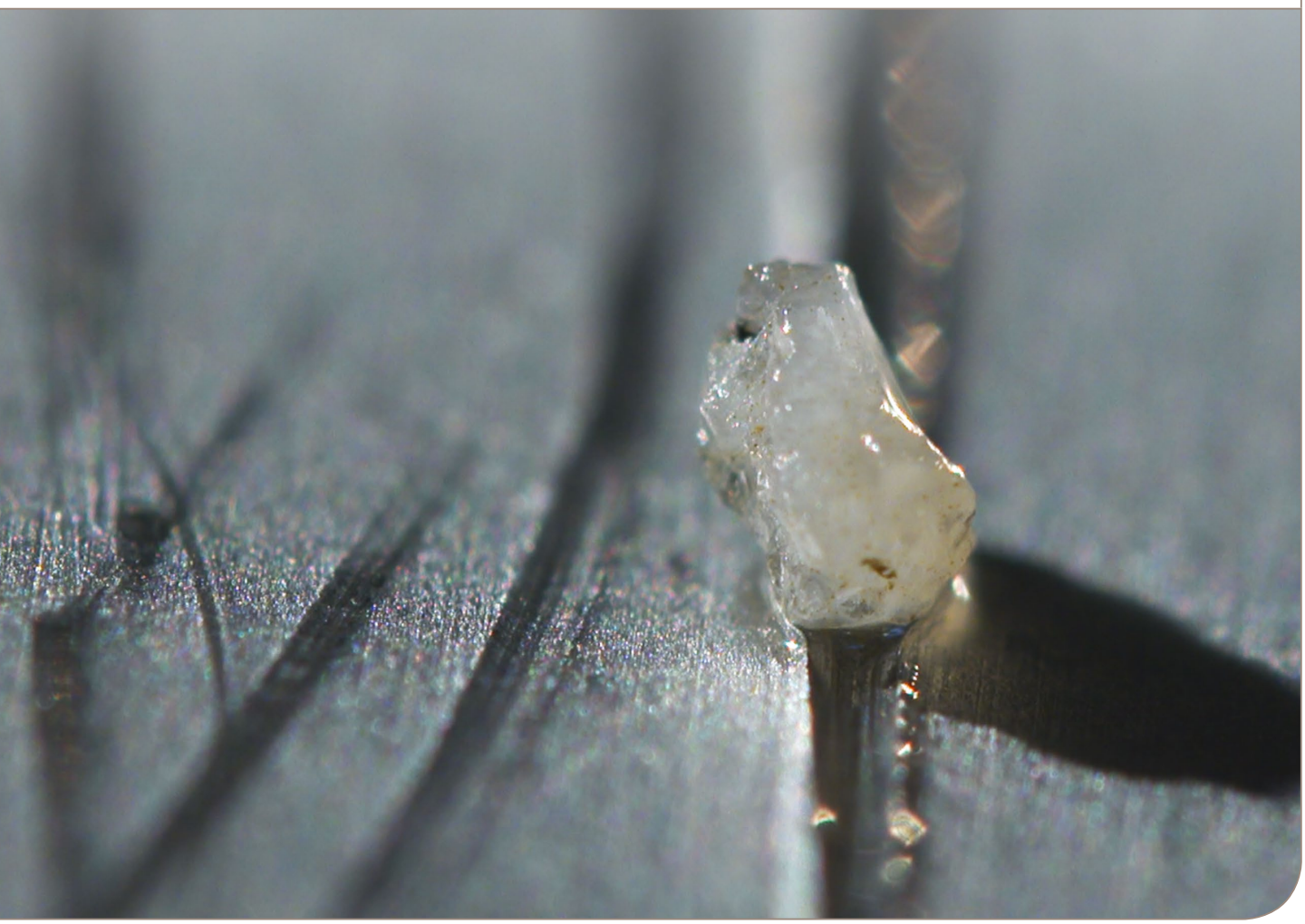
White paper



Flow optimization of the separator feed: Improved separation and energy savings beyond the pump

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In marine fuel treatment, flow optimization is the automatic adjustment of a vessel's separator feed to match the engine's actual fuel needs. During slow steaming, it allows more retention time in the separator, which greatly improves separation efficiency. Moreover, it reduces energy consumption by a margin not widely recognized. While much has been said about the pumping energy saved, an even greater amount of energy is saved within the separator itself.

Introduction

Despite the high efficiency of modern separation equipment, cat fine attacks cost ship owners and operators many thousands of dollars annually in repairs and lost business.

While centrifugal separators continue to be the best line of defence against cat fines, a number of strategies have been introduced to make them even more effective. One of the most prominent is flow optimization, which involves adjusting the separator feed rate in accordance with engine load. This has clear advantages for separation efficiency, but it also creates substantial energy savings, the extent of which is not widely recognized.

