Satisfying tougher bilge discharge standards

New IMO and US Coast Guard requirements dictate higher performance from bilge water treatment systems

Department of Defence, Commonwealth of Australia

An FRL bilge water separator will serve the UK MoD's Royal Fleet Auxiliary support tanker Orangeleaf shown here conducting replenishment at sea with the warship HMAS Anzac

Ship operators approach the selection of an oily water separator (OWS) in one of two ways, suggests **Coffin World Water Systems'** David Evans. Some source an inexpensive unit that conforms to the IMO MEPC 107(49) regulations, only considering the initial price and paying little concern to the actual operating costs or efficiency of the system.

Others research the issue of bilge management and are not so concerned with price; they consider the quality of the effluent and how easy the machine is to operate. Often, they test the products of two or three OWS manufacturers and learn more about operating costs, water quality, reliability and the service network.

The US Coast Guard and other port state authorities are enforcing the rules, says David Evans, and ship operators will realize that there is more to an OWS than the purchase price if they are detained in port due to mechanical problems with their equipment.

US-based Coffin World Water Systems' Ultra-Sep bilge water separator incorporates two treatment stages which avoid chemicals, expensive filters and complex gravity systems.

The Ultra-Sep 1000 bilge water separator with a capacity of 1 m^3/h is one of four compact models with a footprint of 965mm x 890mm from Coffin World Water Systems; manual controls are featured for simplified operation

An initial Heli-Sep high efficiency coalescing separator stage removes free oil using a high density matrix with approximately 242,000 coalescing points and oleophilic polishing beads. Oil is drawn to the beads, where it continues to coalesce, and water exits from this stage with less than 15 ppm oil-in-water.

The second stage is reportedly unique to the industry, Coffin World Water Systems claiming to be the only manufacturer to offer 'ultra-filtration' membranes. Its proprietary Spir-o-Lator membrane is a physical barrier to oil, removing the water content from both chemical and mechanical emulsions (oil that is chemically bonded with a detergent or oil that is mechanically shaken/stirred up to microscopic size and entrained with air and water).

Oily water passes over the spiral wound membrane, which operates under a pressure of approximately 100 lb/in^2. Water is pressed through the membrane but oil and dirt cannot get through. The membrane has a pore size of around 0.01 microns, large enough for a molecule of water but too small for an oil or dirt molecule to pass. The system is automatically flushed to clean the ultra-filtration membrane surface and Heli-Sep separator.

Ultra-filtration membrane technology eliminates the need for a polishing phase, either adsorbing media or a chemical reaction.

Processed water from the Ultra-Sep system contains less than 5 ppm oil-in-water, allowing ships to discharge in environmentally sensitive areas. Another benefit cited is that no additional sludge or byproducts are produced apart from the recovered oil, avoiding onshore disposal costs.

A range of seven US-models embraces compact units with manual controls and larger models with PLC control, covering flow rates from 0.5 m^3/h to 10 m^3/h. Certification has been gained from the US Coast Guard, EC MED, Russian Maritime Register of Shipping and ABS to IMO MEPC 107(49) regulations.

An associated oil content monitor is certified in accordance with the same IMO regulation and offers 18 months of recorded data which can be viewed or downloaded as required by the IMO.

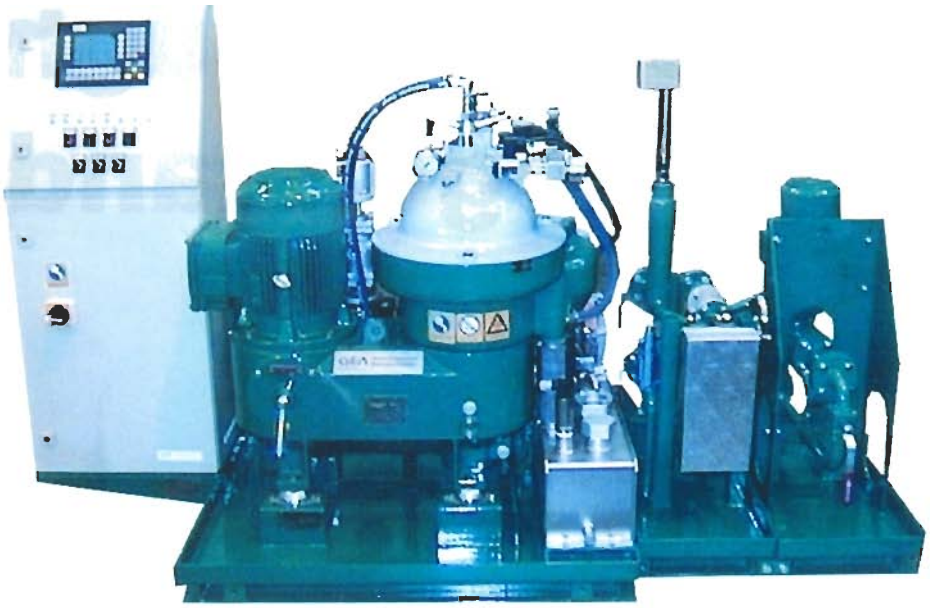
Ceramic membrane bilge water separators from **FRL Fluid Systems** have been selected by the UK Royal Fleet Auxiliary following a trials programme. Units from the Flight Refuelling group company will initially be

supplied for the forward repair vessel *RFA Diligence* and the support tanker *RFA Orangeleaf*, with other installations anticipated to follow across the fleet.

