



**IMO Type
Approved**



**AMS
Approved**



Cathelco 

Ballast Water Treatment Systems



Compliance with confidence

Cathelco – experience and innovation

Cathelco have more than 50 years of experience in the marine engineering market. Today we are recognised as a world leader with a reputation based on quality and innovation with the highest standards of customer service.

The new BWT system represents Cathelco's continuing commitment to innovation.

This began in 2010 by setting up a dedicated research facility in Kiel, Germany to investigate the most effective ballast water treatment technologies through a team headed by Dr Matthias Voigt, an acknowledged expert in the field.

In late 2011, the prototype system based on filtration and UV technology, was tested at the NIOZ facility in Holland, where it went on to pass the ever more stringent IMO standards for land based testing the following year.

Shipboard testing was carried out on the 'MV Eddystone', a 14,200 tonne dwt ro-ro vessel, with successful completion coming in the autumn of 2013.

IMO Type approval for the system was received in April 2014. This was followed by AMS acceptance which enables the system to be used on vessels entering U.S. territorial waters.



“We have trialed a number of BWT systems on our fleet. In terms of initial technical discussions, installation planning, system performance and ease of operation Cathelco's system has exceeded our expectations.”

Andrew Weir Shipping Ltd (Managers of M.V.Eddystone)

Patent pending

As the BWT system incorporates a number of technical innovations, Cathelco Limited have applied for a UK Patent under the Application Number 1405106.4

Timeline - our commitment to marine engineering



Key features of the Cathelco BWT system



Precise adjustment to different water qualities

- A sample of sea water is taken before the chambers and the UVT sensor measures the UV light transmittance.
- A data feedback loop between the UVT sensor and UV intensity meters provides evidence that the correct UV dosage has been applied.
- Future proof for USCG compliance.



Helix flow through UV chambers

- The inlet manifolds have been designed to make the water flow in a helix.
- This ensures that the maximum surface area of the water is exposed to the UV light for thorough irradiation.
- Two lamps in each unit – doubling UV exposure. One of the smallest chambers on the market.



Automatic ball cleaning (CIP)

- 100% chemical free.
- Specialised cleaning balls gently polish the surface of the quartz sleeves surrounding the UV lamps to remove residue.
- Mitigates corrosion on the reflective surfaces of the chambers.

Combining filtration and UV technology

System overview

The Cathelco BWT system is based on a combination of filtration and UV technology, well established processes which are effective against a broad range of marine organisms.

This approach does not involve the use of chemicals, an important factor in ensuring that there is nothing harmful to the ocean environment and no chemical handling on board the ship.

Cathelco BWT units are available with capacities from 34m³/h to 2,400m³/h.

During uptake the sea water passes through the filtration unit where the larger organisms and sediments are removed. At regular intervals the retained material is automatically back flushed and discharged at the original ballasting site with a very minimal reduction of the ballast water flow during the back flushing process.

The sea water continues to UV treatment where smaller organisms, bacteria and pathogens are rendered harmless before the water passes to the ballast tanks in compliance with IMO regulations.

During ballast discharge the sea water bypasses the filter unit and goes directly to the UV chambers where it is sterilised for a second time. This avoids the risk of any contamination due to re-growth in the ballast tank.

