

TWINOXIDE® BIO-SECURITY PACKAGE FOR FOOD INDUSTRY

Financial losses and public concern due to bacterial infection and "food scares" are of increasing concern to the food industry, consumers and regulatory authorities. Strenuous efforts are made to prevent disease and infection spreading whilst stock is on the farm - but it is most often at the processing plant where infection and contamination is picked up.

The problems caused by bacterial infection apply to all sectors of the food industry, including vegetable washing, fish processing and meat production. While great care and attention is often taken to minimize the risk of infection from processing staff and other food handlers, relatively ineffectual biocides and disinfectants are used to treat process water and equipment.

Intended to compliment existing good practice in other areas of plant hygiene, TwinOxide International B.V. is pleased to be able to offer a superior pure and safe biocidal that contributes to the policy that only safe and contamination free food reaches the consumer.

TwinOxide International B.V. offers TwinOxide Diamond 0.3% solution for biocidal and hygiene treatments to overcome the risks associated with contamination of food by using an advanced, pure and clear chlorine dioxide technology. TwinOxide Diamond 0.3% solution does not contain by-products (free chlorine, chlorate, chloride or chlorite), does not cause side effects or by-products when applied. TwinOxide Diamond is delivered in a two component powder based kit without any risk of explosion. Shelf life in the original packaging is 5 years guaranteed. The activated solution has a shelf life of 30-60 days (depending on storage conditions).

Chlorine dioxide is several times more powerful than other biocides commonly used, yet has no associated taste or odor problems. Together with all aspects of hygiene management within the plant TwinOxide Diamond 0.3% solution provides control, security and peace of mind by ensuring safe and contamination free food. When using TwinOxide 0.3% solution your biocidal meets the stringent definitions of EEC directive 2092/91.

TwinOxide Diamond 0.3% solution can be e.g. applied for:

- Fruit & Vegetable Washing
- Meat & Poultry Processing
- Fish Processing
- Bottling & Canneries

Water Quality Regulation in the European Community

Growing consumer awareness and increasingly stringent regulatory demands have resulted in renewed emphasis on the quality of water and selection of disinfectants used for microbiological control.

The European Community has defined many directives on this matter e.g. EN 12671 defining the standard of quality of drinking water in the European countries. The EEC Directive 2092/91 has defined new standards for the quality of water and the selection of disinfectants used for the washing and preparation of vegetables and salads. The EEC 2092/91 bans the use of chlorine or chlorine type products for decontamination of organic food and requires improved technology to be utilized.

TwinOxide Diamond 0.3% solution is a pure and superior quality of chlorine dioxide without the negative characteristics and side-effects from chlorine dioxide known so far and is fully compliant with EEC 2091/91 being a substance allowed to be used under the chapter Disinfectants and sanitizers used in organic crop production (e.g. irrigation systems).

Typical wash water systems incorporate wash tank or flume through which the products are passed. To treat the system with TwinOxide a continuous dosage of the 0.3% solution is required to avoid contamination of the water.

Preliminary Operations

Vegetables are subjected to several preliminary operations before processing and after harvesting. As a result of peeling, grating and shredding, produce will change from a relatively stable product with a shelf life of several weeks or months to a perishable one with a shelf life as short as 1-3 days at chill temperatures. The major preliminary operations include:

Washing: Root vegetables are washed first to remove all field dirt and to allow inspection.

Inspection: Vegetables are inspected for quality to comply with consumer demands.

Selection: Vegetables are selected and graded on a basis of firmness, cleanness, size, weight, color, shape, maturity, mechanical damage, foreign matter, disease, and insects. This operation can be done manually, or by

employing a variety of separation machines to separate and discard unfit produce.

Subsequent operations may include **peeling, cutting and shredding.**

Before the peeling process a careful washing with good quality water is required. After peeling washing should be done immediately. The temperature and amount of washing water should be 4-5°C and 3 L/kg potato, respectively. Washing time: 1 min. Observation: microbiological quality of washing water must be excellent.

Good manufacturing practices (GMP) must be followed (hygiene, low temperatures, and disinfection).

Although chlorine and chlorine type disinfectants are no longer allowed according to EEC Directive 2092/91 we summarize some old facts on the use of chlorine:

Preservatives can be used in the washing water to reduce microbial load and to retard enzymatic activity, thus improving the shelf life and sensory quality of produce. The recommended dosage for chemical preservatives in washing water is 100-200 mg/L of chlorine (Alzamora et al., 2000). These levels are effective in the washing water before, after, or during cutting to extend the shelf life. However, when chlorine is used, vegetable materials require a subsequent rinse to reduce the chlorine concentration to the level of drinking water and to improve the sensory shelf life. The effectiveness of chlorine should be improved by using low pH, high temperature, pure water, and correct contact time (Alzamora et al., 2000). The optimum contact time for chlorine is 12-13 s, if the chlorine concentration is 70 mg/L (Ahvenainen, 1996). According to Ahvenainen (1996), Chlorine compounds are not very effective at inhibiting the growth of *Listeria monocytogenes* in shredded lettuce or Chinese cabbage.

Another disadvantage of chlorine is that some food constituents may react with chlorine to form toxic reactive products. Thus, the safety of chlorine use for food or water treatment has been questioned, and future regulatory restrictions may require the development of alternatives.

(Source: Food And Agriculture Organization of the United Nations (FAO))

According to the FAO the water used for washing should contain 0.01% active chlorine.

