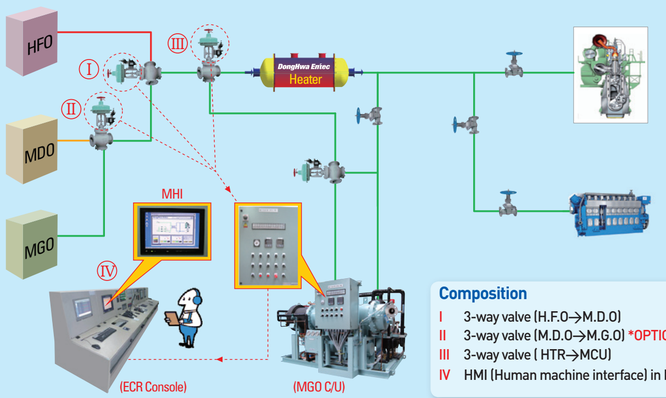
Smart Change-Over System (SCS)



Composition

I 3-way valve (H.F.O→M.D.O)
II 3-way valve (M.D.O→M.G.O) *OPTION
III 3-way valve (HTR→MCU)
IV HMI (Human machine interface) in ECR

Donghwa total solution [MGO C/U + SCS]

Including one control panel can fully control both bunker change and MGO cooling process with very high operational reliability.

Donghwa [SCS] with control panel

will be provided just to control bunker change process where only cooler, not MGO cooling unit, is applied on vessel.

SCS(Smart Change-over System) for automatic changeover between HFO and MGO/MDO.
Change-over to/from MGO can be somewhat dangerous for the fuel equipment as hot heavy fuel is mixed into relatively cold gas/diesel oil. So, it safely can control this process in connection with MGO CU provided by Donghwa. Furthermore, HMI as option can help you to control it and monitor all information under operations with much easy and safety.

The advantage of Smart Change-Over System (SCS)

Lower Cost & Central Control

Yon respectively can control MGO cooling unit & SCS and monitor actual operating condition in real-time through MHI at ECR with One control panel of Donghwa total solution for applying low-sulphur MDO/MGO on sailing in CARB and EU-ECA, compared to providing each equipment of other systems.

Simplicity Design

3-Way valve with simplicity can be designed with easy installation and maintenance, which is able to applied to sea-going vessel as well.

Precise control

During change-over, the temperature increase/decrease rate should be less than 2℃/min. to protect the fuel equipment from the thermal shock resulting in sticking.

Easy operation

You can use and adjust this system due to a simple control logic automatically, Switching to manual during error condition as well.

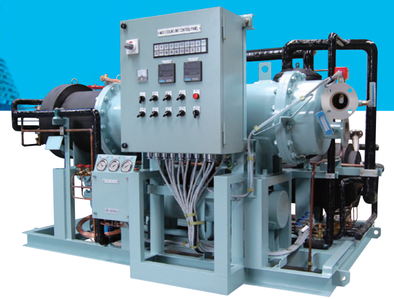
www. dh.co.kr

We wish to communicate with our customers.
If you would like any further information about DongHwa Entec,
please visit our website (www.dh.co.kr).
DongHwa Entec cares for your concerns.

▶ ▶ Engineering technology for the future

MGO Cooling Unit
& Smart Change-Over System (SCS)

Our company endeavor ceaselessly
to develop new products
and for quality improvement



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MGO Cooling Unit

MARPOL 73/78 Annex VI , Regulation 14.
Operation in Sulphur oxides (SOx) Emission Control Area, How to comply,

New and tighter fuel sulphur content regulations by the EU and the California Air Resources Board, MGO Cooling Unit for the solution is applied as follows;

Table : Fuel requirements for Ocean-Going Vessel Main Diesel Engines, Auxiliary Diesel Engines (Including Diesel-Electric), and Auxiliary Boilers.

Area	Effective Date	Fuel Oil
EU Ports	January 1, 2010	Marine Gas Oil (DMA) at or below 0.1% Sulphur
Within 24miles from California (CARB)	January 1, 2012	

From 1 January 2010, this regulation applies to any use of the fuel in auxiliary engines, main engines, boilers for ships berthing more than 2 hours at ports in EU Member States' territory.

The California Air Resources Board (CARB) requirement for large vessels to use low sulfur MGO (up to 0.1%) within 24 nautical miles of the California coast.

*** What is existing problem ?**

1. Ships are not designed for the distillate fuel required by CARB & EU.
2. Difficult to find low sulfur diesel with sufficient viscosity for an engine to operate.
3. Fuel Pumps leak, due to lower viscosity and seal deterioration.

Solution → **MGO Cooling Unit**

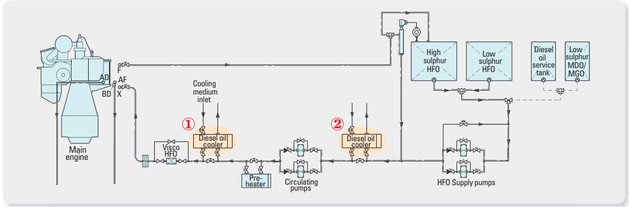
Many factors influence the viscosity tolerance during start and low-load operation:

* Engine condition and maintenance
* Fuel pump wear
* Engine adjustment
* Actual fuel temperature in the fuel system
* Human factors, etc.

Although achievable, it is difficult to optimize all of these factors at the same time.
For the lowest viscosity distillates, a cooler may not be enough to cool the fuel sufficiently as the cooling water available onboard is typically LT cooling water (36°C).
In such a case, it is recommended to install our MGO Cooling Unit.

