

### SCOTMAS BRAVO ULTRA-PURE

Seawater Intake, RO Membranes, and Post Desalination Water Treatment with Ultra-Pure Chlorine Dioxide

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# **BRAVO ULTRA-PURE**

Disinfect seawater intakes, pre treatment, RO membranes and finished stock from one Ultra-Pure system, without creating disinfection by products (DBP).

Scotmas Bravo Ultra-Pure (BUP) is our unique, patented Chlorine Dioxide generation system, designed to produce the purest Chlorine Dioxide solution. A physical barrier prevents impurities and disinfection by products (DBP) from reaching the finished water, leaving a solution which has been independently tested to be 99.7% pure<sup>1</sup>.

BUP is specifically designed for SWRO desalination plants, offering the ability to dose seawater intakes, pre treatment, RO membranes and finished water stock through a dosing manifold from one BUP generator.

Lack of DBP and very low chemical concentrations compared to other biocides make BUP the most environmentally sustainable biocidal choice currently available.

Chlorine Dioxide from a BUP system has a near normal pH, making it more stable and less corrosive than solution from other Chlorine Dioxide generators. Less acid is required in the reaction process, reducing OPEX.

BUP is designed to the exacting, failsafe and security requirements of water



utilities clients with MODBUS integration, whilst using a flexible, industry standard deployment framework to minimise custom engineering costs and delays. PLC design is available with all the leading brands – Siemens, Allen Bradley, Schneider, Mitsubishi etc.

BUP can be provided as a fully preengineered containerised plant room solution for rapid site deployment and integration with other packaged plant.

BUP is designed to operate using bulk storage tanks of concentrated ClO2 precursors and provides for built-in control of all bulk chemical transfer pumps, air scrubbers and safety systems.

Full duty-standby/rotation capabilities allow for 2 identical models to be linked via fibre or Ethernet cable, providing full redundancy capabilities.

<sup>1</sup> Chlorine Dioxide solution from the Bravo Ultra-Pure system has been independently tested by the Desalination Technology Research Institute (DTRI) Saudi Arabia and found to be 99.7% pure.

### Reliability as Standard

Bravo Ultra-Pure Generators are only specified with premium PLCs and circuitry to provide the reliability and durability necessary for high volume disinfection applications.

Where required, PLCs and other key components can be specified by customers to meet project specific requirements. Scotmas work with Siemens, Allen-Bradley, Schneider and Mitsubishi, other PLC manufacturers can be selected on request.

All control systems are supplied in secure, skid mounted enclosures ready for install to site, or within our rapid deployment containerised systems.



### Multi Point Dosing Technology

Multiple-point dosing provides significant savings over traditional approaches.

The Bravo Ultra-Pure offers the ability to dose different levels of Chlorine Dioxide independently at up to 12 points throughout the site via DSX Multi Point Dosing Technology, eliminating the need for multiple generation systems or intermediate bulk storage of Chlorine Dioxide solutions.

System failure risk is reduced – there are fewer pumps, fewer motors, less pipework and less space required, reducing risk of component failure and ensuring a more reliable, lower cost Chlorine Dioxide dosing system.

Each DSX manifold is supplied complete with all instrumentation, pipework and control valves to manage variable Chlorine Dioxide dosing at all required locations.





### **CONTAINERISED** - RAPID DEPLOYMENT INSTALLATIONS





Scotmas' containerised water disinfection systems shorten installation time, ensure minimal on-site disruption, and can be built to clients' individual specifications.

Pre-engineered, containerised water disinfection systems have been supplied to customers throughout the U.K., Europe, and the Middle East in sizes from small 'plant room' style containers to 40' high cube units.

Systems are built in our factory from the initial supply of the empty container to the complete installation ready system, and fully tested by Scotmas, and customer representatives if required, prior to delivery on site. On delivery, a containerised Chlorine Dioxide system is installed for minimum downtime and on-site disruption. If site requirements change, containers can be disconnected, moved, and reconnected much more quickly and efficiently than would be possible with an installed solution. All systems are ISO certified.

Scotmas containerised systems are fitted with:

- Full temperature controls
- Fire & smoke alarms
- Ventilation
- Security rated doors

For temporary installations, our containerised solution can also be specified to include on-board chemical storage, providing for maximum levels of safety and security on complex oilfield or construction sites.



### **Project Management**

Successful implementation of a Chlorine Dioxide system in complex municipal and industrial processes depends on specialist expertise being available at an early stage of the project. Scotmas have successfully worked with consultants, EPC's and water treatment specialists to design and implement Chlorine Dioxide treatment regimes for some of the world's largest industrial processes.

