Box cooler maintenance: From a 21-day schedule to an 8-day turnaround

Cooling various strong engines and motors of a vessel with only limited space in the hull available requires compact heat exchangers. The box cooler with its compact design installed in the sea chest on the side of a ship's hull is a space-saving and efficient solution.

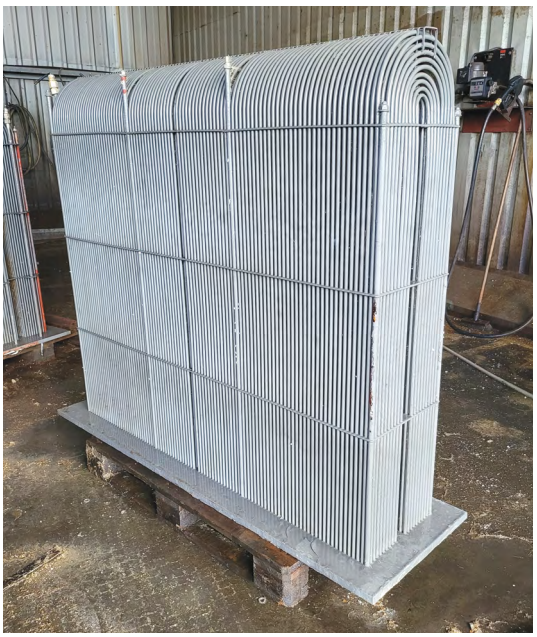
By Christoph Fischer-Zernin - Commercial Director, SÄKAPHEN

Due to the use of sea water as coolant and since the box cooler requires lesser energy to operate, the box cooler can be considered an eco-friendly choice, helping to reduce a ship's carbon foot print. Their rugged design enhances the resistance to the harsh operational conditions in the marine environment and in combination with the good maintainability it makes the box cooler a sustainable solution throughout the life cycle of vessel. The expected life cycle of a box cooler is usually 15 years, even though Nederlandse Radiateuren Fabriek (NRF), inventor of the box cooler, has found units from the 1960s that are still in operation.

