

Reduced cylinder lubricating oil

Cutting cylinder lubricating oil feed rates now offers major savings in operating costs with Sulzer RTA engines. The savings can be equivalent to around 3-5% of fuel costs, depending on circumstances. The reductions in feed rates are being achieved without deterioration in wear rates, and thus without increasing spare parts costs. The low cylinder oil feed rates are largely independent of fuel sulphur content (all values above 1.5% sulphur).

The previous guide feed rate for cylinder lubrication of Sulzer RTA low-speed engines was given as 'less than 1.4 g/kWh'. Now, Sulzer RTA engines built to the latest design standard can be operated with a cylinder oil feed rate of 1.1 g/kWh.

The feed rate can be reduced further to 0.9 g/kWh after analysis of engine performance by a Wärtsilä service engineer who would then guide the step-by-step reduction in feed rate to this lower level. Typical feed rates for Sulzer RTA engines in the region of 1.6 g/kWh are being reported from shipboard experience. Thus savings of 0.5 to 0.7 g/kWh could readily be achieved.

Such savings can have a direct, major impact on engine operating costs, especially for the larger bore engines. In the case of a 29,400 kW Sulzer 7RTA84T-D engine, which is typical for a VLCC, a reduction in cylinder oil feed rate from a typical feed rate of 1.6 g/kWh down to the new guide rate of 1.1 g/kWh can result in an annual cost saving of US\$ 100,000 with cylinder oil costing 1300 US\$/tonne. Reducing the feed rate from 1.6 to 0.9 g/kWh further increases the annual cost saving to US\$ 140,000.

In broad terms, cost savings can be equivalent to around 3-5% of fuel costs, depending on engine type, power, speed, the cylinder oil feed rate reduction actually made, and the relative prices of fuel and cylinder lubricating oil.

Better piston-running

The lower cylinder oil feed rates are made possible by the excellent piston-running behaviour routinely obtained by Sulzer RTA engines built to today's standard design.

The key has proved to be the TriboPack design package introduced as standard in these engines in 1999. Most of the design elements in TriboPack had been employed

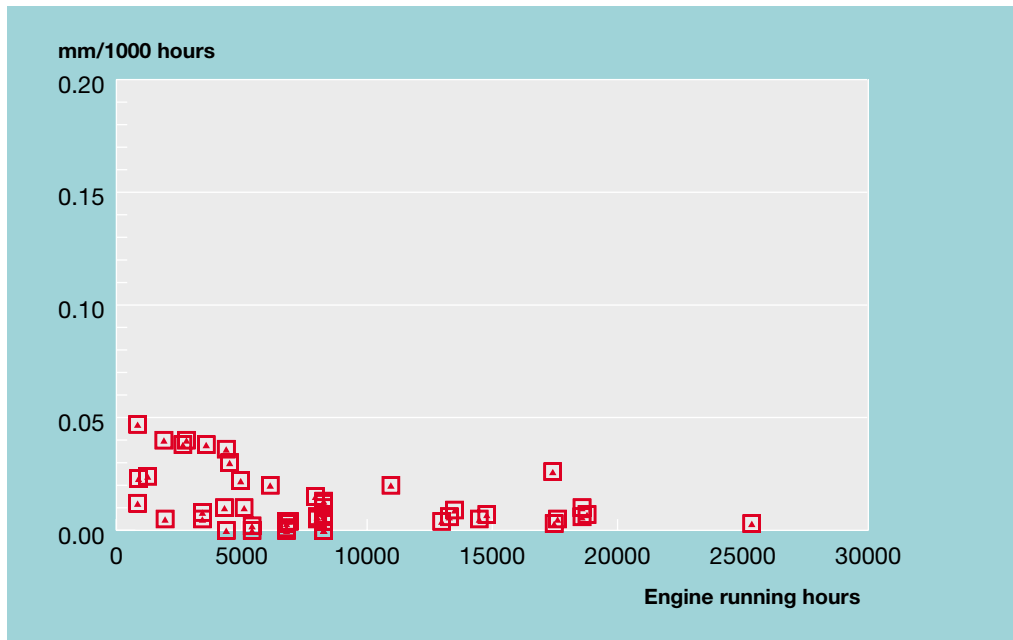


Fig. 1 Liner wear measured in Sulzer RTA engines incorporating TriboPack technology versus engine running hours. Maximum diametrical liner wear mm/1000 hours at top dead centre position of the top piston ring.

