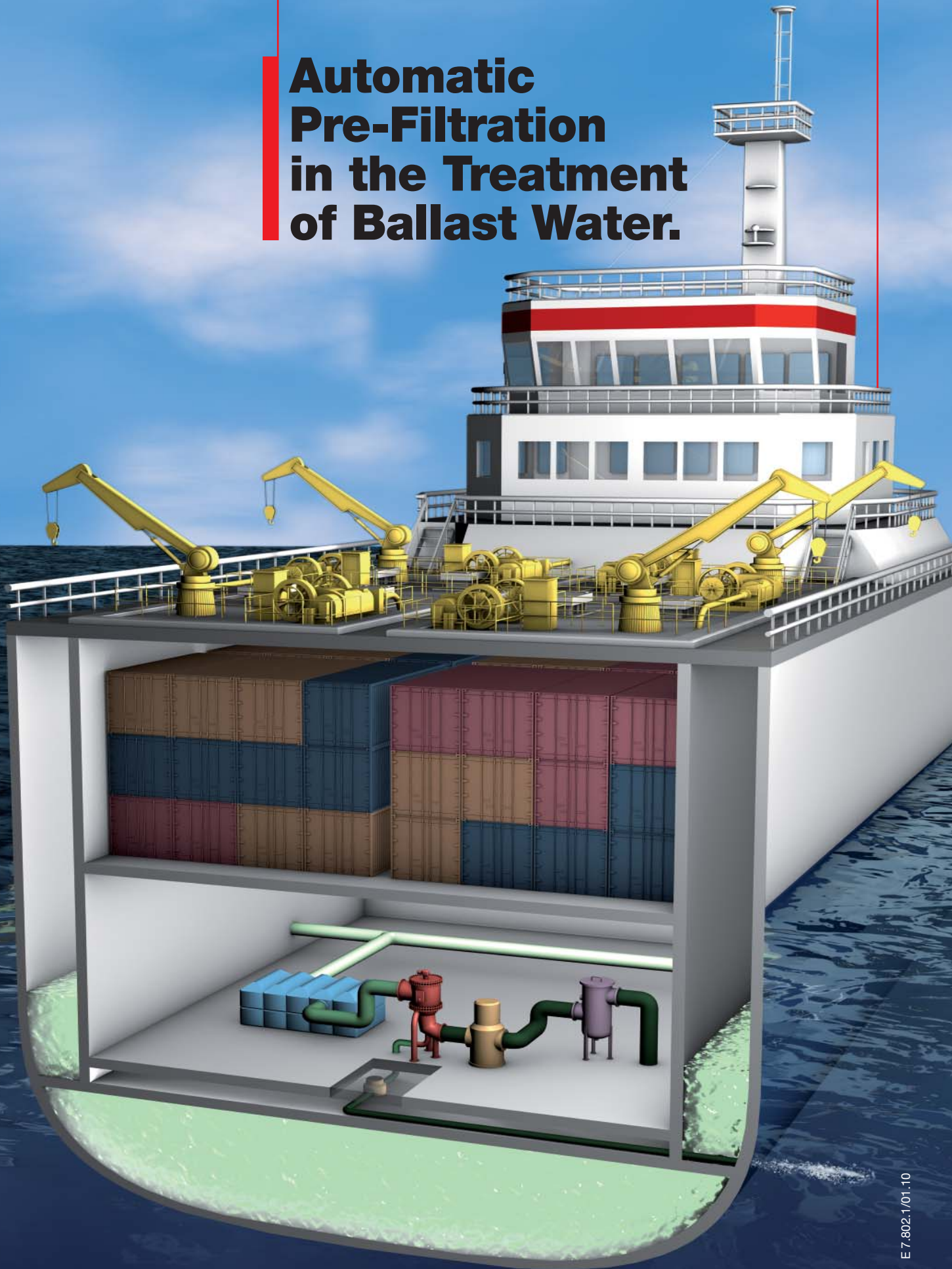


HYDAC INTERNATIONAL

**Automatic
Pre-Filtration
in the Treatment
of Ballast Water.**



in the Treatment of Ballast Water.

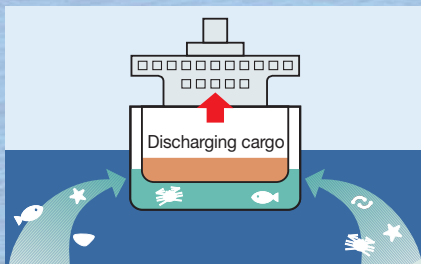
The ballast water problem.