Matching fuel supply to fuel demand

The opportunity for flow optimization stems directly from today's practice of slow steaming. Fuel system guidelines recommend a fuel flow rate corresponding to 110 % of the engine's fuel consumption, with the additional 10 % being recirculated. Most vessels have fixed-speed feed pumps installed, which means the flow rate is based on the consumption of the engines at maximum load.

Since most vessels employ slow steaming, they experience a large overflow of separated fuel. When the engine is at partial load, the unconsumed fuel is returned to the settling tank, after which it has to be pumped and separated again. Unfortunately, this dilution of the settling tank has no measurable effect on the cleanliness of the fuel that eventually enters the engine.

The solution is to replace fixed-speed feed pumps with variable-speed feed pumps, using automatic control to match the flow to the engine load. The day tank is monitored to keep the tank level from falling below a predefined limit, which ensures that it does not run empty.

Improved removal of cat fines

Flow optimization through automatic feed control has a distinctly positive impact on separation efficiency. As the flow rate decreases, the fuel is allowed to spend more time within the separator bowl, which increases the separator's ability to remove smaller and lighter particles.

While a properly operated separator can remove nearly 100 % of all cat fines larger than 10 µm at full flow, cat fines smaller than 3 µm are substantially more difficult to remove because of their small size and relatively light weight. If captured between the piston ring and cylinder liner, however, even such small particles can cause significant wear and damage.

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Energy saved in pumping

Naturally, flow optimization has an impact on energy consumption as well. Because the feed rate to the separator is synched with the engine's fuel consumption, there is no massive overflow from the day tank back to the settling tank, even at minimal loads. As a result, the fuel is pumped only once through the separator, thereby reducing the pump energy consumed.

This has a greater impact than what might be expected. The energy used to pump fuel from the settling tank through the heater and into the separator is typically 30 % of the total flow-related energy consumption. The pumping energy relates to the flow by an order of the power of 3.

Greater energy savings in the separator

Even more surprising than the pump-related energy savings are the energy savings related to the separator, which are often overlooked. While 30 % of the energy saved is related to the pumps, 70 % is related to the separators.

Within the separator, energy is used to accelerate the fuel, drive it through the disc stack and finally pump it out again. The outlet pump, which is a stationary double disc (paring disc), acts as a brake against the rotating liquid, converting the liquid's rotational energy into pressure.

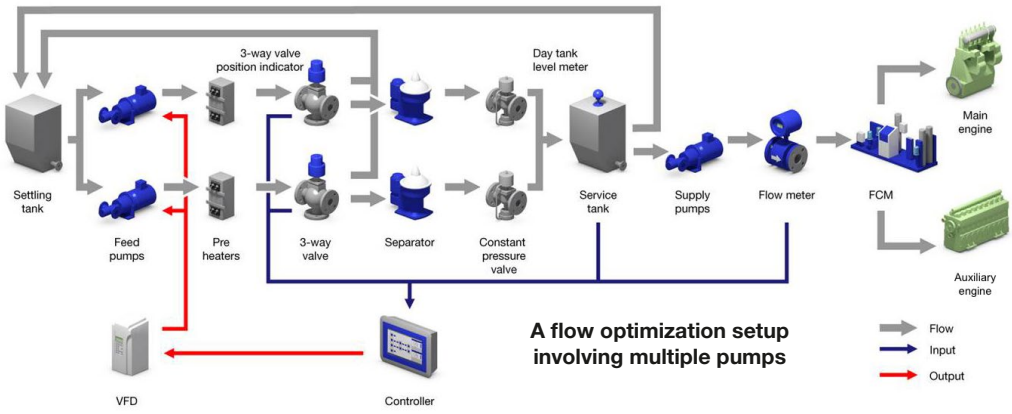
On average, a separator consumes as much as 1 kWh per cubic metre of separated fuel. So for ships that employ slow steaming, the savings potential through flow optimization is great indeed.

Flow optimization – a triple win

With all factors considered, flow optimization of the separator feed creates a triple win in terms of efficiency. Separation efficiency is increased by the longer retention time in the separator bowl, while energy efficiency is increased in both the pumping system and the separator itself.

Flow control will not save energy unless it is used, however. Because manually operated flow control tends not to be used, the control has to be automated.

The benefits are available with even the simplest flow optimization system, involving automatic control of a single separator with a variable-speed pump. Yet still greater benefits are to be had with a fully integrated system, in which multiple pumps and separators are linked to the same control automation. Integrated in this way, the system allows the total flow to be optimized.



A flow optimization setup involving multiple pumps

References

1. *CIMAC, "Paper No.: 51, Onboard Fuel Oil Cleaning, the ever neglected process How to restrain increasing Cat-fine damages in two-stroke Marine Engines", 2013.*
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