MERUS RING IN THE MARINE

MERUS Technology providing solutions for

- Corrosion
- Scaling & Fouling
- Marine Growth
- Sea Shells, Mussels, Barnacles

Some of Our Clients Worldwide

**MERUS Ring in the Marine**

MERUS is working with the marine industry for almost 10 years. Everything started in Greece and today MERUS is one of the leading companies doing Water Treatment on vessels in Europe. Over time a few hundred vessels have been equipped, whereas lately the maritime industry is one of the fastest growing branches of MERUS. All kind of vessels, from the very big cruise liners, container vessels, shipping vessels, ferries, bulk carriers, tankers, fishing vessels, offshore supply vessels, tug boats and river cruisers are treated by the MERUS Rings.

Green Shipping is something everybody in the shipping industry is talking about lately. Using MERUS Rings is adding to greener shipping. Having cleaner equipment, will lead to savings of energy, less effort for cleaning by using chemicals, and a lot more.

A vessel is not only surrounded by water, but as well a lot of water is used inside a vessel. Mainly to produce drinking water and technical water for cooling purposes in the vessel as the engines.

The major problem types we have identified on a vessel, are:
- Corrosion, inside the tubings and of course at the ship hull which is in contact with the seawater
- Scaling and Fouling, mainly where Seawater is used
- Marine Growth, such as Sea Shell or Barnacles, both in the pipes but even more at the hull and other parts direct in contact with the seawater.

MERUS is treating the following applications:
- Fresh Water Generator, to produce drinking water out of sea water
- Drinking water system, where the drinking water is supplied in the vessel for drinking and the showers
- Engine Cooling, either direct or through heat exchangers
- Main Sea Water Inlet, direct when the sea water enters the vessel
- Cooling Water System, for HVAC or engine cooling
- Boiler Treatment, both for hot water and steam production
- Box Cooler, to avoid the marine growth at the outer surface in contact with the water
- Feed water separator, against scaling when using bunker water
- Vacuum sanitary system, fighting scaling which happens more due to the vacuum
- Reverse Osmosis System, to reduce scaling at the membrane and increase the lifetime of the membrane
- Fire Fighting System, to reduce corrosion, especially when seawater is used

Further MERUS is discussing some more applications, where trials might start soon, such as:
- Corrosion and marine growth treatment at the ship hull
- Ballast water treatment, to reduce the marine growth. This will be in addition to ballast water treatment systems.
- Microbiological growth in diesel fuel

MERUS is supplier to a lot of well known companies in the maritime industry such as: Boskalis, Elmira Shipping, Hapag Lloyd, Leonhard & Blumberg, Thenamaris, to tell only about a few.

Some shipowners have already specified MERUS Rings in their whitebook and MERUS Rings will be automatically installed at each new build vessel.
Freshwater Generator Kept Clean, Free of Scale and Marine Growth

Company: Hapag Lloyd, Hamburg Germany

About the customer:
Hapag Lloyd in Hamburg, Germany is one of the biggest container shipping lines in the world with more then 100 vessels operated.
Tokyo Express is a modern container vessel of almost 300 metre length and a capacity of 4890 TEU (Twenty foot equivalent unit)

Green Shipping:
Today the maritime industry is talking about green shipping. A lot of new technology is used to optimize a vessel in this direction. All these efforts are done in order to minimize the impact a vessel has on the environment. Chemicals for cleaning machines and equipment or for operating certain machines, have a negative impact on the environment. So in Hapag Lloyd as in a lot of other shipping companies it is policy today, to use as much as possible new technologies to lessen the burden on the environment.

The Problem:
On all vessels travelling the sea not only along the coastline, drinking water or fresh water has to be produced on the ship itself out of seawater. In this case an Alfa Laval fresh water generator is on board, with a production capacity is 25m3 a day. Even the generator was treated before by chemicals all the time, the production capacity declined over time. Once the production has reached the minimum required on board the fresh water generator has to be disassembled and the plates had to be cleaned manually and with chemicals. Not only the work has to be done, during this no fresh water is produced, the seals have to be replaced, all this caused costs. The picture to the left shows the condition of the plates after a few month of operation. Having such a condition the cleaning took place normally.

