

RainBox

by  AgriWater

**RainBox synergy
with Sulfur
burner**



RainBox synergy with Sulfur burner:

Short Description of Sulfur Burner Water Treatment

The technology has been adapted from earlier versions used in industrial processes. New versions are safer and better suited for agricultural water treatment purposes. It works by burning elemental sulfur (S) inputs to produce sulfur dioxide (SO₂)-rich gas. The sulfur dioxide gas is mixed into water to dissolve and form sulfurous acid (H₂SO₃), which in turn reacts with oxygen in the water to finally form sulfuric acid (H₂SO₄). By effectively loading the water with sulfuric acid, the treated water's pH is lowered, and sulfate (SO₄²⁻) content is increased.

Goal of Sulfur Burner Water Treatment

- The pH of the treated water is lowered; thus, many mineral salts dissolve more easily (aimed at preventing precipitate formation and breaking down existing precipitates).
- By loading the water with sulfate, the increased sulfate content competes with carbonate species to improve the solubility of calcium in the water and soil (formation of CaSO₄ instead of CaCO₃, which has slightly better solubility).
- These two main direct effects of sulfur burner treatment are targeted to relieve hard water effects by preventing calcium carbonate precipitate formation and increasing calcium availability to compete with sodium in the soil.

Other Effects to Consider

- The conversion step from H₂SO₃ to H₂SO₄ requires O₂. Thus, the generation of sulfuric acid in the water during treatment utilizes oxygen from your irrigation water, reducing your dissolved oxygen content.
- Increased levels of sulfate continuously loaded onto soils generate increased competition with phosphates and nitrates for nutrient uptake.
- The process of sulfuric acid generation in the water being treated can have a slight corrosion risk associated with it.
- Calcium sulfate (CaSO₄) is still not readily soluble without proper microbial activity in the soil.
- The main water softening effect is thus delivered by the reduction in pH, which could induce shock/stress on soil microbial populations, especially under reduced dissolved oxygen conditions.

RainBox treatment makes use of advanced oxidation reactions whereby the water is enriched with oxygen (O_2) and other atmospheric gases (N_2 , CO_2). Low concentrations of ozone (O_3) and hydrogen peroxide (H_2O_2) generate highly reactive oxidant species throughout the treated irrigation lines (while flowing and under pressure), causing electron transfer reactions from contaminants encountered in the water being treated. These electron transfer oxidation reactions directly react with carbonate species in the water to hinder their reactivity toward calcium, magnesium, etc. Thus, their ability to form precipitates is inhibited, and the inherent "hard water" effect caused by those interactions and reactions is effectively and efficiently relieved without additional mineral loads being introduced into the water. The AOP-reacted carbonate species (CO_3^{*-}) break down to carbon dioxide (CO_2) upon discharge.

RainBox Effects on Hard Water

- Reactions with carbonates and bicarbonates prevent reactions with calcium and magnesium and cause the breakdown of formed precipitates, i.e., prevention and breakdown of precipitates like $CaCO_3$. Solubility and availability of calcium, magnesium, etc., are thus significantly increased.
- Calcium and magnesium are further protected from precipitate-forming reactions by their interactions with low concentrations of ozone.
- Increased dissolved oxygen content in the treated water.
- Water surface tension and viscosity are optimized to ensure better penetration and infiltration of the treated water into the soil—thus carrying benefits of increased calcium and other nutrient availability, as well as dissolved gas content into the soil profile.
- AOP-reacted carbonate species break down to carbon dioxide (CO_2) upon discharge. These can either escape the water as a gas or redissolve in the soil profile to generate localized decreases in pH, which aids in the breakdown of built-up salt and other precipitates in the soil profile (in addition to the effects of aerobic microbial activity supported by RainBox water).
- No additional mineral load is added to the treated irrigation water. Rather, the existing mineral and nutrient content remains dissolved in the water, improving penetration into the soil and supporting aerobic and well-structured soil environments where nutrient utilization is more efficient and dynamic.

Synergy Between RainBox and Sulfur Burner Treatment

RainBox AOP technology and Sulfur Burner treatment can complement each other in specific agricultural water management strategies. The combination of these technologies can enhance water quality while mitigating some of the limitations each method may have when used independently.

Potential Benefits of Combining RainBox and Sulfur Burner

- **Enhanced Calcium Solubility:** Sulfur Burner treatment increases sulfate content, encouraging the formation of more soluble calcium sulfate ($CaSO_4$). RainBox technology further improves calcium and other nutrient solubility by preventing their reaction with both carbonate and sulfate species. This supports optimal mineral nutrient availability in the treated water.

- **Optimal Nutrient Efficiency:** In addition to the effects mentioned above, the AOP reactions of RainBox treatment with carbonate and sulfate species also aid in relieving competition between anionic nutrient minerals, ensuring optimal efficiency of phosphate and nitrogen inputs. This further supports nutrient use efficiencies under combined treatment.
- **Mitigation of Oxygen Depletion:** The sulfur burner process consumes oxygen from the water, potentially leading to hypoxic conditions in irrigation water. RainBox technology increases dissolved oxygen levels, counteracting this depletion and supporting healthier soil microbiology and soil aeration.
- **Balancing Soil pH Effects:** While Sulfur Burner treatment lowers pH aggressively, RainBox's AOP oxidation stabilizes carbonate chemistry, preventing drastic pH fluctuations and ensuring that pH reductions occur in a controlled manner. This balance prevents stress on soil microbial populations and root systems.
- **Reduction of Corrosion Risks:** The RainBox process does not introduce acidic conditions but instead optimizes carbonate chemistry through oxidation. This means that potential corrosion issues related to sulfuric acid production can be alleviated by using both systems in tandem.
- **Improved Soil Permeability and Infiltration:** By optimizing viscosity and surface tension and increasing oxygenation of high mineral-loaded water, RainBox technology enhances the infiltration of sulfur-treated water into the soil profile, allowing for better distribution of nutrients and a reduced risk of surface salt accumulation.
- **Enhanced Microbial Activity:** Sulfur Burner treatment can create conditions that stress beneficial soil microbes due to lower oxygen levels and pH fluctuations. RainBox-treated water counteracts these effects by providing oxygen-rich irrigation water (in addition to other atmospheric gases), supporting beneficial aerobic microbes and a healthy soil structure that aids in nutrient cycling, mineral movement, and organic matter breakdown.

Conclusion

The combination of RainBox AOP technology with Sulfur Burner water treatment presents an opportunity for enhanced water management in agricultural settings. While Sulfur Burner treatment effectively lowers pH and introduces sulfate to improve calcium solubility, RainBox ensures optimized carbonate chemistry, increased dissolved oxygen levels, and improved water infiltration. Together, these technologies create a synergistic approach to water treatment that maximizes nutrient availability, prevents unwanted precipitation, and maintains healthy soil and microbial ecosystems.