

EndoSan[®]



CHLORINE FREE, HIGHLY EFFECTIVE DISINFECTANT BIOFILM REMOVER

FOR THE MARINE & OFFSHORE INDUSTRY

Worldwide Marine and Offshore Services



Complete on-board disinfection solution for all marine industries:

Ferry, Cruise, Military, Support and Service Vessels
Passenger and freight shipping
Off-shore development & maintenance



Certified to NSF/ANSI/CAN 60

EndoSan is a complete water, surface and indoor spaces disinfection solution for all passenger and personnel carrying vessels.

A multi-use product that is highly effective against:

Legionella and water-borne pathogens. Biofilm and bio-fouling. Viruses, mould and fungi.



EndoSan[®]

THE MOST ADVANCED STABILISED HYDROGEN PEROXIDE

INTRODUCING ENDOSAN

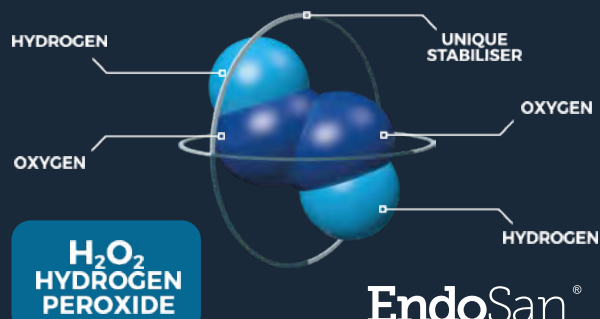
EndoSan is a powerful, highly effective, broad spectrum disinfectant that is both stable and safe.

EndoSan is a solution of Hydrogen Peroxide (H_2O_2) that is stabilised using a unique, proprietary chemistry.

When correctly applied to water or surfaces EndoSan will disinfect through an oxidation process, destroying micro-organisms and pathogens and degrading into only water and oxygen without any harmful disinfection by-products (DBPs).

EndoSan is chlorine and alcohol free, and compatible with usual materials of construction found in water systems and all surfaces with no corrosive effects during application.

MARKET LEADING ULTRA STABILISED HYDROGEN PEROXIDE TECHNOLOGY

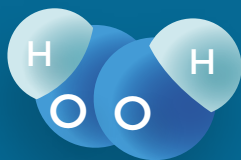


LEGAL FOR SALE
IN UK AND EU



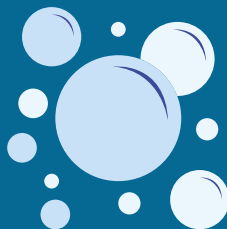
HOW ENDOSAN WORKS - A CLOSER LOOK

BEFORE



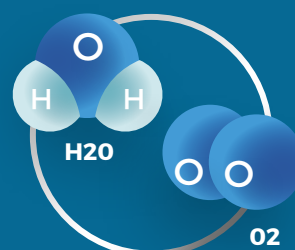
ENDOSAN IS MADE UP
OF STABILISED HYDROGEN
PEROXIDE - H_2O_2

DURING



ENDOSAN IS ATTRACTED TO
MICRO-ORGANISMS
AND DISINFECTS VIA A
STRONG OXIDISING PROCESS

AFTER



THE DISINFECTION
BY-PRODUCTS OF ENDOSAN
IS SIMPLY WATER (H_2O) AND
OXYGEN (O_2)

Representation for illustrative purposes only

EndoSan Stabilised Hydrogen Peroxide

EndoSan Stabilised Hydrogen Peroxide is formulated to sustain the effectiveness of hydrogen peroxide's strong oxidising disinfection power.



Depending on the purpose of use EndoSan has multiple application methods. EndoSan can be sprayed directly or fogged to disinfect surfaces and indoor spaces. EndoSan can also be manually dosed or constantly dosed into water systems via proportional, automated dosing equipment.

TEST STRIP INDICATORS

Checking the residual concentration of EndoSan in water is made very simple by test strip indicators.



BENEFITS

- ✓ Highly effective against bacteria, viruses, mould, fungi and amoeba.
- ✓ Forms no harmful disinfection by products (DBP).
- ✓ Forms no toxic gases.
- ✓ Decomposes into water and oxygen.
- ✓ Non corrosive at RTU concentrations.
- ✓ Compatible with a wide range of materials.
- ✓ No residual colour, taste or odour.
- ✓ Very stable - 3 year shelf life.
- ✓ Ready to use formulas with no dilution required.
- ✓ Zerya certified no residuals.
- ✓ Certified Kosher and Halal product.



Key benefits of EndoSan

- ✔ Drinking water disinfection.
- ✔ Water quality and legionella control.
- ✔ Infection control.
- ✔ Cabin and spaces disinfection.
- ✔ Infirmary and medical services disinfection.
- ✔ Facilities & Equipment disinfection.
- ✔ Waster water management.
- ✔ Food & Beverage disinfection.
- ✔ Swim, Spa and Leisure disinfection.



