



WATER MAKERS & WATER TREATMENT

FOR THE MARITIME, OIL & GAS INDUSTRY



ENWA WATER MAKERS & FILTRATION SYSTEMS

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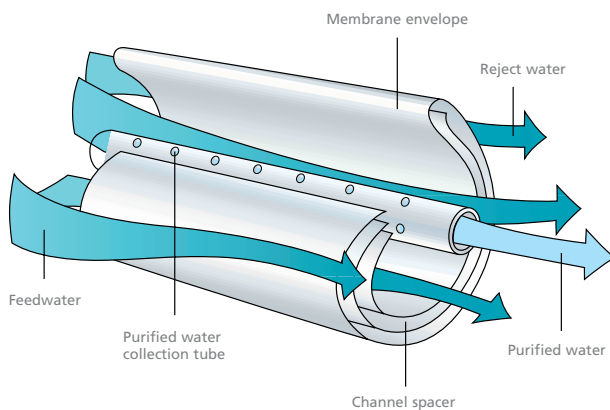
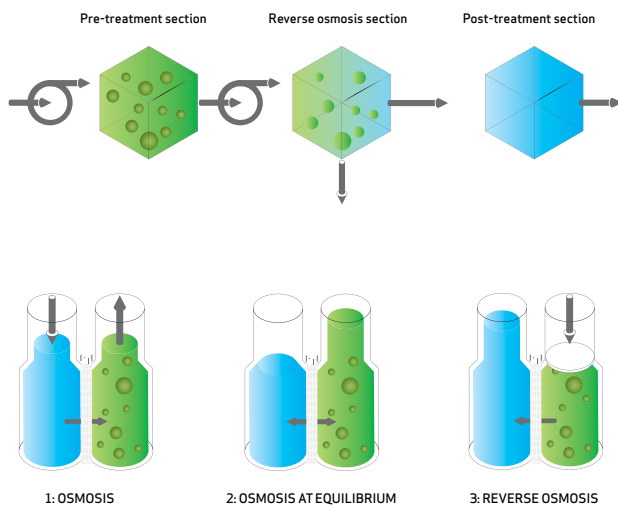
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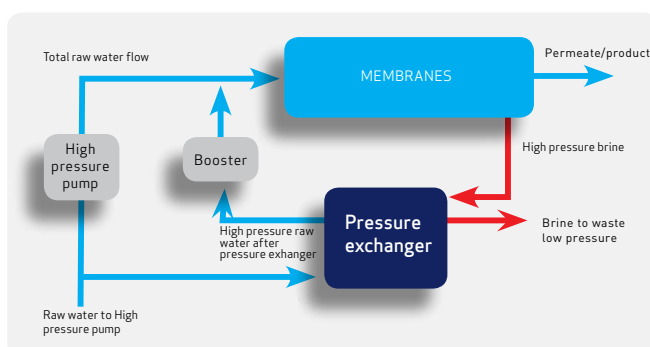


PRODUCING DRINKING WATER

THE PROCESS OF REVERSE OSMOSIS



ENERGY RECOVERY



Several techniques are available. Enwa Water Treatment uses Reverse Osmosis to remove salts and minerals from sea water, brackish water or contaminated fresh water. All of our systems deliver to World Health Organisation standards.

1: OSMOSIS

Osmosis is a natural process, which induces water to flow from a diluted saline solution and through a membrane to a more concentrated salt solution. The concentrated solution then becomes diluted.

2: OSMOSIS AT EQUILIBRIUM

The flow of pure water through the membrane continues until the concentration of salt is equal in both solutions. The difference between the water level in the container, on each side of the membrane, is the osmotic pressure.

3: REVERSE OSMOSIS

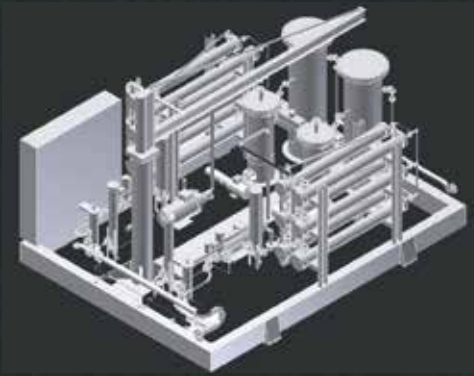
By applying pressure greater than the osmotic pressure to the concentrated salt solution, the process can be reversed. Pure water will then pass through the membrane and flow into the weaker salt solution. Desalinated water is thus obtained by means of dilution.

