



Sustainable and cost-effective lube oil management

**A guide to heat recovery in lubrication
oil treatment systems**

June 2021



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Minimize your OPEX – and your environmental footprint

For most vessels, finding new ways to efficiently reuse onboard energy is more important than ever before. To become more cost competitive and make operation more sustainable, improved onboard energy efficiency can help reduce fuel consumption and thereby your operational costs. It also happens to be one of the smartest and most effective ways of improving your sustainability.

The engine lubrication oil treatments system offers a perfect example for untapped potential. Cleaning the oil using centrifugal separation requires pre-heating, which today is often powered by diesel-generated electricity. If you install a Alfa Laval plate heat exchanger to recover excess heat energy downstream of the separator, you can dramatically reduce fuel consumption. The result is more sustainable and cost-effective lube oil management.

Already today, using a separator to clean lubrication oil will provide you with lower lifetime OPEX than systems with costly filters that must be replaced on a regular basis. With smart heat recovery technology, such as the Alfa Laval Heatpac CBM heat exchanger, you can bring those costs down even further.

Do you want to see how you can achieve lower OPEX for your lube oil cleaning application? Keep reading to see ten key questions, with answers provided from Alfa Laval's own heat recovery experts.



How to cut lube oil preheating costs

10 questions and answers

1. What does a lube oil cleaning circuit look like today?

When cleaning engine lube oil, the oil temperature must be raised to about 80-90°C to ensure adequate separation. After separation, the clean, hot lube oil is fed back to the system tank.

The engine itself, is the main heating source for the lube oil in the sump tank but a small amount of heat is also transferred to the tank from the separator preheater. However, before the oil is used for engine lubrication, it must be cooled in a separate cooling circuit, whereupon all the heat energy is wasted by being transferred to the seawater coolant.

2. What is the purpose of a heat recovery unit?

A heat exchanger, used for heat recovery decrease energy costs for preheating the lube oil prior to separation.

It makes use of heat in the cleaned lube oil that would otherwise be wasted, thus taking load off the preheater. It also reduces the load on the engine cooling system.

3. How much can I cut energy costs with a heat recovery unit?

Energy costs for preheating lube oil can be cut by about 60-90%. Exactly how much is up to you – the more heat exchanger surface area, the higher the degree of heat recovery and the more you will gain in energy savings. Equivalent savings can also be made depending on the type of engine cooling system.

