TREMENDOUS SAVINGS ON BOARD

SPEED CONTROL OF SEAWATER COOLING PUMPS BRINGS TREMENDOUS POTENTIAL FOR SAVINGS TO HAPAG-LLOYD AG

CM-1000 saves energy and maintenance costs already on board 23 Hapag-Lloyd container ships.

As shipping rates drop and competitive pressures increase, shipowners are under tremendous pressure to reduce the operating costs of their vessels. Fuel is still the number-one factor for savings, even with today's lower fuel prices.. And because seawater cooling pumps are larger than required for slow steaming, shipowners will require even more fuel than they need with conventional pump control systems (only valves).

Problem: Hapag-Lloyd must reduce fuel consumption to compete with an oversupply of freight space and reductions in shipping rates.

As early as 2003, Hapag-Lloyd began internal developments to control pump speed. But at that time, frequency converters were expensive and unreliable. Given these conditions and the high utilization of shipping capacity at the time, the shipping company only pursued the project once shipping rates plunged in the wake of the global economic crisis of 2008. The availability of air-cooled frequency converters with a service life of 15 years or longer and lower steaming speeds, which made existing cooling pumps larger than actually needed, were additional incentives.

COLFAX® Fluid Handling

All of the CM-1000's electronics are contained in three switch cabinets. The electronic controller has the GL approval.

Solution: Hapag-Lloyd deploys the CM-1000 intelligent pump controller to reduce energy consumption on board, one of the few cost factors that the shipowner can influence.

To reduce fuel consumption, in 2014, Hapag-Lloyd began to gradually retrofit 23 container ships (13,200 and 8,600 TEUs) with the Smart Technology CM-1000 Series intelligent pump controller from Colfax Fluid Handling, a business operated by the American company Colfax Corporation (NYSE: CFX). Collaborating with Colfax Fluid Handling's experts from Allweiler led to the successive use of the CM-1000 in all of Hapag-Lloyd's container ships. The final CM-1000 will be installed in 2016, making Hapag-Lloyd the smart technology leader in the marine field.

In addition to the technical challenges, the shipping company required rapid service around the world, including spare parts deliveries and marine-capable components. For example, plug connections on cables must be much more vibration-resistant than those used on land and shielded against alternating electromagnetic fields. In Hapag-Lloyd's experience, they were not always able to count on marine-capable components , even with suppliers that deliver other marine products.

Significant savings

The CM-1000 uses frequency converters to intelligently control the capacity of seawater cooling pumps based on the temperature of the fresh water and the momentary need for cooling. The system improves the efficiency of on-board seawater cooling pumps and reduces operating and service costs, resulting in highly-efficient, environmentally-friendly, and sustainable operation of the cooling system. According to Lars Voss, Senior Superintendent at Hapag-Lloyd AG: "With the CM-1000, we save up to 850 MWh per year per ship. This fits in with our Ship Energy Management Plan, which allows us to operate our vessels in an environmentally-friendly manner."

Hapag-Lloyd's container ships move goods between the Far East, Europe, and America. As the ships pass through different climates, the seawater that is used for cooling purposes varies in temperature by more than 30° Kelvin. In addition, slow steaming reduces the need for cooling. With these conditions, the CM-1000 varies the speed of the seawater pumps in the cooling system so that only the exact amount of cooling

The only additional requirements on board are to install the sensors and establish the cable connections. The central switch cabinet contains the frequency converter.

The centralized screen displays all operating data from each of the two connected pumps separately. The CM-1000 provides information about unusual operating conditions both here and in the control room. According to Mr. Voss, "The crew has detailed information about the system at all times."

seawater is provided. If the ship is stopped or is steaming only very slowly, the CM-1000's new All-Off function switches the pumps completely off. Particularly during winter demurrage periods in European ports, there is no need to pump seawater for cooling purposes.

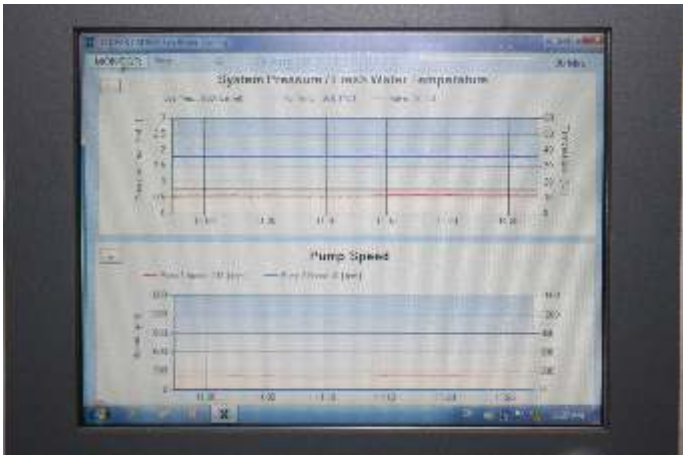
Result: Energy consumption of Hapag-Lloyd's seawater cooling pumps dropped by up to 85%, by up to 96% during port operations, and up to 100% when the All-Off function is used.