The spiral-wound module consists of two sheets of membrane, that are placed on both sides of a channel spacer. The three pieces are then sealed on three sides to form an envelope. The remaining open side is attached to a perforated purified water collection tube. A woven plastic sheet serves as a spacer and is laid on one side of the membrane envelope. The membrane envelope and spacer sheet are rolled up into a cylindrical bundle.

A large scale Reverse Osmosis system uses considerable amounts of energy. With energy prices on the rise this is one of the most important factors determining total costs.

To minimize total energy consumption using ENWA recovery system it is possible to reduce energy consumption by 60%. This energy recovery makes it possible to desalinate sea water with only 2 kWh/m³. A normal desalination plant wastes the energy of the outgoing waste water, this water has a pressure of 65 bars and is normally discharged directly to the sea. The system is recommended for watermakers starting at 250 m³/day.

WHY CHOOSE REVERSE OSMOSIS?



All large scale Reverse Osmosis equipment is planned in detailed and precise 3D rendering.

Supply of fresh water is an important issue in a marine environment. ENWA's products using the Reverse Osmosis process will in most circumstances be the most efficient, economical, and environmental friendly way to secure that supply.

In modern vessels the level of excess thermal energy is reduced to a minimum, thereby making the option of evaporation methods more costly. Also, offshore operations in environments with little wind, sea current and waves call for minimum use of machine power, thereby further reducing the access of spill energy as a source of driving evaporation processes. With the use of our proven Reverse Osmosis technology, the potential danger of contamination through the source of bunker water is also avoided.

Our Reverse Osmosis also gives the added advantage of significantly reducing the possibility of Legionella contaminations and raised levels of E-coli bacteria.



LARGE AND SMALL



ENWA has over the past 30 years built up manufacturing capacity and experience with desalination plants to meet different demands. From small units making 1,5 m³/day onboard pleasure boats to the cruising industry and hotels demanding 3 000 m³ top quality drinking water pr day. We meet special demands from the Oil and Gas industry standards, together with military and specialised industrial specifications.



STANDARD RANGE OF REVERSE OSMOSIS PRODUCTS

	MT-1800	MT-3200	MT-4500	MT-5500	MT-6000	MT-10T SRH	MT-15T SRH	MT-20T SRH	MT-25T SRH	MT-35T SRH	MT-50T SRH	MT-75T SRH	MT-100T SRH	MT-150T SRH	MT-200T SRH
Capacity m ³ /24h	1,8	3,2	4,5	5,5	6	9	13,5	20	25	32	50	75	100	150	200
Power kW	1,5	1,5	1,5	1,5	2,2	5,5	5,5	5,5	7,5	11	15	30	30	45	45
Width (mm)	1300	1136	1300	1139	1139	1309	1309	1309	2264	2264	1695	3267	3267	3206	3206
Depth (mm)	450	584	450	584	641	763	763	815	763	815	1000	1080	1080	1730	1730
Height (mm)	520	581	520	581	609	871	871	871	871	871	1115	1696	1696	1786	1786
Weight dry (kg)	62	65	68	78	85	150	160	170	200	220	640	700	900	1200	1550

The capacity is calculated at seawater temperature of 25°C and a TDS of 35500ppm

ENWA manufacture freshwater makers with capacity from 1.500 l/day to 1.200.000 l/day

SPECTRA OF VARIOUS FILTRATION METHODS

- Sugar -	- Virus -		- Pollen -	
- Dissolved salts -	- Colloids -		- Bacteria -	- Sand -
			Particle filtration	
		Micro filtration		
	Ultra filtration			
	Nano filtration			
Reverse osmosis				
Ion Exchanger				

REDUCING CHLORINATION WITH ENWA BIN-X®

REDUCE CHLORINATION TO A MINIMUM. USE ENWA BIN-X MEMBRANES.
FRESHWATER - CHEMICAL FREE BACTERIOLOGICAL BARRIER

In drinking water systems, water is exposed to conditions that creates a possible hazard to its quality. This can create danger to health and even life-threatening situations such as outbreaks of Legionella and E-Coli related epidemics.

ENWA's BIN-X is a patented cost-effective water treatment system used for removal of particles and bacteria such as Legionella and E-Coli from potable water/drinking water, offering maximum security against such epidemics. With the ENWA BIN-X, this can be achieved with a moderate level of investment.

