WATER

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COMPARISON OF ETC KLORIGEN AND MIOX SYSTEMS

PROCESS

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KLORIGEN	MIOX
Sodium hypochlorite product concentration up to 15 trade % (150 g/L)	Sodium hypochlorite product concentration 0.4 to maximum of 0.8 trade % (4 - 8 g/L)
Chlorine gas product available safely on-demand along with co-product sodium hydroxide	Chlorine + caustic to sodium hypochlorite reaction is instantaneous; system cannot produce chlorine gas or sodium hydroxide for use
“Hybrid” system allows simultaneous production of high-strength sodium hypochlorite, chlorine gas AND caustic	
10:1 turn-down ratio allows for system operating rates based on need at any given time	No turn-down ratio; system runs at either 100% capacity or 0%
Hydrogen diluted to 50% of the LEL *as it is produced* and safely vented to atmosphere	Hydrogen is vented off of the bulk storage tank

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PROCESS (cont.)

KLORIGEN	MIOX
Brine recycle process allows for re-use of un-reacted brine, improving system efficiency; Klorigen has the lowest carbon footprint of any on-site generation process	Higher per-unit salt consumption rates
Spent brine is recovered, residual chlorine is stripped, brine is purified and recycled into the process resulting in 90+% efficiency	Less than 20% of the salt is converted to hypochlorite, the remaining salt ends up in the weak hypo solution product
Klorigen process utilizes less than 8 liters of water per kilogram of equivalent chlorine generated	Requires 125 – 250 liters of water per kilogram of equivalent chlorine generated

ELECTROLYZER

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KLORIGEN	MIOX
Electrolyzer operates at or less than 1 ATM	Electrolyzer operates under positive pressure
Separated cells and high-quality salt eliminate the need for acid-washing	Systems producing in excess of 45 kg/day chlorine require periodic acid-washing
Vertical orientation facilitates natural gas lift and improved hydrogen safety	Electrolyzer design leads to potential hydrogen concentrations in the cells and storage tanks
Electrodes separated by state-of-the-art membrane provide electrical and chemical isolation	Un-separated cells

EFFICIENCY

(per kg of generated chlorine)

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KLORIGEN	
Salt	1.8 kg
Electricity	3.95 kWh
Water	7.9 liters

MIOX	
Salt	2.5 - 3.0 kg
Electricity	4.4 kWh (NaOCl) 6.6 – 7.7 kWh (mixed-oxidant solution)
Water	125 – 250 liters

12.5% v. 0.8%

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PRODUCT/DESIGN CRITERIA	12.5% Hypochlorite Solution from Klorigen System	0.8% from MIOX System
Prior evidence of complying with NSF/ANSI Standard 60	Yes	Unknown
Certification by the US Department of Homeland Security as a Qualified Anti-Terrorism Technology (QATT)	Received on February 16, 2010	Unknown
Chlorate in Hypochlorite	Approximately 1 gm/L in 12.5% solution (equivalent to 64 ppm in 0.8% solution)	310 ppm
Sodium Contribution per mg/L of Chlorine Dosage	Less than 0.6 ppm	Greater than 1.7 ppm (due to salt in hypo product)
Storage	Less than 8 liters of solution at 12.5% concentration per kg of chlorine	125 liters of solution at 0.8% concentration per kg of chlorine – requires 15x the storage of a similarly sized 12.5% hypochlorite generator
Product Compatibility	100% compatible with commercially supplied bulk sodium hypochlorite at “trade” concentration; no changes required in storage, pumping or injection equipment	Dilute concentration requires separate pumping, mixing and dilution facilities; mixing with commercially supplied bulk product can be problematic

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Des Moines Water Works – 1,500 GPD On-Site 12.5% OSG Installation