The Variable Speed Drive (VSD) of the CM-1000 controller can reduce energy consumption during sea operations by up to 58 percent. If the additional Active Valve Control (AVC) function is used in the cooling water system, reductions of up to 85 percent are possible. In the experience of Hapag-Lloyd, energy savings of up to 96 percent are achievable during port operations. When the All-Off function is used, savings of up to 100 are possible. If the cooling water system requires a minimum pressure, AVC will deliver that pressure even when speeds are low. But in Hapag-Lloyd's experience, this is only rarely necessary. AVC controls the valves in the seawater outlet line and automatically adjusts the system's characteristic curve so that the pumps are always running at the ideal operating point, preventing cavitation.

VSD drops energy consumption from 2 x 142 kW to 2 x 40 kW. AVC reduces it from 2 x 142 kW to 1 x 35 kW; during periods of low loads the reduction can be as low as 1 x 5 kW. For Hapag-Lloyd this translates into potential savings of approximately 16 metric tons of fuel oil per ship per month.

The capacity of the four seawater cooling pumps is between 50 and 1750 m³ per hour. With the CM-1000, approximately 75% of the two pumps' output is sufficient, even at maximum cooling requirements. The third and fourth pumps are no longer needed.

This screen shows the previous and total savings of electrical energy for both seawater cooling pumps among other information. In this image, the Kyoto Express is being loaded, so only one pump is in operation at low speed (215 rpm). After 60,098 operating hours, the saving is 455,385 kWh.



This chart indicates that the controller has reached the desired cooling water temperatures with precision and uniform pump capacity as well as balanced control behavior.

Unusual operating conditions are monitored and displayed separately for each pump. Disturbance and alarm messages can be forwarded to any personal computer.

An analog sensor transmits the pressure reading to the valve controller (AVC).

The PT 100 temperature sensor in the LT cooling water system transmits the CM-1000's target value with a two-channel output. The set point on the Kyoto Express is 24 °C.

Automatic Valve Controller (AVC) actuator for the seawater outlet flaps of the LT cooler.

Wiring box (left) for the sensors of the CM-1000 system. Control box (right) for the controller drive of the three-way valve in the original controller of the LT cooling water system. On the Kyoto Express, its set point is always 4 °C below the set point of the CM-1000. This ensures that the "old" and "new" controllers do not mutually influence each other.

Pays for itself in just a few months

The 8600 TEU Kyoto Express demonstrates how quickly the CM-1000 can pay for itself, just from lower fuel consumption alone. Since going into operation at the beginning of August 2016, the intelligent controller has realized savings of more than 455,000 kWh for the two seawater pumps. Monetary savings were approximately €35,000 at current fuel prices. In less than nine months, the CM-1000 is saving the shipowner money with every hour of operation.

There are other benefits as well. With lower speeds, wear to the casing, impeller, bearing, and mechanical seals is significantly reduced. As a result, the need for overhauls approximately every 20 years will be reduced many times over, according to the Chief of the Kyoto Express. Improvement of mechanical seal life is evident after just two years. Prior to installation of the CM-1000, the seals required replacement every year on average. Since the CM-1000 went into operation, not a single seal has required replacement. Such performance allows the shipowner to reduce its stock of spare parts on board the vessel, ultimately increasing availability and improving safety on board. Less maintenance also means less downtime. With the CM-1000, two of the four pumps are sufficient to meet all requirements, from maximum cooling to stoppage. The third and fourth pumps, previously held in reserve and used during demurrage, are no longer needed, remaining operational as redundant systems instead.

Retrofitting without the shipyard

The CM-1000 controller can be installed when the ship is built or at any time thereafter. From Hapag-Lloyd's perspective, the Cabinet version of CM-1000 has been a particularly valuable solution for ships that never or only rarely stop at European ports. Colfax Fluid Handling provides all of the

The output of the Kyoto Express's main engine has been reduced from 68,690 kW to 34,500 kW. As a result, the required cooling output dropped and the potential for savings through frequency regulation increased.

electronics as a turnkey installation in switch cabinets, including the frequency converter and all cable connections. According to Mr. Voss, a climate- controlled space on board the ship is the ideal solution. In his experience, a uniformly low ambient temperature is the most important condition for ensuring a long service life of the frequency converters. The Cabinet version can be brought into operation while the ship is in motion and installation is usually concluded in four days.

The Kyoto Express went into service in 2005 and can hold 8,749 TEU.

Expectations met

Mr. Voss concluded, "All of the CM-1000 systems have been operating without any disturbances whatsoever since mid-2015. Our expectations have benn fulfilled. We now examine all new ships in advance to determine whether they are suitable for the CM-1000."