Traditionally, UV systems are used to neutralise bacteria in potable water systems. The ENWA BIN-X employs ultra filtration to actually remove the bacteria, and as the membranes are self maintained by an automatic patented backwash/flush technique. Consequently time spent on system maintenance is very limited.

The ENWA BIN-X holds VA (water and discharge) approval for installation in drinking water. It operates in temperatures up to 80°C, so both cold- and hot- water systems can be treated with the ENWA BIN-X.



The seven-hole capillar tube membranes.



ENWA BIN-X complete ultrafiltration system.

STATENS SERUM INSTITUT (DENMARK)

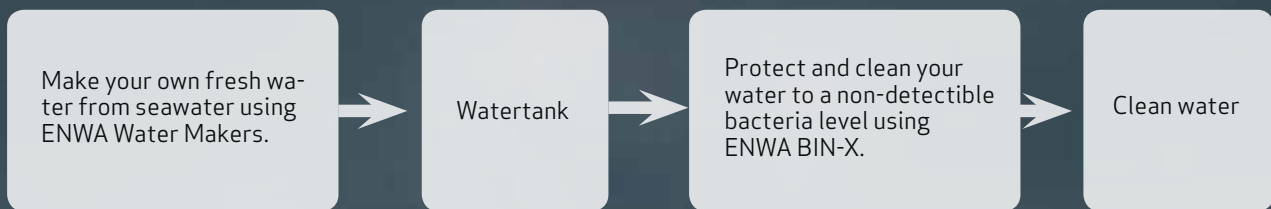
"The report concludes that the concentration of legionella contamination was reduced from 10 000 CFU pr/litre to a non-measurable level!"

OUR RANGE OF ENWA BIN-X® PRODUCTS

Product	UF23	UF24	UF26	UF45	UF410 B1-B4	UF815 B1-B4
	0-35 l/hour	0-100 l/hour	50-150 l/hour	50-400 l/hour	200-2600 l/hour	2-35 m3/hour
	Tea, softdrink, waterdispensers					
	Water coolers, ice cube machines					
			Laboratories			
				Domestic households		
				Industry		
					Hot water systems	
	Hospitals					
	Special applications					

ENWA BIN-X is a module based system that can accordingly be scaled to every need in terms of capacity

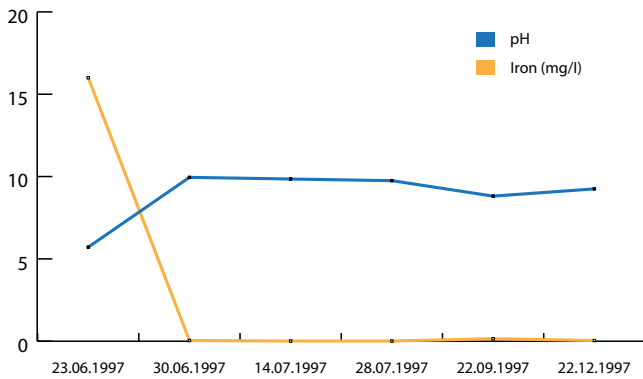
CLEAN WATER TANK CLEAN PIPE DISTRIBUTION MINIMUM CHLORINE



On board Ocean Rig – Eirik Raude the odour and taste from chlorine is kept to a minimum by protecting against bacteria using membranes.

ENWAMATIC® MARITIME CHEMICAL FREE WATER CONDITIONER

- Comfort cooling and heating systems (hvac)
- Engine cooling systems
- Water cold machinery



The graph illustrates the effectiveness of the carbonate balance/ pH shift approach in the control of corrosion - 6 months trial - Norske Veritas, Norway. Non-detectable level of corrosion.

ENWAMATIC® MARITIME

In any freshwater based, closed loop, cooling or heating system there is a certain quality of the water used for heat transport and exchange. The quality of the water is very much a source of degeneration of the system in form of corrosion, scaling and bacterial growth.

Corrosion, scaling and bacterial growth reduces the systems ability to exchange and transport heat. If the water is left without any treatment, the system will rapidly degenerate and cause operational problems and high maintenance cost. If treated in the right way, such degeneration can be stopped. Particles and bacteria will be removed from the system and corrosion will be stopped. This will make great savings in both operational and maintenance cost and protect your investment in the best way.

Traditionally this treatment has been performed using chemical injections. This is a rather expensive treatment method as chemicals have to be purchased, handled and disposed of according to strict rules and regulations. Chemicals can be harmful to the environment and also a risk subject for the people handling the chemicals.

