WHITE PAPER

Addressing zoogleal film build-up on dissolved oxygen probes in aeration basins - City of Hobbs, New Mexico

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Introduction

The City of Hobbs is located in southeast New Mexico, close to the Texas border. Our wastewater reclamation facility provides uninterrupted wastewater treatment for the community of Hobbs, including liquid wastes transported to the facility. It serves over 43,000 people and is currently receiving and reclaiming about 3.2 million gallons of wastewater a day.

The Hobbs WWRF has been twice awarded The Max Summerlot Award, the State of New Mexico's highest and most respected industry award, which is presented annually to the New Mexico water or wastewater facility that demonstrates the highest level of professionalism and excellence in the operation, maintenance, management, and safety.

The plant processes approximately 95% residential wastewater, with the remaining 5% light industrial. After treatment, 70% of the effluent is used by local farmers for irrigation, and the remaining 30% is used by the City for irrigation of local public parks and sports facilities. Potable water for the city is drawn from the Ogallala Aquifer before being treated and used by the residents and light industry. Given the arid climate, Hobbs has low measurable rainfall, so the re-use of all wastewater is critical to sustainable irrigation by the city and local farming.

Process overview

The plant is classified as an activated sludge, biological nutrient removal (BNR) facility employing the Modified Ludzack-Ettinger (MLE) activated sludge process, with nitrate removal in 3 parallel trains (Figure 01). In each train, after initial grit screening, the effluent goes through an anoxic zone, comprising 4 basins, where nitrates are removed through bacteria or “bugs”, in a low oxygen-starved environment, utilizing molecular oxygen from the nitrate molecule and releasing harmless nitrogen that bubbles to the surface. In this process, optimal performance is achieved by keeping dissolved oxygen levels at the 0.1 to 0.3 mg/l level. Bacteria are constantly introduced through activated sludge and mixed liquor-suspended solids returns from the end of the process.

The next part of the process involves the effluent from the anoxic zone flowing into the first of 3 aeration basins located in a series, where bacteria is used to break down and consume organic matter that forms clumps of suspended solids. The biological oxygen demand (BOD) of this process is key and oxygen is pumped into these aeration basins continuously from large blowers located in a building next to the aeration basins.

In each basin, the dissolved oxygen levels are maintained at a fixed level to optimize the breakdown of the organics in the wastewater. Basin 1 is 3%, Basin 2 is 2%, and Basin 3 is less than 1%. This process has many benefits, including the significant reduction in effluent odors that make our location near some residential houses a non-issue.

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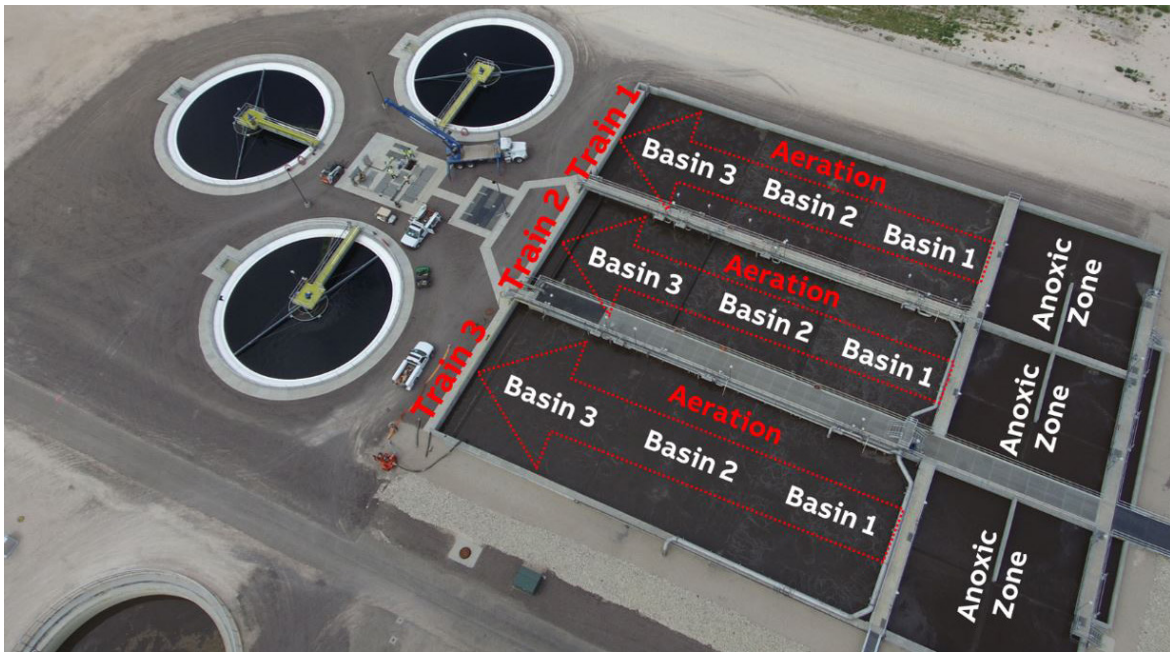
01 Location of anoxic zones and 9 aeration basins in 3 trains