Ballast water has been a global problem for cargo shipping for over 100 years. Ballast water provides stability for ships at sea where seawater is either taken into or discharged from the relevant tanks, depending on the freight. This additional weight ensures that the part-loaded or empty container giants achieve their optimum position in the water. Without ballast they would be unstable in the water.

During sea transport, millions of animal or plant organisms are however also transported in the ballast water and are taken to alien environments. When discharging the ballast water, these organisms – including bacteria, phytoplankton, zooplankton, viruses and also small fish, crabs or jellyfish – are released at the port of discharge.

If the environment in the new location is similar to their native environment, the non-native species can survive. Non-indigenous species are therefore introduced into the local ecosystem where they can proliferate or mutate unhindered.

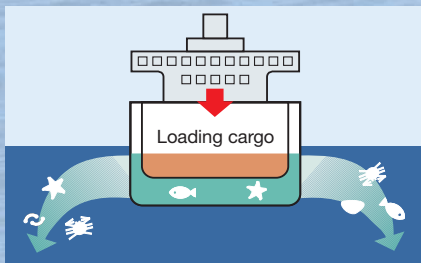
In order to overcome this problem it was decided through the adoption of the Ballast Water Convention of the International Maritime Organization (IMO) in February 2004 in London, that the treatment of ballast water on ships will be compulsory from 2009.



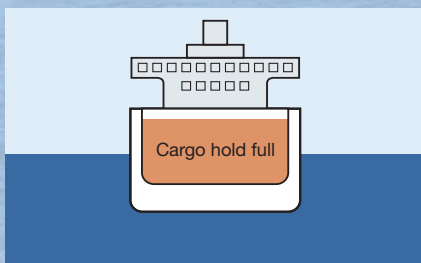
1: At the home port



2: During the voyage



3: At the destination port



4: During the voyage



North American Sea Walnut/Ribbed Jellyfish (Mnemiopsis leidyi)



Habitat: East coast of North America.
Introduced into: Caspian, Black and Asov seas.
Effect: rapid proliferation (hybrids), decimation of the zooplankton, alteration to the food chain and the ecosystem.

Toxic algae (several species)



Habitat: widespread.
Introduced into: several species in non-native regions.
Effect: damaging algal blooms are triggered and depending on the species, their mucilage/toxins reduce the oxygen level or cause native organisms to die, contamination of beaches is detrimental to tourism, death and serious illnesses are caused by contaminated mussels, harmful algal growth.

Black-mouthed gudgeon (Neogobius melanostomus)



Habitat: Caspian, Black and Asov seas.
Introduced into: Baltic Sea, North America.
Effect: rapid spread, reproduction several times per season, captures native species and their eggs/young, resistant to poor water quality.

Chinese mitten crab (Eriocheir sinensis)



Habitat: Northern Asia.
Introduced into: Western Europe, Baltic Sea, West Coast USA.
Effect: mass emigration, silting up/erosion due to hollows in levees/river banks, decimation of native fish, invertebrates and organisms, economic damage to fisheries.

Asian wakame algae (Undaria pinnatifida)



Habitat: Northern Asia.
Introduced into: South Australia, New Zealand, West Coast USA, Europe, Argentina.
Effect: spreads rapidly, displaces native algae/organisms, alters ecosystem and food chain, reduces shellfish stocks.

Global Problem. Local Solutions.



Cholera (*Vibrio cholerae*)



Habitat: widespread.
Introduced into: South America, Gulf of Mexico and other regions.
Effect: some epidemics linked to ballast water.

Zebra mussel (*Dreissena polymorpha*)



Habitat: Eastern Europe, Black Sea.
Introduced into: Western and Northern Europe, Ireland, Baltic Sea, North America.
Effect: displaces native organisms, alters ecosystem and food chain, causes heavy contamination in the infrastructure and to ships.

European green crab (*Carcinus maenas*)



Habitat: European Atlantic coast.
Introduced into: USA, South Australia, South Africa, Japan.
Effect: highly invasive, the hard shell makes it resistant to predators, displaces native crabs, decimates many species, alters the ecosystem in rocky intertidal areas.

North Pacific starfish (*Asterias amurensis*)



Habitat: North Pacific.
Introduced into: South Australia.
Effect: very rapid, epidemic-like displacement of other species, feeds on shellfish, oysters, scallops and other mussels.

Cladocera water flea (*Cercopagis pengoi*)



Habitat: Black Sea, Caspian Sea.
Introduced into: Baltic Sea.
Effect: rampant populations dominate the zooplankton, clogging fishing nets or trawl nets, economic damage.

HYDAC AutoFilt® RFBW Backflush Filter for pre-filtration in the treatment of ballast water.