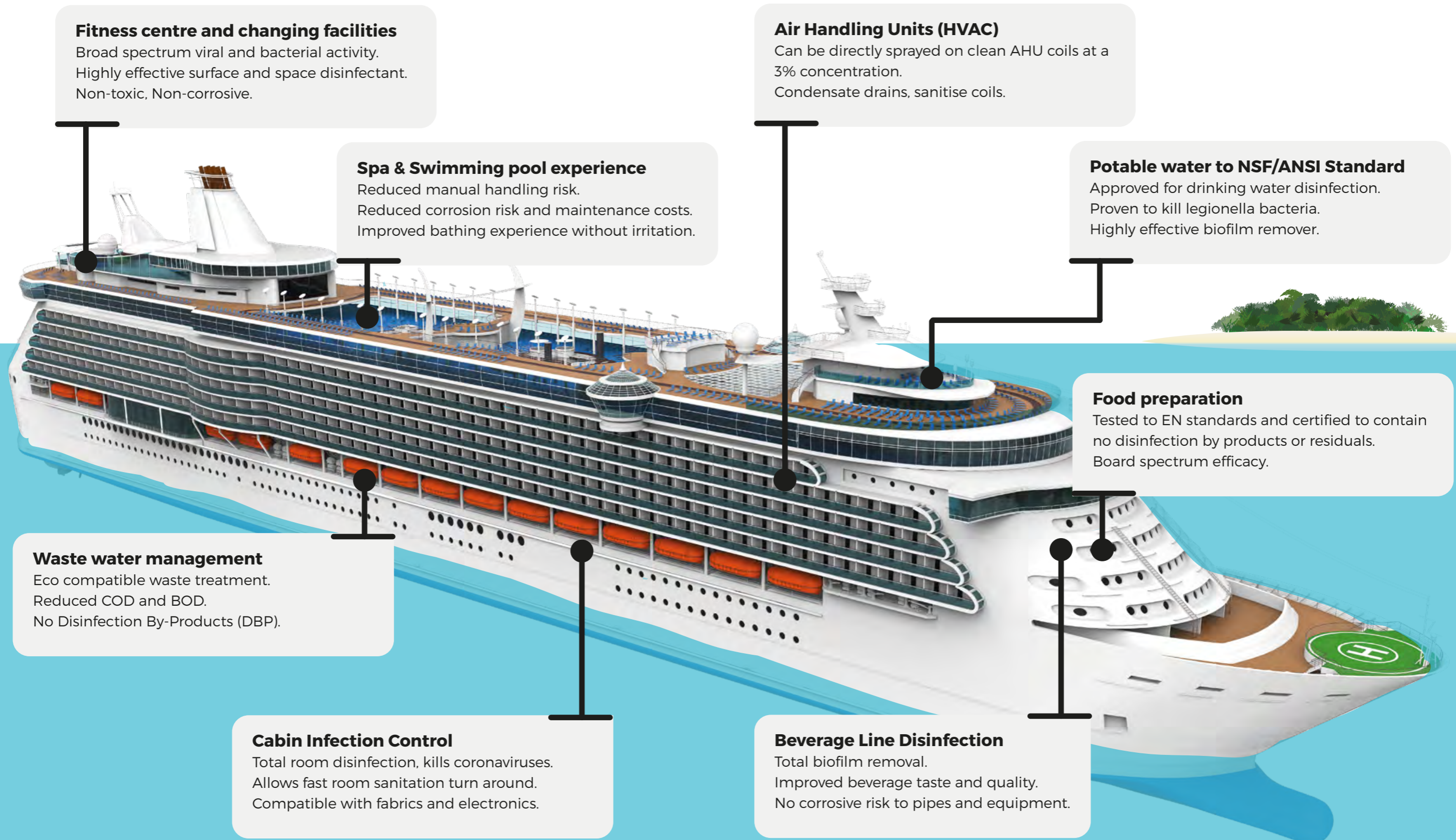
Certified to
NSF/ANSI/CAN 60

The National Sanitation Foundation (NSF) approved EndoSan and included it in the **NSF/ANSI Standard: Drinking Water Treatment Chemicals register.**



EndoSan provides total ship disinfection with one product:

With its unrivalled ability to effectively kill a broad spectrum of micro-organisms including Norovirus, MRSA, Legionella and E-coli, EndoSan is proving to be the multi-application, on-board disinfectant of choice.



Applications

EndoSan is a multi-purpose disinfectant which allows its oxidation power to be used in many ways to combat a wide variety of micro-organisms.



EndoSan is proven to destroy:



BACTERIA



VIRUSES



SPORES



FUNGI



AMOEBEA



ALGAE

SURFACE DISINFECTION

Basic cleaning of surfaces and equipment is often inadequate at eliminating disease causing micro-organisms which presents infection control risks.

Using EndoSan as a surface disinfectant post basic cleaning will provide terminal disinfection when applied as directed according to dose rates.

EndoSan is a leave in place disinfectant with no rinse requirement. The product can simply be applied and left in place.

EndoSan is a DEFRA approved disinfectant of inanimate surfaces for general orders and treatment of Foot-and-mouth disease.



Department
for Environment
Food & Rural Affairs



WATER SYSTEM DISINFECTION

The Merchant Shipping (Crew Accommodation) Regulations 1997 and the Merchant Shipping (Crew Accommodation) (Fishing Vessels) Regulations 1975 require the supply of drinking water and fresh water to be such as to prevent any risk of contamination.

Improperly managed water is an established infectious disease transmission route on ships. Outbreaks of illness have been associated with contaminated bunkered water, cross connections between potable and non-potable water, improper loading procedures, poor design and construction of potable water storage tanks and inadequate disinfection. Evidence from outbreaks indicates that sewage is one of the more common sources of the pathogens that cause water-borne disease outbreaks on ships.

Merchant Shipping and Fishing Vessels: Guidelines for the Provision of Food and Fresh Water, MGN 525 (M+F) Amendment 1



EndoSan³®

Ready to Use Formula For Highly Effective Disinfection of Surfaces, Equipment, and Public Areas



SAFE FOR USE
with electronics



SAFE FOR USE
on fabrics



SAFE FOR USE
in food prep/eating areas



EndoSan3 is a broad-spectrum, high-level disinfectant that is safe for use on all surfaces.

