



Town of Bethlehem, New York Clapper Road Water Treatment Plant

Concentrated Oxygen Injection for Pre-Treatment (Injection Skids & PFR)

THE PROBLEM: The Clapper Road Water Treatment Plant (WTP) was originally constructed in 1994 and was designed to treat up to 6 MGD of water drawn from the Selkirk Wellfield. As part of the existing plant's treatment process, chlorine was injected into the raw water to oxidize dissolved iron and manganese. The chlorinated water was then collected in a reservoir before continuing to pass through the following additional treatment steps: dissolved air flotation (DAF); gravity filtration; and chlorine disinfection. While the plant was designed to treat 6 MGD, the pre-treatment chlorination process was limited to 3 MGD, significantly limiting the plant's capacity.

In 2013, the U.S. Environmental Protection Agency (EPA) introduced its Stage 2 Disinfection Byproduct Rule requiring more stringent monitoring of trihalomethanes (THMs). THMs occur when chlorine combines with naturally occurring organic compounds found in source water. The Clapper Road WTP quickly found itself in violation of this new rule and commissioned a plant improvement project to resolve the issue by eliminating the pre-chlorination step.

A secondary goal of this project was to address the dissolved oxygen (DO) deficiency in the raw water. Low DO levels were negatively affecting the DAF unit's ability to remove inorganic and organic contaminants, leading to a higher chlorine demand during the final disinfection stage and resulting in further THM formation.

THE SOLUTION: As part of the plant improvement project, a new pre-treatment facility was installed to enable the plant to inject concentrated oxygen, rather than chlorine, to oxidize the dissolved iron and to assist with the oxidation of dissolved manganese. Hazen, serving as the design engineer, was familiar with Mazzei Injector Company's reliable and efficient in-line gas contacting systems and implemented it for this project. The resulting system consisted of (3) oxygen injection skids and a single 24" Pipeline Flash Reactor™ (PFR). The injection skids are fed by a Deployable Oxygen Concentration System (DOCS) Oxygen Concentrator manufactured by PCI, and are designed to operate in a (2) duty — (1) standby configuration to provide the plant flexibility to handle both turndown and redundancy requirements.

Each injection skid includes a skid-mounted booster pump which draws a sidestream from the mainline flow and pumps it through the skid-mounted venturi injector. The injector creates a vacuum so that concentrated oxygen gas can be injected into the sidestream. The water/gas mixture is then blended directly back into the mainline flow through a stainless steel PFR that employs high velocity mixing nozzles to aggressively mix and uniformly transfer the oxygen into solution. The Mazzei gas contacting systems are simple to operate and require very little footprint since they do not utilize any type of saturation tanks or vessels.



THE RESULT: After (3) years of operation, plant personnel confirmed that only minimal, routine maintenance had so far been required. Along with the other upgrades completed as part of the plant improvement project, the installation of the new oxygen injection system has enabled the plant to reduce THM levels by 40% - 50%, improve the DAF's efficiency, and expand treatment capacity to 8 MGD, all without adding to the daily responsibilities of plant personnel.

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