The Solution:
The Tokyo Express is equipped only with one generator, as most of the cargo vessels are. The Merus Ring was installed on the common feed line, to treat all the feed water to the machine, so both sides of the fresh water generator could be treated by only one Merus Ring. Both sides means, the condenser side and the evaporator side of the plates in the heat exchanger. In order to get a clear picture about the capability of the Merus Ring it was also decided by the customer, not to clean the heat exchanger plates, but to assemble the generator with the plates seen on the two pictures on the top. At the same time the dosing of the water treatment chemicals has been stopped as well, so only Merus is treating the system. It was planned from the beginning to open the generator in 8 month again, when the vessel will be anyhow in the dry dock.
The Monitoring:

The data from the daily produced fresh water and also the pressure drops over the heat exchanger are automatically logged by the system. So it was very easy to check if there is a decline in the production. It was observed the production capacity have been stable and is still until today.

As seeing is believing, in the dry dock, the customer opened the freshwaterregenerator even if there is no actual problem. Just to see and document the actual state inside and to check if all the plates are clean, as the production values have indicated. As can be clearly seen on the two pictures at the bottom, the scale has been removed, there is next to no trace of scale or corrosion left. Neither on the plates itself nor on the housing of the plate heat exchanger. It was observed, the light red colouring on the plates can be easily removed by using a tissue.

The Fleet manager from Hapag Lloyd wrote in his Email: "After 8 month of the last cleaning the condition of the evaporator is very good. All plates are clean no residues on surface of evaporator or condenser."

How long it really took for the Merus Ring to get rid of the scale inside the heat exchanger plates, we can’t tell, because the opening happened only after 8 month. So it could be easily possible the plates have been cleaned in only a few days after the installation.

The customer is now not only saving the time and effort for the cleaning, but as well there is no need of using chemicals to treat the seawater. This is not only saving money, but this is as well a clear step in the direction of green shipping.

The data we have gathered as well as the original letter from the fleet manager are available upon request.

Marine diesel engines

Marine diesel engines are often very large assemblies which generate a great deal of heat during operation. Frequently, these engines are cooled directly with seawater. Seawater contains sodium and calcium carbonate. These sodium and calcium carbonates are deposited, together with other seawater constituents, in the cooling circuit of the engines. This impairs cooling of the engines and consequently, the engines can no longer be operated at full output so as to avoid overheating. For this reason, the engines must be cleaned chemically at regular intervals in order to ensure optimum cooling again.

New build vessels it is tried to avoid using seawater direct for the cooling of the engines. So the problem of scaling is shifted to the heat exchanger, where seawater is used to cool down the cooling water in the second loop, which will then cool the engine. As this solution is the more expensive there are still vessels build, where the seawater is used direct in the cooling loop.

Merus has proven at several diesel engines big and small, either on ships or on offshore platforms, where seawater is used direct for the cooling of the machines, the problem of scaling and corrosion can be reliable solved. See as well the case study offshore platform.

In addition to the control of the scaling, barnacles or other sealife which is passing the filters are treated also. It can be seen in several applications, there are far less or no barnacle able to settle in the system and start growing. This has been done and proofed in
either onshore applications, where seawater is used for cooling purposes in plants, or offshore on cooling facilities on offshore platforms or even on ships.

The picture before shows the disassembled sea water filter ahead of the diesel engine. It can be easily seen, there is no scale at all left on the filter. The corrosion, which is normally a big problem has entirely stopped and no marine growth found.

The picture to the left shows the engine of a small ferry which sails the channel from France to UK. The vessel is rather old, and the cooling is done direct with seawater.

Seashells and mussels

When sea water is used to produce drinking water or as cooling media in heat exchangers or machines, there is always along with the well known problems of corrosion and scaling, the problem of marine growth. Technically speaking marine growth is the general term for all kind of mussels, sea shells, barnacles. All these marine growth have the common characteristic, they settle on all surface, stick to them and grow bigger and bigger. This is a very common problem for instance on ship hulls, but as well inside systems. About ship hulls we will not talk at this place, but we will concentrate on piping system and heat exchangers.

When water is taken from the sea into a ship or a cooling unit, it is not easy to avoid sea life or marine growth that is taken in together with the water. In order to avoid major problems the common countermeasure is to install filter systems, in order to keep the sea life out. As a filter is reducing the flow as well, there has to be found a balance in between what is held back, and that there still is sufficient flow of water.

