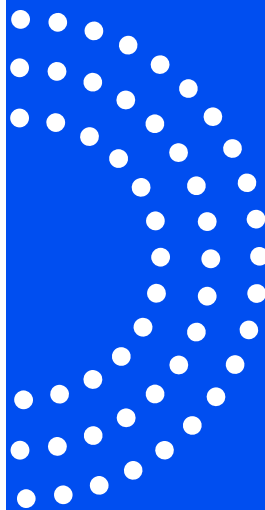




“ The Ray System has proven itself effective as a decentralized and low energy BOD/COD pretreatment system, particularly for high strength wastes.
Tyler Radneicki, Ph.D ”

Photocatalysis to Combat Biochemical Oxygen Demand and Chemical Oxygen Demand in Wastewater:

Breakthrough Remediation Advances Using the Ray® Solar Photocatalytic Generator



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Introduction

Biochemical oxygen demand (BOD) and chemical oxygen demand (COD) refer to the dissolved oxygen consumed by aerobic organisms to break down the organic material present in water at a certain temperature over a specific time period. The higher these concentrations, the less available oxygen is present in the water, limiting the support the oxygen can provide the other species that rely on it for survival.

The EPA has established effluent guidelines that set forth discharge requirements on an industry-by-industry basis. However, these guidelines are costly to adhere to, with dischargers being subject to third party lawsuits for noncompliance. The Ray® unit delivers the photocatalytic process in an autonomous and transportable design that allows for BOD and COD breakdown in a cost-effective method.

What is Special about the Ray Solar Remediation System?

The Ray® System is a breakthrough technology. It is a solar-powered water remediation unit that breaks molecular bonds by concentrating solar wavelengths, including the visible and UV ranges, for photocatalysis. This sterilizes and destroys bacteria, while simultaneously breaking oxygen demanding carbon structures in wastewater.



Overview of 8' Ray® System

- > Autonomous use
- > Reaches internal temperatures of 900 degrees
- > Operates at up to 360 gph currently -potential for more
- > No use of harmful chemicals, gases, or filtration
- > Carbon neutral
- > Portable, and can work alongside preexisting systems
- > Use of solar enables low operational cost
- > Made in the USA

Industrial Pretreatment for BOD and COD

Biochemical and chemical oxygen demand represent significant threats to aquatic species. The greater the BOD and COD content of the water, the less oxygen is available in the water to support aquatic species and their habitats and live off of. Maintaining a sufficient concentration of dissolved oxygen is critical for maintaining the wildlife diversity and aesthetic beauty of aquatic bodies.

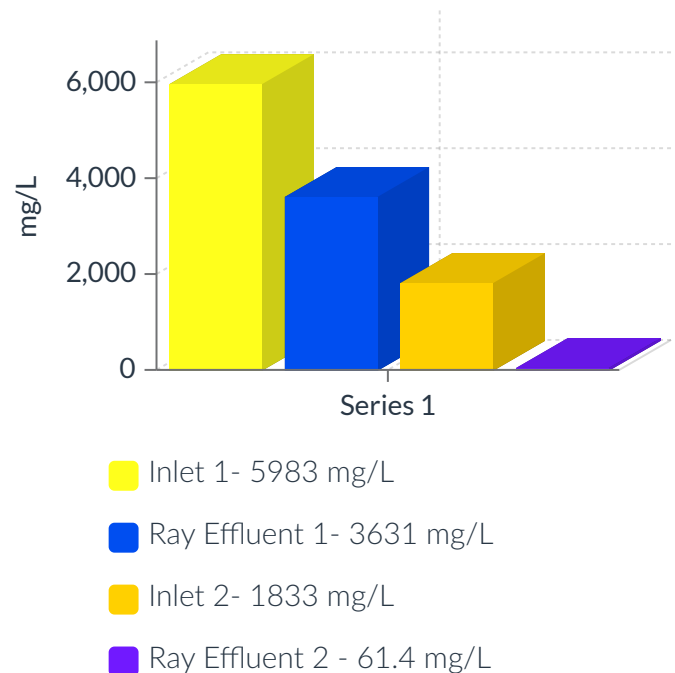
Many industrial processes significantly increase the BOD and COD amounts in their wastewater, including brewing, wine making and food processing. Focal Technologies' Ray® System concentrates the sun's ultraviolet (UV) and thermal power, to activate photocatalytic and photochemical catalysts resulting in lower BOD and COD concentrations.

Specialty Analytical laboratory in Clackamas, OR, has run multiple tests on the effectiveness of the Ray® System. (see graph)

These results demonstrate that Ray® is a capable and ideal solution for the industrial pretreatment of BOD and COD. Specifically, Ray's process provides the most value when the system can support upstream treatment at sources, where the volume of material to be processed is manageable, before it contaminates a large body of water.



BOD





Photocatalysis for Landfill Leachate

Landfills contribute a large amount of BOD and COD to wastewater. In fact, BOD and COD measurements are the most widely used standards to assess pollution in landfill leachate. Unlike other processes, the content of landfills' wastewater, or leachate, can be highly inconsistent due to factors such as the materials in the landfill at any given time, the amount of rainfall and the state of decomposition. Thus, measuring the levels of BOD and COD will at least provide an idea to how much stress the varying contaminants will have on the surrounding environment.

The ability Ray® has to treat both BOD and COD, as well as showing promising results for remediating per- and polyfluoroalkyl substances (PFAS),

also known as "forever chemicals," positions the system as the ideal solution for the contaminants found in landfill leachate. Ray® works autonomously alongside existing treatment systems to improve effluents and further reduce their concentrations. As a mobile system, it can be easily deployed without any ground penetration or pre-construction.

The Ray® System maximizes the natural and freely available energy of the sun to provide significant degradation with minimal to no external energy required. This creates the potential for a long-term, cost-effective, and sustainable solution for the treatment of effluents and impacted groundwater, particularly in remote environments or locations where energy delivery is particularly cost intensive.

Concentrated UV for Propylene Glycol Remediation

Propylene glycol, otherwise known as antifreeze, is a prevalent organic compound that pollutes many industrial waste streams and contributes to high COD concentrations. Its widest applications are as a deicing agent for aircraft operations and as a coolant in automobiles. Antifreeze's utilization is so vast that effectively remediating the compound is crucial to the well-being of aquatic environments.

"The Ray® System was able to successfully lower the antifreeze concentration by 33 +/- 1% at a flowrate of 1 gpm and 7 minute HRT. This is a reduction of roughly 100.000 mg/L of propylene glycol over 7 minutes. This rate is 3-4 orders of magnitude greater than anything shown in the literature previously and demonstrates the potential of the Ray system to act as a low energy photocatalyst accelerator."
(Hammervold, 3)

"The slow rates of photocatalysis is one of the primary reasons it is not more widely applied in industry. The Ray® System directly attacks that market hurdle."
(Hammervold)



Works Cited:

Hammervold, Meredith, and Giardina, Forest. Final Report for Oregon BEST: Study of solar concentration from the remediation of E. coli and the breakdown of organics in wastewater using the Ray Solar Concentration System provided by Focal Technologies. 2018. Oregon State University, Research Report.

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