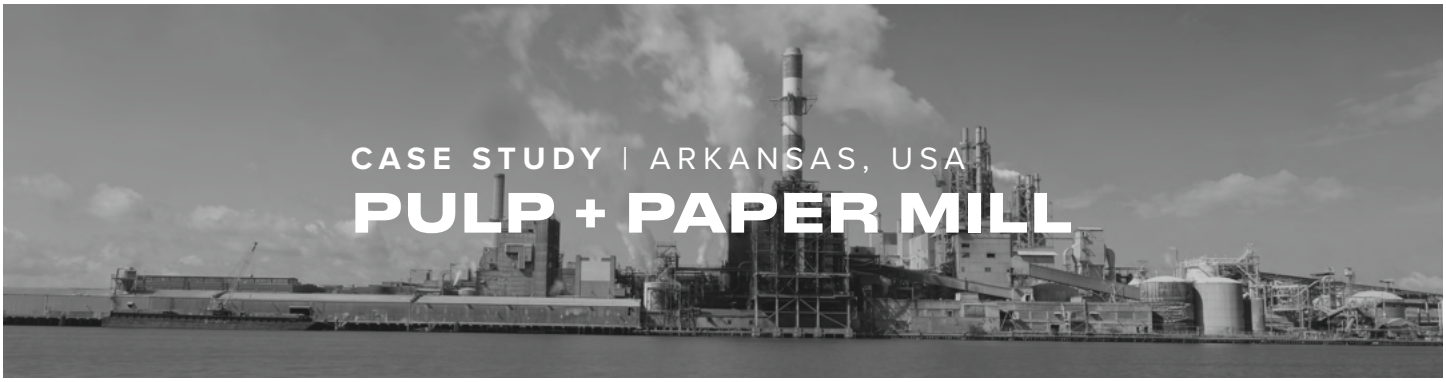


CASE STUDY | ARKANSAS, USA

PULP + PAPER MILL

SITUATION

- The 50 MGD[1] wastewater treatment facility serving a pulp and paper mill in Arkansas, USA uses regular chemical treatments of hydrogen peroxide and an iron catalyst to address odor and bio-chemical oxygen demand[2] (BOD) of their wastewater, dosing the pulp mill's effluent at the clarifier before it travels downstream in an open channel and into a large, aerated stabilization basin (ASB).

COMPLICATION

- In addition to the expense of chemical treatment, the mill's broad product portfolio and dynamic production schedule results in significant changes in the flow and water quality of the effluent, making it difficult to effectively manage odor issues using regular chemical treatments.

- Unable to effectively manage sulfides and control odor, the wastewater treatment facility faced tremendous scrutiny from regulators and the community – resulting in a regulatory consent decree and significant headline-risk due to a substantial component of odor complaints and perceived risk to human health – eroding the Company's social license to operate.

RESOLUTION

- To improve odor management, reduce peroxide (a chemical treatment), operating costs, and pre-treat the BOD, the wastewater treatment facility replaced the chemical treatments of hydrogen peroxide with two SDOX® systems injecting a super-oxygenated solution to the process in series at two locations. The first, into the center well of the primary clarifier, oxidizes any existing sulfides, and again in the open channel that conveys the wastewater to the ASB, increasing the dissolved oxygen in the lagoon, effectively suppressing the formation of additional sulfides prior to discharge from the system.

- The SDOX® systems improved the oxidation reduction potential[3] (ORP) of the effluent along the entire treatment process, increasing the DO, mitigating downstream sources of odor, and initiating the pre-treatment of soluble BOD in the channel leading to the ASB. Oxygenation of the channel also contributed significantly to higher DO levels throughout the water column in the ASB.

---

[1] MGD = Million gallons per day; 50 million US gallons is approximately 189.3 million liters.

[2] Biochemical oxygen demand (BOD) – also called biological oxygen demand – is the amount of dissolved oxygen needed by aerobic, biological organisms to break down organic material present in a given water sample at certain temperature over a specific time.

[3] To prevent odor, the greater the ORP value the better. Negative 150 ORP is the point at which the formation hydrogen sulfides are suppressed. To prevent the formation of hydrogen sulfides in wastewater, the objective is to ensure that the ORP value is greater than negative 150 (e.g.: -149, -148, etc.).