Powered by a unique formula of stabilised hydrogen peroxide, EndoSan3 is highly effective and ready to use whilst remaining non-corrosive and free of odour.

As EndoSan breaks down into only water (H₂O) and Oxygen (O₂) it forms no harmful disinfection by-products or chemical residues.

EndoSan3 is a leave in place disinfectant and requires no rinsing and can even be left to air dry without needing to wipe if used after manual cleaning and removal of debris.

Third Party Efficacy Testing

- ✔ **PASS** BS EN1276: Evaluation of bacterial activity
- ✔ **PASS** BS EN1650: Evaluation of fungicidal activity
- ✔ **PASS** BS EN13697: Evaluation of bacterial and fungicidal activity on surfaces
- ✔ **PASS** BS EN14476: Virucidal activity against all enveloped viruses

Product Specification

Contains:	Stabilised Hydrogen Peroxide < 3.5%
Hazard Statements:	None
Precautionary Statements:	None
Pack sizes:	Ready to use 500ml trigger, 5L, 10L, 20L, IBC (1,000L)
Shelf life:	3 Years from date of manufacture
Shipping Requirements:	None



The Importance of Surface Disinfection

It has been widely understood for some time in healthcare and food preparation settings that effective disinfection chemistry and practices are both key to preventing the spread of viruses and pathogens.

However the COVID-19 pandemic has brought a sharper focus on how good surface, object and equipment hygiene is key to stopping the spread of micro-organisms and contamination.

Although regular exercise is associated with numerous health benefits, individuals who exercise at public gyms can be exposed to dangerous bacteria. For example, **the CDC estimates that up to 30% of the general population are carriers of potentially harmful bacteria that can cause skin infections, such as Staphylococcus aureus.** Skin infections can be transferred to unaffected individuals through contact with shared surfaces.

Between 10 and 30% of tested gym surfaces were found to contain bacteria that can lead to skin infection or illness (Oller, Province, & Curless, 2010; Markley et al., 2012).

One of the ways to eliminate the bacteria that may be present on the surface of gym equipment is through post-use cleaning with a disinfectant. **A 2010 study, found that cleaning with a disinfectant eliminated antibiotic-resistant Staphylococcus aureus (or MRSA) on gym and locker room surfaces.** Given the high rate of gym use and membership globally, cleaning gym equipment post-use can create a safer exercise environment.

Elba I, Ivy JW. Increasing the Post-Use Cleaning of Gym Equipment Using Prompts and Increased Access to Cleaning Materials. Behav Anal Pract. 2018 Feb 26;11(4):390-394.



Water Treatment & Control Programme

On-board Shipping Vessels when using EndoSan



Maintenance Regimes

Distribution Systems Maintenance

Parts	Actions	Intervals
Shower heads	Particularly in accommodation that has been out of use for an extended period. Clean in a 3% EndoSan solution which equates to 600ml Endosan50 in 10L water. Let reside for at least 30 minutes. No max residence time.	3 Monthly or more frequently if required
FW Hoses	Flush and fill with a 3% EndoSan solution which equates to 600ml EndoSan50 in 10L water and allow to stand for at least an hour before emptying and stowage.	6 Monthly or more frequently if required

Fresh Water Storage Tanks

Persons inspecting or working in fresh water tanks should wear clean protective clothing and footwear which has not been used for any other work area and they should not be suffering from any skin infection or communicable disease.

Actions	Intervals
<p>FWST Super Disinfection Where EndoSan is used, the refill should be to a concentration of 10-20ppm as H₂O₂ or 20-40ml of EndoSan50 per m³ water. This can be tested using simple H₂O₂ test strips. The tank cleaning process should include surface disinfection with a solution of 3% EndoSan, sprayed onto the surfaces of the tank or fill the tank and treat to a concentration of 2,000ppm or 4L Endosan50 per m³ water leaving to reside for 12-24 hours before draining away.</p>	12 months
<p>Super Disinfection of System Where EndoSan is used, the system (from machinery to all outlets) should be shock dosed with EndoSan to a concentration of 2,000ppm as H₂O₂ or 4L EndoSan50 per m³ water for a period of 12-24 hours then flushed out completely and refilled to a concentration of 10-20ppm as H₂O₂ or 20-40ml Endosan50 per m³ water.</p>	Refit or dry dock

Note: Ensure systems have suitable venting to release generated oxygen build-up during disinfection/biofilm removal. Use biocides safely. Always read the label and product information before use.



WARNING: Shock dosing potable water systems requires the system to be taken off-line. No users should draw water until the residency time has elapsed and the system flushed.



WARNING: Never conduct an EndoSan Disinfection if there is a Dialysis Unit or a Hospital Laboratory linked to the water system or there is any possibility of EndoSan getting into the water supply to these units.



The information collated in this document is for operational guidance. For specific advice or further support please contact us.

Constant Dosing Systems



It is recommended that a shock disinfection using EndoSan is undertaken on water systems to remove any historic biofilm that is present. However biofilms can re-form very quickly, meaning untreated water systems are left vulnerable to re-contamination.

Installing a 'Guardian Dosing System' ensures that your water is protected with a continuous and controlled concentration of EndoSan. EndoSan is injected directly into the water system providing a biocidal barrier against a broad spectrum of micro-organisms including Legionella, E-coli and Pseudomonas. This automated system is extremely accurate and doses proportionally to the water usage. Requiring very little maintenance it also allows the building manager or owner to save energy by reducing the temperature of the calorifiers*.