HYDAC Process Technology has engaged intensively with the pre-filtration stage of mechanical ballast water treatment and provides a comprehensive technical range of components, systems and services for shipping. Experience shows that the quality of the products remains outstanding following years of use and constant monitoring in many sectors.

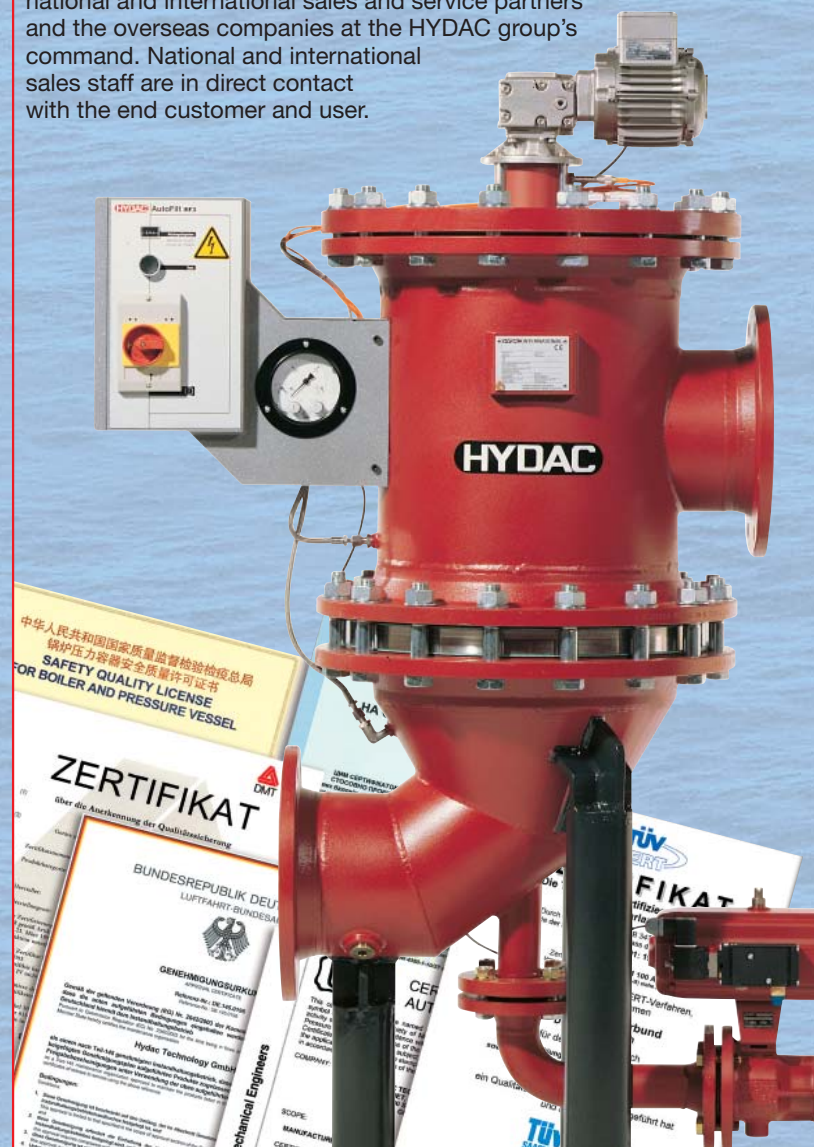
The new automatic backflush filter HYDAC AutoFilt® RFBW has been specially developed for shipping technology and is particularly suitable for such applications. The RFBW is used in the pre-conditioning of the ballast water where small particles and organisms $\geq 50 \mu\text{m}$ are removed from the ballast water. A physical or chemical separation system can then be installed downstream so that microorganisms, bacteria and viruses can be killed.

Worldwide Sales and Service.

All over the world, HYDAC engineers and technicians are working with great dedication on projects concerned with ballast water treatment.

On the basis of global and local quality standards, system approvals and product approvals, HYDAC Process Technology guarantees that the products and services are manufactured and supplied in accordance with requirement.

Our one-stop sales and service organisation provides the perfect range worldwide and with local expertise, thanks to the numerous national and international sales and service partners and the overseas companies at the HYDAC group's command. National and international sales staff are in direct contact with the end customer and user.



Automatic Backflush Filtration for Ballast Water Treatment.

The living organisms transported in the ballast water are of varying sizes and consistencies. For this reason, ballast water treatment plants generally consist of a prefiltration stage to prefilter particle contaminants $\geq 50 \mu\text{m}$ and a disinfection stage installed downstream to eliminate the remaining microorganisms. The automatic backflush filter HYDAC AutoFilt® RFBW is used in the pre-filtration stage for the mechanical treatment of the ballast water. An additional coarse filter can be installed before it.

