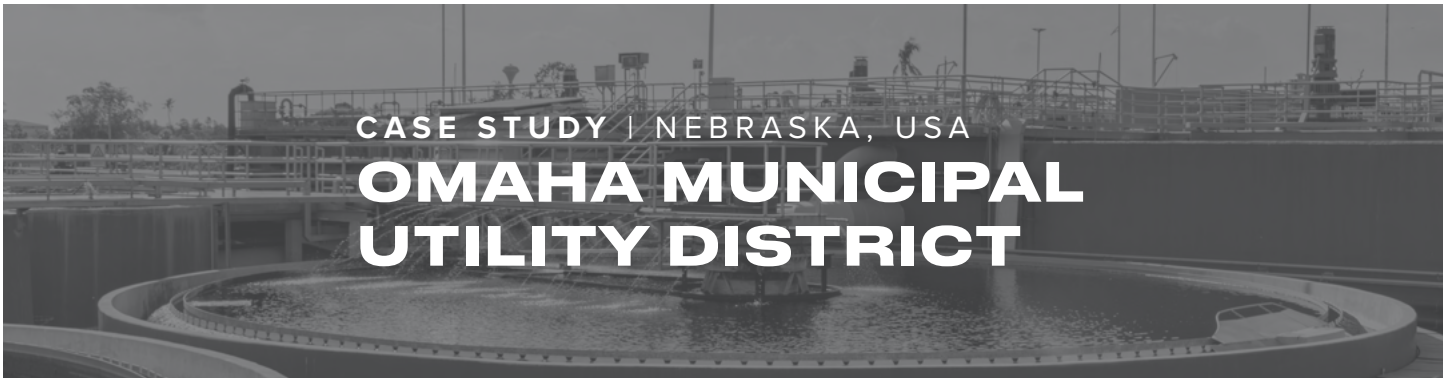

CASE STUDY | NEBRASKA, USA

OMAHA MUNICIPAL UTILITY DISTRICT

SITUATION

- The Omaha Municipal Utility District initiated a major facility improvement project to enhance the recarbonation process[1] of its 160 million-gallon per day (~606,000 m3) water treatment plant, installing a new pressurized CO_2 feed system and static mixers to normalize the pH of the water after the lime softening process.
- The municipal water treatment plant uses finished water as the carrier stream for the facility's recarbonation process, directing a portion of the plant's finished water to the process. Consequently, one of the key objectives for the improvement project focused on the need to minimize the quantity of carrier water required by the recarbonation process. Other operational objectives included the ability to stabilize the pH levels within three minutes and a desire to increase overall efficiency of water treatment facility.

COMPLICATION

- Despite the large capital costs invested in a new pressurized CO_2 feed system – a competing product to BlueInGreen's supersaturated carbon dioxide gas-dissolution (CDOX®) technology — facility managers were unsatisfied with its performance.
- Key concerns included the amount of finished water – 2,020 gallons (7,656 liters) per minute – required as the carrier stream for CO_2 feed system, the associated energy use and pumping costs of the recarbonation process, and the overall negative effect on the efficiency of the facility as a result of diverting over a billion gallons (~418,000 m^3) per year of finished water to the process – effectively treating this water twice and eroding the overall efficiency of water treatment facility.

RESOLUTION

- Since the Omaha Municipal Utility District required one duty system and one stand-by system, the facility manager engaged the engineering firm HDR to conduct a full-scale operational test comparing the recently installed pressurized CO_2 feed system to BlueInGreen's CDOX® technology. The system offering the superior performance would be chosen as the primary system.
- Engaged under a short-term services contract, ChartWater's BlueInGreen Center of Excellence commissioned a skid-mounted CDOX® 400 system for the direct, full-scale comparison.
- Over a three-month period, HDR evaluated the operational performance of BlueInGreen's CDOX® technology relative to the competing pressurized CO_2 feed system.