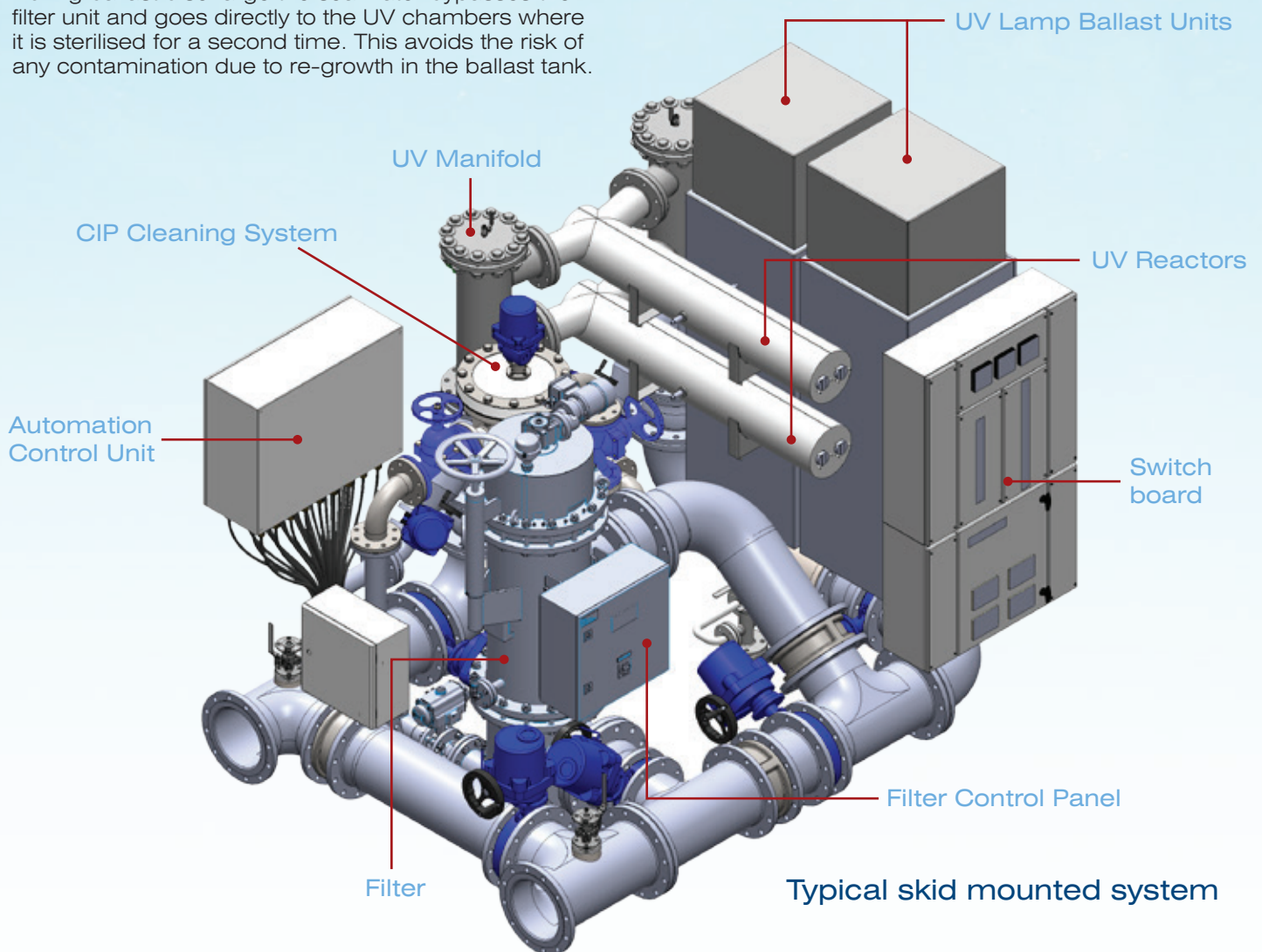
Power saving features

A key feature is the use of a step-less power supply for the UV lamps. This ensures the most economical use of power without compromising the effectiveness of the system. The use of the latest switch mode technology to provide a 'linear' electrical supply is much more efficient than conventional systems where current is provided in larger incremental steps with resulting wastage.

In saving energy, this works in tandem with the UVT sensor which monitors the light transmittance of the sea water, allowing the UV lamp power to be automatically adjusted to the prevalent water quality. Again, this avoids unnecessary wastage of power.

System configurations

- Modular
- Skid mounted
- Containerised



A choice of filtration systems

The Cathelco BWT system can be operated with two different types of filters. Both have automated back flushing which allows for a continuous ballast water flow, even during the back flushing process. The mesh size of both filters is $40\mu\text{m}$. During ballast water uptake, all of the separated material is automatically discharged at the point of origin. The filtration is bypassed during de-ballasting.

Hydac RFCA filters

These filter units have been selected for their reliability and proven performance in many different applications. They are highly efficient at removing sediment and larger organisms from ballast water whilst incorporating a unique self-cleaning system.

In determining the size of the filter, Cathelco considers all the operating conditions of the vessel, not just the ballast flow in isolation.

Where access is limited, these filters can be broken down into four separate components.

- Automatic back flushing – does not interrupt ballasting.
- Easily scaled to different BWT system capacities.
- Filter candles have super-flush coating to resist sticky deposits.
- Can be dismantled into four separate parts for easy access.
- No booster pump required.
- Heavy load filter option.