First stage of the ballast water treatment: Pre-filtration

Mechanical treatment:

- Solid-liquid separation using centrifugal separator, e.g.: HYDAC AutoFilt® TwistFlow Strainer ATF
- Solid-liquid separation with automatic filters, e.g.: **Filtration using HYDAC Backflush Filter AutoFilt® RFBW**

Second stage of the ballast water treatment: Disinfection

Chemical or electrochemical treatment:

- Dosing of disinfection chemicals, e.g.: chlorine compounds, peroxides (hydrogen peroxide, peracetic acid ...)
- In situ production of disinfection chemicals, e.g. from seawater, chlorine electrolysis, etc.
- Water ozoning

Physical treatment:

- UV oxidation
- AOP (Advanced Oxidation Process)
- De-oxygenation / inert gas
- Ultrasound
- Cavitation

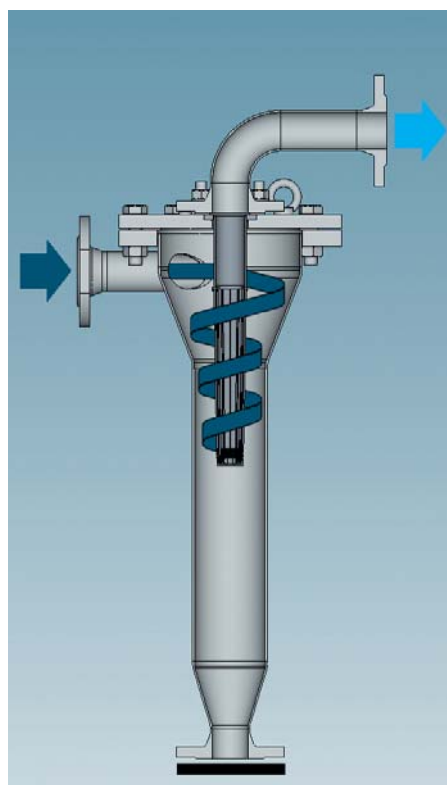
Function of the HYDAC AutoFilt® TwistFlow Strainer ATF.

Generally the seawater is first piped through a coarse separator with a filtration rating of about 5 mm. Precisely when there is a high level of sediment, the TwistFlow Strainer is recommended as an additional filtration stage to pre-condition the ballast water. It is then automatically pre-filtered to a rating of 50 μm through the RFBW.

The TwistFlow Strainer is particularly suitable for the continuous filtration of particles $> 200 \mu\text{m}$. In the treatment of ballast water several filters are combined on a skid to ensure continuous operation of the system.

The fluid enters the housing tangentially. As a result of the tangential flow and the tapered housing cross-section, the fluid flows down in a spiral. The centrifugal forces created separate the high density particles (e.g. sand particles, mussels, sediment ...) to the edge of the housing. These are then deposited in the lower part of the housing and can be cleaned out periodically.

The remaining low-density particles which are not deposited at the bottom of the housing by the centrifugal force are filtered through the conical slotted tube which has a defined filtration rating.

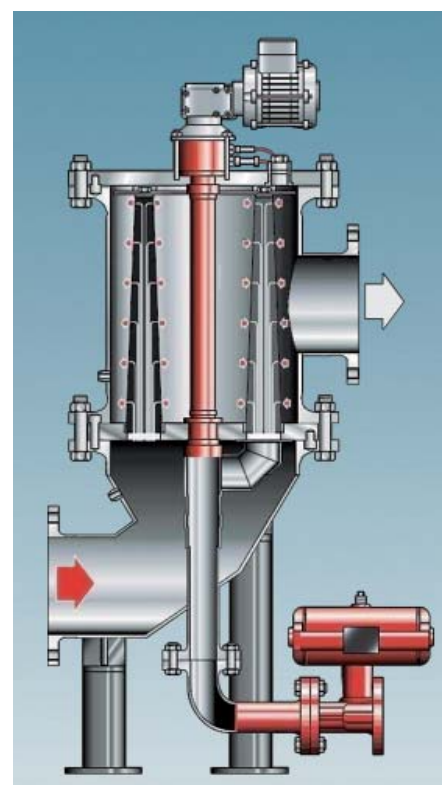


Function of the HYDAC AutoFilt® RFBW.