Recommended Location of MGO Cooling Unit

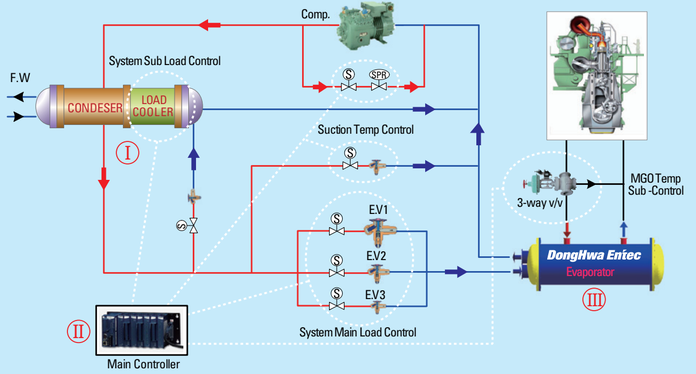
1. The advantage of installing the cooler just before the engine is that it is possible to optimize the viscosity regulation at the engine inlet. However, the viscosity may drop below 2 cst at the circulating pumps in the system.



2. The cooler can also be installed before the circulating pumps. The advantage in this case is that the viscosity regulation may be optimized for both the engine and the circulating pumps.

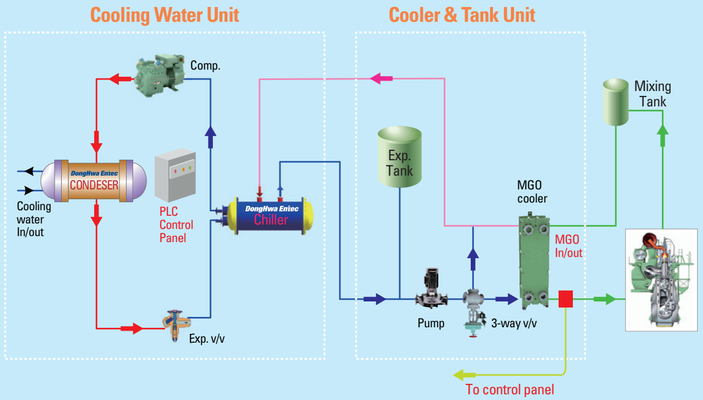
   The right location of MGO Cooling Unit will be decided by customers.

Direct Syetem



❖Remark : 3-Way valve will be applied to system as option depending on the required control accuracy of MGO outlet temperature.

In-direct Syetem



Donghwa Entec MGO Cooling Unit can clearly satisfy engine builder's requirements about Direct Cooling system.

It can satisfy small change in viscosity adopting 3-way PID control valve in MGO side combined with very logical expansion valve control system. The required viscosity in controlled according to the signal coming from inlet MGO temp. to engine on board. Also, Donghwa Entec have already cleared Engine Builder's comments below and received letter of them which mentioned below and got a perfect test results for some vessels on sea trial.

Engine Builder Comment # Ⅰ

Stability of compressor (*Patent : 20-2009-0009888)

Q) Limitation in compressor starts max 8-10/hour as the compressor is running on/off & the minimum capacity of the compressor, with capacity regulations, is 25%

A) Donghwa System was designed to assure stable and continuous operation of compressor with min.25% load without frequent stop adopting additional HEAT EXCHANGER (LOAD COOLER).

Engine Builder Comment # Ⅱ

Steady MGO temperature control

Q) During operation on MGO/MGO we are of the opinion that you should control the cooling by the fuel oil temperature to the engine – not by the viscosity. The reason is that too big temperature changes (more than 2°C/min) might cause sticking fuel pumps.

A) Our system can strictly control and satisfy inlet temperature of MGO/MDO to the engine linearly by PLC & 3-way valve control, through sophisticated control system.

Engine Builder Comment # Ⅲ

Leaking evaporator (*Patent : 20-2009-0009888)

Q) In case of leaking evaporator, the refrigerant will be forced into the fuel line and expanded which will create gas pockets with a risk of destroying the fuel pumps.

A) Donghwa System was designed absolutely to protect the mixing problem between refrigerant and MGO/MDO adopting very special heat exchanger with DUAL TUBE. So, if leakage would be happened, you easily can check it at grooves in the interfaced surface of both tubes.

Our system is also equipped with a device for leak detection and will give a signal for alarm in case of any leakage, but the supply scope and its application will be decided case by case after a discussion with customers for the environment notation under each class.

In-Direct MGO Cooling Unit consists of three units, direct system(chiller unit), water tank unit and oil cooler, can cold down MGO with by applying brine water.
Donghwa's MGO solution including more advantages of Direct system is very simple and reliable and can be installed relatively freely, supplied as package unit with more compact size according to customer's comment within limited space.

The advantage of Donghwa Entec MGO Cooling Unit

Compact Size	All models of MGO C/U were standardized as very compact size to install it within given space where only cooling water and oil connection is required.
Easy operation	You can very easily operating MGO C/U through hybrid control system by just setting the target temperature.
Easy maintenance	You can easily cleaning MGO C/U through internal Electric Heater on Evaporator when it is polluted by bunker-C due to ship's crew mistake.
Perfect performance	Performance strictly is evaluated through best facilities simulating engine condition in Donghwa R&D Center.
Sufficient delivery record	MGO C/U were delivered through strictly performance test evaluation in attendance of owner's superintendent.