ENDOSAN GUARDIAN PULSE PLUS DOSING SYSTEM



Pulse fed, proportional dosing system with traffic light chemical indicator, lance, cable, bund, pump and associated ancillary equipment.

- ▶ 'Plug and Play' system.
- ▶ Proportional dosing via direct injection.
- ▶ Drum level monitoring, warning on low readings.
- ▶ High quality pump with de-gassing head.
- ▶ Completely mounted in bespoke bund.
- ▶ Stress tested.

ENDOSAN GUARDIAN INSTALLATION & SERVICE



We offer a full Installation, calibration and commissioning package carried out by a fully qualified engineer on site. This includes an extra visit to site within 12 months and a 2 year extended warranty.

* In line with HSG274. Specific RAMS available on request.

ENDOSAN GUARDIAN SMART DOSING SYSTEM



Smart Dulcometer (H₂O₂ sampling), monitoring and communication system intelligently controlling proportional dosing system with traffic light chemical indicator, lance, cable, bund, pump and associated ancillary equipment.

- ▶ Fully automated 'smart monitoring' and dosing.
- ▶ Automated adjustment via H₂O₂ probes.
- ▶ H₂O₂ sensor up to 200ppm.
- ▶ Probe housing with flow detection
- ▶ User friendly, large, colour changing display.
- ▶ Drum level monitoring, warning on low readings.
- ▶ High quality pump with de-gassing head.
- ▶ Doser completely mounted in bespoke bund.
- ▶ Optional LAN or BMS interface.
- ▶ Optional control via mobile device (tablet, phone)



EndoSan[®]

WINNING THE BATTLE AGAINST BIOFILM

What is Biofilm?

The term 'biofilm' refers to the formation of an encased or protected community of micro-organisms that stick to each other and surfaces via a self-produced protective slime referred to as an extracellular matrix (ECM). A biofilm is referred to as sessile, meaning they are attached in place.

The slime is made up of an extracellular polymeric substance (EPS), bacterial cells, other proteins, organic materials, and water.

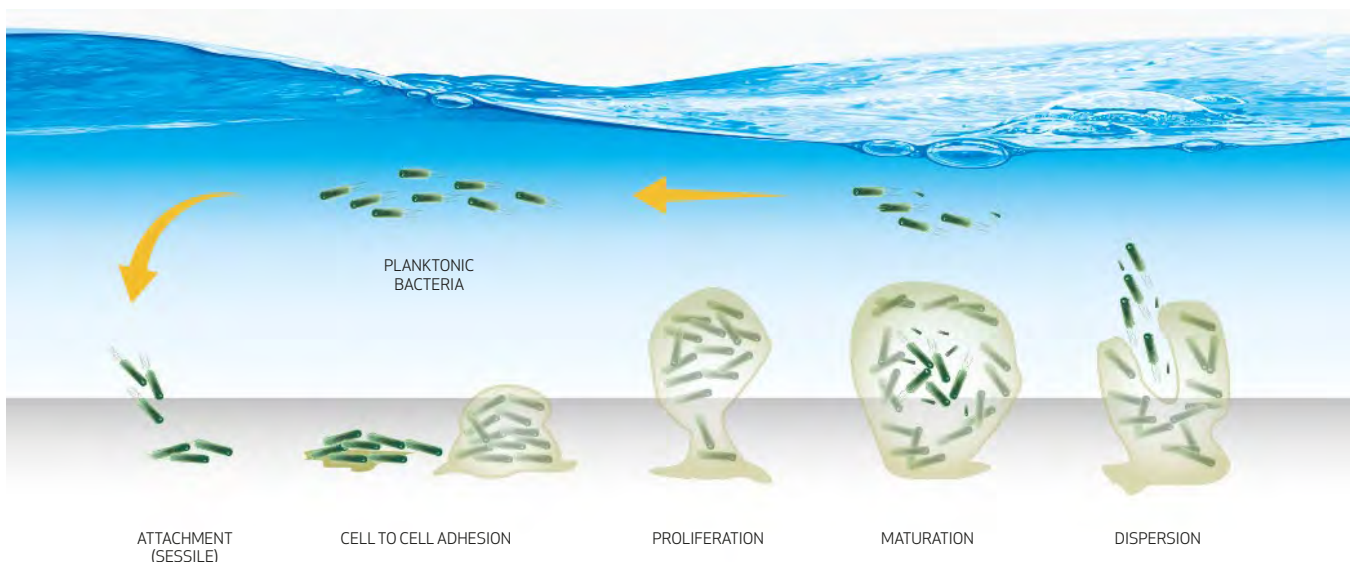
The ability to produce the adherent slimy EPS is a universal attribute of bacteria. Once formed the slime/matrix can provide a protective environment for one or more species of bacteria offering more resistance to anti-microbial agents than in a free swimming, planktonic state.

The protection provided by the biofilm can allow for booming colonies of bacteria and micro-organisms to flourish.



How do Biofilms form?

The life cycle of a biofilm can vary depending on the species however the following life cycle marks the process of biofilm formation:



Biofilm is an Invisible Threat

The natural growth and subsequent removal of biofilm using EndoSan was tested using a biofilm generator.

Plastic tubes representing the water system pipework were filled with contaminated water and system usage behaviour was mimicked by a daily flow/no-flow schedule.

The images below reveal the problem.

Water quality was determined by measuring the amount of adenosine triphosphate (ATP) as a marker for micro-organisms.

When the growing biofilm was clearly visible by eye and water ATP measurements stabilised, the continuous addition of an extremely low ppm level of EndoSan was started to investigate its effect on the biofilm.