ENWA's DNV approved (report no 270113) EnwaMatic® Maritime technology provides a safe, chemical-free and environmental friendly solution that also will make great savings in the operation of your systems.

DNV TECHNICAL REPORT NO. 27013BSC.N1 (DET NORSKE VERITAS)

The copper, iron and zinc contents have decreased to approximately omg/l during the test period. Further the particle content has been distinctively reduced. The weightloss measurements show that C-Mn steel was not susceptible to corrosion in the treated water during the test period. Hence the testing shows that the corrosivity of the water has been reduced as result of the water treatment.

Water samples from system treated with EnwaMatic® technology. From day 0 to day 30 to the right.



The EnwaMatic® Maritime Technology

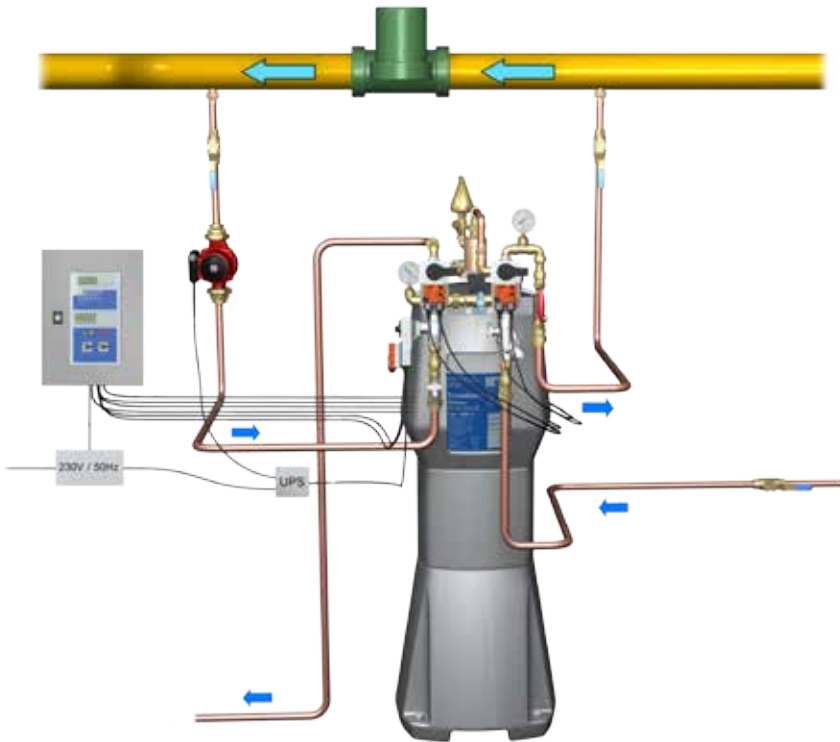
The ship owner Color Line, operating several cruise ferries, has decided to change all closed loop water systems for engines and HVAC systems on their entire fleet to EnwaMatic® Maritime.



©Color Line AS



THE ENWAMATIC® PROCESS



ENWAMATIC® MARITIME FUNCTIONS:

- Corrosion inhibition
- Scale control
- Side-stream filtration to < 5 microns
- Environmental control of bacterial growth
- Air separation

ENWAMATIC® MARITIME BENEFITS:

- Reduced energy consumption
- Prolonged system lifespan
- Reduced service and maintenance costs
- Cost-effective alternative to chemical dosing
- Continuous filtration and self-regulating water treatment
- Non-scouring solution for refurbishment projects
- Environmentally sound technology

HEALTH, SAFETY AND ENVIRONMENT

- EnwaMatic® will create an ideal documented 'Clean Ship' Water Treatment environment
- No Hazardous Chemicals
- Drained water consist only of harmless particles
- Closed loop operation
- Automatic operation without the potential for mechanical failure
- Make up water can be pre-treated by passing through the EnwaMatic® Maritime
- The unit is bolted to the deck and attached to the walls to prevent movement
- Low Voltage System
- The EnwaMatic® Maritime is bolted to the deck to a sorb static forces
- High grade insulation
- No corrosive materials
- No sharp edges

DESIGN AND APPROVALS

- 10 years documented experience with the technology
- World patent
- DNV test report
- Cranfield University, School of Water Science
- TÜV Safety Approval
- EnwaMatic® is the only water treatment system on the German market fulfilling water treatment and environmental demands.
- Pioneering ship companies are recommending EnwaMatic® in their specifications
- EnwaMatic technology is utilized in the Wärtsilä Water Conditioning Unit (WWCU), which is the only accepted cooling water treatment system for Wärtsilä 4-stroke engines