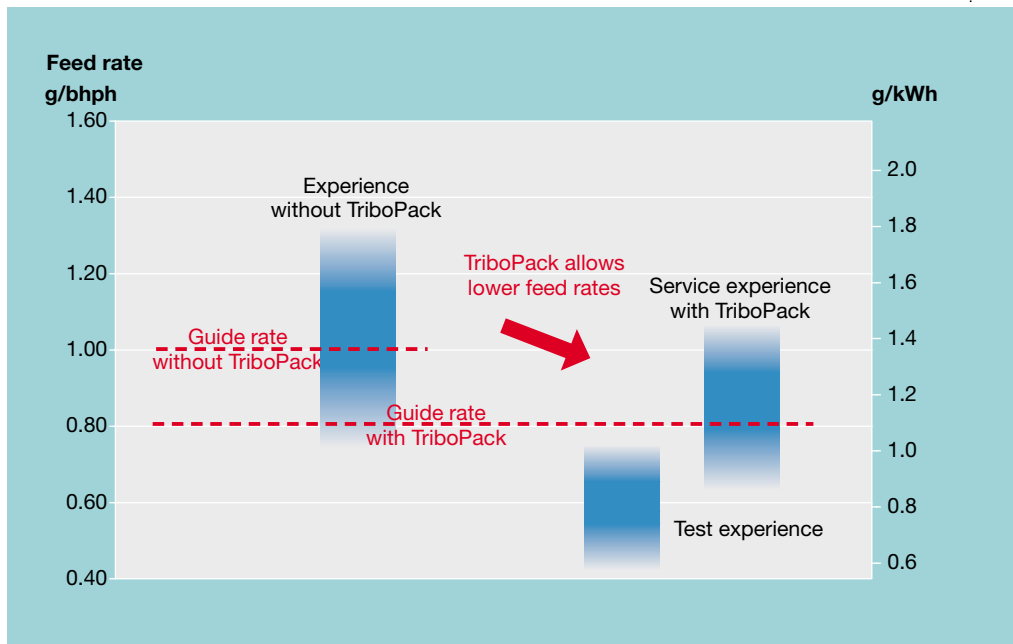


Fig. 2 The shaded areas indicate the range of typical feed rates for cylinder lubricating oil. With engines built to the TriboPack technology, guide feed rates are reduced from 1.4 g/kWh to 0.9-1.1 g/kWh. The new guide rates are supported by research experience at lower rates, and are valid for engine loads of 50-100% and all fuel sulphur contents above 1.5%.

previously, but it was only when they were combined in a rational package that they met the necessary requirements:

- Physically good liner surface with stable geometry for good running behaviour

- Long times between overhauls, as largely determined by the chromium-ceramic top ring and chromium plating of piston ring grooves

feed rates

by Matthias Amoser, Tribology and Material Technology
Leo Schnellmann, Technical Service
and Thomas Werner, Technology, Wärtsilä Switzerland Ltd

Specific cylinder oil feed rate, %

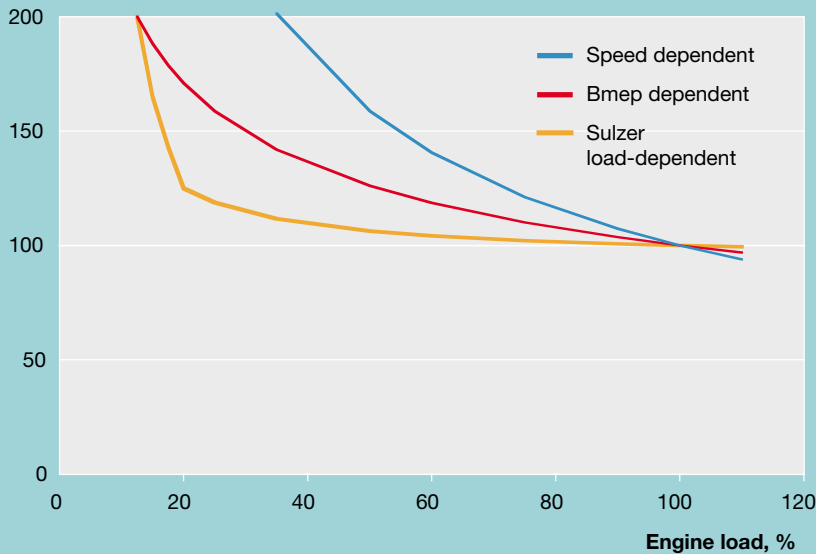


Fig. 3 The Sulzer accumulator system uses load-dependent control for a fairly constant specific feed rate of cylinder lubricating oil. Other forms of control give higher specific feed rates.

good piston-running behaviour with low, stable wear rates. Maximum liner wear rates of less than 0.04 mm/1000 hours are routinely being reported while using cylinder lubricating oil feed rates in the range of 1.0 to 1.4 g/kWh.