FRL's automatically-controlled system meets the IMO MEPC 107(49) regulations and reportedly requires no crew supervision once running. The bilge separator was originally developed by the British company to supply the Royal Navy with equipment capable of treating emulsified oils and discharging water containing less than 5 ppm of hydrocarbons. It has been fitted to a number of naval platforms and selected by BAE Systems for the Royal Navy's latest Type 45 destroyers. Service feedback is said to be excellent.

FRL is pursuing further development based on ceramic membrane technology for commercial and naval marine applications, and in autumn this year plans to launch a system variant promising a significantly reduced footprint and high flow rates with the same discharge quality performance and reliability.

Success is reported by **Westfalia Separator** for its BilgeMaster processing systems in cruise and cargo shipping markets. A residual oil content of less than 5 ppm is achieved in over 95 per cent of installations by including a downstream adsorption filter, it is claimed.



Westfalia Separator's BilgeMaster package

A visibly clear and colourless discharge is particularly valued in the cruise sector, says the German company, which argues that flotation separating processes with settling tanks do not produce clear bilge water, even if they meet the IMO limit of 15 ppm residual oil content.

The centrifugal separator-based BilgeMaster series was recently extended from three to nine capacity ratings, the original 1,500, 3,000 and 6,000 litres/h sizes being joined by nine intermediate sizes from 1,000 to 7,000 litres/h. The programme can thus cover the requirements of ships with diesel engine power ratings of 5,000kW and above.

A tenth member of the family – the BilgeMaster 200 – is offered for smaller

commercial tonnage as well as pilot boats, supply vessels and motor yachts. Based on the non-self-cleaning WTC 2 separator, this model covers capacity requirements up to 200 litres/h.

Three basic types with a total of five sizes of adsorption filters can be combined with WSD 8, WSD 18 and WSD 35 separators to create nine different customised options to meet specific requirements. A compact size enables the system to be specified for newbuildings or retrofitted in existing tonnage.

Apart from expanding the product portfolio to nine systems, the company changed the three basic types of self-cleaning separators from gearwheel drive to belt drive. Speeds between 20 and 30 per cent higher are achieved, with a greater centrifugal force, more efficient separation and better performance.

Designed for ships burning high density residual fuel oils, the BilgeMaster system is delivered and installed as a complete, self-contained Centripack unit incorporating all the ancillaries required for operation.

Oily water is taken from storage tank or engineroom bilge and pumped through the filter and pre-heater into the separator bowl. The heavy water phase is separated from the finest oil particles and conveyed under pressure to the discharge. The separated impurities accumulated in the sludge space are periodically discharged into the sludge tank.

The BilgeMaster range extension also addressed the new testing regulation embodied in IMO MEPC 107(49), which is applicable not just for heavy fuel oil and diesel oil but also for a new test medium – oil-in-water emulsion – added to the bilge water to demonstrate the performance of a processing system.

As the composition of bilge water is diverse and variable it is essential that a cleaning system can handle a range of contaminants. Detergents from regular washdowns and cleaning processes cause the oil content to be emulsified, rendering gravitational separation techniques redundant, according to Westfalia Separator.

Theoretically, the company explains, centrifuges are not able to separate such emulsions from water if the emulsion is stable. In the past this problem had been solved by treatment with emulsifiers or ceramic filters. BilgeMaster separators, however, are generally confronted with bilge water which, in 95 per cent of all cases, comprises unstable emulsions; and such emulsions can be separated to the specified efficiency of 15 ppm.

For the remaining stable emulsions, Westfalia Separator has installed an adsorption filter downstream to make certain. This is able to separate 99 per cent oil or emulsion, which means that concentrations of less than 15 ppm are achieved in the filter discharge irrespective of the quantity of oil in the bilge water.

The adsorption filter only starts operating when the bilge water processed by the centrifugal separator is actually discharged overboard into the open sea from the clean section of the bilge water tank.

A residual oil content of 15 ppm or less in the discharge water is guaranteed by Westfalia Separator as long as its original spare parts are used: otherwise, the manufacturer's guarantee is not applicable and the operator accepts full responsibility.

Clean water discharge is supervised by an oil-in-water monitor; if the oil content exceeds 15 ppm or 5 ppm the water is recirculated into the oily water tank for reprocessing.

Equipment supplied under IMO MEPC 107(49) has a degree of in-built extra assurance in that oily water separator status is recorded along with time and date, and it should not be possible for clean water to be used when in the discharge cycle. Even this record and control, however, cannot prevent the 'magic pipe' type of discharge which bypasses the system.