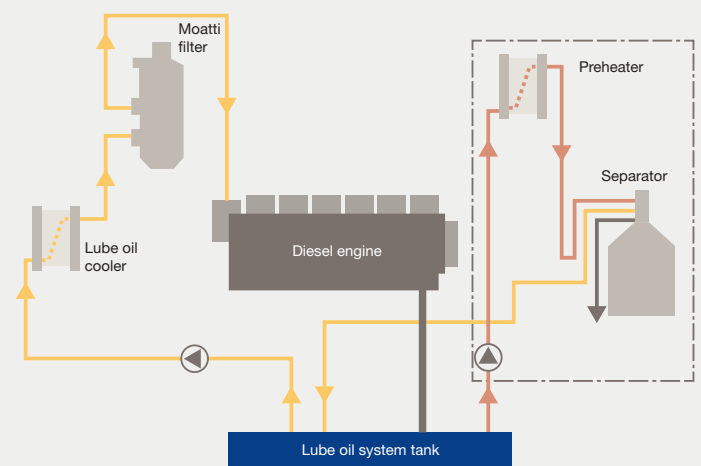


Fig 1. Conventional lube oil system

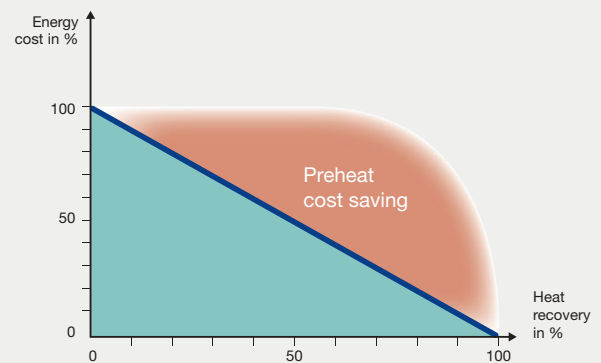


Fig 2. Energy cost when using a heat recovery unit

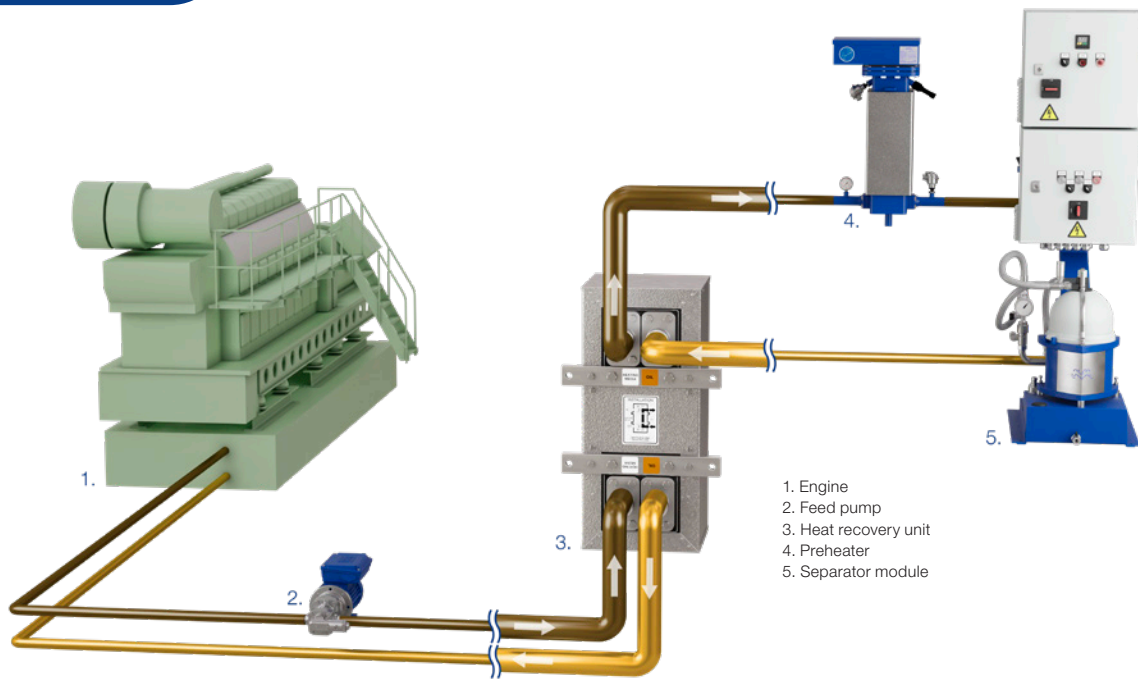


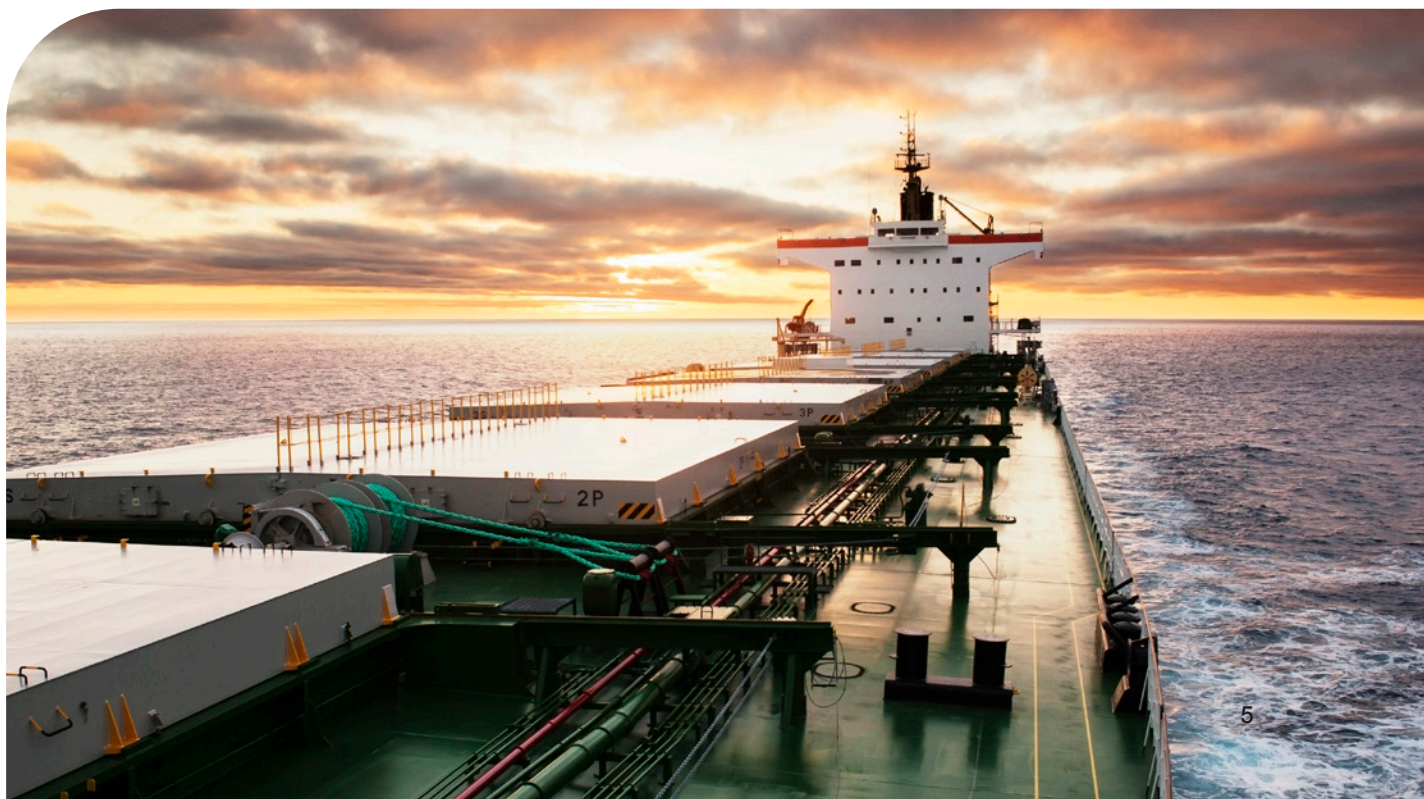
Fig 3. Design for a typical lubrication oil treatment system with an Alfa Laval Heatpac® CBM heat exchanger installed for heat recovery