Hydac RFCA filter



Filtrex ACB Filter

Filtrex ACB Filters

Filtrex ACB filters can be selected as an alternative to the RFCA, when space is at a premium. While the ACB filters share the same basic features with the RFCA filters, they have the additional advantage of an extremely compact design. This makes them particularly useful in combination with smaller ballast pump flows.

This filter comes with a back flush pump to allow for a controlled and effective cleaning of the active filtration surface. The back flush pump will also compensate for any pressure changes that may occur in the ship's ballast water system during the back flushing process. Each ACB filter houses a single filter basket ($40\mu\text{m}$ mesh), which is scaled according to the required capacity of the filter.

- Automatic back flushing – does not interrupt ballasting.
- Compact design – ideal for vessels where space is at a premium.
- Can be scaled to different BWT system capacities.

UV technology with innovative features

Chamber designed for optimum UV exposure

A key factor in the treatment process is to maximise the exposure to the UV light as the ballast water flows past it. Therefore, each UV unit consists of twin chambers with two lamps. The compact arrangement causes the ballast water to flow along one side of the chamber and then along the other, doubling the UV exposure.

As a result, the Cathelco BWT system has one of the smallest chambers on the market.

Secondly, Cathelco have designed the chamber manifolds using computational fluid dynamics simulation software to make the sea water flow in a helix as it enters the chamber. The spiral flow ensures that the maximum surface area of the water is exposed to the UV light source, significantly increasing the efficacy of the process.

The relationship between UVT sensors and UV intensity meters

It is essential that the BWT system can automatically adjust to different qualities of sea water, compensating when necessary for changes in levels of sediment.

The key factor that differentiates Cathelco from other BWT systems is the relationship between the UV Transmittance (UVT) sensors and the UV Intensity (UVI) meters.

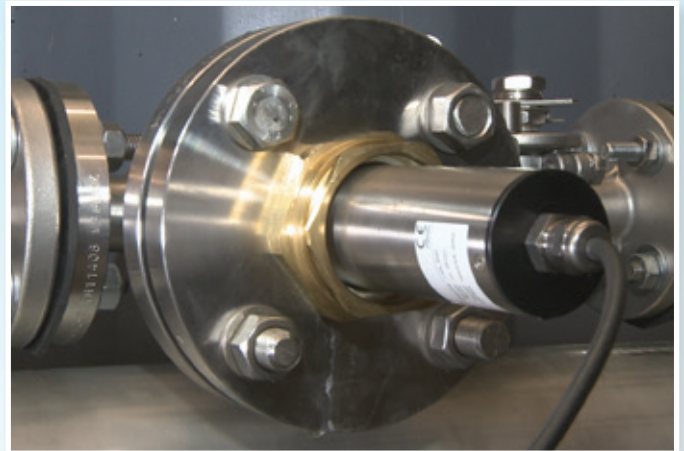
UVT sensors measure the UV light transmittance through a sample of seawater before it reaches the UV chambers. This is measured at the same wavelength (UVC 254 nm) as the biocidal light emitted by the UV lamps. From this data, the automation control unit calculates the correct UV dosage.

UV intensity meters are mounted at the edge of the UV chambers and measure the intensity of UV light actually received during irradiation.