TwinOxide 0.3% solution has a wide spread efficacy to kill all kind of organic organisms. To give you a small overview on the biocidal capacity we summarize below:

Summary of Germicidal Spectrum of TwinOxide Diamond 0.3% solution

Bacteria		Fungi	
Pseudomonas Aeruginosa Pseudomona Specie Enterobarcter Cloaceae Enterobarcter Hafnia Proteus Vulgaris Klebsiella Pneumoniae Salmonella Typhi Salmonella Enteritidis Salmonella Gallinarum Salmonella Typhimorium Salmonella Choleraesuis Salmonella Typhosa Corynebacterium Nucleatum Sarcinae Lutae Streptococcus Pyrogenes Strep 1, 2, 3. Mycobacterium Smegmatis	Campylobacter Jejuni Flavobacterium Species Yersinia Enterolitica Clostridium Sporogenus Clostridium Dificile Clostridium Perfringens Fusobacterium Nucleatum Bacilus Subtilis Bacilus Circulans Bacilus Megatarium Bacilus Cereus Bifedibacter Liberium Staphylococcus Aureus Staphylococcus epidermia Streptococcus Faecalis Mycobacteroi Bovis Mycobacterium kansaaii	Candida Albicans Scopulariosis Species Trichophyton Mentagrophytes Mucor Species Saahromyces Cerevisiae	Trichophyton Rubrum Aspergillus Niger Aspergillus Flavus Fusarium Specie Fonsecaea Pedrosoi
		Virus	
		Herpes Virus I Herpes Virus II Adenovirus Echovirus Coxsackievirus Influenza Feline Parvovirus Mouse Flu Minute Virus of Mice (MVM) New Castle Disease Virus Iridovirus	Poliovirus Encephalomyocerditis (EMS) Vaccina Virus Vesicular Stomatitis Virus (VSV) Para Influenza Bluetongue Virus Mouse Hepatitis Virus (MHV) Mouse Encephalomyelitis Virus Mouse Polio Virus (MEV) Pertiviries - Togaviridae
		Others	
		Vidrio Cholerae Mycopiasm	Culex Quinquifasiatus

Summary of Microbiological Spectrum of TwinOxide Diamond 0.3% solution

Bacteria	Fungi	Virus
Pseudomonas Salmonella Coliforms Staphylococcus Streptococcus Clostridium Bacillus Klebsiella Others	Candida Mucor Penicillium Aspergillus Fusarium Trichophyton Eschopulariosis Others	Herpes I Herpes II Adenovirus Echovirus Influenza Encephalomicarditis Vesicular Stomatitis Togavirus (PPC) Iridovirus (PPA) Others

Indication of Contact Time of TwinOxide Diamond 0.3% solution
(Actual contact time may differ)

Test Type	Test Organism	Contact Time	Result
9a	Aspergillus fumigatus spores	60 seconds	99.9999% kill
9b	Bacillus cereus Spores	5 minutes	99.999% kill
8f	Candida albicans	60 seconds	99.99999% kill
12	Canine Parvovirus	10 minutes	100% virucidal
	Erwinia carotovora carotovara	60 seconds	99.999% kill
1	Escherica coli	60 seconds	99.9999% kill
	Lactobacillus sp.	60 seconds	99.999% kill
3	Legionella pneumophila	60 seconds	99.999% kill
4	Listeria monocytogenes	60 seconds	99.9999% kill
	Listeria monocytogenes (ATCC15313, Briel, Scott A)	60 seconds	99.999% kill
	Mycobacterium bovis	10 minutes	> 6 log kill
13	Newcastle Disease virus	10 minutes	100% virucidal
10	Pediococcus sp.	60 seconds	99.999% kill
	Proteus mirabilis	60 seconds	99.999999% kill
8e	Pseudomonas aeruginosa	60 seconds	100% kill
8a	Pseudomonas aeruginosa	10 minutes	100% virucidal
5c	Pseudo rabies virus	10 minutes	99.999% kill
11	Saccharomyces cerevisiae	60 seconds	100% kill
8c	Salmonella choleraesuis	10 minutes	100% kill
5a	Salmonella choleraesuis	60 minutes	99.999% kill
6a	Salmonella typhimurium	60 seconds	100% kill
2	Staphylococcus aureus	10 minutes	100% kill
5b	Staphylococcus aureus	60 minutes	100% kill
6b	Staphylococcus aureus	60 seconds	99.9999% kill
8b	Staphylococcus aureus	60 seconds	99.99999% kill
8b	Streptococcus faecalis	60 seconds	99.9999% kill
8g	Streptococcus faecium	60 seconds	99.9999% kill
8d	Trichophyton mentagro phytes	5 minutes	100% kill
7			

***Test Types**

AOAC Germicidal & Detergent Sanitiser Test
 AOAC Available Chlorine Germicidal Equivalent Concentration Test
 3 & 4 Bacterial Studies
 5 a-c Bacterial Studies – Dental Pumice Slurry Disinfectant
 6 a-b AOAC Bactericidal Study – Water Tank Disinfectant
 AOAC Fungicidal Study
 8 a-g European Suspension Tests (0.03% BSA Organic load)
 9 a-b European Suspension Tests – Sporocidal Tests – (0.03% BSA O.L.)
 10-12 Virucide Assay – EPA Method – Pesticide Assessment Guidelines
 Qualitative Tuberculocidal Test Log Reduction Method

Dosing Rates

Many questions we receive involve dosing rates. TwinOxide International B.V. recommends performing an application test with TwinOxide® Diamond solution on the water in your process. The dosage rate may vary by vegetable or fruit type, the type of contamination, the basic water quality, hygiene procedures within the plant, climate and temperature influences.

As TwinOxide® is far more efficient and faster than chlorine or sodium hypochlorite the dosage rate of TwinOxide® will be significantly lower.

When applying TwinOxide® we advise to focus when dosing on a minimum of 0.05ppm *residual* as a minimum.

Disclaimer

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