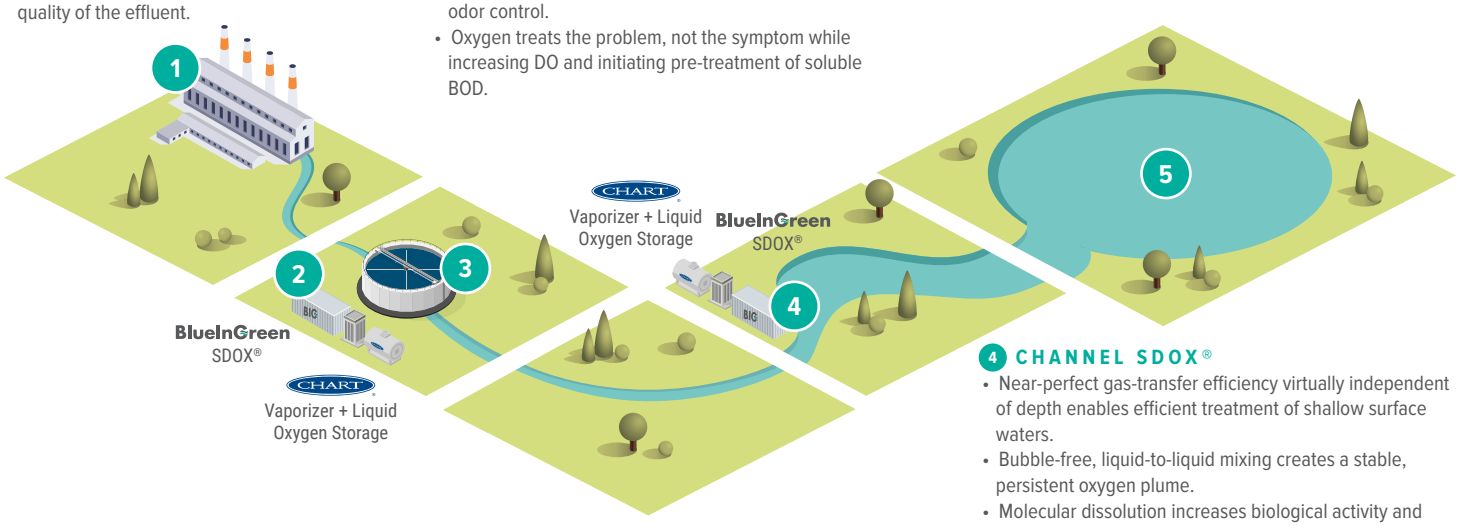
[4] Estimated using a cost of US$3.00 per gallon of hydrogen peroxide and a cost of US$0.08 per pound of oxygen.

1 PULP + PAPER MILL

- The mill's broad product portfolio and dynamic production schedule results in significant changes in the flow and water quality of the effluent.

2 CLARIFIER SDOX®

- More responsive dosing to dynamic water treatment demands. Active monitoring in combination with an extremely fast oxygen transfer rate delivers superior odor control.
- Oxygen treats the problem, not the symptom while increasing DO and initiating pre-treatment of soluble BOD.



3 CLARIFIER

- Eliminated incoming hydrogen sulfide and created an environment less conducive to formation of any new hydrogen sulfide, achieving an ORP of negative 119 using SDOX® compared to negative 190 using hydrogen peroxide.
- Achieved DO levels ranging from 2.5 to more than 4 mg/liter using SDOX® compared to zero using hydrogen peroxide.
- Removal of soluble BOD, achieving maximum values in excess of 30% compared to an average of 4% using hydrogen peroxide.

4 CHANNEL SDOX®

- Near-perfect gas-transfer efficiency virtually independent of depth enables efficient treatment of shallow surface waters.
- Bubble-free, liquid-to-liquid mixing creates a stable, persistent oxygen plume.
- Molecular dissolution increases biological activity and associated treatment capacity.

5 ASB

- Achieved a significant improvement in DO at all 10 sampling locations within the ASB, with sampling recording the DO at the bottom, middle and top of the water column.
- DO across all 10 sampling points achieved an average improvement of 514% at the bottom of the water column, 910% at the middle of the water column, and 749% at the upper part of the water column.

ECONOMIC/OPERATIONAL

- A 62% reduction in chemical costs, reducing net operating cost by an estimated US$1-to-1.6 million per year after accounting for the cost of oxygen.[4]
- More responsive dosing to dynamic water treatment demands – delivering superior odor control by actively monitoring and automatically and rapidly addressing suboptimal levels of ORP and/or DO throughout the treatment process.
- Promotes a healthy and robust population of micro-organisms, increasing the efficacy of biological processes from end-to-end.

SOCIAL/COMMUNITY

- Enhances worker safety and compliance issues related to storing and handling of chemicals.
- Improved odor control and social license.

ENVIRONMENTAL

- Improved water quality and odor control.