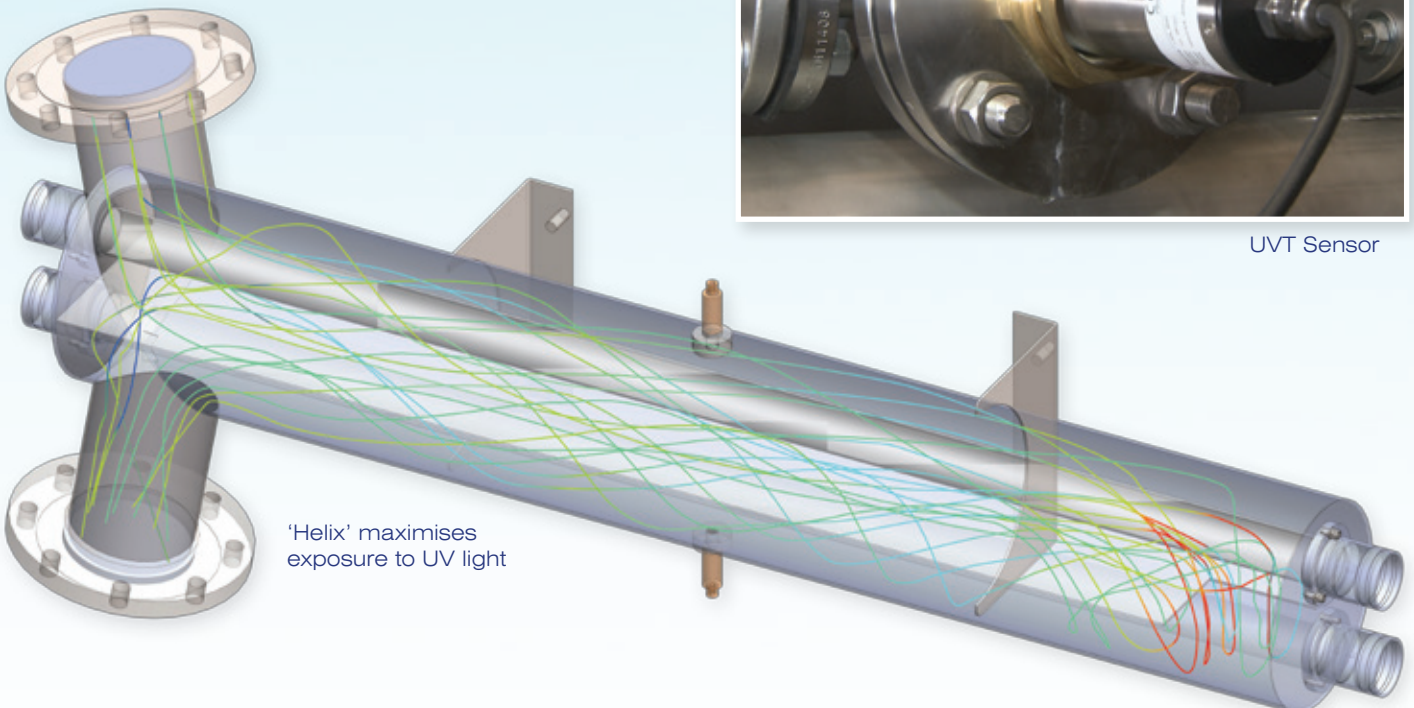
This relationship creates a feed-back loop in which the calculated dose is continuously compared with the actual dose. If the actual dose is within the prescribed range, ballast water treatment continues as normal. However, if the dose is less, the automation control unit indicates a cleaning cycle is required or that lamp renewal is necessary.

Greater accuracy – greater power savings

An additional benefit of this precise level of control is that the power consumption of the lamps is reduced. Maximum power is only used occasionally, when the conditions demand. The readings from the UVT sensor are automatically recorded. This provides the owner with proof that the system is operating according to specification.



UVT Sensor



'Helix' maximises exposure to UV light



Medium pressure UV lamps for greater effectiveness

Cathelco are using medium pressure UV lamps because of their superior disinfection potential. The broader UV spectrum of these lamps allows for a more effective inactivation of organisms across a wide range of water qualities, particularly in the more demanding fresh water and brackish water conditions.

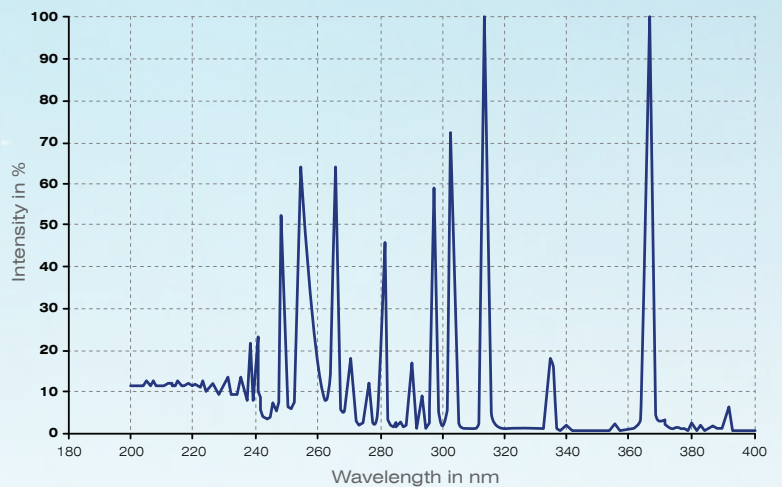
The quartz sleeves surrounding the UV lamps are doped during manufacture to filter out the lower part of the UV wavelength. This eliminates the production of ozone and other chemical pollutants in the treated water, ensuring the system is entirely chemical free.