Normally this is managed quiet well, so there are next to no seashells or mussels entering a water system. But the problem is the larvae of these. These larvae are so small, they can easy pass the filter, once inside the water system they might start to grow, mainly at places with less flow or other favorable conditions to grow. As the flow rates in such pipes are rather high, the mussels once they reach a certain size are taken by the water down stream and are very often accumulated at the inlet of a plate heat exchanger. See as well the two pictures. In the picture above it could be seen a lot of mussels have settled at the inlet of the heat exchanger plates and are blocking the flow of water significant, and reducing the heat capacity of the heat exchanger.
The picture to the right shows a dismantled heat exchanger plate, and where water is supposed to flow it is full of mussels or seashells. Merus has proven in several cases on ships and onshore, where seawater is used for cooling, such as internal Heat exchangers or so called box coolers installed in the seawater itself, that Merus Rings are able to lessen significant or even stop entirely this kind of marine growth. Merus Ring is installed as close as possible to the filtering unit, in order to solve the problem from the beginning. On a ship this is typically direct behind the sea chest. Onshore Merus Ring will be installed when the pipe reaches the land, as it is not possible to install Merus Ring sub sea. Depending how much consumers are connected it might be necessary to install more Merus Rings direct ahead of the machine where the problem occurs. In the case shown at the pictures this would be direct at the inlet to the plate heat exchanger.

Two effects of the Merus Ring are taken place. The effect against scaling or fouling helps to establish clean surface inside the pipe. A clean surface gives less spots for the larvae where they might settle, and the larvae are just taken downstream and are passing the heat exchanger, and not cause a problem. The second effect, Merus is establishing a film of water at the inside of the pipe wall. So the larvae will have less spots where they can settle, because the film of water prevents a hold for the larvae.

For barnacles the same effect as described above is happening. See also the related case study Barnacles on the MV”Waterway”. There will be less barnacles in the entire system Merus is also constant in search for application to proof the same effect happening not only inside a piping system but outside as well, where surfaces like a ship hull is in direct contact with sea water.

Several technical problems-- especially how to apply the oscillations of the Merus Ring outside a pipe has to be solved. There are ideas and soon we hope we will come up with a solution.

**Barnacles in the main seawater inlet of "MV Waterway" from Boskalis**

Company: *Royal Boskalis Westminster, Netherlands*

**About the customer:**
Royal Boskalis Westminster is a more then 100 year old company from the Netherlands. Boskalis is a leading global service provider for maritime infrastructure, they own more than 1100 vessels for this purpose. The MV "Waterway" is a so called *trailing suction hopper dredger*.

In general dredgers are used to remove material from the seabed and so clean channels and harbours, or for land reclamation or coastline fortification. One of the well known projects has been the artificial Palm Islands in Dubai, UAE or the extension of the harbour in Rotterdam.

Merus Rings are used on several vessels of Boskalis in different kind of applications. In all these applications Merus Rings has shown very satisfying results, so Boskalis decided to go for the main seawater line.
The Problem:
Most vessels need seawater on board. This seawater is used for cooling the engine, for jet water, to produce drinking water as well as technical water in a fresh water generator, or for the pressurized water systems (hydrofoor) to supply the drinking water taps and the showers on board. This seawater is pumped inside the vessel from the so called sea chest, below the water line. When taking in seawater all kind of marine growth is coming in along with the seawater. This marine life is kept outside by a filtering device, but the pipe which takes in the seawater gets over a period of a year totally chocked up with barnacles and seashells. Even more so as the "MV Waterway", at the moment dredging along the African Atlantic coast and thus sailing under hardest conditions when it comes to marine growth. So it is normal procedure on most vessels to clean this pipe at least once a year. In a vessel like a dredger, this problem might be even bigger, as dredgers are operating near the shore line or inside a harbour, where the water is warmer and the conditions to grow for marine life are better then when sailing the open sea. As this pipe is directly connected to the open sea, the cleaning can also be done only from outside. This means the vessel has to be either in a drydock or divers have to be used when cleaning this pipe section.

To keep this pipe as clean as possible is a very important task, as the water passing this pipe is one of the lifelines of the vessel. Without enough water a lot of processes on board will be badly affected.

The Solution:
A vessel like the "MV Waterway" needs a lot of water, so the pipe is a 24" line. In order that Merus is able to have effect on most of the pipe, the installation should be done as far as possible upstream, or in other words as near as possible to the entrance of the water into the vessel. As there is limited space, the installation of the Merus Ring, especially one of this size, has been a special technical challenge, but was finally successfully managed.

The Monitoring:
As told above the pipe is directly connected to the sea, and so the inspection of this pipe can be done also only from outside. When the schedule of operation has allowed app. 12 month after the installation the pipe has been checked as well, and the picture to the right has been taken. The fleet manager of Royal Boskalis Westminster wrote:"Normally after 12 month of operation Jacques Cousteau would be jealous about the amount of sea-life found in this place", BUT the pipe was almost clean. As well it has been observed by the cleaning crew, not only that there where next to no barnacles left in the pipe, but also the few remaining barnacles could be very easily removed. On an untreated pipe line this is not the case and it takes usually a lot of effort to remove barnacles from the pipe wall.