Figure 1 – Visual appearance from the outside of the tube (top) inside the water system (bottom left) and on the inserts (bottom right) before (left) and after (right) the continuous addition of EndoSan to the water.

During the biofilm growing period, the water ATP count rapidly increased up to 1,662 RLU, indicating severely polluted water (Figure 2a).

After the continuous low maintenance addition of EndoSan, the RLU count rapidly decreased within a short time-frame and remained low, as the measurement in week 19 shows with an RLU value of 66.

The ATP measurements rapidly increased within 6 weeks (Figure 2b) to an almost two million-fold (1.9×10^6) increase.

The subsequent continuous addition of EndoSan quickly resulted in a two million-fold (log 6) decrease, demonstrating the fast and effective removal of microbiological contamination from the surface of the inserts and inner lining of the tubes.

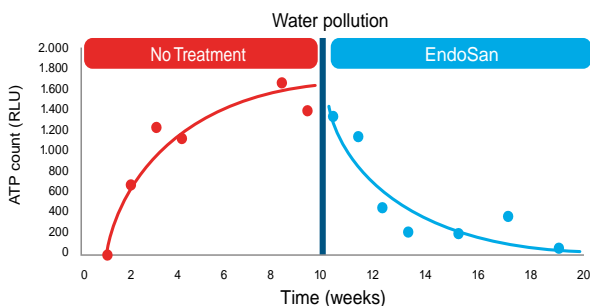


Figure 2a – Water pollution before (red) and after (blue) the continuous addition of EndoSan.

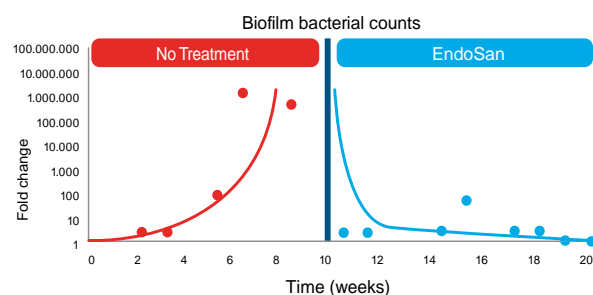


Figure 2b – Biofilm bacterial counts before (red) and after (blue) the continuous addition of EndoSan. Please note that the bacterial counts are plotted on a logarithmic scale.

Summary of Relevant Anti-Microbial Activity Against Test Organisms

TEST ORGANISM	CERTIFIED TEST METHOD								
	EN1656:2009	EN13697:2015	EN13623:2010	EN13624:2013	EN14349:2012	EN13704:2018	EN16438:2014	EN1276:2009	EN1500
<i>Aspergillus Brasiliensis</i>		✓		✓			✓		
<i>Campylobacter Jejuni</i>								✓	
<i>Candida Albicans</i>		✓					✓		
<i>Enterococcus Hirae</i>	✓	✓			✓				
<i>Escherichia Coli</i>		✓			✓			✓	✓
<i>Legionella Pneumophilla</i>			✓						
<i>Proteus Vulgaris</i>	✓				✓				
<i>Pseudomonas Aeruginosa</i>	✓	✓			✓			✓	
<i>Salmonella Typhimurium</i>								✓	
<i>Staphylococcus Aureus</i>	✓	✓			✓				
<i>Clostridium difficile</i>						✓			

The EndoSan dossier has been submitted to the HSE, under the newly formed Great Britain Biocidal Product Regulation - GB BPR.

Following the end of the Transition Period on 31 December 2020, Great Britain is no longer part of the EU scheme for regulating biocides. The Health & Safety Executive (HSE) are now the Biocidal product regulator in Great Britain. The existing EU Biocidal Products Regulation (EU BPR) have been mirrored and updated in GB law by the HSE to enable them to authorise product use.

The active substance/ingredient of EndoSan, Hydrogen peroxide, is approved for PTs 1, 2, 3, 4, 5 and 6 and the supplier is an Article 95 listed supplier.

All dossiers for the product are still under review after being submitted before 29th June 2021. Stabilised Hydrogen Peroxide (H₂O₂) is in this category. During this time EndoSan is legally for sale in both the UK and EU.

EndoSan entered the GB BPR process within the specified time with a complete and up to date record of technical properties, efficacy and product uses, fully supported by strong case studies in all relevant PT classes.

Under dossier ref BC-QU029364-11, EndoSan is already authorised in some EU member states via national authorisation in the following:

- PT2: Disinfectants not intended for direct application to humans or animals.**
- PT3: Veterinary hygiene disinfectants.**
- PT4: Food and feed area disinfectants.**
- PT5: Drinking water disinfectants.**