The lamps incorporate a unique anti-blackening device to maximise their life and efficiency.

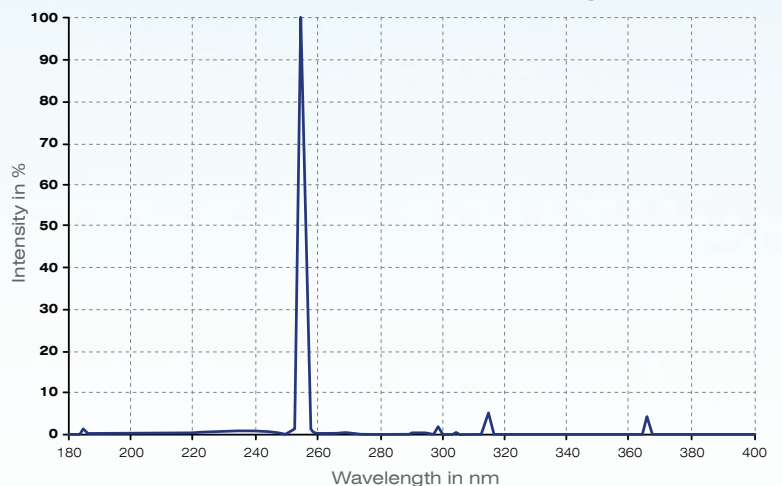
The UV lamps can be easily removed from the quartz sleeves by releasing the snap-tight electrical connections and withdrawing them. Access is only required from one end of the chamber in order to do this. As the chambers are relatively short, the length of the lamps (1175mm) is equally compact and therefore less space is required in order to carry out maintenance.

Our UV lamps have been specially selected to work reliably, not only in sea water, but also in areas of brackish and fresh water such as The Great Lakes.

Medium Pressure UV Lamps



Low Pressure UV Lamps



Chemical free ball cleaning system

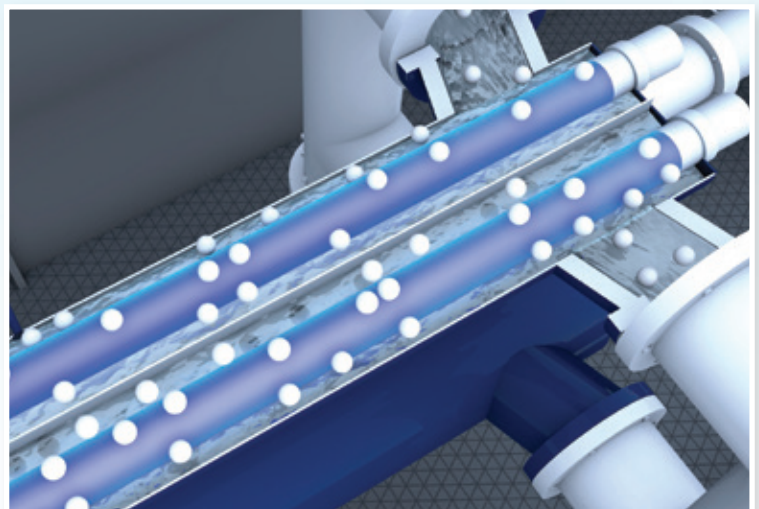
A major aim in the design of the Cathelco BWT system was to keep it completely 'chemical' free, a principle which has also been applied to the cleaning method. This overcomes many of the problems associated with systems that use citric acid as a cleaning agent where storage, handling and documentation have to be taken into consideration.

As a result, Cathelco have developed a unique cleaning system which ensures that the manifold, UV chambers and outside of the quartz tubes is thoroughly cleaned of biological residue.

When the cleaning cycle is automatically initiated, the UV chambers are isolated from the rest of the BWT system by valves. A separate pump is activated enabling specialised cleaning balls to be introduced into the reactor line from a reservoir. These polish the surface of the quartz UV sleeves, gently removing any residue that may have accumulated. The balls also polish the inside of the chamber ensuring that its reflective surfaces are kept bright and free from residues. This also helps to mitigate corrosion on the internal surfaces of the chamber, maintaining its reflective performance.

At the end of the process, the balls are automatically reclaimed, the cleaning system is isolated and the main system is ready for the next ballast water operation.

