# T-SERIES MANUAL CHLORINE DIOXIDE GENERATOR

MANUAL - THREE CHEMICAL

**Sabre Oxidation Technologies, Inc.** has developed the next generation of vacuum driven chlorine dioxide generation systems, which utilizes both two and three chemical precursor chemical processes. The three chemical process uses 25% aqueous sodium chlorite solution, 15% hydrochloric acid, and 12.5% sodium hypochlorite.

The Sabre System patented[1] *Tuned Reaction Column* is designed to eliminate the build-up of material in the reaction column that could lead to frequent flushing, disassembly and manual cleaning. The Sabre patented[1] *Integral Component Block Mounted* designed generator is built from a block of chemically resistant Schedule 80 PVC plastic with most of the pipe connections, chemical feed lines, and reaction column bored into the block. This process avoids the need for most of the external tubing, fittings, and connections common to other generators which are a source of pressure and vacuum leaks resulting in poor performance and efficiencies.

## METHOD OF OPERATION

The generator operates by water flow through an eductor that creates a vacuum and drives the entire system. This vacuum draws the precursor chemicals from their storage points through the generator's ten inch precision glass meters and into the patented[1] Sabre *Tuned Reaction Column* where the chlorine dioxide reaction takes place. The hydrochloric acid and sodium hypochlorite solutions premix to form chlorine *in situ*, which then reacts with the sodium chlorite solution inside the reaction column. Within milliseconds the chlorine dioxide is formed and educted from the reaction column into the water stream where it is immediately diluted and piped to the point of application. There are no dangerous concentrations of chlorine dioxide in the Sabre generation process.

## ANALYTICAL ANALYSIS

With the included inlet water flow meter and the feed rate chart, a sample port is provided to quickly and easily obtain a sample of the generator product stream for analysis. This convenient sample can be analyzed for the information needed to calculate generator efficiencies and mass balances. These may be required by government agencies (depending on your application) using Standard Methods and guidance found in EPA's support documents to Stage One DBP Rule. A sight glass for a visual indication of chlorine dioxide production is also provided.

## ADVANTAGES

**Vacuum Operated -** No costly troublesome chemical feed pumps are required. Leaks in the Sabre chemical feed lines potentially result in air being drawn into the system.

**Not Dependent On Low pH -** Sabre generators are not dependent on low pH and operate near the stoichiometric range required for efficient generation of chlorine dioxide. Those low pH dependent systems typically require excess acid to be fed to significantly depress the pH to enhance conversion of sodium chlorite. This results in a more corrosive product stream containing excess chlorine which increases chlorate formation. Sabre System chlorine

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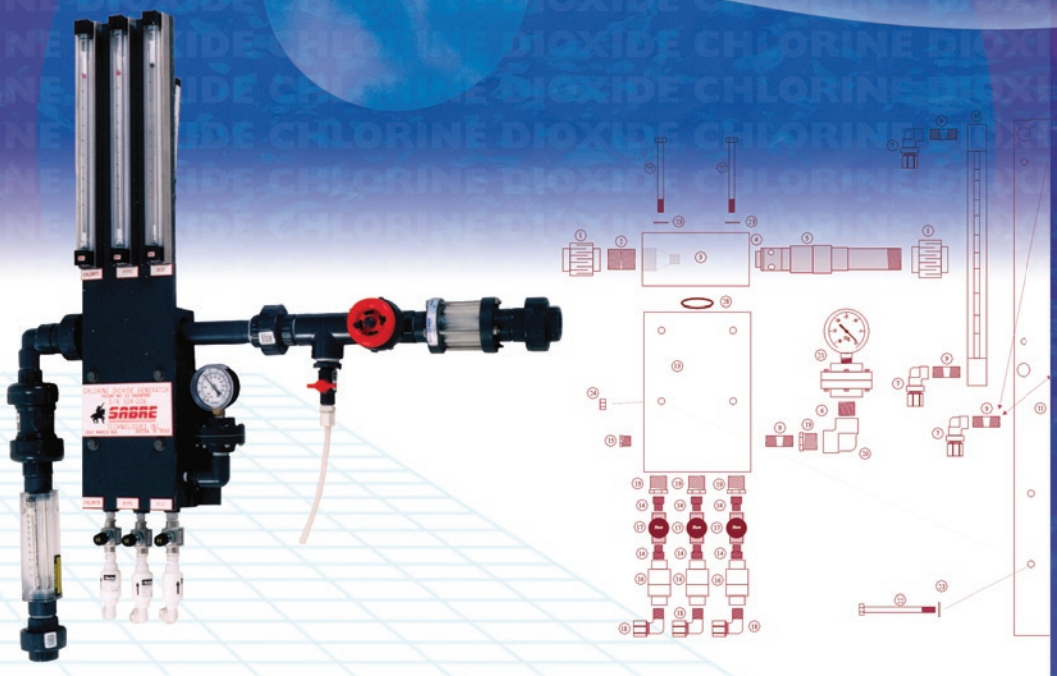

