Introduction to ClO_2

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Cooling System Treatment

Treatment of a cooling system has two basic objectives:

1. **To protect and extend the life of the cooling system**
2. **To insure good heat transfer and removal.**

Three components to a cooling water treatment program:

1. **Microbiological control,**
2. **Scale and deposit control, and**
3. **Corrosion control.**

The treatment program selected based upon its performance and its compatibility

Microbiological control is arguably the most important portion of a cooling tower treatment program.

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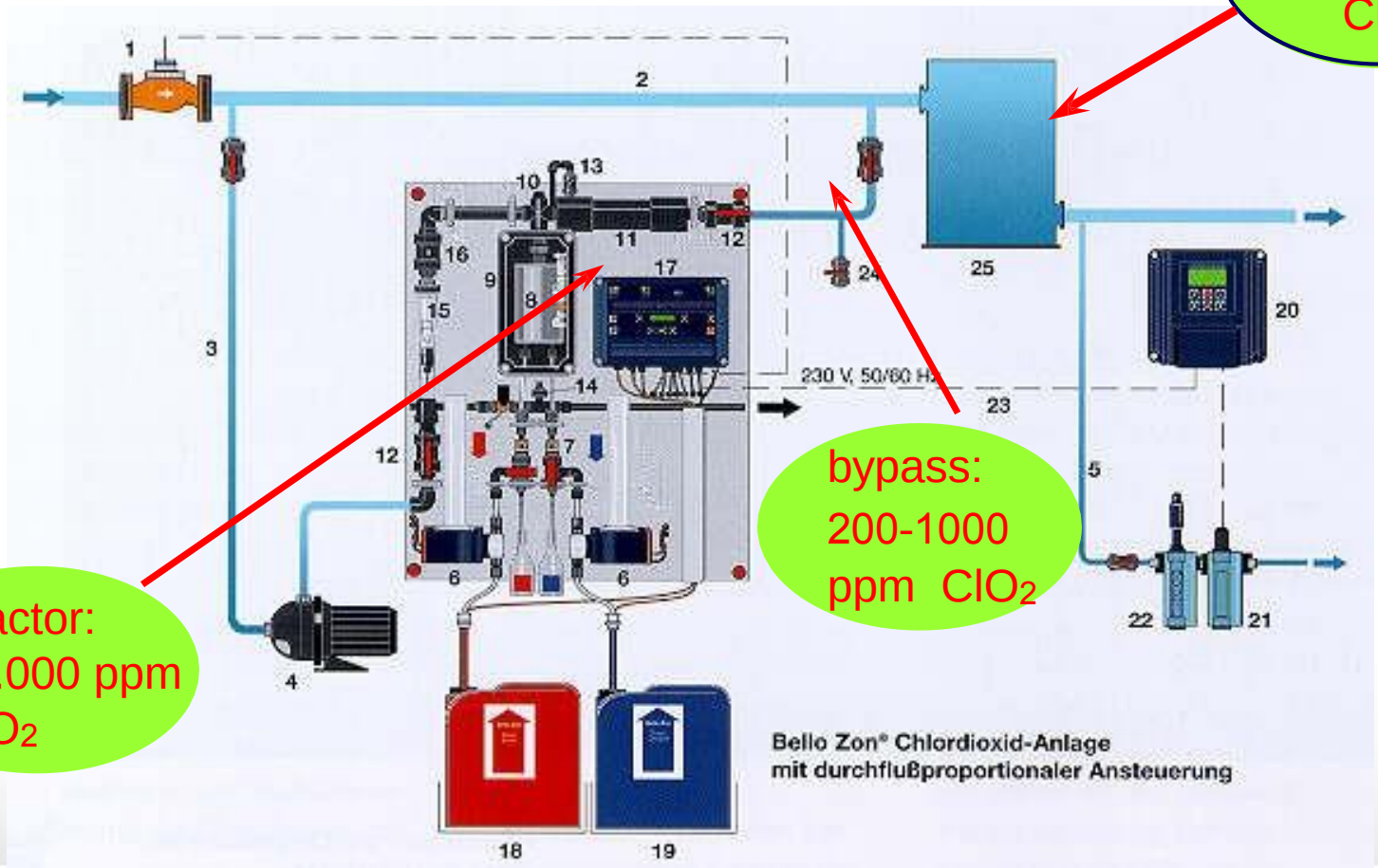
Typical ClO_2–Concentrations