- Efficient cleaning of quartz sleeves and reflective surface of chambers to optimise UV lamp performance.
- No chemicals are involved in the process – not even citric acid.
- Eliminates damage to the sleeves caused by mechanical cleaning methods.
- Prevents scratches on surface of sleeves which reduce their efficiency.
- Avoids the use of moving parts inside the reactor.
- Mitigates corrosion on internal surfaces of chamber.



Unique ball cleaning system

Control Systems

The automation control panel governs the operation of the BWT system and enables the functions to be monitored and logged at a local level, near the BWT equipment.

It also monitors the 'health' of the system by checking the performance of the filters, UV chambers and initiating the cleaning cycles.

The main controls include:-

- Ballasting
- De-ballasting
- CIP Cleaning
- Refill
- Optional tank stripping
- Sea and fresh water operation

The control panel shows a graphical representation of the system and can be supplied with a touch screen or a screen with a key pad according to customer preference.

At the 'overview' level the screen shows a schematic drawing of the pipework and all of the major components. The user can then access screens covering specific areas including UV reactor performance, the operation of the cleaning in place (CIP) system and other screens which are used for the set-up and commissioning of the system.

The control panel is password protected at three levels for security. The user level allows for day to day operation, the engineering level opens a wider range of functions and there is also a manual mode which enables any element of the system to be controlled for testing purposes.

The automation unit continuously logs all of the data concerning the performance of the BWT system for a period of two years. This includes the ballast tank number, time/date of event, mode of operation, flow rate, temperature, power to UV lamps, UV transmission and calculated UV dose. The UV transmission rate is recorded at 32mm (the distance between the UV source and the edge of the reactor) and also at 10mm according to the Class Body requirements.

Salt/Fresh Water operation

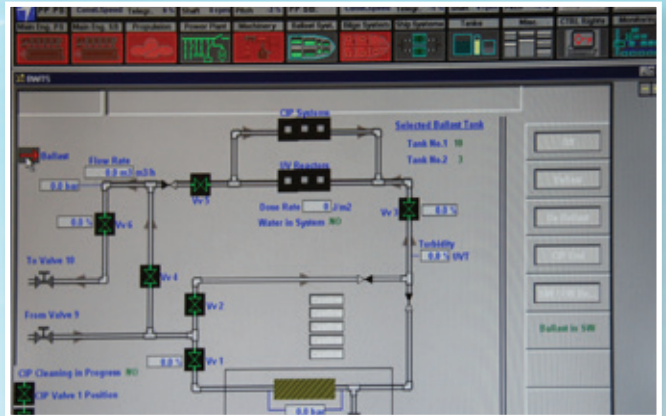
As the amount of UV dose varies between salt and fresh water, the automation unit allows for a simple switchover. This ensures that the correct UV dose is achieved, improving the efficiency of the system and thus saving power.



Full integration



Automation control unit



Example of control screen

Summary Software File

This software simplifies the process of maintaining a Ballast Water Handbook by gathering the essential data from the log files stored in the control panel and presenting it in a form which is easily understood

- Date/ time of BWT transfer
- Tanks used for transfer
- Mode of operation
- Average flow rate
- Average water temperature
- Total volume of water treated
- Date/time process completed

Control Options

Local

All of the functions are controlled from the single automation control unit situated close to the BWT equipment using a touch screen or screen with key pad.

Remote

With remote control, a duplicate control panel is provided in a more convenient location such as the cargo control room or engine control room. This operates in a master/slave relationship with the automation control panel and displays the same data.

Full integration

By fully integrating the BWT automation system with the ship's computer system, a single operator can control all of the functions from one location saving considerable time and effort.

Integrating the BWT controls with the ship's IPMS system uses the standard MODBUS protocols. It allows for greater flexibility of control with multiple screens in different areas of the vessel, any of which can be used to control the system.

Surveying & installation

Cathelco can provide suitably qualified marine engineers to survey vessels to determine the most suitable locations for the BWT equipment and to identify the necessary access routes for installation.

In the case of retrofit installations, 3D scanning is also available to supplement the survey information allowing for ease of layout of the equipment during the planning stage.

Typically, a survey will examine the following:-

- Space availability
- Power availability
- Existing pipework layout (retrofits)
- Pump flow rates
- Potential cable runs
- Pressure drops
- Flow characteristics
- Information about the existing ballasting requirements including the number of pumps and whether they run consecutively.

On completion of the full survey detailed drawings and calculations are required to be submitted to the relevant Class Body for the vessel for evaluation and approval.

