TwinOxide International B.V.
Industrial Water Solutions

TwinOxide® in Fruit and Vegetables Applications

TwinOxide® 0.3% solution is a pure and clear chlorine dioxide solution generated from two powder components meeting the most stringent standards in the world on water treatment and drinking water.
TwinOxide has all the positive characteristics of chlorine dioxide known for decades but does not have the negative characteristics known from "classic generated" chlorine dioxide. TwinOxide has a kinetic halftime of 30-60 days (depending on storage conditions).
TwinOxide® contains NO free of chlorine, chlorate, chlorite or chloride. TwinOxide® 0.3% solution does not generate Disinfectant By-Products (DBP's) and has no side effects and is NOT explosive.
This document provides more insight in applications of TwinOxide® in the Fruit and Vegetable industry.

Lettuce

Washing of lettuce for supply to supermarkets, fast food chains, restaurants etc.

Quality Requirements	• Salmonella zero • Listeria zero • E.Coli zero • Must pass sensory evaluation test criteria (no chlorine taste) • Appearance of lettuce must be good. • TPC must be within guidelines at day 10. (TPC= Total Plate Count (microbiological surface contamination)
Old Process Description	• Chlorine at 100-200ppm dosed from sodium hypochlorite 12.5% • Terrible chlorine smell in factory with employees complaining of eye and skin irritations • Impossible to control chlorine residual and required manual chemical addition every 15 minutes • pH control not possible as always creeping high. • Required to dump a lot of water to maintain chlorine residual which was high cost for chilling and extra ice. • E.Coli was not always zero. • Always concerned about Listeria as Listeria is not affected by chlorine at low temperatures. • TPC at day zero was inconsistent (usually 1 x 10^5, 3 x 10^5, 1 x 10^6 counts)
Description of TwinOxide® based system	• TwinOxide® solution at 1.0ppm in 2 stage wash. First wash stage is 8 deg.C and second wash stage is 2 deg.C • Dosing is done automatically using TwinOxide® solution storage tank, automatic residual control and a dosage pump(Acid resistant, equal to Prominent B-Line). • Operators do a check on the dosing equipment every hour or so but don't add any chemical manually. • pH is automatically controlled to 7.5 • Very little dumping of water and only chilled water is used. • E.Coli is always zero. • No concern about Listeria as TwinOxide® solution easily kills Listeria at low temperatures. • TPC at day zero is consistent and always less than 7 x 10^4

Potatoes

Potatoes are transported by truck and placed into heaps. They are then washed and cut into French fry shapes prior to freezing. Water used for processing is from municipal supply.

Process Description	• Potatoes are cut and washed with TwinOxide® solution treated water • TwinOxide® solution is flow pace dosed into the treated water at a dose of 0.7-1.0 ppm to maintain concentration of 0.5ppm of ClO_2 residual.
Advantages/benefits	• Improved control on residual control of TwinOxide® solution. • Unusual taints on processed product are removed. • Chlorine Dioxide delivers better micro-biological control (than chlorine at 5-10ppm. • Automatic operation simple and effective. • No chlorinated organic by-products.
Required equipment	• TwinOxide® solution storage tank • Chlorine dioxide residual controller/sensor (Redox) • Flow meter • Dosage pump (Acid resistant, equal to Prominent B-Line) Use a by-pass of 2,500L/hr tap of the main flow and dose the required TwinOxide® solution and feed back to the main flow.

Corn Peas and Beans

Process Description	• General process water contains 0.5ppm chlorine (municipal supply). • Wash water is process water with up to 2 ppm TwinOxide® solution added. • Corn is blanched and then cooled down. As the corn is cooling microbiological growth can occur. • The corn is cooled by water spraying with up to 2 ppm TwinOxide® solution (critical stage).
Advantages/Benefits	• No taste and odor influence on the corn • TwinOxide® solution works well in an environment of high organic load • No chlorine smell in the factory hall • Easy generation, dosing and control of disinfection.
Required equipment	• TwinOxide® chlorine dioxide storage tank • Chlorine dioxide residual controller/sensor • Dosage pump (Acid resistant, equal to Prominent B-Line)

Raw Shrimp

Raw shrimp from farms (natural sea or rivers) are sent to a factory for processing