Here too, the ballast water is first piped through the coarse separator. It can then be automatically pre-filtered to a rating of 50 μm through the RFBW. The TwistFlow Strainer can also be included in the circuit – for example, if there is a high level of sediment. In the filter, conical filter elements separate organic and inorganic elements from the ballast water. If the elements are clogged, automatic cleaning starts. During back-flushing, the flow of filtrate is uninterrupted. The backflush fluid is carried back into the sea. The microorganisms remaining in the filtrate are eliminated in the physical or chemical separation system installed downstream.

All materials are compatible with critical seawater parameters. The filter's robust design and the automatic backflushing make a significant contribution to operational reliability and therefore reduce the costs of operation and maintenance.

The small footprint and variable filter geometry ensure optimal integration of the filter in your system.

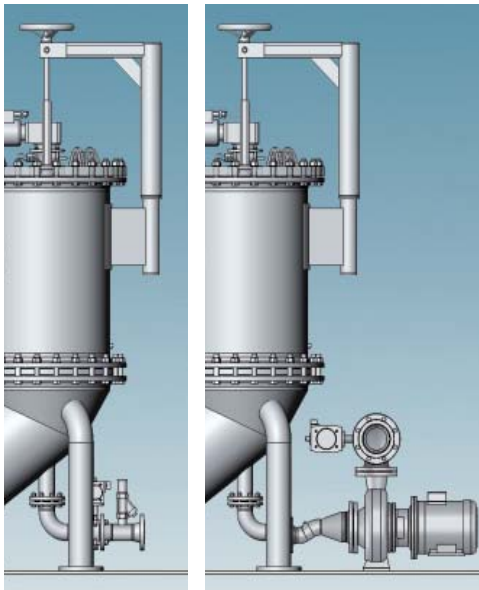


System integration.

The key factor for continuous operation of the AutoFilt® RFBW in the treatment of ballast water is the pressure differential required of 1.5 bar minimum between the backflushing line and the filter outlet. This minimum pressure drop ensures the operation of the filter.

Depending on the height of the waste water outflow from the backflush line, an additional backpressure of up to 2.0 bar can accumulate.

The HYDAC AutoFilt® RFBW product series has been adapted to different pressure ratios. There are two different filter models for the treatment of ballast water:



HYDAC AutoFilt® RFBW

HYDAC AutoFilt® RFBW with suction pump

Model 1: RFBW

If the ballast water in the treatment plant has the required minimum operating pressure, the RFBW can be used without any additional measures because the pressure drop required for element cleaning can be built up easily.

The backflush fluid is automatically piped directly back into the sea. The filter on its own guarantees smooth operation.

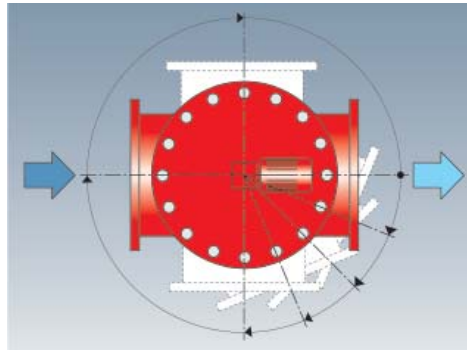
Model 2: RFBW with suction pump

If the required pressure drop is not available in the whole system, the flushing pressure is increased with the aid of a suction pump between the backflush connection and the back flush valve, so the filter elements can be cleaned efficiently and the backflush fluid piped back into the sea. The pump is operated by the filter control unit and switches on only during the backflush process.

The filter and backflush pump are mounted on a base frame and are ready for operation.

Simple retrofitting.

The RFBW can be easily integrated into any system geometry because of its variable filter isometry since the inlet and outlet flanges and the backflush line can be arranged in various configurations.



Another important feature for this filter is the fact that it can be easily disassembled: in confined spaces, the individual filter components can be moved to a new location without any difficulty and reassembled again there.

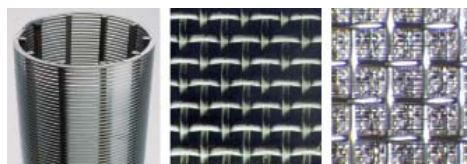
With older ships, the selection of a suitable ballast water treatment system often depends on whether retrofitting is possible.

Selection of filter materials.

In order to optimize your ballast water treatment plant, a wide variety of filter materials and element types is available to handle the most diverse filtration demands.

All filter materials can be cleaned, which means that the considerable costs of replacement, warehousing and disposal can be eliminated.

