PRAXAIR

Making our planet more productive

Water & Wastewater Treatment

UNOX™ Process Upgrades

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Background

At Praxair, we are constantly working on finding new ways to make our planet more productive.

Over the years, Praxair has had an extensive history of innovation in the wastewater treatment process. In the 1960's, Praxair wastewater engineers developed the *UNOX*™ process. At the time, it was a revolutionary concept. Today, with aging equipment and changes in treatment requirements, Praxair can provide a wide range of technologies for *UNOX*™ upgrades. These enhancements can help *UNOX*™ facilities achieve reduced operating costs and improved reliability through the upgrade of oxygen generation and dissolution equipment.

Oxygen Supply: A critical *UNOX*™ wastewater treatment system component

Oxygen Generation Systems

Many of the oxygen generation systems installed at *UNOX*™ facilities were put in place in the 1970's and 1980's. These oxygen generation systems use either PSA (pressure swing adsorption) or cryogenic technology. Today, Praxair offers a newer generation of on-site air separation technology that can produce oxygen much more efficiently.

The Praxair VPSA (vacuum pressure swing adsorption) system offers the following benefits:

- Reduction in power requirements of up to 70%
- Improved power turndown
- Reduced maintenance
- Faster startup
- Improved operability
- Full service oxygen plant operation and maintenance from Praxair

Praxair is a leading global industrial gas company with over a century of experience in the industry. It is also the largest industrial gas company in North and South America, with an extensive network and varied oxygen supply options to ensure that your oxygen needs are met. Our world class International Monitoring and Production Assistance Center (IMPAC) provides added value to our customers by continuously monitoring product levels at your back up liquid oxygen facility.

In situations where a *UNOX*™ facility is located near a Praxair pipeline, we can enable the facility and avoid all of the energy and operational challenges associated with onsite oxygen generation altogether. At the City of Detroit, this 650 million gallon per day facility was able to close its onsite oxygen generation system completely, and rely exclusively on oxygen supplied from a Praxair pipeline.

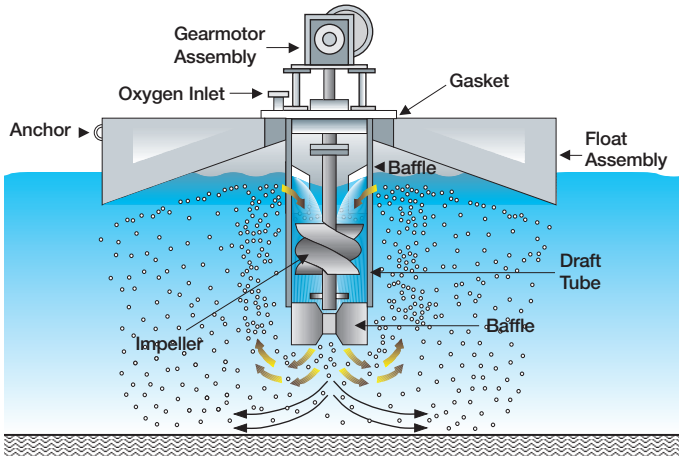
Table 1: Oxygen Supply Systems for *UNOX*™ Plants

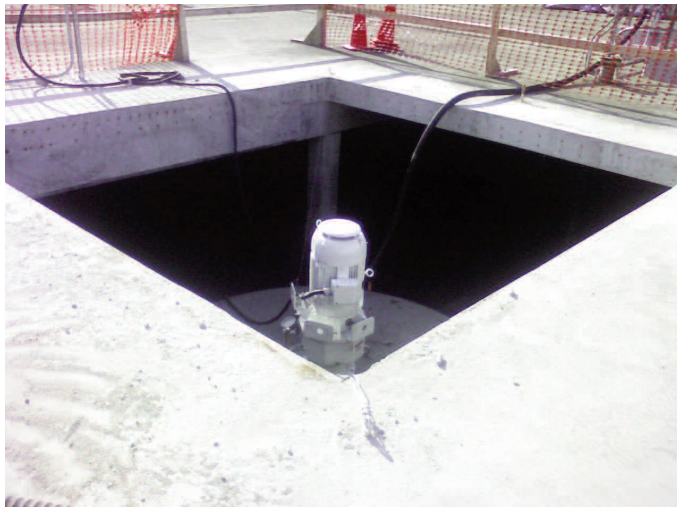
	LOX	PSA	VPSA	Cryogenic
Typical Gas Flow Rate (tpd)	1-20	1-20	>20	>20
kWh/ton	n/a	724	185	257
Max Turndown	100%	20%	45%	20%
Startup	~10 min	~10 min	~10 min	>2 days
Pressure (psig)	10-20	80-90	2-3	10-20
Purity	99%	90%	90%	99%

