**21-1: Plasma Activated Water for Crewed Transit and Planetary Habitation: A Study of Gas Type, Electrode Material, and Power Supply Selection and the Impact on the Final Frontier**

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**Activity Type:** New Start

**Primary STMD Taxonomy:** TX06.1.2 Water Recovery and Management

**Start TRL:** 1 **End TRL:** 3

**Executive Summary:** An in-depth study of plasma activated water (PAW) generation was conducted to link changes in power supply, electrode material, input gas, and treatment time to the resulting reaction chemistry. These changes in chemistry can help tailor PAW for different space applications. An AC, DC, and nanosecond (ns) pulsed power supply were each used to generate PAW with stainless steel, copper, tungsten, or platinum (Pt) electrodes while utilizing air, nitrogen (N2), carbon dioxide (CO2), helium (He), or argon (Ar) as the feed gas. Tap or deionized (DI) water was treated for 1 to 15 minutes, and the generated PAW was tested for changes in pH, conductivity, oxidation reduction potential, nitrates (NO3-), ammonium (NH4+), and peroxide. Calculations showed that the production of reactive nitrogen species was the leading cause of pH and conductivity changes. The DC generated air plasma was able to reduce the pH of DI water and generate NO3‑. The pulsed supply, operating at 20% of the input power of the DC supply, lowered the pH generated NO3‑. When a simulated Martian gas mixture of 95% CO2 and 5% N2 was used as the feed gas, NO3‑ was generated with the DC and pulsed supplies, respectively. Mixing PAW with plasma generated ash from inedible biomass allowed pH control, thus enhancing PAW’s potential use for sanitation applications. The large shift in pH was used to study sanitation effects of *Escherichia coli (E. coli)* reduction and *Staphylococcus aureus* (*S. aureus)*, in which log reductions were found to be negligible. Additionally, the plasma generated ash in combination with PAW was also implemented in 10-day microgreen growth trials, in which PAW and ash resulted in quicker emergence of the microgreens compared to the standard growth conditions and comparable dry masses to Hoagland’s nutrient solution treated samples.