CHLORINE BASED DISINFECTANTS

Vs

EndoSan® STABILISED HYDROGEN PEROXIDE

BIOFILM	
<ul style="list-style-type: none"> Chlorine is ineffective at penetrating and removing biofilms. 	<ul style="list-style-type: none"> EndoSan is highly effective at penetrating and removing biofilms.
EFFICACY	
<ul style="list-style-type: none"> Chlorine is an oxidiser unable to effectively penetrate biofilms. Chlorine is also ineffective against amoebae. 	<ul style="list-style-type: none"> EndoSan is a powerful oxidiser that effectively penetrates and destroys biofilms. EndoSan is bactericidal, virucidal, sporicidal, fungicidal, algacidal and amoebicidal.
IRRITANT	
<ul style="list-style-type: none"> Even at low dose levels chlorine is irritating to the nose, throat and skin. 	<ul style="list-style-type: none"> At dose levels EndoSan causes no irritation to the nose or throat.
HEALTH CONCERNS	
<ul style="list-style-type: none"> When chlorinated products mix with acids or acidic liquids then toxic chlorine gas is released. When chlorine reacts with organic matter it creates Trichloromethanes (TCM) and Trihalomethanes (THM). Studies suggest that THM's are carcinogenic to animals and humans. The EPA regulates that there must be a THM presence of less than 80ppb in water systems. Chlorine vapours can be very aggravating to asthma sufferers. 	<ul style="list-style-type: none"> EndoSan releases no toxic gasses. EndoSan produces no TCM's or THM's. EndoSan is biodegradable, creating no harmful by-products. EndoSan simply degrades into water and oxygen.
CORROSION	
<ul style="list-style-type: none"> Chlorine is corrosive to metals, rubbers and fabric. This can cause an increase in repair and maintenance costs and requirements over time. 	<ul style="list-style-type: none"> EndoSan is non-corrosive at dose rates. This results in lower repair and maintenance costs and requirements over time.
pH	
<ul style="list-style-type: none"> Outside of a neutral pH range Chlorine decreases in efficacy. 	<ul style="list-style-type: none"> EndoSan is effective at a wide pH range. Outside of a neutral pH range EndoSan continues to be effective.
TEMPERATURE	
<ul style="list-style-type: none"> Chlorine decreases in efficacy at higher temperatures and becomes unstable above 45°C. 	<ul style="list-style-type: none"> EndoSan is stable and effective at a wide range of temperatures.
TAINT	
<ul style="list-style-type: none"> Chlorine has an obvious taint. It has a noticeable strong odour and taste. 	<ul style="list-style-type: none"> EndoSan has no taint. It has no colour, taste or odour at dose levels.
DISPOSAL	
<ul style="list-style-type: none"> Chlorine requires neutralisation before disposal. Incorrect neutralisation can be toxic to aquatic life. 	<ul style="list-style-type: none"> EndoSan has no neutralisation requirements at dose levels.

Approvals



Certified to NSF/ANSI/CAN 60

NSF International

EndoSan is certificated to NSF/ANSI/CAN 60 meaning it meets the regulatory requirements for the USA, Canada, Israel, Saudi Arabia, Spain and the UAE. NSF/ANSI 60 certification can often meet or fulfil the testing requirements for many other countries as well. Market leaders strive to attain NSF certification as a mark of distinction that provides their customers with assurance that the product is safe for use in drinking water.

HSE - Health & Safety Executive UK

Stabilised Hydrogen Peroxide is listed as an approved constant dose biocide in the HSE Approved Code of Practice (ACOP) HSG274 Pt2:

'Silver stabilised hydrogen peroxide has a history of use in the control of legionella in water systems. A silver hydrogen peroxide solution is injected directly into the water system and if applied and maintained according to the manufacturers instructions, can be an effective means of control. However, this should not be used in water systems supplying dialysis units'.

HSG274 (2014) Technical guidance for legionnaires disease, part 2 (Page 39)



Department for Environment Food & Rural Affairs

EndoSan is DEFRA approved disinfectant for general orders and foot-and-mouth disease.

EndoSan®

WATER TREATMENT

ON-BOARD PASSENGER/FREIGHT FERRY
INTERNATIONAL FERRY OPERATOR



OVERVIEW OF BENEFITS

- REMOVAL OF BIOFILM & WATER CONTAMINATION
- COMPLIANCE WITH EU LEGISLATION
- MINIMAL SYSTEM DOWNTIME
- NO RISK OF CORROSION TO WATER SYSTEM
- NO RISK OF HARMFUL BY-PRODUCT EXPOSURE
- AUTOMATED, CONSTANT PROTECTION
- ODOUR, COLOUR & TASTE FREE - UNDETECTABLE
- MARINE INDUSTRY RECOGNISED SOLUTION

Controlling the microbiological quality of water and minimising risk of hazard exposure to passengers aboard ferries and cruise liners can be a difficult task. The same high-risk contamination areas exist when compared with controlling water quality in a building, however on board a marine vessel it is much more complex.

CHALLENGES

A few examples of the complexities that are faced are:

- Multiple sources of water (varying in quality, temperature, etc).
- Physical layout and configuration of water storage and distribution systems (more areas with a greater potential for low flow and dead legs).
- The stagnation risk of stored water due to the working cycles of the ship.

With the likelihood that passengers will be on-board for extended periods (increasing potential exposure to contamination) the task of implementing best practices to meet regulation and protect public health is a real challenge.

In October 2016, one of the world's leading ferry operators continued its roll out of the EndoSan technology across its fleet, initially targeting ferries with pre-existing water quality challenges.

The vessel for this case study is a RoPax (roll-on/roll-off passenger) ferry which operates on an extremely popular route and attracts many passengers and a large number of freight vehicles.

Before disinfection commenced, water samples were taken from both the hot and cold water systems, following the protocol described in BS 7592:1992 (Methods of sampling for Legionella organisms in water and related materials). As per the standard, a sample was taken immediately on opening water fittings, to represent the quality of water contained within the outlet, then a second sample was taken after the outlet had been allowed to run to waste, which is representative of the water quality supplied by the fitting in regular operation. Analysis and comparison of these samples can be seen in Table 1.

SHOCK DISINFECTION AND BIOFILM REMOVAL

After sampling was completed work began to return the water system to a clean state via shock disinfection.

The total capacity of fresh water aboard the ship is circa 60m³ which is split across two fresh water tanks and associated pipework, the water levels in both tanks was reduced before shock disinfection.