An important aspect is the stability of the running behaviour and wear rates, which is leading to a growing confidence among ship operators. With such excellent results, it is a natural decision to reduce cylinder lubricating oil feed rates.

Furthermore, experience has shown that reducing the cylinder oil feed rates to the new guide levels can be achieved without shortening the lives of cylinder liners or piston rings. Thus the cost savings from reduced oil feed rates are not offset by any penalty in increased expenditure on spare parts.

The lowering of the guide feed rates is further supported by the excellent results from research testing. Engine tests have been made at cylinder oil feed rates down to 0.8 g/kWh without any problems.

Insensitivity to fuel sulphur

Another important benefit of the excellent piston-running characteristics of Sulzer RTA engines built to the latest design standard is that the engines are fairly insensitive to fuel sulphur content.

The reason is that, as part of the TriboPack design measures, liner surface temperatures are kept mainly above the dew point. This is to prevent corrosion caused by acid attack on the liner running surface by the products of combustion. The alkaline content of the cylinder lubricating oil, as expressed by the Base Number (BN), is nevertheless still necessary to provide an extra factor of safety.

The new guide feed rates are, in fact, applicable for all fuel sulphur contents above 1.5%, and there is no need to increase feed rates according to fuel sulphur content. This makes the guide feed rates for Sulzer RTA engines highly competitive when compared with those of other low-speed engine designs relying on 'controlled corrosion', which requires a careful balance between the Base Number of the cylinder lubricant and the fuel sulphur content.

Proven cylinder lubrication system

It is important to note that the above-mentioned low cylinder liner wear

Specific wear, mm/1000 hours

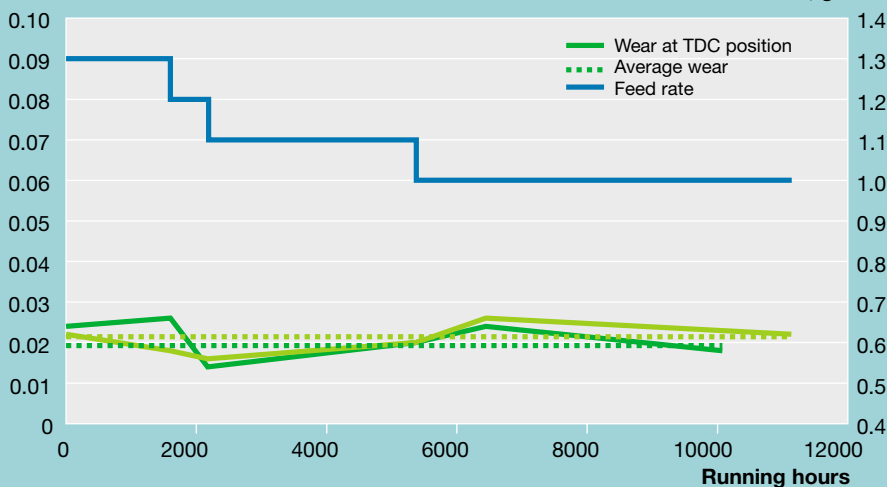


Fig. 4 Liner wear remained fairly constant as the cylinder lubricating oil feed rate was lowered step by step from 1.3 to 1.0 g/kWh in two cylinders of a Sulzer 10RTA96C engine. The diametrical liner wear was measured at the TDC position of the top piston ring.

- Efficient provision and distribution of cylinder lubricating oil
- Protection by the anti-polishing ring against any build-up of carbon deposits

- Optimized liner temperatures to make the engines insensitive to fuel sulphur levels.
- The new design standard has proved highly successful. It is resulting in consistently