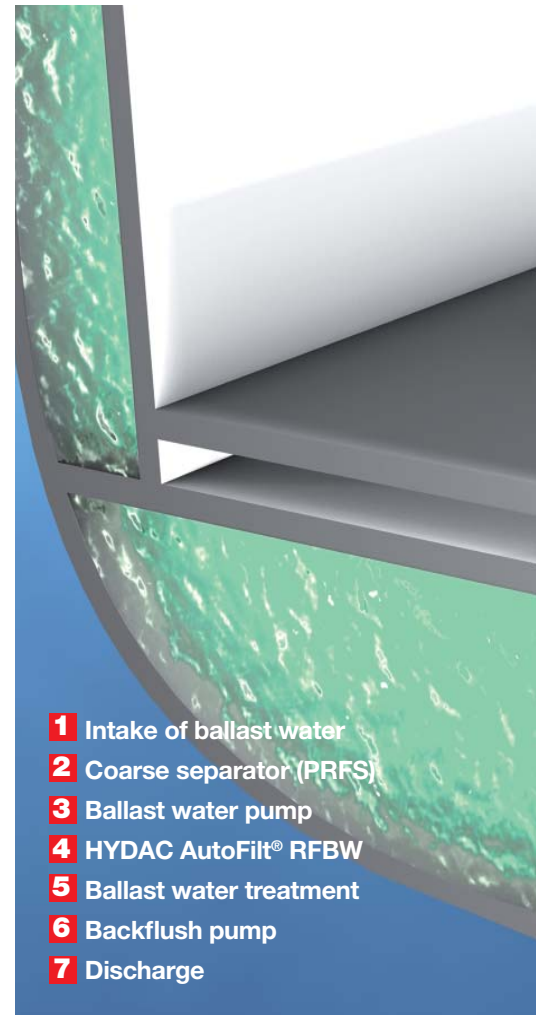
Particularly for ballast water treatment, slotted tubes, filters with wire mesh, sintered triple-layer material in wire mesh and SuperMesh are available.



Cleaning (CIP – Cleaning in place).

Hygiene, too, plays an essential role in ballast water treatment. Regular cleaning and conservation are necessary – e.g. after downtimes, such as after a voyage lasting several weeks – and this must be specific to every component and part.

The RFBW can be cleaned using the CIP procedure (Cleaning-In-Place). The choice of cleaning materials can comply with the next treatment stage at the same time: the material compatibility of the RFBW means that different dosages and chemicals can be used.



- 1 Intake of ballast water
- 2 Coarse separator (PRFS)
- 3 Ballast water pump
- 4 HYDAC AutoFilt® RFBW
- 5 Ballast water treatment
- 6 Backflush pump
- 7 Discharge

Backflush Filter AutoFilt® RFBW – Summary of the technical data of the standard model.

Maximum operating pressure:
10 or 6 bar *

Operating temperature:
90 °C *

Filtration rating:
15 µm to 3 mm

Energy supply:
Electropneumatic, electrical or pneumatic

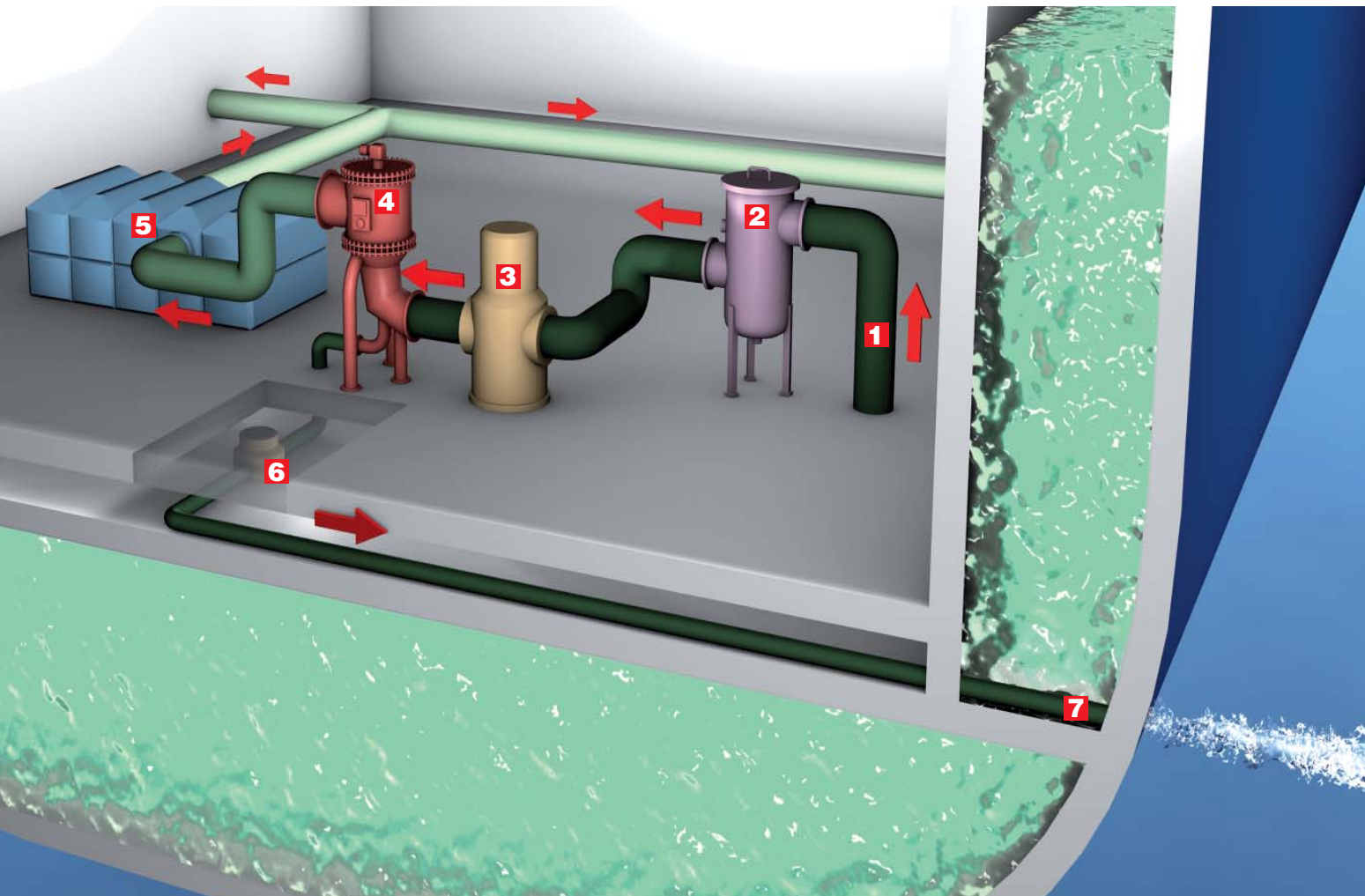
Material of filter housing:
Carbon steel or stainless steel

