

Dr. Ing. Wolfgang Storch

# **TwinOxide Chlorine Dioxide**





 **TwinOxide®**  
Total Water Disinfection Concept





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## Chlorite und Chlorate in TwinOxide Produkten

### Who is TwinOxide International B.V.



#### **TwinOxide International B.V.**

TwinOxide International B.V. is the exclusive worldwide license holder, producer and distributor for *TwinOxide®*, a transportable non-explosive two-component chlorine dioxide. TwinOxide® provides safe and disinfected water compliant with the European Quality Standard DIN EN 12671 for drinking water.

#### **TwinOxide worldwide**

Our headquarters are based in The Netherlands, a country with an extensive history with water. Our rapidly expanding distribution model is based on a network of [strategic partners](#) who are able to provide you *TwinOxide®* for water disinfection in your country.

#### **TwinOxide-0,3%-Solution is a Biocide for the groups**

**PT2, 3.4,5,11,12, 20**



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## Eurofins Umwelt Deutschland

Umweltanalysen und Luftmesstechnik



Eurofins Environment-East is the partner of Twin oxides International BV to ensure the quality.

**Eurofins Environment East controlled chlorites and chlorates in Twin Oxide 0.3% -Solutions.**

### **Worst-case test result of a Twin Oxide 0.3% -Solution:**

Chlorine dioxide concentration: 3800 ppm (3800 mg / l)

Chlorite: 480 ppm (480 mg / l)

Chlorate: 528 ppm (528 mg / l)

### **Dosage of chlorine dioxide in drinking water: max. 0.4 ppm**

(according to the German Drinking Water Regulation TVO 2012):

It follows:

Chlorite in drinking water: 0.05 ppm  
Chlorate in drinking water: 0,055 ppm

### **Limit according to the WHO guidelines:**

0.7 ppm for the sum of chlorite + chlorate

EUROFINS Umwelt Ost GmbH · Löbstedter Straße 78 · D-07749 Jena

**Twin Oxide International B.V.  
De Tongelreep 17****NL-5684 PZ Best  
NIEDERLANDE**

Title: **Test report to order 61303363**  
Test report: **No. 6007680030F1**

Project: **No. 6007680**  
Title of project: **Product testing**  
Number of samples: **3 samples**  
Sample type: **chlorine dioxide solution**  
Sampler: **Eurofins Umwelt Ost GmbH, Mr. Dr. Herschel**  
Receipt of samples: **2013-02-18**  
Test period: **2013-02-18 - 2013-02-28**

Subcontracting in a consolidated company:

Determination was performed by an accredited laboratory of the EUROFINS group:  
(FG)

The test results refer solely to the analysed test specimen. Unless the sampling was done by our laboratory or in our sub-order the responsibility for the correctness of the sampling is disclaimed. This test report is only valid with signature and may only be further published completely and unchanged. Extracts or changes require the authorisation of the EUROFINS UMWELT in each individual case.

Our actual General Terms of Sales GTS (Allgemeine Verkaufsbedingungen AVB) are applicable, if nothing else is agreed. The GTS will be submitted in German on request.

Accredited test laboratory according to DIN EN ISO/IEC 17025 notification under the DAkkS German Accreditation System for Testing. The accreditation shall apply for the tests listed in the certificate.

Jena, 2013-02-28



Dr. A. Herschel  
Analytical Service Manager  
03641 / 46 49 - 81



## Test report to order 61303363

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Project: Product testing

			Sample designation	Chlorine dioxide solution, made from TwinOxide Component A+B (S.110050)
			Lab-ID#	613019643
Parameter	Unit	LOQ	Method	

### Determination from the original sample

chlorine dioxide	mg/l	0,1	DIN EN ISO 7393-2	3800
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### Determination after stripping

chlorite (FG)	mg/l	0,1	DIN EN ISO 10304-4 (D 25)	480
chlorate (FG)	mg/l		DIN EN ISO 10304-4 (D 25)	528

### Remarks:

Chlorite and chlorate are produced in varying ratios as by-products during chlorine dioxide treatment and subsequent degradation. In drinking water, chlorite ( $\text{ClO}_2^-$ ) is the predominant reaction endproduct, with approximately 50 to 70 percent of the chlorine dioxide converted to chlorite and 30 percent to chlorate ( $\text{ClO}_3^-$ ) and chloride ( $\text{Cl}^-$ ) (Werdehoff and Singer, 1987\*).

Before the analysis of chlorite and chlorate the sample was bubbled with the inert gas nitrogen to strip chlorine dioxide. The chlorite and chlorate values were after stripping of the chlorine dioxide much lower than without stripping. This means that chlorine dioxide disproportionated to chlorite and chlorate on the chromatographical column. This leads necessarily to distort raised chlorite and chlorate values.

Typical dosages of chlorine dioxide used as a disinfectant in drinking water treatment range from 0.07 to 2.0 mg/L. Germany demands a limit for chlorine dioxide in the processed drinking water of 0.2 mg/l. This means that if the dilution of the TwinOxide solution less than 0.2 mg/L chlorine dioxide, TwinOxide solution may be used as a disinfectant because the chlorite/chlorate ions byproduct not exceed the maximum level allowed.

\* Werdehoff, K.S. & P.C. Singer 1987: Chlorine dioxide effects on THMFP, TOXFP and the formation of inorganic by-products. Jour. AWWA, 79 (9); 107-113

## Summary statement

### Chlorite and chlorate in Twin Oxide products

All technologies where chlorine dioxide is produced in watery solution, produce chlorine dioxide solutions containing the other products and by-products of the reaction plus unreacted feedstock reagents.

Sodium chlorite is used in the preparation of Twin Oxide chlorine dioxide solution. Chlorate and chlorite are also two of the three products of the decomposition of chlorine dioxide in water. Chlorite is the predominant decomposition product with chlorate and chloride also being produced. Thus, water treated with chlorine dioxide contains both chlorate and chlorite. The analysis is complicated by the possible interactions of some components in the Twin Oxide solution. A procedure for determining the concentration chlorate and chlorite in Twin Oxide solution by ion chromatography was developed.

The procedure is based on the following considerations:

- A disproportionation of chlorine dioxide to chlorite and chlorate take place.
- Chlorine dioxide interferes with chlorite and chlorate on the IC-column.
- In the components to be analyzed, only chlorine dioxide is a gas which can readily be removed from the solution by bubbling inert gas through it.
- The solution free from chlorine dioxide can be analyzed for chlorite and chlorate chromatographically.

Before the analysis of chlorite and chlorate the sample was bubbled with the inert gas nitrogen to strip chlorine dioxide. The chlorite and chlorate values were after stripping of the chlorine dioxide much lower than without stripping.

The time course of the chlorate concentration was examined more than 2 weeks. The results are documented in the table 1. The Twin Oxide chlorine dioxide solution shows constant concentrations of chlorate for the test period.

Furthermore, the formation of chlorite and chlorate in terms of reaction time was also influenced from the concentration of chlorine dioxide, pH value, temperature and UV irradiation.

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Tab. 1: time course of the chlorate concentration

time after solution preparation (day)	concentration on chlorate (mg/l)
1	528
7	580
15	565



Dr. A. Herschel  
Analytical Service Manager