Installation

Careful planning is the key to trouble free installation. In the case of installation on new vessels, Cathelco can supply the system in the form of individual components, complete skid mounted units or containerised systems. The latter have the advantage of minimising the time taken on fitting the system.

With retrofits, space is usually a major consideration, however Cathelco can provide the equipment in modular form enabling components to be distributed within available spaces and 'void' areas.

All of the larger items in the Cathelco system can be broken down into smaller components for ease of handling. This is an important advantage when planning access routes.

Supply/Installation options

Equipment supply only

Cathelco supply the equipment and the project is managed by the yard.

Supervision of installation/commissioning

Cathelco supply the equipment and appoint one of their own dedicated project managers to supervise the installation and commissioning of the system. Equipment installation is carried out by engineers from the vessel or yard.

Full turn-key project management

The full resources of Cathelco's project management team are available to plan and supervise the installation. This includes the supply of equipment, thorough resource planning and a careful analysis of the logistical requirements. The equipment is fitted using Cathelco's own highly skilled teams of mechanical and electrical engineers who see the project through to final commissioning.

After sales service

One of Cathelco's major strengths is its agent network which has been established over a period of 50 years to provide representation at major ports and shipbuilding centres around the world.

Cathelco's agents have received comprehensive training in the BWT system and can provide advice and technical support to ensure that it continues to operate at the highest level of effectiveness.

To provide a faster response, stocks of BWT spares and equipment are stored at strategically placed service centres around the world. These include items such as:-

- Filter candles
- UV lamps
- 'O' ring kits
- Balls for cleaning system
- Sacrificial anodes for filter



Work progresses on containerised system.

IMO & AMS Approval

Key extracts from IMO certificate

Salt water and fresh water operation

“At high salinity as well as in fresh water five independent consecutive and successful experiments were carried out.”

Effective in challenging water conditions

“45% minimum UV-Transmittance of the ballast water after filtration at a wavelength of 254nm and a layer of 10mm thickness.”

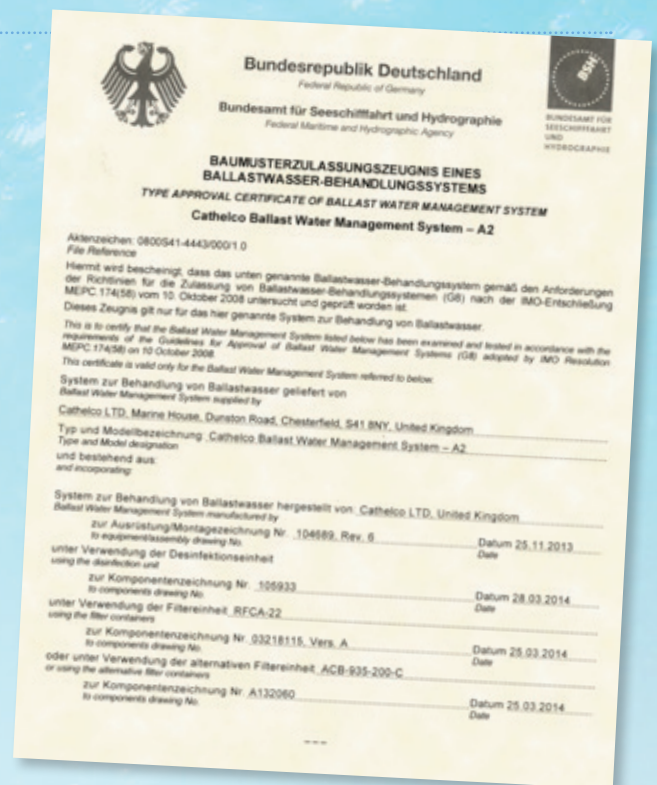
This means that the system has been proved to operate effectively in extremely challenging water conditions. Normal water conditions are around 75% UVT.

Shipboard testing in wide ranging conditions

“Tests were conducted on board the vessel in Gran Canaria (ES), Marchwood (UK), Gibraltar (UK), English Channel.”