Material of filter elements:
Various qualities of stainless steel possible

Material of internal parts:
Stainless steel

Corrosion protection for carbon steel filter housing:
Rubber coating*

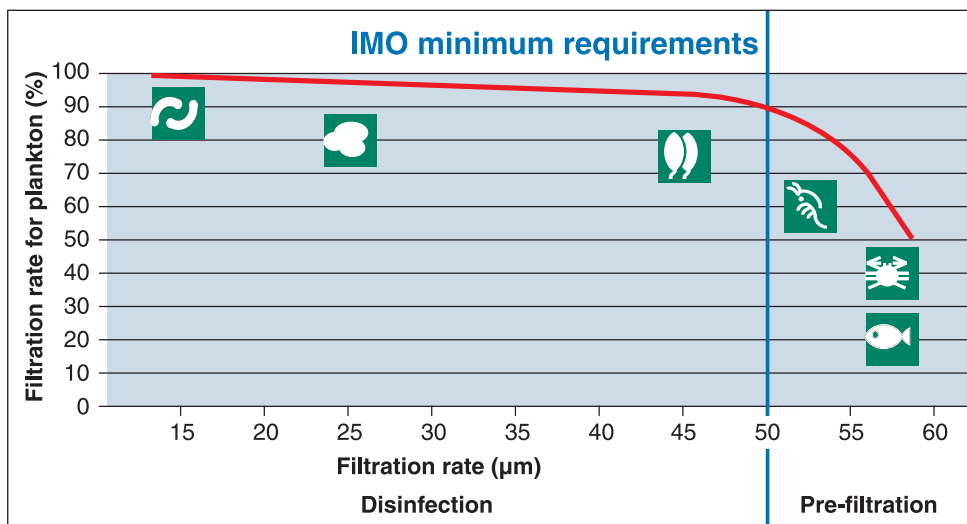
* Other models on request.



HYDAC AutoFilt® RFBW in operation.

An accredited Institute has defined the separation rates of the RFBW during operation in a ballast water treatment plant. The graph shows the separation rate of living plankton before and after the filter.

The results of this test are convincing: For a filtration rating of 50 µm the zooplankton (multicell) is almost completely filtered out. 90 % of all living plankton is eliminated at a filtration rating of 50 µm.