Our practical approach, combined with our extensive global experience means we are well placed to provide early stage support to FEED studies, and back-up scientific support where jar testing and side stream trials are required.

Upon project commencement, our commitment to quality and safety is embodied by our longstanding accreditation to the ISO45001, ISO14001 and ISO9001 safety, environmental and quality standards. Diagnostic analysis can be supplied by our support technicians to ensure that you select the most appropriate Chlorine Dioxide dosage and monitoring strategy. Planned and reactive maintenance can be catered for by a wide range of service options, provided on a "full service" or "parts only" basis.

Our experienced team of engineers and support technicians are accredited to the Global ISO45001 Health & Safety Standard, and have experience working in demanding environments such as offshore oil installations, power stations and healthcare environments. As such, you can expect the highest standards of professionalism and service from our personnel in order to complete your installation quickly, efficiently and above all, safely. Our specialist engineers are experienced in HAZID, HAZOP and LOPA/SIL analyses, and are well placed to provide supporting reference information from previous projects to support your design outcomes.

### BRAVO ULTRA-PURE MODELS

UP 6,000	6,000,000 l/hr water (144MLD) treated @ 1 mg/l ClO2 Generates up to 6,000g ClO2/hr
UP 12,000	12,000,000 l/hr water (288MLD) treated @ 1 mg/l ClO2 Generates 6,000 - 12,000g ClO2/hr
UP 25,000	25,000,000 l/hr water (600MLD) treated @ 1 mg/l ClO2 Generates 12,000 - 25,000g ClO2/hr
UP 40,000	40,000,000 l/hr water (960MLD) treated @ 1 mg/l ClO2 Generates 25,000 - 40,000g ClO2/hr



# BRAVO ULTRA-PURE **APPLICATIONS**

#### **Seawater Intakes**

Prevent macro fouling by dosing Chlorine Dioxide direct to seawater intakes. Low chemical concentration and no DBP minimise environmental impact. Scotmas Reactive Dosing<sup>™</sup> takes account of unique patterns at the dosing location and ensures the minimum level of biocide is used to remove the target organisms.

#### **Feedwater Pre Treatment**

Pre treatment with chlorine or other biocides requires high chemical concentrations. Potential impacts include increased corrosivity and creation of toxic DBP, which can be multiplied by disinfectant reapplications further down the treatment train.

Pre treatment with Ultra-Pure Chlorine Dioxide is at very low concentration, does not create DBP and minimises corrosivity risk.

#### **Reverse Osmosis Membranes**

Studies show that 20-30% of SWRO plant OPEX is due to biofouling of membranes, chlorine rapidly degrades membranes and cannot be used.

Apply Ultra-Pure Chlorine Dioxide at the membrane to prevent biofilm build up, without degrading membrane, preventing biofouling giving reduced energy consumption, increased membrane life and lower maintenance costs.

### **Finished Water Stock**

Disinfect finished water stocks prior to entry into distribution network. Unlike chlorine, disinfection throughout the treatment train with Chlorine Dioxide does not result in cumulative multiplication of disinfection by products and potential breach of WHO guidelines.



### SCOTMAS YOUR CIO2 EXPERTS

The Scotmas range of Chlorine Dioxide generators has been designed to deliver ClO2 for drinking water and disinfection applications safely and securely, with unparalleled control and monitoring capabilities.

With more than 30 years' experience in ClO2 technology, utilising the latest chemical engineering techniques, Scotmas systems are backed by unrivalled application expertise and technical support.

The team at Scotmas encompasses chemists, microbiologists, electrical, mechanical and controls engineers; working together to innovate and provide support to over 4000 ClO2 installations worldwide.

Scotmas are **the Chlorine Dioxide specialists**, focused on delivering Chlorine Dioxide systems engineered to suit your individual needs.

### WHY CHLORINE DIOXIDE

Chlorine Dioxide has been proven to offer a reduced whole-life cost when compared with competing biocidal technologies, such as electrochlorination, ozone, and hypochlorite treatments, due to its powerful mode of action, low dose rates, and superior environmental performance.



#### Destroys biofilm completely at source

Biofilm removal is the most important part of an effective water treatment system. Without it, it is simply not possible to have a safe, pathogen free environment.

### Lower biocidal contamination

Some biocides require very high concentrations to produce the required disinfection impact. Where Hydrogen Peroxide has been promoted as a biocide for water treatment, dose rates can be up to 30 times the equivalent Chlorine Dioxide dose rate to achieve the same disinfection impact.