4. When should I use a heat recovery unit?

The higher the cost per unit of energy generated on board, the greater the economic benefits of a heat recovery unit. This is why heat recovery units are particularly beneficial for retrofitting on older ships, where they cut the cost of expensive diesel-generated electricity.

5. What does a lube oil cleaning circuit look like when a heat recovery unit is connected?

Any Alfa Laval plate heat exchanger can be used as a heat recovery unit. Alfa Laval can help you select the most suitable option for your system. The heat recovery unit is installed prior to the preheater. It makes use of heat energy from the clean oil outlet and is thereby reducing the load on the preheater which is powered by electricity, steam or, in some cases, hot water or thermal oil.



6. How much energy can I save?

For a typical case (using lube oil SAE 30), the degree of heat recovery (η_{reg}) can be calculated in the following equation:

$$1 \quad \eta_{reg} = \frac{(t_1 - t_0)}{(t_2 - t_0)}$$

where $t_1 - t_0$ = temperature rise over the heat recovery unit and $t_2 - t_0$ = temperature rise over the heat recovery unit plus the additional preheater.

Let us assume that $\eta_{reg} = 0.65$ (65% heat recovery), based on:

- t_0 (temperature in the system tank) = 55°C
- t_1 (temperature after the heat recovery unit) = 78°C
- t_2 (temperature after the preheater) = 90°C

The total heat load for heating the oil (\emptyset), in kW, is:

$$2 \quad \emptyset = \frac{Q \times \zeta \times C_p \times (t_2 - t_0)}{860}$$

Where:

- Oil flow: $Q=1150$ l/h
- Oil density: $\zeta=0.87$ kg/dm³
- Oil specific heat: $C_p=0.48$ kCal /kg °C

Therefore:

$$\emptyset = \frac{(1150 \times 0.87 \times 0.48 \times 35)}{860}$$

$$\emptyset = 19.54 \text{ kW}$$

The energy saved (\emptyset_s) is:

$$3 \quad \emptyset_s = \emptyset \times \eta_{reg}$$

$$\text{Therefore: } \emptyset_s = 19.54 \times 0.65 = 12.7 \text{ kW}$$

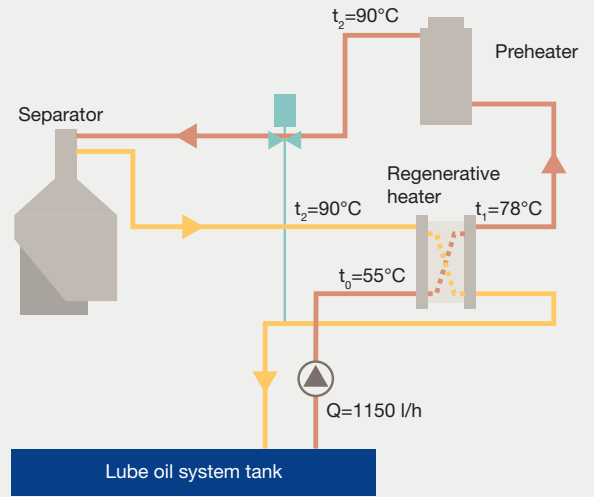


Fig 4. Typical example of temperatures and flows in a lubrication oil treatment system with a heat exchanger installed for heat recovery

7. How much money can I save?

Cost savings depends on the unit energy cost (EC) on-board which varies according to the energy source used for heating the lube oil. For example, diesel-generated electricity cost 0.18 USD/kWh.

The yearly operating time of the separator (t) is another factor that must be taken into account, as well as the amount of energy saved (\emptyset_s). The energy cost saving (S) will be:

$$4 \quad S = EC \times t \times \emptyset_s$$

When, making the following assumptions:

- a) Diesel-generated electricity cost of 0.18 USD/kWh,
- b) 8000 hours yearly operating time of the separator and
- c) 12,7 kW in annual energy saved by a heat recovery unit

The energy cost saving will be:

- $S=0.18 \times 8000 \times 12.7$
- $S = \text{USD } 18,294$ per year, i.e. 65% saving on lube oil heating costs.

8. How much does a heat recovery unit cost?

The investment depends, of course, on the physical properties of the lube oil, and its flow rate and temperatures, but mainly on the desired degree of heat recovery. The investment cost (IC) for a heat recovery unit per degree of heat recovery is illustrated in Fig. 5.

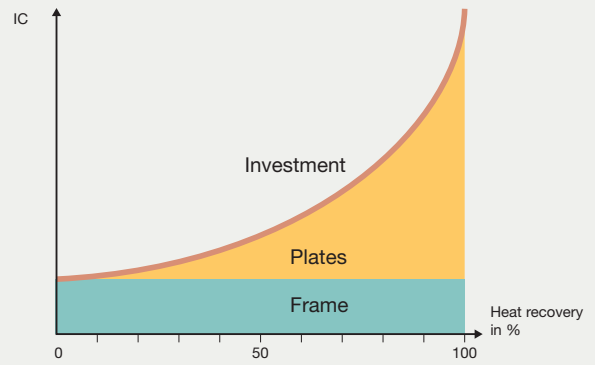


Fig.5 Investment cost of the heat recovery unit/ degree of heat recovery

9. How soon will a heat recovery unit pay off?

By means of an investment calculation, we can compare the investment cost with the energy savings. This is illustrated in Fig. 6 below.

Normally when making investment calculations, the interest rate must be taken into account. However, for short pay-off times, the interest rate can be neglected. With this simplification, the return on investment can be calculated using the following formula:

$$5 \quad \frac{(\text{Investment costs})}{(\text{Energy savings})} = \frac{IC}{S} = \text{Return on investment}$$

The return on investment for a heat recovery unit, with 70-80% regeneration and where the electricity for pre-heating is diesel generated, is less than 2 months!

Alfa Laval can help you calculate the required size of the heat recovery unit (approximately within +/- 10%), as well as its cost compared with the energy savings achieved using an investment calculation.

10. What are the benefits of Alfa Laval plate heat exchangers?

- High efficiency: It is thermally the best type of heat exchanger, especially when treating liquids
- Easy installation: It consists of small, lightweight components that can be assembled on site in the engine room
- Compact design: It fits into tight corners, even in the smallest engine rooms
- Flexibility: The degree of heat recovery can be increased by simply adding more plates to the existing frame
- Easy maintenance: It requires little attention for operation and the design makes it easy to service

If this sounds almost too good to be true, why not let Alfa Laval calculate your cost savings.

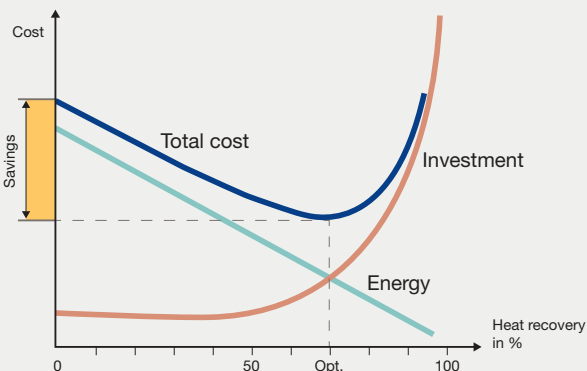


Fig 6. Total cost/degree of heat recovery

How much money can you save?