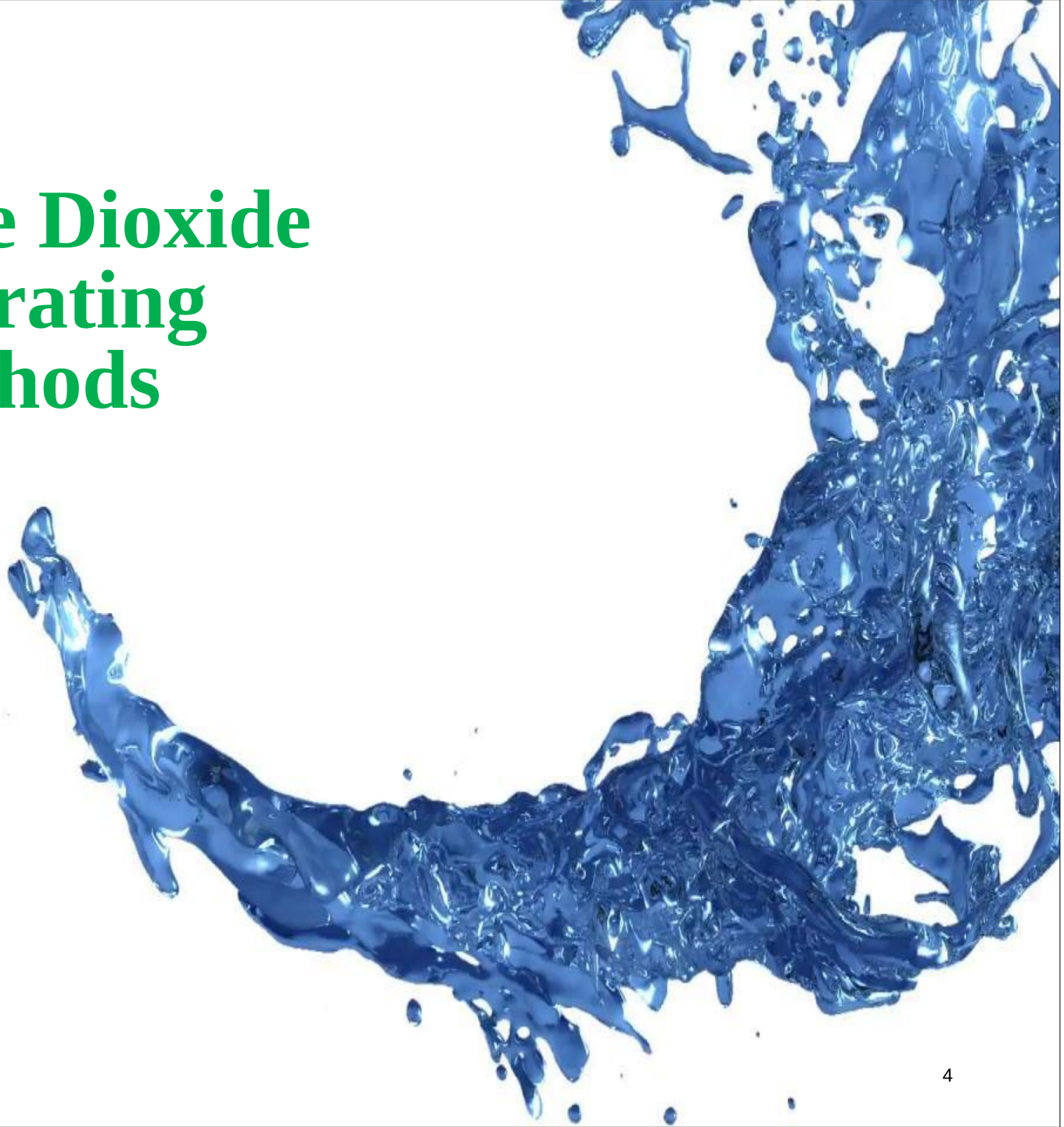
water:
0,05-2 ppm
ClO_2



bypass:
200-1000
ppm ClO_2

reactor:
20.000 ppm
ClO_2

Chlorine Dioxide Generating Methods



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Chlorite / Chlorine - Procedure

chemicals:
Sodium Chlorite ($NaClO_2$)
Chlorine Gas (Cl_2)