### **Disinfection by-products**

High concentrations of certain biocides can cause environmentally persistent, potentially carcinogenic by products to form, including Trihalomethanes, Chlorinated Organics and Bromate. Chlorine Dioxide does not react to form complex organic by products.

# Effective against complex organisms

Chlorine Dioxide has been found to be effective against complex organisms such as cysts and protozoa including Cryptosporidium, Giardia and amoeba.

# Oxidation strength vs. oxidation capacity

Compared with other oxidising biocides, Chlorine Dioxide has a significantly lower oxidation strength, yet is strong enough to attack the disulphide bonds found in the membranes of bacteria and other biological material. This process of "selective oxidation" allows the Chlorine Dioxide biocide to be targeted where it is needed most, disinfecting areas quickly at low dose rates, and minimising the creation of potentially harmful disinfection by products.



## 400km Pipeline, 4 Day Transit Time, 40°C Heat and a **Disinfection Residual**

#### The Problem

Maintaining water quality<sup>1</sup> in a major city in the GCC, whilst minimising system operating expenditure.

- Water is pumped 400km (240m) from a desalination plant through pipelines exposed to very high temperatures, with a four-day transit time.
- Lack of residual biocide and high ambient temperatures provide ideal conditions for biofilm build up.
  Biofilm creates biological corrosion<sup>2</sup>, frictional resistance<sup>3</sup> and sub standard water at the end of the pipeline, which would require major disinfection prior to distribution.

#### **Remedial Options**

- 1. Frequent chlorination of supplies at regular points along the pipe.
  - Disinfection with chlorine creates disinfection by products (DBP). Repeated disinfection using chlorine risks a multiplication of DBP and possible breach of World Health Organisation (WHO) guidelines for chlorate.
  - Construction and operation of disinfection stations would be expensive, especially so given the remote nature of most of the pipeline.
  - Gas chlorine has safety implications for transport, storage and usage, exacerbated by the high temperatures.
- 2. Install Chlorine Dioxide generation at the desalination plant and remote monitoring at key sites in the transmission pipelines.



### **Scotmas Solution**

- A Scotmas Bravo Ultra-Pure Chlorine Dioxide generator was installed in the desalination plant at the start of the transmission pipeline, dosing Ultra-Pure<sup>4</sup> Chlorine Dioxide to the start of the transmission pipeline.
- 2. Scotmas Sentinel Guard remote monitoring stations were installed at strategic locations throughout the pipeline, recording residual Chlorine Dioxide levels, water temperature, pH, and other key variables. Data is viewable in real time, allowing adjustments to dosing regimen to suit changes in environmental conditions.
- 3. The Scotmas support team worked with operators at multiple locations to develop a system wide understanding of the water network.





#### **Customer Outcomes**

- Proven biocidal residual at the end of the 400km transmission pipeline (0.1 mg/l Chlorine Dioxide), ensuring a high quality water supply, no biofilm build up, minimal corrosion in the pipe, and efficient pump operation. If secondary disinfection is required at local level, Ultra-Pure Chlorine Dioxide ensures no cumulative multiplication of DBP.
- **2.** <u>Flexibility</u>. Sentinel Guard records parameters in real time, allowing rapid changes to dosing strategy in response to temperature, flow rate or other system changes.
- **3.** <u>Safety</u>. Chlorine Dioxide is generated in a submerged reactor in one location from two precursor chemicals. Multi point dosing manifolds allow one reactor to treat the seawater intake, reverse osmosis membrane, and finished water stock as it enters the pipeline. No intermediate storage of bulk Chlorine Dioxide solutions.
- 4. <u>Security</u>. Offering full redundancy capability, three year cloud based history for all remote monitoring, and web and app based data access, the system provides the fundamental security the customer urgently required.

<sup>&</sup>lt;sup>1</sup> Residual target of 0.1mg/l Chlorine Dioxide at the delivery end of the transmission pipeline. Overall target is to ensure treated water meets the microbiological and chemical standards set by the World Health Organisation.

<sup>&</sup>lt;sup>2</sup> Biological corrosion is caused by the metabolic activity of microorganisms living within the biofilm. Waste materials are acidic, causing pitting, stress cracks and other damage to pipe walls.

<sup>&</sup>lt;sup>3</sup> Frictional resistance caused by biofilm growth results in increased pumping costs.

<sup>&</sup>lt;sup>4</sup> Scotmas Ultra-Pure Chlorine Dioxide has been independently tested by the Desalination Research Technologies Institute (DTRI) Saudi Arabia and found to have purity >99.7%.



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