Fill in the form with your own data

$t_0 =$ _____ °C $t_1 =$ _____ °C $t_2 =$ _____ °C

1 $\eta_{reg} = \frac{(t_1 - t_0)}{(t_2 - t_0)} :$ _____ = _____

$Q =$ _____ l/h $\zeta =$ _____ kg/dm³ $C_p =$ _____ kCal/kg°C

2 $\emptyset = \frac{Q \times \zeta \times C_p \times (t_2 - t_0)}{860} :$ _____ x _____ x _____ x (-) = _____ kW

3 $\emptyset_s = \emptyset \times \eta_{reg} :$ _____ x _____ = _____ kW

EC = _____ USD/kWh t = _____ h/year

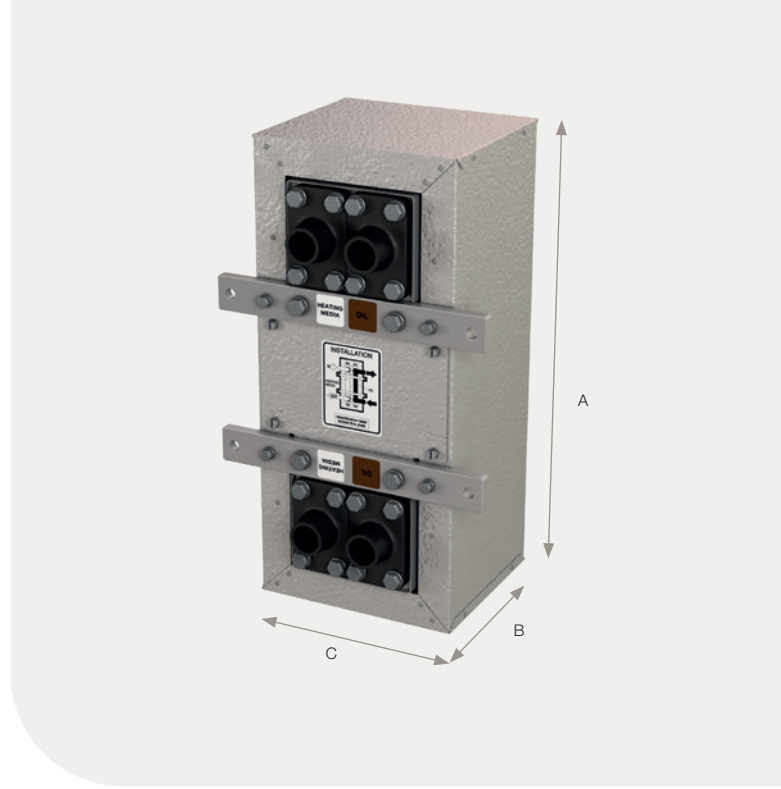
4 $S = EC \times t \times \emptyset_s :$ _____ x _____ x _____ = _____ USD/year

IC = _____ USD

5 Pay-off time = $\frac{IC}{S} :$ _____ = _____ years

Dimensions

This table illustrates the most important dimensions with respect to space considerations for the range of Alfa Laval Heatpac CBM heat exchangers recommended for heat recovery duty.



Dimensions						
Type	Dimensions (mm)			Connections		Weight (kg)
	A	B	C	(mm)	(inch)	
CBM 30-100	400	310	240	25	1	19
CBM 110-100	700	370	320	40	1½	55





This is Alfa Laval

Alfa Laval is active in the areas of Energy, Marine, and Food & Water, offering its expertise, products, and service to a wide range of industries in some 100 countries. The company is committed to optimizing processes, creating responsible growth, and driving progress – always going the extra mile to support customers in achieving their business goals and sustainability targets.

Alfa Laval's innovative technologies are dedicated to purifying, refining, and reusing materials, promoting more responsible use of natural resources. They contribute to improved energy efficiency and heat recovery, better water treatment, and reduced emissions. Thereby, Alfa Laval is not only accelerating success for its customers, but also for people and the planet. Making the world better, every day. It's all about *Advancing better*[™].

How to contact Alfa Laval

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Alfa Laval reserves the right to change specifications without prior notification.