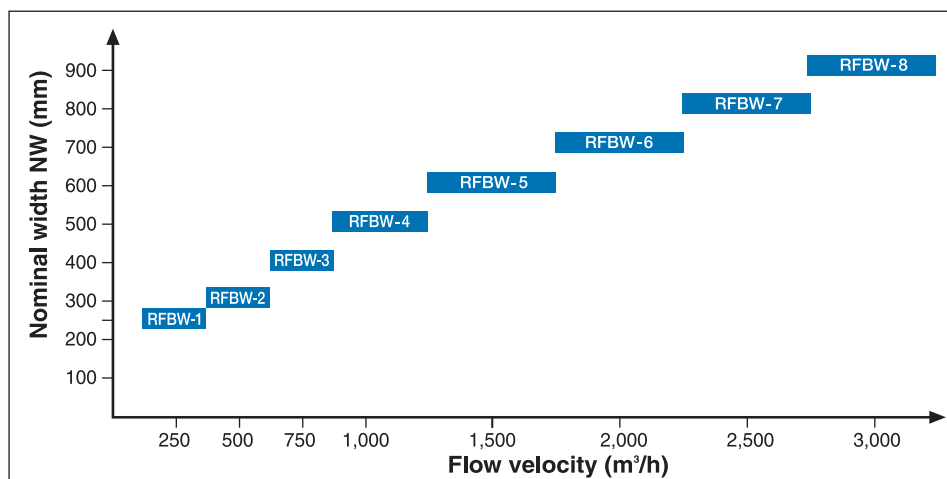
Organisms	Sizes	IMO Requirement	Average concentration in seawater
Predominantly zooplankton (multicell)	≥ 50 µm	< 10 living organisms/m ³	10 ³ to 10 ⁵ /m ³
Zooplankton (single cell)	10 to 50 µm	< 10 living organisms/ml	10 ² to 10 ⁴ /ml
Phytoplankton			
Vibrio cholerae	0.1 to 1 µm	< 1 CFU*/100 ml or < 1 CFU*/g zooplankton mass	Occasionally present
Escherichia coli	0.1 to 1 µm	< 250 CFU*/100 ml	Occasionally present
Enterococci	0.1 to 1 µm	< 100 CFU*/100 ml	Occasionally present

CFU* = Colony forming unit

The Advantages of automatic Pre-Filtration ...

Features and the benefits to you:	TwistFlow Strainer	RFBW
Extensive standard features for individual applications	➔ Excellent price / performance ratio	●	●
Fully automatic operation	➔ Reliable and safe, no intervention by staff required Low operating costs	(●)	●
Continuous filtrate flow even during back-flushing	➔ No interruption of operation		●
Flow velocity up to 3,000 m ³ /h	➔ High process performance	●	●
Service friendly	➔ Low maintenance costs	●	●
Isokinetic filtration and back-flushing	➔ Maximum utilisation of filter area Full filtration performance after back-flushing		●
Conical filter elements	➔ Unbeatable Δp curve	●	●
Slotted tube filter elements	➔ Long service life Optimum filtration and back-flushing properties	●	●
Pulse-aided back-flushing	➔ Additional dynamic element cleaning with low loss of cleaning fluid		●
Individually adjustable control parameters	➔ Customized adaptation to the particular application	●	●
Flow-optimised filter	➔ High throughput with compact dimensions	●	●
Static sealing between contaminated and clean sides	➔ Guaranteed high filtrate quality Low maintenance	●	●
Cleaning using CIP procedure	➔ Filter cleaning on site Only one cleaning agent is required	●	●
Variable housing isometry	➔ Reduced costs due to space-saving and simple installation	●	●
Numerous equipment options	➔ Customized adaptation to the particular application	●	●
Ready-to-operate	➔ Simple installation and commissioning Guaranteed reliability due to HYDAC system test	●	●
Certified to ISO 9001	➔ Consistently high quality	●	●
No rotating parts	➔ No wear – no replacement costs	●	

Sizes of the HYDAC AutoFilt® RFBW.



Note:

The information in this brochure relates to the operating conditions and applications described.

For applications or operating conditions not described, please contact the relevant technical department.

Please contact Head Office for sizing of the HYDAC AutoFilt® RFBW.

Subject to technical modifications.



Brochure: Accumulators DEF 3.000



Broch.: Filtration Range DEF 7.000



Br.: Filters for Industr. Processing DEF 7.700



Br.: Systematic Fluid Service DEF 7.929



Broch.: Compact Hydraulics DEF 5.300



Brochure: Accessories DEF 6.100



Brochure: Electronics DEF 18.000



Broch.: Cooling Systems DEF 5.700

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**HYDAC PROCESS TECHNOLOGY
GMBH**

Industriegebiet Grube König
Am Wrangelflöz 1
66538 Neunkirchen
Germany

Phone:
+49 6897 509-1241

Fax:
+49 6897 509-1278

Internet: www.hydac.com
E-Mail: prozess-technik@hydac.com