EVOQUA NSF 61 CERTIFIED GENERATORS – 3 CHEMICAL T-AUTO SERIES MILLENIUM III™ CHLORINE DIOXIDE GENERATOR

The Millennium III™ Series self-tuning automatic generators are the next generation in chlorine dioxide technology combining high safety performance with durability, simplicity of use and easy maintenance. The generators are designed, built and certified in compliance to NSF 61, Section 8 standards.

The Millennium III T-Auto Series generator produces chlorine dioxide in a continuous two stage reaction process under vacuum conditions to generate chlorine dioxide safely and efficiently. In the first stage, molecular chlorine gas is generated in situ as part of the generation process by the reaction of either a 12.5% solution of sodium hypochlorite or 0.8% on-site electrolytic-generated sodium hypochlorite solution (patent number: 8, 784, 733 B2) with a 15% solution of hydrochloric acid. The generators are available as a free-standing auto configuration with touch screen controls, integral chlorine dioxide production analyzer and SCADA interface capability the option of an integral chlorine dioxide optical analyzer capability is available.

The Millennium III T-Auto generators are available in various capacities utilizing a standard modular design and a small installed footprint. Available options include a multi-port ClO_2 batch injection skid, optical real time chlorine dioxide analyzer (0-4000 PPM), SFC / MFC series controller with Depolox® 5 analyzer, Varisens™ flow cell, ClO_2 and chlorite ion residual probes, Micro/2000® real time chlorine dioxide residual (0.1-2.0 PPM) analyzer, ORP /pH monitors, and GMS Plus CLO_2 in-air monitors. Included is a multi-stage water booster pump with motor starter control panel.

Key Benefits:

- Direct flow path of motive water and chemical precursors provide for minimal pressure losses and improved flexibility.
- Injector design improves overall performance.
- Rotameters and check valves are designed specifically for their intended uses.
- Materials of construction are compatible with chlorine dioxide and chemical precursors.
- Similiar compact footprint for larger capacity units.
- The safe generation of chlorine dioxide continues to be a primary design consideration. Generation under vacuum is used to minimize and control the reactions and concentrations.
- Efficiency / yield is maximized by reaction of chemical precursors in their concentrated form. These reaction conditions favor the immediate formation of chlorine dioxide, thereby minimizing by-product formation found in other types of generators.

Automatic Control Benefits

- State-of-the-art control valves specifically designed for low flow control of sodium chlorite and chlorine gas.
- Flow controls include PID loop for sodium chlorite.
- Touch screen interface allows for maximum performance, ease in set up, parameter changes and troubleshooting.
- Real time generator effluent analysis using an in-line (full flow) chlorine dioxide analyzer allows self-tuning and performance display.

Equipment Description

Generator:

- The same basic process is used for all models, from simple manual units to the most complex automatic model.
- Simple design reduces operational difficulties.
- Standard features for raw material flow measurement and control include:
  - Wallace & Tiernan® Products' S10k™ rotameters and Evoqua auto metering control valves
  - Magmeter on chlorite flow and water flow.

Automatic Controls:

- One state-of-the-art process controller performs all functions including generator self-tuning.
- Flow pace application (including dosage control), alarm monitoring and more.
- Parameters (for generator sizing, flow meter set-up, etc.) are accessible from easy to access and understand touch screen displays.
- Significant program changes can be made utilizing removable memory modules that allow for quick changes and updates.
- Industrial control valves and flow meters are utilized throughout to insure continuous trouble-free operation.
- Standard features on control components are industry accepted, compatible and include:
- Allen-Bradley® Products MictoLogix™ 1500 with 10" Color Automation Direct Cmore touch screen.
- Alternate Control systems are available. Please contact Evoqua for more information

Assembly:

- All components are securely mounted on a specially designed stainless steel skid with a smaller footprint that will allow placement in areas previously not considered.
- The skid construction is heavy duty, allowing location in operating areas that are subject to severe service conditions.
- Each valve and flow meter is secured to the frame to minimize vibration and flow related stresses. Piping runs are designed to insure a simple and safe flow path.
- Components requiring maintenance are easily accessible.

Typical Specifications

Chlorine dioxide feed equipment shall be manufactured by Evoqua and shall be comprised of a process or chlorine dioxide generation utilizing 25% sodium chlorite solution, 12.5% sodium hypochlorite solution and 15% hydrochloric acid solution from a two stage continuous reaction. The first stage combines the sodium hypochlorite solution with the hydrochloric acid solution under vacuum to produce molecular chlorine in-situ according to the reaction:

$$NaOCl + 2HCl \rightarrow Cl_2 + NaCl + H_2O$$

The subsequent reaction is between the sodium chlorite solution and the in-situ produced molecular chlorine under vacuum conditions according to the reaction:

$$2NaClO_2 + Cl_2 \rightarrow 2ClO_2 + 2NaCl$$

The feed system shall be arranged with equipment to suit plant requirements. The generator shall maintain a minimum yield efficiency of 95% chlorine dioxide from the reaction of sodium chlorite solution and chlorine gas. The yield efficiency shall be based on the above stoichiometric reaction.

The reaction of sodium chlorite solution and molecular chlorine shall take place under vacuum without the use of a separate mineral acid feed or the excess chlorine method (adding chlorine in excess of the stoichiometric chlorine requirements in order to lower the process pH). Excess chlorine shall be considered as any amount greater than 10% of the stoichiometric chlorine requirement that remains in the generator product stream as unreacted chlorine. Yield shall be defined as the maximum production of chlorine dioxide, compared to the theoretical maximum available, where;

$$\% \text{ Yield} = (ClO_2/(ClO_2 + ClO_2^- + (ClO_3^- * 67.45/83.45)))*100$$

The theoretical maximum shall be determined from the feed rates of the chemical reactants. They shall be confirmed by an Amperometric analysis capable of differentiating between chlorine, chlorine dioxide, chlorite and chlorate ions. Analysis shall be confirmed by the procedure as described in Standard Methods for the Examination of Water and Wastewater, APHA-AWWAWEF, 20th edition 1998, Amperometric Method II, 4500-ClO2E.

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