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

100 % theoretical chemical conversion efficiency

Relatively low cost especially if Cl2 is locally available

> 90 % yield, if the gas chlorine dosing system is perfectly trimmed

no chlorine-free solution of chlorine dioxide

- **chlorinated by-products are not excluded**

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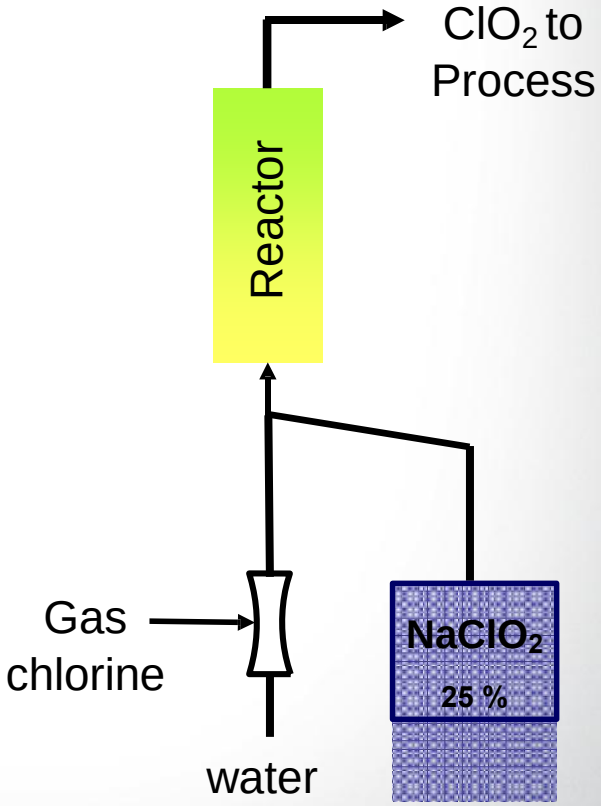
Chlorite / Chlorine - Procedure

- eductor driven dosage of gas chlorine into water
- metering pump driven dosage of chlorite
- pressurized system avoiding development of gas bubbles
- precise control of gas and water flow required
- capacity hardly controllable



Methods of Feed

The sodium chlorite reacted with a Chlorine gas to convert ClO2 through a ClO2 generator

applied as a dilute solution

It should be applied to processing system in a manner, which permits adequate mixing and uniform distribution

The feed point should be well below the water level to prevent volatilization of the ClO2

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ClO2 Generator Model AD DS

ClO2 generator +

Four-point dosing system

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Selection Criteria for ClO_2-Generators

Capacity

- Small < 1 kg/h
- Medium 1 – 10 kg/h
- Large > 10 kg/h

precursor chemicals

- liquid chemicals
- liquid + gaseous chemicals (chlorine gas)

yield and chemical by-products chlorite and chlorate

- chlorinated organics

safety features

Costs

- invest costs
- operating costs

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when to consider it

Large cooling systems with problems

- **>2000 l/day bleach**

Open recirculating cooling systems

- **Minimum recirculation rate 7500 m3/h**

Electro-Chlorintors high generating and maintenance costs.

Once through Sea Water Cooling Systems:

- **Minimum 20 000m3/h**

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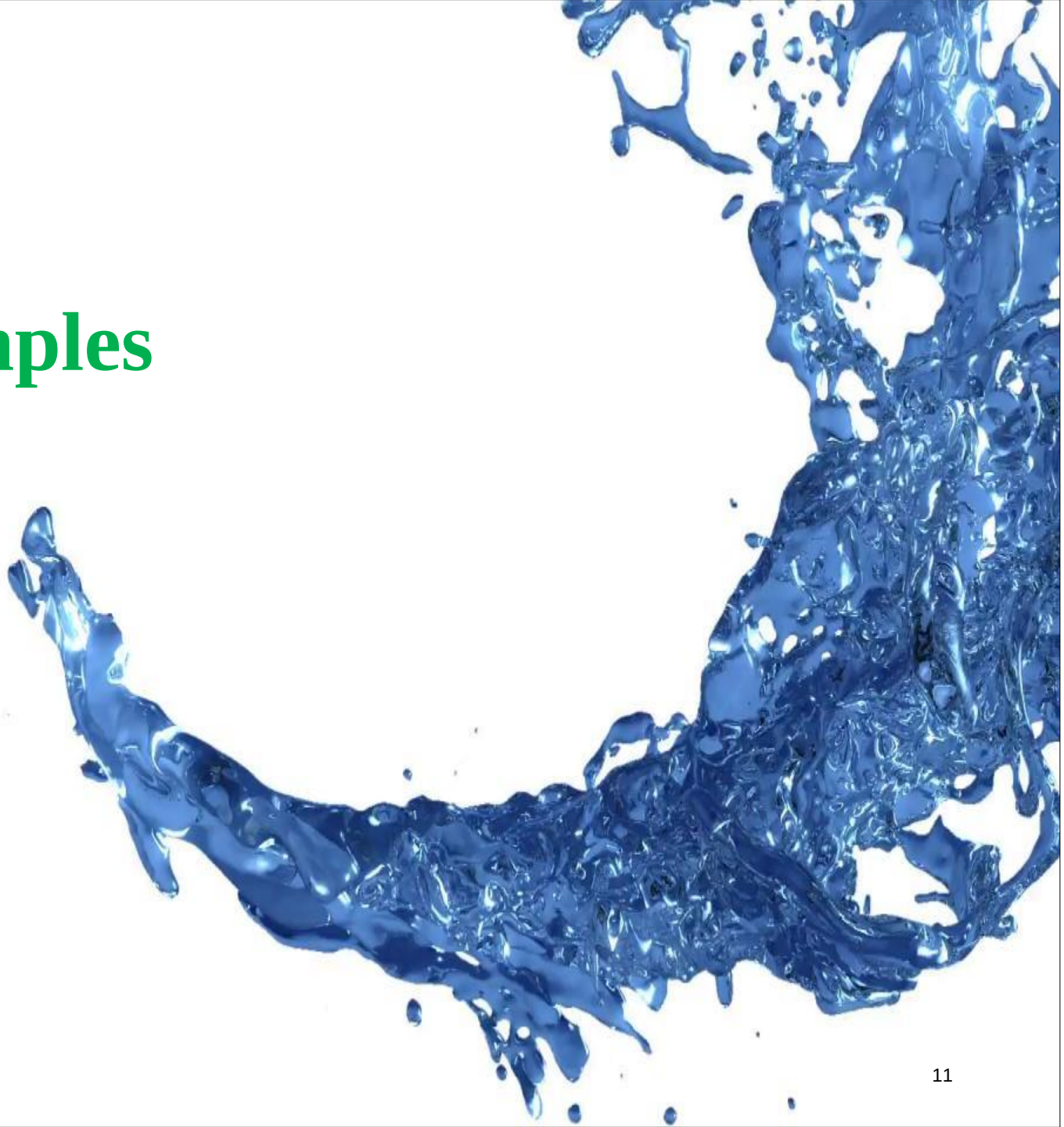
Examples



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Sea Water Cooling System.

The Sea Water Cooling System in the Middle East has a history of bio-fouling leading to poor thermal efficiency and under-deposit corrosion.

Historical attempts to address this had not been successful due to a variety of factors including efficacy and control problems.

This technology has addressed these factors and is providing a significant improvement in microbiological control and thermal efficiency.

The trial has focused on better targeting of the chlorine dioxide to further improve cost-effectiveness as we work towards finalizing the target dosage.

Further improvements to safety and monitoring required.

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Visual Inspection

Before Treatment	After Treatment
	
	

Microbiological Analysis

Plant 35 – Plate # 4	BEFORE ClO2 INJECTION	AFTER ClO2 INJECTION
Analyte	**Result**	**Result**
AEROBIC BACTERIA		
Total Viable Count @ 35°C	130 000 CFU/gram	9 000 est. CFU/gram
Pigmented Bacteria	1 Type	Not Detected
Total Coliforms	<1 000 CFU/gram	<1 000 CFU/gram
E. coli	<1 000 CFU/gram	<1 000 CFU/gram
Pseudomonas spp @ 35°C	7 000 est. CFU/gram	<1 000 CFU/gram
Spores	3 200 CFU/gram	4 300 CFU/gram
ANAEROBIC BACTERIA		
Sulfate Reducing bacteria	30 000 CFU/gram	300 CFU/gram
FUNGI		
Mold	<100 CFU/gram	<10 CFU/gram
Yeast	<100 CFU/gram	<10 CFU/gram

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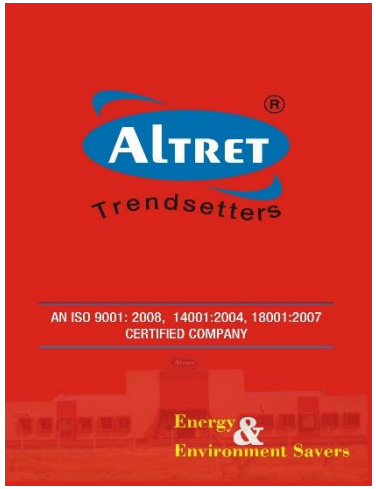
Other Product Ranges

Water treatment chemicals for Boilers & Cooling tower

Hygiene Care Specialty Cleaning Solutions

Combustion Monitoring Chemicals- Solid & Liquid Fuels Additives



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