**Compact Systems -**
30"w x 36"h x 6"d
<1,000 lbs. $ClO_2$/day

**Typical Systems -**
10 to 1,000 lbs. $ClO_2$/day

**Other System Designs -**
Up to 100,000 lbs. $ClO_2$/day

$ClO_2$ is generated at minimum of 95% efficiency with <5% excess chlorine.

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dioxide generators achieve 95% plus efficiencies with no more than 5% excess chlorine. Effluent pH of the T-series Sabre generators are near neutrality or only slightly acidic.

**Chemical Handling -** Sabre generators operate on 25% active sodium chlorite solution that is easily shipped in drums, totes or bulk truckload shipments. 25% sodium chlorite is listed as corrosive and is not an oxidizer as is dry sodium chlorite. Once delivered there is no chemical handling required by plant personnel.

## GENERATOR SYSTEM SPECIFICATIONS

The chlorine dioxide system shall operate based on the reaction, under vacuum, of 25% sodium chlorite, 15% hydrochloric acid and 12.5% sodium hypochlorite in solution. Flow of the three chemicals shall be proportioned through feed rate control valves under vacuum adjacent to the reaction column. The vacuum will be created by an internal water eductor system. The chlorine dioxide formation reaction will be completed within the reaction column prior to entry into the eductor water stream. The water used to create the vacuum shall also dissolve the chlorine dioxide gas ordered for delivery at concentrations between 200 and 3300 mg/l.

The chlorine dioxide generator will be of single block construction to minimize connections and leaks associated with unnecessary and excessive connections and fittings as manufactured by Sabre Oxidation Technologies, Inc., of Odessa, TX.

All materials in contact with the precursor chemicals or chlorine dioxide shall be constructed of Schedule 80 PVC, Teflon, polyethylene, or acceptable non-corroding materials. Piping shall be furnished with sufficient unions to permit easy assembly and disassembly. All shutoff valves shall be true-union ball valves.

Sodium chlorite, hydrochloric acid and sodium hypochlorite solution flows shall be metered through separate glass meter tubes calibrated from 0-100% and shall be accompanied by a feed rate chart to show the appropriate setting for the desired chlorine dioxide dosage.

The major generator components shall be:

- Visual flow meters for all precursors
- Vacuum producing eductor
- *Sabre Tuned Reaction Column*
- Inlet water flow meter
- Chlorine dioxide sampling port
- Chlorine dioxide sight glass

The generator will be capable of a 10:1 control range and the chemical feed meters will have an accuracy: ± 4% of the full flow meter range.

The chlorine dioxide generator will provide a minimum yield of 95% based on the conversion of sodium chlorite with no more than 5% excess free chlorine in the generation process. The yield will be determined by amperometric titration, which is capable of differentiating between chlorine dioxide, chlorine, chlorite, and chlorate. The analysis procedure shall be the method published in *Standard Methods For The Treatment Of Water And Wastewater*, APHA, AWWA, WEF, 19th (and later) Edition, Method 4500-$ClO_2$ E. pg 4-80 to 83. Published APHA, Washington, DC.

Efficiency will be based on the theoretical stoichiometry optimized to produce chlorine dioxide from chemical feed rates of the reactants, according to:

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

Chlorine ($Cl_2$) gas is preformed under vacuum just before entering the patented[1] Sabre *Tuned Reaction Column*:

$$HOCl + HCl \rightarrow Cl_2 + H_2O$$

ACCESSORIES:

- On-Line chlorine dioxide ppm Analyzer
- Amperometric Titrator
- Water Pressure Booster Pumps
- Electrical Control Panel
- ORP Controls
- Generator Chemical Flushing System

CUSTOMER APPLICATION INFORMATION:

- Generator Size or Dosing Information
- Motive Water Pressure and Flow Rate Available
- Back Pressure at Application Point
- Electrical Requirements

[1]US Patent No 6,468,479 B1, and 6,645,457 B2. International & Other Patents Pending