Smart pumping rewards investment

Shipowners are starting to reap the benefits of pumping control, with savings and increased efficiencies materialising due to their investment in these technologies

The seawater cooling system on a ship is controlled by centrifugal pumps that send ambient seawater in a circulating loop into a heat exchanger with the vessel's freshwater cooling system. The freshwater cooling system cools the engines, generators, other cooling loops and auxiliary equipment that consume significant amounts of energy. Seawater that has taken on heat from fresh water is then pumped back into the ocean as cooler ambient seawater is drawn in. This continuous operation is vital to the ship's operation.

Where this process offers scope for savings is in the use of energy-optimisation systems. Such systems adjust the speed at which pumps operate, in line with conditions. They are starting to see considerable levels of adoption throughout industry.

One of the most significant large-scale adoptions of such technology in recent years was by Hapag-Lloyd, which in 2014 decided to use an electronic pump control from Colfax Fluid Handling. Hapag-Lloyd elected to equip ships of the 13,200 TEU *Hamburg Express* class and other vessels with the CM-1000 intelligent pump control system.

The CM-1000 system controls the flow rates of seawater cooling pumps based on the temperature of the fresh water and the current need for coolant. As a result, the amount of seawater pumped into the seawater cooler matches requirements, saving electrical power on board the ship.

Colfax Fluid Handling's CM-1000 series allows seawater cooling system pumps to operate at variable speed for energy savings, while its active valve control (AVC) feature limits the risk of pump cavitation and delivers additional savings by adjusting the duty point for optimal operation. Equally, its condition monitoring and operation monitoring features provide maintenance savings by preventing catastrophic breakdowns and increasing mean time between failures.

Ships of the *Hamburg Express* class provide regular freight service between the Far East and Europe. As they pass through the various climate zones, the temperature of the seawater (used for cooling) fluctuates by 20°C and more. Slow steaming reduces the need for cooling. The CM-1000 system can control seawater pumps in the cooling system by varying their speed, so the volume of pumped seawater precisely matches requirements of the moment. If the ship is stopped or is steaming only very

RIGHT: The intelligent controller has realised savings of more than 455,000 kWh for the two seawater pumps on *Kyoto Express*

slowly, the CM-1000's new All-Off function switches the pumps off completely. During winter demurrage periods in European ports, there is no need to pump seawater for cooling purposes.

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 was installed in late 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, some suppliers that deliver marine products cannot always be counted on to supply marine-capable components.

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 onboard seawater cooling pumps and reduces operating and service costs, resulting in highly efficient and sustainable operation of the cooling system.

Hapag-Lloyd AG senior superintendent Lars Voss explained "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."

The variable speed drive of the CM-1000 controller can reduce energy consumption during sea operations by up to 58%. If the AVC function is used in the cooling water system, reductions of up to 85% are possible. In the experience of Hapag-Lloyd, energy savings of up to 96% 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.

The variable speed drive 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 to as low as 1 x 5 kW. For Hapag-Lloyd this translates into potential savings of approximately 16 tonnes of fuel oil per ship, per month.

The results on the 8,600 TEU *Kyoto Express* suggest the system's payback will be fairly rapid from lower fuel consumption alone. Since going into operation at the beginning of August 2016 and up to May this year, the intelligent

controller has realised savings of more than 455,000 kWh for the two seawater pumps. Monetary savings were approximately €35,000 (US$41,000) at current fuel prices. In less than nine months, the CM-1000 is saving the shipowner money with every hour of operation.

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 engineer of the *Kyoto Express*.

Improvement of mechanical seal life is evident after just two years of operation. 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.

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 electronics as a turnkey installation in switch cabinets, including the frequency converter and all cable connections. Mr Voss stated that 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.

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

The CM-1000 is not the only such system on the market, though. Another maritime pumping solutions manufacturer, Desmi, offers an energy-optimisation approach that is reducing costs for shipowners struggling to comply with new regulations.

Desmi has a long track record in the development and manufacture of pump solutions for the marine industry, oil spills, and the

defence and energy industries. It has focused on reducing the amount of energy consumed by onboard equipment in and around enginerooms, and has found plenty of ways to cut consumption with a wide range of solutions from seawater pumps to ventilation systems. Its solutions generally have short payback times, but the ongoing annual savings often offer the most compelling argument for shipowners. The company is happy to provide customer data to prove its claims.

Auxiliary systems in enginerooms and their pump components are designed to cope with the worst possible foreseeable conditions, but in reality such systems can be made to run at operating levels that correspond to the vessel's actual load at any given time. Desmi marine and offshore director Michael Lassen said that this is a good strategy for shipowners keen to comply with the new regulations.

He explained: "A lot of onboard machinery constantly operates as though the vessel is under 100% load and having to cope with air temperatures of up to 50°C and seawater temperatures of up to 32°C. But those conditions reflect, perhaps, only 1% of a ship's operating lifetime. The rest of the time, you might say, it is like running the heating in your house at full blast with the windows wide open. Making control systems that closely match energy consumption to actual requirements is something we have been focusing on for a number of years."

As a starting point, Desmi's own seawater pumps are designed to extract maximum efficiency from today's pumping technologies. But the company has extended its energy efficiency range to optimisation solutions such as Desmi OptiSave. This, it asserts, can save up to 80% of power consumption for a vessel's seawater pumping tasks.

"We have delivered many of these solutions," said Mr Lassen. "All of them have been shown to provide savings of 60-80% for ships travelling, for example, between ports in Europe and Asia."

Seawater pumping systems are not the only pumps in a vessel's engineroom. Other systems cool down steam that has not been used in steam turbines, for example, condensing vapour into liquid again before feeding it back into the boiler. When there is little steam to be returned to the condenser, less seawater is required, enabling the speed of the pump to be reduced to the minimum that is necessary.

Another area for potential savings arises when a vessel is sailing at lower speeds. Normally, three or four fans push compressed air into the engineroom to boost the combustion effect. These systems usually run at full speed, regardless of load, even when less air is required. OptiSave controls these components, too, reducing their speed to correspond to actual requirements.

One beneficiary of this system has been Grindrod Shipping, owner and manager of IVS and Unicorn Tankers. It has installed OptiSave on board nine vessels: seven bulk carriers and two tankers.

The co-operation with IVS goes back to 2009, and the first OptiSave system was installed on board one of the bulk carriers soon after.

"We have a great co-operation with Desmi and their automation team. We always look at how much fuel can be saved and where we can improve the efficiency – and more ideas for improvements are coming up all the time," said Grindrod Shipping technical project manager Per Fabricius.

OptiSave has saved Grindrod a total of 125 tonnes of fuel a month on average, and Mr Fabricius keeps track of the fuel index from year to year so that he always knows how well each tanker and bulk carrier performs.

"All vessels sail worldwide and report the numbers on CO_2 , NOxand SOx monthly to the main offices in Singapore and South Africa. With the OptiSave system this is an easy task to complete," he explained.

At the moment Mr Fabricius and Desmi are developing a training simulator that will make it easy to train crew to handle the system and improve efficiency. *MP*

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BELOW: Desmi OptiSave, it is claimed, can save up to 80% of power consumption for a vessel's seawater pumping tasks