Next thing Boskalis will do is to check how lasting the Merus ring will keep the pipe clean. But one thing is for sure, the risk of getting a problem with a blocked pipe has minimized a lot. Also the rather expensive cleaning has not to be undertaken as often as before.
**Calorifier - Hot-water boilers**

Drinking water is heated and stored in hot-water boilers which are generally connected to the central heating system. Or in a calorifier where an electrical coil is used to produce the heat. These boilers tend to scale up very greatly if the water is hard, primarily if the temperature is high accordingly. Frequently, such boilers also start to rust after a few years and this is why stainless steel boilers are used to a greater extent today. Merus clears the scale in the boilers if used properly and this scale is then flushed out with the water. Existing rust deposits are partially dissolved and converted. At boilers heated electrically might occur the problem of less efficiency, if the coil gives a strong electrical field. These electrical heating systems may emit fields, which impair the action of Merus so only slight scale removal occurs. Generally, only the build-up of scale again is greatly reduced in such cases.

**MARINE GROWTH BOX COOLER**

On a seagoing vessel there is in general a lot of cooling required. This is done traditionally, by using seawater, bringing into the vessel through the sea chest, and then use this seawater for cooling and as well to produce drinking water in a so called Fresh Water Generator. Bringing in huge amounts of seawater inside a vessel causes the well known problems inside the vessel. As seawater leads to corrosion in pipes and equipment, fouling in the heat exchangers, also more and more problems with maritime growth such as barnacles, mussels, etc. occur.

The maritime industry is constantly looking for new solutions to reduce the problems inside the vessel. So the so called box coolers are one approach to solve these problems.

What is a box cooler. In principle this is a pipe bundle, as known from tubular heat exchangers, which is put direct in the seawater, whereas the seawater can be used direct for the cooling of the different processes on a vessel. Inside the tubes there is cooling water circulated, used for the cooling of the engine. Outside there is seawater. This pipe bundles are installed in special compartments, where the ship is open to the sea so all time seawater is around the tubes of the box cooler. Picture left shows a fresh cleaned tube bundle using hydro jetting. As can be seen when using hydro jetting, not all the scale could be removed.
As seawater is known causing problems, such as scaling, corrosion and fouling, there are taken precautions, to avoid the corrosion for instance material is choosen which is inert against corrosion. Two problems remain, there is scaling and a very big problem is the marine growth.

Classical methods as using chemicals to avoid scale or even sea growth are not possible to use in this case, as the chemicals would be needed to put direct in the seawater, what will never work due to the amount of seawater and as well due to the regulations of IMO and other authorities. So what will happen over time the box cooler will be full of all kind of marine growth as can be seen on the picture. You can hardly see the pipes due to the massive growth happening there. The picture to the right was taken at a vessel, after one year of operation. It was found that especially inside the tube bundle all is full with this stuff. It is very obvious, having a bundle like this, where hardly any water or at least far less can pass through, the efficiency of the cooling will be very less. So the procedure today is as soon the cooling is not sufficient anymore, the box cooler has to be removed, cleaned and brought back in operation. Of course during the cleaning the vessel cant be in operation, so this cleaning is very expensive for the ship owners.

Our customers facing such problems have approached us if MERUS might be able to solve or at least lessen this problem of the fouling. The difficulty in this case, a MERUS Ring cannot be installed in this compartment or the sea chest either. So what we are doing now is to install MERUS Rings on the inside of the vessel on the line where water is circulating. The idea is, when inside the tube bundle all the water is treated by MERUS, there should be also some effect on the outside of the pipes. This we already know from other cases. So we have established several long term trails on various vessels, to find out, how much MERUS can improve the situation. Will the fouling be less, so the cleaning cycles of the box cooler can be extended, or will the MERUS Rings even be able to keep the box cooler clean or nearly clean.

The development of the fouling in the box cooler will be regularly checked by divers from outside the vessel. Also the performance of the cooling will be closely monitored and compared to historical data.

Fire fighting sprinkler systems

Fire department regulations prescribe the use of sprinkler systems in large rooms or for installations at risk. Such sprinkler systems are intended to extinguish a fire as early as its incipient stage. The system is generally a separate pipe system installed on the ceiling of the rooms. Ceiling sprinklers which emit water in the event of a fire are located at certain intervals.