Explanation of sludge types

All the sludge in anoxic, aeration, and clarifiers is called Activated Sludge. There are different names for the Activated Sludge depending on where the sludge is located in the process, as it recirculates through the basins and clarifiers. Mixed Liquor Suspended Solids (MLSS) is the sludge in the anoxic and aeration basins. Internal Recycle sludge is just MLSS that is recirculated before it can leave the aeration basins - this is an integral part of the MLE nitrate removal process. MLSS that has settled to the bottom of the clarifier is called Return Activated Sludge (RAS). Waste Activated Sludge (WAS) that is diverted to aerobic digesters in order to maintain a consistent microbe and solids concentration in the MLE process.

Too much or too little oxygen can reduce the bacteria's ability to break-down organic matter and nitrogen. Both conditions will negatively impact the operation of the wastewater facility. In extreme cases, over or under oxygenating can poison and kill the bacteria leading to expensive and lengthy plant shutdowns, as the whole MLE process has to be re-established, permit violations could be incurred, irrigation water has to be sourced elsewhere, and strong effluent odors become an issue in the surrounding residential area. Given that the rebuilding of the MLE process can take many weeks, this would be a major expense and environmental issue for the local community.

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02 RAS pumped back to Anoxic Zone from Clarifiers to maintain biological processt

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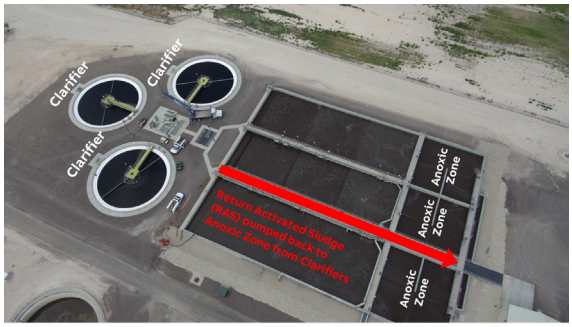
03 Display showing incorrect DO measurement from old probes coated in Zoogleal film



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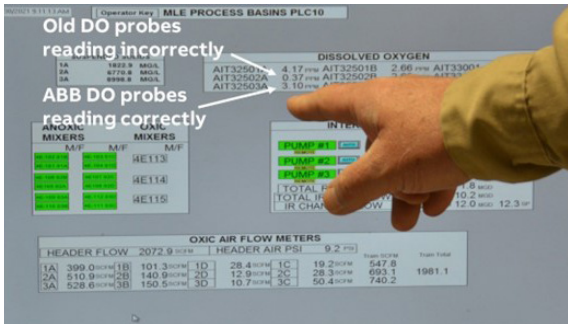

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Final treatment, solid waste removal and water reuse

Once the wastewater has passed through these 3 aeration basins, it is sent to three final clarifiers, where the suspended solids settle to the bottom. This Return Activated Sludge (RAS) is returned to the front of the anoxic basins where it mixes with internal recycle sludge and incoming wastewater (Figure 2). The clarified water leaves the clarifier and gravity flows through UV channels and a mild chlorine treatment to a holding pond before being pumped to the farm, parks, and cemetery for irrigation. The solids are removed, aerobically digested, de-watered and 100% reused for soil amendment by the city, its residents, and farmers.

The importance of reliable dissolved oxygen (DO) measurement

Tight control of the dissolved oxygen (DO) levels is critical to the optimal performance of the plant (Figure 3). Accurate DO measurement in the aeration basins enables the multistage centrifugal blowers to be optimized to avoid wasting energy. This can save $1000's per year in operating costs. More importantly, it also avoids over or under oxygenating the aeration basins which can significantly impact the bacteria's effectiveness.

The challenge of zoogleal film build-up affecting DO measurement

Zoogleal film is a natural occurrence in wastewater plants and consists of bacterial matter building up into a jelly-like mass or slime layer that coats plant equipment. It is especially a problem for DO sensors that are relied upon to measure the oxygen levels in the aeration basins and send that data back to the control room for plant operation and optimization. Accurate control over oxygen levels in the basins is 100% reliant on accurate measurement by the DO sensors being used. If the measurements become unreliable, serious consequences can occur due to over or under oxygenating the basins – as described previously.