Rivertrace Engineering's Increased Assurance Discharge Monitoring System (IADMS) is primarily designed to prevent such illegal oily water discharge to the sea and to record whether such an event has taken place.

For a system to be effective, says the UK-based company, all aspects of the discharge process should be monitored and recorded. The IADMS reportedly achieves this using the

separator control, oil content output, flow rate and cumulative flow through the discharge pipe; additionally, it logs the ship's GPS position, speed and track. Ships fitted with a Purplefinder can send certain data regularly to shore via Inmarsat.

The system is adaptable to an operator's own definition of 'increased assurance', whether this is secondary oil content monitoring or additional diverter valves for added assurance.

At the end of the discharge process a batch record is printed containing all aspects of the discharge and any errors or event triggers that occurred during the process. The print-out can be attached to the manual Oil Record Book for presenting to Port State Control surveyors.

Additionally, the data is stored within the system and can be played back graphically on the in-built screen, sent for storage to the ship's local area network (LAN), printed remotely or downloaded to a standard PC. Each start and stop of the oil discharge process creates a new file that cannot be tampered with.

Genoil's Crystal Sea separator features a six-stage treatment process

Operational simplicity is among a number of merits cited by Canada-based **Genoil** for its Crystal Sea separators in treating bilge water and handling high density emulsions and oils. No backwashing or flushing with fresh or sea water is necessary and the system has a footprint three to six times smaller than other technologies. Other than a pump, there are no moving parts, no chemicals are involved and very little power is consumed during the six-stage process.

The oil-water mixture is admitted to the first stage, a rectangular chamber for preliminary separation by gravity which is divided into three spaces by baffles designed to reverse the flow and impart a circular motion to enhance separation efficiency and minimise undue eddies.

Most of the oil retained in the first section rises towards a primary oil collector where it accumulates prior to evacuation. Sludge and other contaminants denser than water are deposited at the lower portion of the first stage. A steam line surrounding the sludge collector is provided to fluidise the fines for retrieval.

The liquid flows over a weir into a second stage for further separation by gravity and then reaches an oleophilic basket; some oil remains in the upper region of the stage and migrates to a secondary oil collector. The basket is designed to allow free movement of the oleophilic beads and agitate the liquid, thus enhancing both the coalescing effect and the self-cleaning process.

As a result, oil droplets adhering to adjacent beads are readily brought together, forming larger drops that overcome the force of attraction exerted by the beads. Furthermore, the rubbing action occurring between the beads releases the oil droplets and solid contaminants in a self-cleaning process. The basket also incorporates an arrangement designed to form an oil layer that absorbs small hydrocarbon particles resulting from mechanical emulsification.

Oil layer thickness is self regulating, thanks to a suitable design of second stage separation. The liquid undergoes gravitational separation during its upward movement towards the third stage, its velocity conveniently reduced to allow the oil drops to break away from the stream and travel to the oil collector. The liquid reverses its motion before entering the next stage, where separation is repeated in a similar fashion.

Liquid is drawn from the third chamber and pumped to the fourth stage for additional separation by a vortex-generating device. Centripetal forces created within the vortex agglomerate the oil particles and force them to coalesce, forming larger globules. A vortex effect similar to a cyclone works in conjunction with the centripetal force, enhancing the coalescing process.

A conduit retrieves the globules that migrate towards the eye of the vortex and transfers them above a plate attached to the generator. The liquid exits the vortex generator via an annular space and reaches a quiet zone for separation by gravity. A plate separates the flow of liquid from the oil particles which gather around a funnel and migrate towards an oil collector by pressure differential created between the stages.

Further separation of minute oil particles occurs in the fifth stage where the flow is given a sinusoidal path through an oleophilic basket equipped with an oil collector. In most cases, separation is completed prior to the last stage as tests in accordance with IMO requirements showed less than 5 ppm oil with no need for filters, Genoil reports.

For oils of higher density the polishing chamber retains the remaining particles using a special filter; minute particles are thus forced to coalesce on the surface of the filter media. Enhanced buoyancy and the sweeping effect of the liquid motion take away the oil particles which are then retrieved by the oil collector through a pressure differential.

Oil accumulated in the collectors is evacuated automatically, oil-sensing probes detecting the position of the oil/water interface. Where continual operation is required, a positive displacement pump removes oil while the separation process is maintained.

Genoil tested two sizes of unit for IMO MEPC 107 (49) certification, the smallest designed for treating bilge water at a flow rate of 2 gal/min and the largest with capacity for handling 20 gal/min. Three designs with respective flow rate capacities of 5, 10 and 15 gal/min cover intermediate requirements.

The Crystal Sea separators CSS-2 and CSS-20 models reportedly achieved below 15 ppm effluent in the discharge water before the last stage of separation and below 5 ppm effluent after the last stage. Testing at an inclination of 22.5 degrees demonstrated the system's capabilities in seagoing and inter-coastal waterway installations. MP