There are various systems. The most widespread system is the wet-pipe sprinkler system made out of carbon steel, which is constantly filled with water and which is at very high pressure.

Hopefully, there will always be water in these pipe systems, apart from when testing and when carrying out servicing work. This standing water frequently leads to major corrosion in the pipe system. In the case of major corrosion, there is a risk of a great deal of rust being detached if the sprinkler system trips, thus clogging the sprinkler nozzles.

Merus is used by many customers successfully in such applications. One phenomenon which is particularly important in this case is that Merus works even when no water is flowing. The corrosion generally disappears after only a few weeks and the pipes are provided with a protective coating. And it is very simple done, after the installation there is water flushed out, and checked the colour. Once the water is clean, the frequency of flushing can be reduced.
On ships there is a lot of drinking water needed. Of course it is used for the crew as water and for taking showers. Water in a good quality is as well needed for technical applications, for instance to produce steam. Depending on the route of the ship it will be sometimes for weeks away from a port, and therefore from fresh water supply. So it is pretty normal to produce the drinking water on board. Seawater cannot be used for drinking, so the seawater has to be treated in order to get rid of the salt and other impurities. One of the most common ways of doing so is to use evaporators. As the name is telling, such machine evaporate seawater. When this water becomes steam the salt and other particles stay in the seawater, so the condensate formed out of the steam has a good drinking water quality. There are several techniques how to evaporate the water, but all have in common the solved salt from the seawater causes technical problems, and is responsible for heavy scaling. The inner surfaces of a evaporator which are used the transfer the heat in the water, start to scale a lot until if there is no adequate action taken lead to blocked systems.

The most common way to solve this problem is to have two evaporators on board, where one is producing water and the other is either cleaned or in standby. Depending on the part of the world the ship is cruising, the need for cleaning the evaporator arises every 2 to 3 weeks. The cleaning is done either with chemicals and/or manually, which is a very tough task to do. Installing Merus ahead of the evaporator is lessening or even stopping the scaling. The salt and calcium is kept solved in the so called brine, which is dumped back into the sea.

Increasing the capacity of a evaporator by cleaning the system with Merus
Company: THENAMARIS INC., Shipping Company, Greece

Description of the problem and its negative consequences
In next to every sea going ship there is at least one seawater boiler (evaporator) installed to produce drinking water. In an evaporator the seawater partially evaporates (at low pressure due to low temperature) and the residual brine is conveyed back into the sea. The produced water vapors are condensed at a cold surface and feed the ship’s fresh water tanks. Inside the heat exchanger of the evaporator a stony layer consisting of salt, lime and other solids contained in the seawater is gradually formed. This layer absorbs an essential part of the thermal energy, which is normally intended for the evaporation of the seawater. As a result, the evaporator’s performance is day by day reduced and the fresh water production becomes
insufficient for the ship's needs. When this point is reached, expensive fresh water has to be purchased at the harbors. The traditional solutions are the chemical and the mechanical cleaning. Both processes are hard, tough, unhealthy and expensive. Also they have the additional disadvantage that they presuppose that the evaporator has to be stopped for many hours once per one to two months, which is not always feasible.

Our solution
We adapted two Merus® rings on the pipe which supplies with seawater one boiler, which had been recently cleaned. At the same time we installed two more Merus® rings on the feed pipe of another evaporator, which had not been cleaned lately and its daily fresh water production had already dropped noticeably. We used two Merus® rings instead of one for safety reasons only, in orders to make sure that the trial would be successful, because the flow rate was several m³/h, which might exceed the capacity of one single ring.
However, it is very probable that one ring for each boiler would have been efficient, too.

In which way our customer checked the results of the trial
The first boiler did not need any cleaning again, because its performance was not reduced. On the contrary, about one month after the installation of the rings the tanker's engineer informed the company's technical department that the daily fresh water production of the evaporator, instead of dropping gradually, as it always happened until then, had increased from 28 to 31 tons. This obviously leads to the following two conclusions: First, the chemical and the mechanical cleaning can never remove the whole mass of the accumulated scale and, second, the Merus® rings not only prevent the formation of new scale, but they also manage to dissolve the residual one, which cannot be properly cleaned with the traditional cleaning methods. Neither the second evaporator had to be cleaned again. Its performance increased at a quick rate and within a short time reached its highest limit, according to the evaporator's features. This means that the boiler had shaken off the scale, without the planned chemical cleaning, which is very often responsible for the corrosion and the leaks which happen to equipment cleaned in this way.

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