EnwaMatic® Maritime Technical information	EnwaMatic® Maritime F1	EnwaMatic® Maritime F2	EnwaMatic® Maritime F3
Capacity (m3)	0 - 7	0 – 20	0 - 40
Power (W)	25-30	25-30	25-30
Width (mm)	550	600	600
Depth (mm)	550	600	600
Height (mm)	1500	1700	2000
Weight empty (kg) inclusive automatic head	30 kg	45 kg	50 kg
Weight full (kg) Inclusive water.	90 kg	200 kg	240 kg

Capacity is the total volume of water within the closed loop of cooling/heating water.
 Weight empty is the dead weight without filter media. Weight full is the calculated weight inclusive filter media and water.

Optional: real time monitoring with alarm functions

A FULL RANGE OF WATER TREATMENT SOLUTIONS

ENWA has a long experience with tailormade large waterworks. Whilst there are clear benefits from standardisation, there are many instances where it is not possible, and our flexible organisation has the skills to offer solutions which can mean great savings for our customers. Our intimate knowledge of fluid mechanics and the usage of steel as building material means that we can customize pipes, rather than demand the whole construction must be changed. ENWA produces pipe-parts with the necessary knees and elbows in both stainless and carbon steel up to size DN1600. The customers' benefits are reduced costs owing to the reduced need for space. Furthermore, with plant extensions and/or revamps we often achieve reduced downtime.



AFTERSALES AND SERVICE LIFE CYCLE COST

We know that we deliver good products, but that alone is not enough to ensure satisfied customers. Our customer's experience of doing business with us is also dependant on our ability to deliver top-class aftersales and service. This is why we give it priority as one of our key areas. For some products and systems, regular service can be as important as the initial purchase. Life Cycle Cost (LCC) is dependent on service to meet the cost/benefit target.

Many of our customers have a certain time window service or repairs MUST be performed in. Therefore speed of response, and reliability, form the core of our service philosophy.

Our service teams are involved in construction, installation and commissioning, as well as the training of the customers' own operatives in the running, supervision and routine maintenance of the systems, sometimes with yearly refreshment-courses. This secures an in-depth knowledge of both products and

customers. The lessons learned from these processes are used to improve the products and delivery process through our ISO 9001-2008 system.

Our service teams cover Scandinavia, UK and the Far East from India and Singapore. Outside Europe the majority of the services are in Maritime and Oil and Gas market segment.



REFERENCES

We have over 30 years of experience. These are some of our satisfied customers:



OCEAN RIG - EIRIK RAUDE



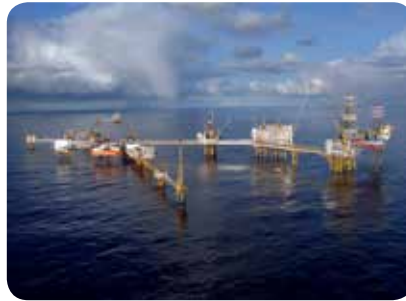
ODFJELL - DEEP SEA STAVANGER



CG RIEBER - POLAR DUCHESS



SWEDISH NAVY - VISBY



CONOCOPHILLIPS - EKOFISK



VOLSTAD - GRAND CANYON



HURTIGRUTEN - FRAM



SEADRILL - SEADRILL 3



RESIDENSEA - THE WORLD



STATOIL - HULDRA



SOLSTAD OFFSHORE -
NORMAND CUTTER



AIBEL - GUDRUN

A FULL RANGE OF COST EFFECTIVE AND ENVIRONMENTALLY FRIENDLY WATER TREATMENT SOLUTIONS

ENWA manufacture water treatment solutions to numerous sectors. We work closely with our customers; this enables us to provide efficient systems for specific water treatment needs.

Our Maritime Oil and Gas division (MOG) provides a wide range of products and services. Production and design personnel work as integrated teams to ensure transparency. Each product is tested extensively prior to installation to ensure longterm reliable performance in the marine environment. The company work according to ISO 9001-2008 and is certified accordingly.

We offer solutions for maritime vessels and oil & gas installations where desalination of water and water quality is an issue. Depending on the needs and requirements of the customer, ENWA delivers standard products as well as customised turnkey solutions. Technical support and advice is provided for all ENWA products and services.

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