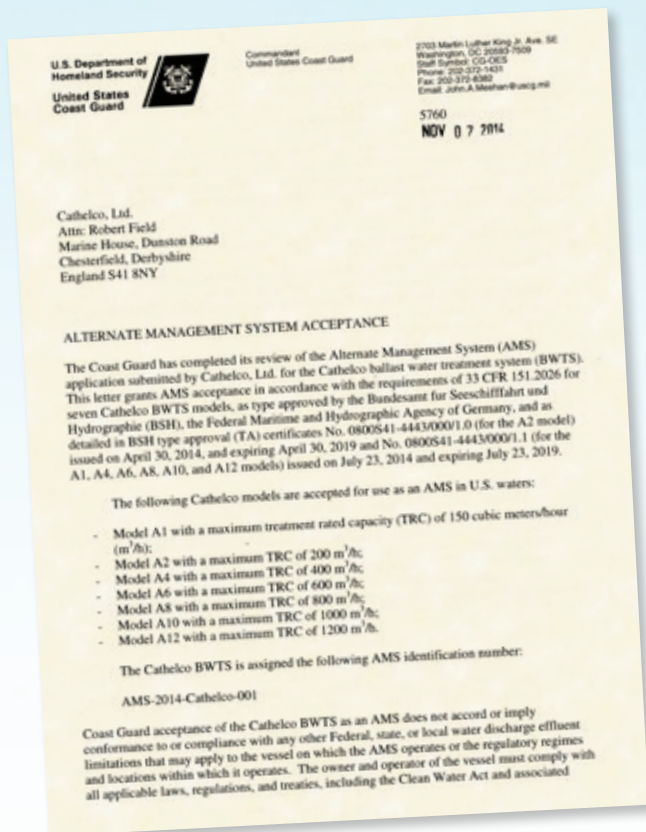
The trading pattern of the M.V. Eddystone enabled shipboard test results to be obtained in the North Atlantic, Mediterranean Sea, English Channel and the Solent Estuary.

The Type Approval Certificate issued by the Federal Maritime and Hydrographic Agency (BSH) of the Federal Republic of Germany is a nine page document containing detailed information about the results of land based and shipboard testing. It is far more comprehensive than certificates issued in the past, reflecting the introduction of more rigorous testing procedures. Furthermore, the test results are open to public inspection.



Patent pending

As the BWT system incorporates a number of technical innovations, Cathelco Limited have applied for a UK Patent under the Application Number 1405106.4



Alternate Management System (AMS) approved

Cathelco received Alternate Management Systems (AMS) acceptance from the U.S. Coast Guard for the ballast water treatment system in November 2014.

This enables the BWT system to be used on vessels entering U.S. territorial waters for a period of up to five years, while the system undergoes type approval testing to U.S. Coast Guard standards.

Key aspects of AMS approval

Full range of salinities

There is no limitation to the range of salinities in which the BWT system can be operated. Therefore, it is approved for use in marine, brackish and fresh water, enabling ships to operate without restriction.

Effective in difficult water conditions

“The Cathelco BWTS has an allowable minimum dose of 190 Joules/square metre (J/m²)... this corresponds to a UV light transmittance value of 45% for the treated ballast water”.

The AMS approval recognises that the BWT system will continue to disinfect heavily silted water where UV light transmittance values are as low as 45% (75% being the value for normal seawater) at 190 Joules per square metre.

A portfolio of products for the shipping, offshore and renewable energy markets

Seawater pipework anti-fouling systems



ICCP hull corrosion protection systems



ICCP systems for offshore wind turbines



Reverse osmosis desalinators



Worldwide Service Network

Our worldwide network of sales and service centres can provide immediate advice and assistance on the complete range of Cathelco products. Agents' contacts details are available on our website: www.cathelco.com

Abu Dhabi	Israel
Algeria	Italy
Argentina	Japan
Australia	Korea
Belgium	Malaysia
Brazil	Mexico
Bulgaria	New Zealand
Canada (<i>East & West Coast</i>)	Norway
Chile	Peru
China (<i>Hong Kong, Shanghai, Qingdao</i>)	Philippines
Colombia	Poland (<i>Gdansk & Szczecin</i>)
Croatia	Portugal
Cyprus	Romania
Denmark	Russia (<i>Murmansk, St Petersburg, Vladivostok</i>)
Ecuador	Saudi Arabia
Egypt	Singapore
Finland	South Africa (<i>Durban & Cape Town</i>)
France (<i>Atlantic & Mediterranean Coasts</i>)	Spain
Germany	Sweden
Greece	Taiwan (<i>Kaohsiung & Taipei</i>)
Holland	Thailand
Iceland	Turkey
India	United Arab Emirates
Indonesia	USA (<i>East, West & Gulf Coasts</i>)
Iran	Vietnam
Ireland	Venezuela

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