Oxygen Dissolution Systems

The original covered basin mixers found on the *UNOX*™ systems can be replaced with Praxair's In-Situ Oxygenation (*I-SO*™) system. This system is designed to dissolve oxygen into wastewater with a high transfer efficiency. The *I-SO*™ also offers automated and manual dissolved oxygen (DO) control. Controlled oxygen flow can be used to optimize oxygen usage, operate swing aeration zones, or establish anoxic cells for total-nitrogen removal.

In-Situ Oxygenation (*I-SO*™) Unit





Power Reduction and Optimization

Many *UNOX*™ systems have installed mixing capacity per stage ranging from about 100 – 200 hp/MG. Praxair's high efficiency In-Situ Oxygenation (*I-SO*™) systems can meet the mixing and oxygenation needs in each *UNOX*™ stage with 50 hp/MG. The *I-SO*™ systems have successfully replaced the existing surface aeration devices in *UNOX*™ tanks, providing up to a 30% reduction in the mixing and oxygenation energy used at the facility.

I-SO™ *installed in a UNOX*™ *aeration tank.*

Biological Nutrient Removal

Since their original construction, many *UNOX*™ facilities have new regulations that require either nitrification or total removal of reduced nitrogen (TKN or NH3-N). As the *UNOX*™ aeration basins are closed, CO_2 tends to accumulate in the head space, which reduces the pH and can lead to upsets in nitrification. Praxair offers a retrofit to promote nitrification or total nitrogen removal. The mixer for each *UNOX*™ stage is removed, so that the aeration tank is open to the atmosphere. Once this step has been complete, Praxair's *I-SO*™ systems are installed in the open tank, which allows the CO_2 to be vented during aeration.

Praxair has provided upgrades at multiple *UNOX*™ facilities in the United States. These upgrades have included both oxygen generation systems as well as *I-SO*™ installations.

Table 2: Praxair Upgrades at *UNOX*™ Facilities

Facility	Year	O_2/TPD	Upgrade	Benefit
Euclid, OH	2001	15	Switch from PSA to VPSA	Power Savings
Detroit, MI	2004	600	Switch from Cryogenic to Pipeline Oxygen	Life Cycle Cost Savings
Ocean City, MD	2005	12	Switch from Cryogenic to VPSA	Power Savings
Holyoke, MA	2007	8	Switch from PSA to Liquid Oxygen and installation of six *I-SO*™ systems	Lower maintenance, better dissolved oxygen control, total nitrogen removal
Louisville, KY	2014	135	Switch from Cryogenic to VPSA	Power Savings
Holland, MI	2015	12	Switch from PSA to liquid oxygen and installation of four *I-SO*™ systems	Increase capacity with *I-SO*™ system addition

Summary

As *UNOX*™ wastewater treatment facilities strive to improve their environmental performance, Praxair offers oxygenation generation and dissolution options that will help you to meet your goals. Whether your interest is in energy reduction, improved reliability and maintenance, or complete nitrogen removal, Praxair offers systems that will help meet your needs.

To learn more about Praxair's wastewater treatment options and how we can help you improve your productivity, call us at 1-800-PRAXAIR or visit us at www.praxair.com/wastewater

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