RESULTS

- The BlueInGreen CDOX® technology provided superior operational performance, demonstrating marked improvements relative to the competing technology, including a 90% reduction in carrier water and associated energy use and pumping costs of the recarbonation process, reducing the direct, annual operating costs by approximately US$ 89,000.
- The BlueInGreen CDOX® technology reduced carbon dioxide use by more than 24% -- reducing CO_2 use from 595 to 450 pounds (270 to 204 kg) per hour during average operating conditions, all while effectively stabilizing pH levels within the required three-minute span.
- The BlueInGreen system also increased worker safety within the building housing the recarbonation process, eliminating undissolved CO_2 that collected in the building while the pressurized CO_2 feed system was in use – creating an oxygen poor environment and hazard for facility operators.

System	Target pH	Average CO_2 Delivery Rate (lbs./hr. | kg/hr.)	Carrier Water Required (GPM | LPM)	Annual CO_2 Cost	Annual Pumping Cost	Combined Annual Cost
CDOX®	9.0	380 | 172.4	210 | 795	US$99,900	US$6,600	**US$106,500**
Competitor	9.0	500 | 226.8	2,020 | 7,647	US$131,400	US$64,000	**US$195,400**

  - During its operation, the relatively low gas-transfer efficiency of the pressurized CO2 feed system results in undissolved CO_2 escaping into the atmosphere and pooling in lower areas of the closed building. The heavier CO_2 molecules displace ambient oxygen, triggering the oxygen monitors that measure the quantity of oxygen in a closed environment and alert staff of danger when encountering an oxygen-poor environment. Due to the ~98% gas-transfer efficiency of BlueInGreen's CDOX® technology, minimal CO_2 escapes to the atmosphere, virtually eliminating undissolved CO_2 as a source of risk.
- Based on the results of the independent evaluation, the Omaha Municipal Utility District permanently installed a BlueInGreen CDOX® system, retaining the pressurized CO_2 feed system as idle back-up capacity.
- In retrospect, HDR estimated that if the Omaha Municipal Utility District had designed the improvement project around the smaller footprint and piping requirements of BlueInGreen's CDOX® technology, the facility would have reduced the installation costs of the project by approximately US$500,000.

BENEFITS

- **90% Reduction in Carrier Water:** Benefitting from the smallest carrier stream in the market, the CDOX® system reduced the quantity of carrier water required by the recarbonation process by more than 951 million gallons (~3.6 million m^3) per year compared to the competing CO_2 pressured feed system.
  - While the pressurized CO_2 feed system operates at fixed flow and pressure with a fixed, BlueInGreen's CDOX® technology is equipped with variable frequency drives to ensure that only the amount of carrier water required to dissolve the CO_2 required to achieve the treatment objective is pumped, reduced the amount of finished water diverted to the recarbonation process from 1.82% of the total flow to 0.19%, increasing the overall efficiency of the water treatment facility.
- **90% Reduction in Energy Costs and Greenhouse Gas (GHG) Emissions:** Benefitting the smallest carrier stream with the lowest pumping costs in the market, the CDOX® system reduced energy use and associated GHG emissions by 90%, saving more than US$57,000 annually.
- **24% Reduction in Carbon Dioxide Use:** Benefitting from the highest gas-transfer efficiency in the market, the CDOX® system reduced the quantity of carbon dioxide consumed by the recarbonation process by more than 635 tons (~576 tonnes) per year compared to the competing CO_2 pressured feed system, saving an estimated ~US$89,000 in annual CO_2 costs.
  - Eliminated 32 truckloads of CO_2 Annually, reducing traffic within the community and associated greenhouse gas emissions.
- **Increased Worker Safety:** 98% gas-transfer efficiency virtually eliminates undissolved CO_2 released inside the building, maintaining save levels of ambient oxygen within the closed space.
- **Increased Operator Productivity and Flexibility:** CDOX® systems are fully automated and communications ready. Cellular modems enable real-time monitoring from internet browsers and smart phones with instant-messaging alerting operators of any variation outside of normal operating conditions so they can focus on other tasks.

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[1] Re-carbonation after lime softening is the process of adding lime (calcium hydroxide) to water to raise the pH and precipitate minerals (Ca, Mg) out of solution, after which, the pH is normalized by adding dissolved carbon dioxide.