactors (MBfRs) with direct hydrogen generation. Each study was comprised of multiple discrete tests and phases of operation to achieve experimental objectives. Sludge from the site's ex-situ perchlorate treatment plant utilizing Fluidized Bed Reactors (FBRs) was used as an inoculum in certain tests. Nutrient availability and competing electron acceptors were also variables that were studied.

**Results/Lessons Learned:**

Factors that control biological perchlorate reduction include the availability of organic carbon, the presence of competing electron acceptors, and the robustness of the biology. The primary factor as demonstrated here is the development and sustainability of a robust and functional biological community.

**Aspect of Work that Relates to Sustainability:**

Traditional remediation technologies such as pump-and-treat are energy-intensive and can take decades to achieve cleanup goals. Hydrogen may be a long-term sustainable alternative for in-situ bioremediation of perchlorate and other contaminants, if applied electrochemically via low-voltage direct current generated from solar arrays or via the sustained slow release from ZVI corrosion.