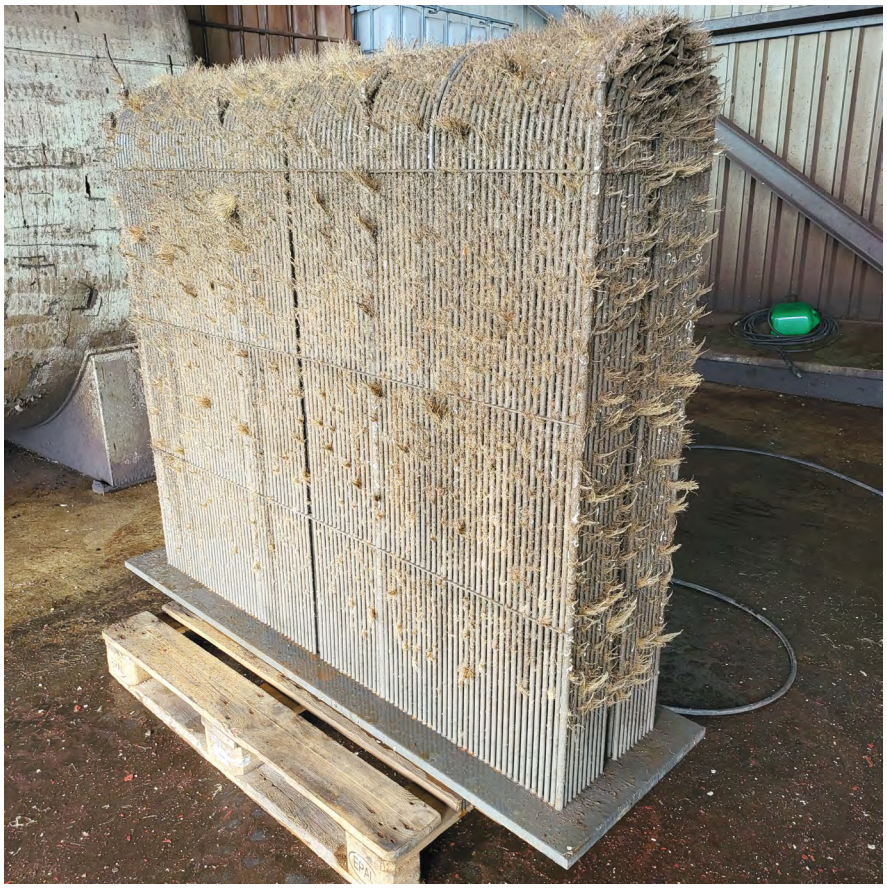
Coating under harsh conditions

Since box coolers are made of a copper nickel alloy and are installed in carbon steel sea chests, there is a huge potential of galvanic corrosion due to the dissimilar metallurgy. Thus, it is very important to apply a protective coating not only in the sea chest but also on the surface of the box cooler to avoid such galvanic corrosion. The importance of a very good insulation between box cooler and ship hull was stressed in 2016 by DNV GL, an internationally renowned classification society.

Hence a coating solution for box cooler not only has to be resistant to the harsh operational conditions in the marine environment, which is not only sea water or brackish water, but also has to withstand the mechanical stress caused by the flow of water through the cooler tubes with the velocity of the sailing vessel as well as the vibrations and air bubbles potentially causing cavitation. Moreover, the coating has to withstand the permanent electrical stress caused by the ICAF system, a system impressing an electrical current into a copper anode to reduce fouling and marine growth on the coolers.



A box cooler coated with Säkatonit Extra AR-F after 5 years in service. The cooler has only been pressure washed to remove marine growth. The smooth surface of the coating eases the removal of barnacles and other organic growth.



A box cooler coated with Säkatonit Extra AR-F after 5 years in service, prior to pressure washing. The vessel operated in cooler water which can be derived from the amount of marine growth.

Case study: Scandinavia

Having applied baked phenolic coating on box coolers since the early 1970s, Säkaphen was contacted by a Scandinavian vessel operator back in 2016 to provide a re-coating solution that is available in all geographical key regions of operation of their fleet of offshore supply vessels. The vessel operator not only wanted to reduce docking times but also wanted to avoid sending coolers, partly by air freight, back to Europe for maintenance – a costly but still understandable undertaking considering the immense docking costs that can accumulate to up to 50.000€ per day for an extension due to delays.

A box cooler coated with baked phenolics after being in service for 5 years. The marine growth has been removed by cleaning and pressure washing. The condition of the coating requires a full re-coating.

The initial idea of both parties involved was to establish a network of Authorized Applicators for Säkaphen's baked phenolics in all relevant locations, such as Rio de Janeiro, Singapore, Eastern Europe, Scandinavia, Middle East and so forth. But this was quickly discarded, considering the high investment costs per location, foremost due to need an oven in order to polymerize this type of coating, but also due to the relatively large number of potential docking sites.

Based on the unavailability of polymerization ovens, it became clear that a coating solution would have to be cold-cured, while offering a pot life long enough to allow the coating to be applied in a certain way that the cooler surface is completely coated but at the same time curing fast enough to have a feasible processing time.

Furthermore, all of this had to work under various environmental conditions ranging from colder temperatures in Scandinavia (10°C) to elevated temperatures in South America or the Middle East (38°C) and potentially at elevated humidity up to 80%. Last but not least, the application procedure had to be simplified to allow cleaning and re-coating of the box coolers around the world in or near the respective dry dock location chosen by the vessel operator for the 5-year class renewal.

Cold-curing solution

One such coating solution that fulfils all these requirements is the new and innovative epoxy hybrid coating system Säkatonit Extra AR-F from Säkaphen. With a volume of solid over 80% and applied at DFTs around 150 microns, the coating provides very good protection while at the same time maintaining the heat transfer rate.

The re-coating process for box coolers on-site starts with setting up a mobile production line beginning with a cleaning station to remove marine growth followed by an abrasive blasting station and completed by the coating station.