To carry out an effective disinfection, it was calculated that a Hydrogen peroxide strength of 1000ppm (mg/l) was required to remain in residence for at least 6 hours.

To achieve this, sixty litres of EndoSan50 was added to each of the fresh water tanks via the standpipes located on deck 3 (120 litres in total), then it was drawn through all water outlets across all decks.

Every outlet, both hot and cold, was tested using hydrogen peroxide test strip indicators to ensure the required 1000ppm was being achieved throughout the system.

After completion of drawing the solution through every outlet, a water sample was taken and analysed on-site using a tintometer which confirmed the 1000ppm concentration. The system was then left to dwell with the solution soaking inside for the required 6 hours without use.

After the six hour shock dose was completed work began to flush the solution from the system by opening all of the outlets.

Test strips were used once again to ensure the solution was drained down to a residual hydrogen peroxide level of 10ppm from cold water outlets and 50ppm for hot water outlets.

There was clear evidence of biofilm and biofouling which had been removed by the shock dose and was present in the water drained out of the hot water system (visible in Images 1 and 2 below).

Particulate matter was also detected from several outlets.



Image 1: Hot water deck 6

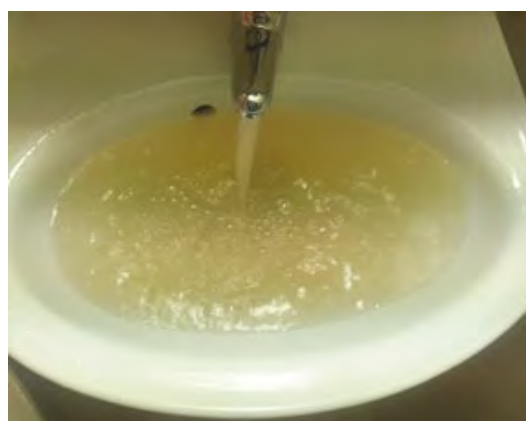


Image 2: Hot water deck 5

Following the successful flushing operation, post-disinfection samples were taken again from both hot and cold water fittings and form part of the data for comparison in section 3.

ONGOING PROTECTION - CONSTANT DOSING



During and after the solution flushing procedure, both fresh water tanks were refilled to around 200m³, thus reducing the residual hydrogen peroxide concentration in the water system to 50ppm.

At this point and EndoSan Guardian Pulse Plus dosing system was installed to prevent any biofouling issues returning.

The plant room aboard the ship had previously featured a chlorine dosing system which, although had failed to maintain the water quality, did leave an injection point and water flow meter ideal for the EndoSan dosing equipment.

The injector nozzle was fitted and the flow meter pulse leads attached to the constant dosing pump to ensure a correctly metered, proportional maintenance dose of EndoSan is released every 10 litres of water.

This automated safeguard provides a residual concentration of EndoSan in the system at all times, preventing regrowth of bacteria and biofilm while being at a very safe level for human consumption.

Additionally, the dosage is so small it poses no threat of corrosion to the ship's water system.

EndoSan is completely free of any taint meaning it is undetectable to users with no change to smell, taste or colour of water.



WATER SAMPLE RESULTS & ANALYSIS

Sample Reference	Legionella spp cfu/L	TVC @ 22 deg C (cfu/ml)	TVC @ 37 deg C (cfu/ml)
Hot outlet, sample taken immediately. Deck 6 Cabin.	Not detected	30	60
Cold outlet, sample taken immediately. Deck 6 Cabin.	Not detected	2180	300
Hot outlet, run to drain. Deck 6 Cabin	Not detected	40	40
Cold outlet, run to drain. Deck 6 Cabin	Not detected	1240	70
Hot outlet. Main Galley	Not detected	<10	<10
Cold outlet. Main Galley	Not detected	<10	<10

Table 1: Pre and post disinfection sample results

Pre disinfection data
 Post disinfection data

WATER SAMPLE RESULTS & ANALYSIS continued

From the sample results, in Table 1 on the previous page, it is clear that while there were no Legionella bacteria detected there was a considerable problem detected in the cold water samples before disinfection.

High TVC's (Total Viable Count) detected with 2180 and 1240 CFU's (colony-forming unit) per ml found in the cold outlets. These readings were reduced to <10 after disinfection with EndoSan which is the lowest level the laboratory could test to.

According to the EU's drinking water standards, Council Directive 98/83/EC on the quality of water intended for human consumption, the microbiological parameters for colony forming units or CFU/ml is required to be 100/ml at 22°C and 20/ml at 37°C.

As you can see at 2180 cfu/ml and 1240 cfu/ml this vessels cold water system was in serious breach of this standard.



CONCLUSIONS

The efficacy of EndoSan for biofilm removal and water quality control has been proven time and time again in many installations across the globe.

In this case, it was shown that EndoSan is ideal for removing obdurate biofilms and returning a water system back to required EU standards, with substantially reduced Total Viable Counts.

The installation of the EndoSan Guardian Pulse Plus dosing system after the system received shock treatment has also allowed the ferry operator to maintain a clean water system without any risk of corrosion or compromising the quality of the water supplied to crew and passengers on board.

EndoSan is a globally recognised, trusted technology that is being utilised by the marine shipping industry to ensure that vessels have a clean, safe water supply from a cost effective, approved water treatment solution..



EndoSan[®]

WATER TREATMENT

LIGHTHOUSES



Northern
Lighthouse
Board

The NLB has 206 lighthouses protecting the coastline of Scotland, the Northern Isles, The Western Isles and the Isle of Man as well as an office in Edinburgh, and bases in Oban, Inverness, Lerwick and Kirkwall.