Process steps	• Washing with water containing a dosage of 5-10 ppm TwinOxide® solution • During sizing and peeling, washing with 2-3 ppm TwinOxide® solution • Final rinse 0.2-0.5 ppm TwinOxide® solution • Freezing.
Required equipment	• TwinOxide® solution storage tank • Contact water meter or by DPD measurement • Dosage pump (Acid resistant, equal to Prominent B-Line)
Advantages/benefits	• High oxidizing power of TwinOxide® solution guarantees sufficient disinfection • No influence by pH • No smell or taste after final rinse water • Better customer acceptance compared to chlorine treated shrimp • Improvement of Total Plate Count (TPC) Values

Tomatoes

TwinOxide® 0.3% solution is used to destroy moulds on the tomatoes and the flume tank.

Process Description	• Tomatoes are dumped from the truck onto a conveyor • Coarse rinse with municipal water sprays to remove dirt, stems and leaves etc. • Tomatoes fall into flume tank (20m^3). The flume water is pumped to the sorting conveyor and back into a closed circuit with the tomatoes. Operators remove unacceptable product. • Make-up condensate water is continually added (5m3/hr) from the tomato paste process • TwinOxide® solution is dosed into the flume water to maintain concentration of 0.2-0.4 ppm. (in this stage a pH of 4.0 is acceptable)
Required equipment	• TwinOxide® solution dosing directly into flume. By-pass water is the condensate flow • Control to 650mV by redox controller and proportional control with industrial redox probe • This system is only used in wet weather and occasionally during dry weather. Mould is a bad problem when there is a lot of rain during harvest.
Previous Treatment	• TwinOxide® solution provides easy residual control of chlorine dioxide. With previous chlorine type of disinfectants (e.g. sodium hypochlorite) there is great difficulty in maintaining any free chlorine due to the concentration of organic material. This means that moulds are not controlled and surfaces are fouled. Further the production process does no longer need to be stopped due to chlorine smell in the sorting area.
Advantages/Benefits	• Low concentration of TwinOxide® solution is very effective in destruction of moulds on tomatoes. (Moulds affect the total production process negatively and should be avoided. • Low concentration of TwinOxide® solution is very effective in destruction of moulds in the flume water. If untreated, the moulds attach to surfaces of tanks and flumes and look like "meat". Eventually, they foul screens and smell. • TwinOxide® solution is effective at pH 4-10 • No smell for operators • Control on the process • No chlorinated organic by-products
Point of attention	• Two parallel redox measuring systems are advised. • Operators preferably wear suitable gloves when touching the fume water. (in many countries mandatory according to HACCP regulations)

Citrus

Citrus fruits are immersed with water containing TwinOxide® 0.3% solution during the washing stage.

Aim of reduction	• Geotrichum Candidum Sour Rot Spores • Penicillum Digitatum blue mold • Green mold
Process Description	• Dosage rate of 1-2ppm TwinOxide® solution to the recirculated wash water (that also goes to the shower bin) to ensure a residual of 0.35ppm TwinOxide® solution • Dosage controlled via redox as wash water is very dirty • Wash water temperature 20 deg.C, pH8
Required equipment	• TwinOxide® solution storage tank • Contact water meter or by DPD measurement • Dosage pump (Acid resistant, equal to Prominent B-Line)
Advantages/benefits	• Increased production yield with TwinOxide® solution (significantly less outturn compared to Nylate (bromine) or chlorine type treatment • No taste or odor problems with the citrus fruits • Shelf life of citrus fruit may increase threefold • TwinOxide® solution removes fungi thus no longer need for a separate fungicide
	• The immerse tank be cause airborne spores that might require the use of an exhaust system.

Spinach

Process Description	• Spinach is moved dry (removing of beetles and caterpillars) • Washing with cold tap water • Blanching at 80-90 Degrees Celsius, cooling • The water from the last blanching segment is taken to a cooler
Production	• Two processing lines, each 12T/hr • Make-up water per line 12 m^3/hr
Required equipment	• TwinOxide® solution storage tank • Chlorine dioxide residual controller/sensor • Dosage pump (Acid resistant, equal to Prominent B-Line)
Dosing of ClO_2	In the cooler TwinOxide® solution is dosed, time proportional, interlocked with the last zone of the washing machine.