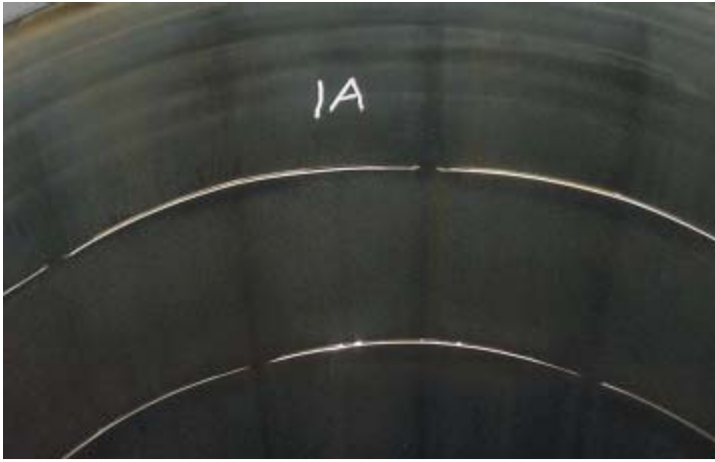


Fig. 5 Liner surface from one of the RTA96C cylinders measured in Figure 4. This is typical for a liner with a cylinder oil feed rate of 1.0 g/kWh.



Fig. 6 Typical piston ring condition for a cylinder oil feed rate of 1.0 g/kWh. These are the rings corresponding to Figure 5.

rates are achieved using the well-established Sulzer accumulator cylinder lubricating system.

In the Sulzer accumulator system, cylinder lubrication oil is fed from an electrically-driven lubricator unit for each cylinder to two rows of lubricating quills in the cylinder liner, to give multi-level lubrication. The timing of the oil feed to the liner surface is self-regulating, according to the pressure difference between the oil feed and the cylinder gas pressure. Distribution of the oil on the liner surface is provided by grooves in the liner surface and by the piston rings. The system is reliable, requiring minimal maintenance.

This is a well-proven system which has been used as standard on Sulzer low-speed engines since the late 1970s. It was introduced in 1975 as the CLU-1 system with hydro-mechanical drive, and has been developed over the years with the addition of electronic control (as the CLU-3 system in 1995) and to suit multi-level lubrication.

The key feature of the Sulzer accumulator system from the very beginning is that it has load-dependent control, which adapts the cylinder oil feed rate according to engine load. This means it does not need manual adjustment as engine load is varied. As load is reduced, the specific feed rate (g/kWh) remains virtually constant with reference to the actual operating load. The specific feed rate at 20% load is only 25% more than at full load.

This small increase in specific feed rate with reducing load achieved by the Sulzer accumulator system has, for many years, given Sulzer engines an advantage over the

usual engine load range when compared with other makes of engines. In fact, competitors have only recently introduced cylinder lubrication systems which match the performance of the Sulzer accumulator system.

The Sulzer CLU-3 accumulator system has been shown in engine tests to be adequate and problem-free at feed rates down to 0.8 g/kWh. As for the future, Wärtsilä is now also developing alternative cylinder lubricating systems for introduction in some years time when feed rates below the current guide rates are required by ship operators. The systems under development feature controlled timing, more precise dosage metering and improved distribution on the liner surface, all of which become more important as the quantities of lubricating oil are significantly reduced below today's guide rates. These new alternatives will, however, require extensive testing, including shipboard trials before they are released for production.

Experience at the new, low guide feed rates will be an important contribution towards development of the next step.

Lowering feed rates

The new guide feed rates can be achieved for all engines which are built to the TriboPack standard. To those shipowners and operators intending to optimize the feed rates further below the guide rate for cylinder lubricating oil, we strongly recommend the revised recommendations available through the Wärtsilä Service organization.

Before reducing the cylinder lubricating oil feed rate, engine operators should assure

themselves that the engine is running satisfactorily in all respects. The reductions in feed rate should then be made in small steps at intervals of around 1000 running hours.

Before each step, the following inspections are recommended:

- Visual inspection of liners and rings
- Sample analysis of used cylinder oil from the piston underside drain for iron content and Base Number
- Measurement of piston ring gap to indicate ring wear
- Measurement of liner wear.

This process will give engine operators confidence in reducing cylinder oil feed rates. With such care, major reductions in cylinder oil feed rates and thereby substantial reductions in operating costs can be achieved. ■

References

- Kaspar Aeberli, 'TriboPack for Sulzer engines', Marine News, Wärtsilä Corporation, 3-1999, pages 4-7.
- Matthias Amoser, 'Insights into piston-running behaviour', Marine News, Wärtsilä Corporation, 2-2001, pages 23-27.
- Matthias Amoser, Leo Schnellmann and Thomas Werner, 'Sulzer TriboPack: Service Experience Report', Wärtsilä Corporation, May 2003.
- Service Bulletin RTA-63, 'Cylinder Oil Feed Rates', Wärtsilä Corporation, 12 August 2003.