Once the production line is in place, the local shipyard starts dismantling the coolers and after a course cleaning with pressurized water, the coolers are handed over to an authorized party, e.g. Multi Solutions from Norway, a company with profound knowledge in safe, efficient and environmentally friendly cleaning of equipment and surfaces on all types of vessels at yard stays. After cleaning, the box coolers are blasted to SA 3, which means all old and deteriorated coating has been removed. Next the coolers are carefully inspected. Damaged tubes can either be plugged or even be exchanged. Once those steps are completed, the coolers are ready to be coated. After the coating is fully polymerized, the coolers are handed over to the shipyard, ready to be re-installed into the hull of the vessel. Finally, any damages that may have occurred during installation are touched up. Multi Solution is not only an authorized partner of Säkaphen for re-coating but also of NRF for maintenance and onsite repair of their box coolers.

Inspection and review

Having started with the application of this technology in February 2018 and since then having coated several 10.000m² of box cooler tubes around the world, everybody was keen to see the real-life performance of this solution. Since the class renewal of a vessel is usually due every 5 years, the first vessel being operated with box coolers re-coated with Säkatonit Extra AR-F was due for drydocking for class renewal at the end of 2022.

Säkaphen recently had the opportunity to inspect and review the set of 31 box coolers in Denmark that had been re-coated onsite within a shipyard in Stavanger, Norway over 4 years ago – at the time, this was only the second project carried out using Säkaphen's ultra-high solids two-pack coating system, Säkatonit Extra AR-F. The box coolers were part of an ROV construction support vessel carrying out subsea operations.

The original scope in February 2018 included the dismantling and cleaning of the box coolers to remove barnacles and other marine growth prior to grit blasting to remove the old coating and carrying out a complete re-coating of the box coolers with Säkatonit Extra AR-F. During the dry docking, all 31 box coolers were removed from the hull to be cleaned, inspected, have their gaskets renewed and pressure tested prior to being placed back in the vessel.

Säkatonit Extra AR-F is an ultra-high solid coating material with over 80% volume of solids (VS) and contains no biocidal filler ensuring a move towards a greener, environmentally friendly, and sustainable world. The coating withstands the harsh marine environment in warm and cold waters. The use of box coolers as well as cleaning and re-coating with Säkatonit Extra AR-F allows vessel operators to prolong the life cycle of their box cooler and at the same time improve sustainability. It supports them in their efforts to reach UN sustainability development goals and ESG standards.

A set of Box Cooler manufactured by Nederlandse Radiateuren Fabriek (NRF) installed in the aft portside sea chest of a vessel.

After an initial inspection, the vessel owner decided to only carry out pressure washing of the box coolers and the results were very good. The marine growth was not only less than expected due to the hydrophobic surface, but any barnacles etc. present were easily removed. Further inspection showed minimal mechanical damage which was largely caused by routine handling of the box coolers during service. Furthermore, neither the Marine Growth Prevention System (MGPS), an Impressed Current Anti Fouling (ICAF) System, nor erosion had any negative effect on the coating. The mechanically damaged areas were duly repaired and the box coolers returned to service, reducing an initially planned 21-day schedule to an impressive 8 days. Another vessel with Säkatonit-coated box coolers was drydocked in January 2023 in Brazil. The coolers were re-coated in the United States in early 2018 and the vessel later operated in the warmer waters of coastal Brazil. Same as in November 2022 in Denmark, the box coolers inspected in Brazil showed an equally good result after 5 years of service. ■

About the author

Christoph Fischer-Zernin is Commercial Director of SÄKAPHEN, a 3rd generation family business renowned for its internal linings, especially for internal and external coating of heat exchangers. Christoph's professional experience reaches from international sales and technical consultancy to lining inspection and application supervision of own products. He has experience in lining related technical consultancy as well as material composition, application technologies and procedures. He is also acquainted with laboratory related testing procedures. As trained NACE CIP Level 2, he is experienced in failure analysis concerning internal linings.