DO sensors are inserted into the 9 aeration basins and measure oxygen levels 24/7. The City of Hobbs recently switched to optical sensors that utilize the 'dynamic luminescence quenching' principle, a light- based measurement technique. This technology is superior to electrochemical sensors, as they have no membrane or chemical components that wear out quickly and need constant re-calibration and maintenance.

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04 Photos showing difference in impact of Zoogleal film on probes vs new ABB probes

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05 ABB Aztec AWT440 multi-channel transmitter controls up to 4 sensors and their compressed air cleaning process

Over the years we have used DO sensors from various suppliers and faced many challenges due to zoogleal film build-up. Until we switched to the ABB DO system we had to remove and clean our DO sensors every two days to avoid inaccurate readings. This process takes about 2 hours to clean all 9 aeration basin DO probes, meaning that we were spending on average, 20 hours per month or 240 hours per year cleaning DO sensors.

With the installed ABB DO system, we are only cleaning them once every 14 days, that means we save 16 hours per month or 194 hours per year in labor costs that can be utilized elsewhere.

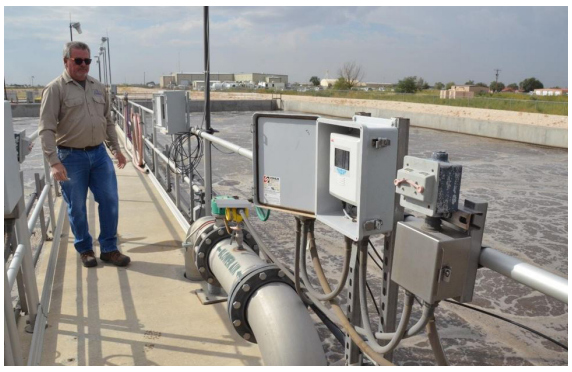
How ABB's DO system handles zoogleal film build-up

The ABB system comprises of the Aztec ADS430 sensor and Aztec AWT440 multi-channel transmitter and utilizes the latest developments in optical measurement technology. Consistent, reliable, and accurate, it helps us to realize significant savings through reduced energy consumption and maintenance.

The ADS430 optical DO sensor's robust design enables it to withstand the problems that can affect conventional membrane-based sensors, such as abrasion, fouling or poisoning. The sensor is not affected by photobleaching or stray light and is also immune to the effects of sulfides, sulfates, hydrogen sulfide, carbon dioxide, ammonia, pH, chloride, and other interferences.

This enables it to provide consistent, accurate readings over long periods of time without suffering from sensor drift. The ADS430 sensor is also constructed from inert, non-corrosive materials, making it suitable for use in high-salinity environments.

A key benefit of the system is its simplicity. ABB's EZLink plug-and-play technology automatically connects the transmitter and sensor, with no need for wiring or complicated configuration. Set-up is straightforward, with a user-friendly HMI and clear operator menus making it easy to set parameters and view diagnostic information.



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Available in two and four-channel versions, the Aztec AWT440 universal transmitter enabled us to connect four Aztec ADS430 DO sensors, enabling monitoring at multiple points without purchasing and installing separate transmitters.

Our previous supplier required one transmitter for each sensor which increased purchase and installation costs, plus spare parts and maintenance. In addition, this simplicity also extends to the sensor itself, which features a smart sensing cap with automatic setup. The SmartCap comes pre-loaded with factory calibration coefficients, serial number, lifetime indication, and manufacture date which are automatically uploaded to the sensor, eliminating the time normally required for set-up.

By automatically prompting the user when replacement is due, the SmartCap also removes the risk of unexpected sensor failure.

The SmartCap is capable of up to 24 months of continuous operation, greatly reducing the requirement for maintenance. When the cap does need to be replaced, it simply unscrews from the sensor, and the existing transmitter will automatically recalibrate to the new cap's calibration coefficients.

When cleaning is necessary after 14 days, it can be cleaned and redeployed without calibration. To manage the zoogleal film in between cleanings, the sensor is kept accurate using ABB's auto-cleaning system. This system periodically injects a high-pressure burst of air across the sensor surface to remove the zoogleal film build-up. Our previous supplier offered an air-cleaning nozzle, but it required a special air supply and compressor to operate. The ABB system uses small, packaged air compressors to achieve much better results that are controlled by the AWT440 multi-channel transmitter.

Overall, we are very pleased with the ABB DO system and feel that we finally have a solution that delivers the accurate, reliable, cost-effective DO measurement solution we need to keep the Hobbs WWRF running efficiently despite the challenges of zoogleal film build-up. The fact that ABB offered a 3 month, no commitment trial period gave us the time to evaluate the effectiveness of the system before we made the purchase. Ultimately, it's a win-win for the whole community as the farmers, residents and city leadership team are kept happy and we have more time to spend on managing other areas of the process.

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06 City of Hobbs WWRF team is happy with their new ABB DO analyzer system

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