CHALLENGES

Due to remote locations many of the lighthouses maintained by The NLB have a water system that is supplied from stored water delivered by lighthouse vessels and helicopter.

The NLB have a duty to ensure those systems are assessed, compliant and maintained to ensure they pose no risk to staff and visitors to the sites.

Lighthouse stations are not manned and operate remotely meaning they are infrequently visited, with some being on an annual or biennial maintenance visit of varying durations.

The water systems at the lighthouses are not potable water systems, NLB provide bottled water for drinking and cooking but clean water is required for washing, shower and toilet facilities.

CURRENT APPROACH

The lighthouse water systems are fitted with filters and existing UV disinfection measures are in place. Unfortunately, due to varying visit lengths and schedules, optimal maintenance is not possible presenting a risk The NLB would like to mitigate.

The system for provisioning the lighthouses with water currently relies on delivery via multiple 500L Allibert intermediate bulk containers (IBC's) of freshwater, filled on board lighthouse vessels like NLV Pharos and transported via helicopter to each lighthouse.



NLV PHAROS

A lighthouse tender ship designed to maintain, support, provide supplies and transportation to lighthouses. Able to travel at 12.5 knots with 30 cabins, 7 offices and 30 crew and a forward helicopter deck.

NLV Pharos is based in Oban and works mainly in Scottish and Manx waters, servicing over 200 automatic lighthouses, buoys and beacons.

ENDOSAN SOLUTION

SHOCK DOSING

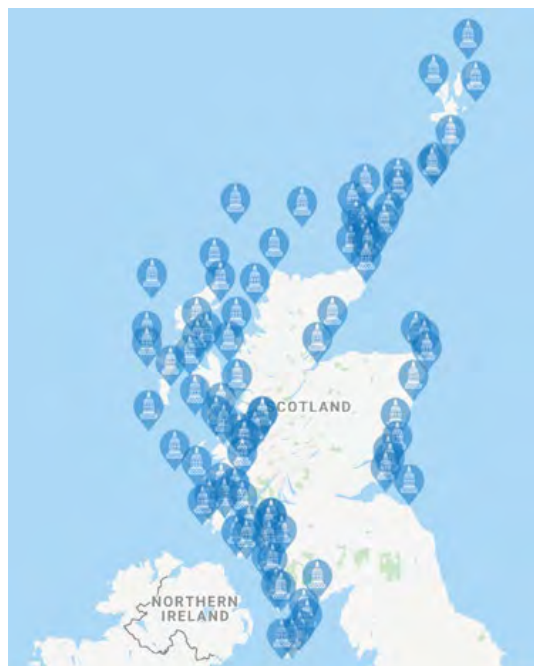


NLB Engineers and crews were trained to shock dose the lighthouse water systems with EndoSan.

Shock dosing allows the existing water systems to be fully disinfected and all established biofilm/pathogenic threat removed.

A water system downtime of 24 hours is required for the chemical dwell time and the crew are able to perform this initial system disinfection on a maintenance visit. The water system is out of use and no water drawn for the duration.

After the 24 hours the system is flushed ensuring the residual EndoSan concentration is reduced to correct levels using test strips.



A map of lighthouses serviced and maintained by The NLB

CONSTANT DOSING



Following the shock dose it is important that micro-biologically secure water is returned to the water system to prevent reintroducing pathogens and the potential for biofilm reformation.

As the source of water to the lighthouses relies on the NLV Pharos vessel a solution was designed that allowed a constant dosing system to be installed on-board.

The vessels deck fresh water line was fitted with a proportional dosing system. A secure but small footprint solution that constantly delivers a fixed and optimal amount of EndoSan directly into the freshwater as it is filled on-board into 500L IBC's.



The system consists of:

- ▶ Powerful positive displacement (diaphragm) pulse fed pump with maximum flow rates of 50 L/Hr at 4 Barg.
- ▶ Secured pump station and integrated bund protection for 20L EndoSan container.
- ▶ Water meter with pulsed output to measure water flow to calculate chemical dose rate.
- ▶ Product injection point directly into water line including a non-return valve.

ENDOSAN SOLUTION continued

The previous IBC filling system was quick allowing the crew to be efficient loading the IBC's to be transported by helicopter to the lighthouse.

The EndoSan dosing system allowed for filling to be maintained at a fast pace with chemical dosing meeting demand via a powerful pulse fed pump.

The system provides treated water to the filled IBC's without reducing operating speed and agility.

The dosing equipment is easy to use and clearly displays the set point required dose rate for the IBC filling operation.

Traffic light style, status indicator LEDs display the status of the EndoSan chemical reserves with alerts on low and empty drums.



Top down view of the dosing system in operation at 250ppm dose rate

BENEFITS

EndoSan has provided The Northern Lighthouse board with a highly effective chemistry that will disinfect lighthouse water systems and protect the water supplied to them with no disruption to the current filling and maintenance routines.

The residual power of EndoSan as a water disinfectant makes it the ideal solution to protect treated water from microbiological threat despite infrequent visitors to the lighthouses. EndoSan is non-corrosive at dose rates and forms no harmful by-products of disinfection (only water and oxygen).

A constant dosing solution was designed, delivered and installed on board the NLV Pharos to ensure the correct dosage of EndoSan was automatically applied during freshwater IBC filling processes.

This allowed The NLB to maintain their required speed of operations and provide treated water to their lighthouses.

Staff were fully trained on the EndoSan chemistry and dosing equipment.

Residual EndoSan levels are simple to measured using test strip indicators and form only a minor additional check to the maintenance routines already in operation.





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