Раздел 2 СУДОВЫЕ ЭНЕРГЕТИЧЕСКИЕ УСТАНОВКИ, СИСТЕМЫ И УСТРОЙСТВА

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FUEL CHANGE AUTOMATION PROCESS

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In 2015, Annex VI to the International MARPOL Convention regulated the reduction of sulfur content in fuels to 0.1% in special areas. If there is no scrubber on board, the ship must switch to light fuel when entering special navigation areas. Alfa Laval's autonomous control system is designed to facilitate and speed up the process of switching from heavy to diesel fuel on merchant ships. The effectiveness of this system is beyond doubt, since the establishment of the operating mode when switching from one type of fuel to another takes approximately 2 minutes. Thus, this system avoids the installation of an expensive scrubber and solves the human factor problem.
Keywords: automation, fuel grade, crewless vessel, ECO-areas, fuel system, Alfa Laval.

ПРОЦЕСС АВТОМАТИЗАЦИИ СМЕНЫ СОРТА ТОПЛИВА

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В 2015 году в приложении VI к Международной конвенции MARPOL было регламентировано снижение содержание серы в топливе до 0.1% в особых районах. При отсутствии на борту скруббера, судно обязано перейти на легкое топливо при вхождении в особые районы плавания. Система автономного управления Alfa Laval предназначена для облегчения и ускорения процесса перехода с тяжелого на дизельное топливо на судах торгового флота. Эффективность данной системы не вызывает сомнений, так как установление режима работы при переходе с одного сорта топлива на другой занимает приблизительно 2 минуты. Таким образом, эта система позволяет избежать установки дорогостоящего скруббера и решить проблему человеческого фактора.
Ключевые слова: автоматизация, сорт топлива, безэкипажное судно, экозоны, топливная система, Alfa Laval.

The struggle for a clean environment is a global trend that has not bypassed the sphere of ship transportation. In 2015, Annex VI to the International MARPOL Convention regulated the reduction of the sulfur content in fuels to 0.1% in special areas. This drastic reduction in fuel sulfur content has forced shipping companies to decide which way to go. And there are only two of these ways: the use of low-sulphur fuel or the installation of a scrubber on the ship and the use of fuel oil with a high sulfur content. If there is no scrubber on board, the ship must switch to light fuel when entering special navigation areas. Alfa Laval's autonomous control system is designed to facilitate and speed up the process of switching from heavy to diesel fuel on merchant ships.

Application of Alfa Laval automatic control system:

Switching from heavy fuel to light fuel is a complex process associated with changes in fuel viscosity, lubricity and combustion quality. Onboard fuel systems must therefore be adapted to provide protection for fuel oil injection components. Marine fuel systems must be equipped with fuel supply element protection systems. Coolers are required to lower the temperature of low sulfur marine fuels so that the fuel supplied to the engine is of the correct size. Alfa Laval Automatic Fuel Change System. The Automatic Fuel Change System is a fully automatic changeover system that facilitates the use of fuel while maintaining the viscosity within the limits set by the engine manufacturer. In the fuel heating stage, the automatic control system replaces the heating phase with a cooling phase to keep the separated fuel at a low temperature and ensure the correct viscosity [1, 2, 4].

Features and Benefits:

– Compliance with new fuel requirements:

The automatic control system allows mechanics to:

- Achieve a simple and fully automatic fuel change.
- Operation with three different types of fuel.

- Safety

- Automatic control system provides state-of-the-art change control temperature and viscosity of the fuel. This allows ensure safe fuel changes without thermal shock or drop in fuel viscosity.

- Integration

- Uninterrupted communication between the automatic control system and the fuel preparation system for an automatic and reliable fuel change procedure.
- Full compatibility between the automatic control system and any fuel pump from any manufacturer.

- Automation

- Automatic control system ensures fully automatic operation.
- Full control over the process is available from the remote panel.
- Control of all process parameters allows complete set up transition procedures [1, 4, 5].

Key Components:

– Cooler of the automatic control system.

The automatic control system is equipped with a heat exchanger using fresh water or sea water as the cooling medium.

– Mixing valve.

This electrically operated 3-way mixing valve controls fuel temperature by partially distributing the amount of fuel flowing through the automatic control cooler.

- Temperature sensor.

The temperature sensor provides the control unit with an automatic control system for data on the temperature of the fuel in the engine. It is installed next to the engine or on the injection module.

– Changeover valves.

The automatic control system has one three-way switching valve located before the inlet of the automatic control cooler. It is also possible to install two more three-way changeover valves: one fuel changeover valve at the fuel inlet and one changeover valve for a third fuel, if applicable [1, 4].

- Control system.

Management and control of the automatic control system is carried out from the control panel.

Principle of operation:

The operation of the automatic control system is based on the regulation of temperature relative to the set value and the control of viscosity, determined by the viscometer.

– Switching from heavy fuel to low sulfur fuel.

To initiate the transition from heavy fuel to low sulfur fuel, the system gradually changes the position of the changeover valve (V1) from heavy fuel operation to low sulfur fuel operation. The combination of valve settings and continuous heating power control ensures a safe and gradual transition without the risk of thermal shock.

After the programmable temperature setpoint is reached, the automatic control system changes the position of the changeover valve (V2) from preheater to cooler and starts to control the fuel temperature during the transition phase using the three-way mixing valve (V3). Continuous control of this 3-way mixing valve ensures the correct fuel temperature and viscosity [7, 8, 9].

– Switching from low sulfur fuel to heavy fuel.

To initiate the transition from low sulfur fuel to heavy fuel, the system gradually changes the position of the changeover valve (V1) from low sulfur fuel to high sulfur fuel. After the programmable temperature setpoint is reached, the automatic control system gradually changes the position of the changeover valve (V2) from the cooling position to the heating position. Injection is controlled by ramping the temperature until the operating viscosity of the heavy fuel is reached [1, 4, 5, 6].

– Operation with three types of fuel.

As an option, the system can operate with three different types of fuel. This allows you to save money by using the most suitable fuel at any given time [10, 11, 12].

Thanks to the graphs, we are convinced that the main advantage of this system is the time spent preparing the fuel system. By sending a signal through the automatic control system, the operation mode is established on a different type of fuel in 1 - 2 minutes.

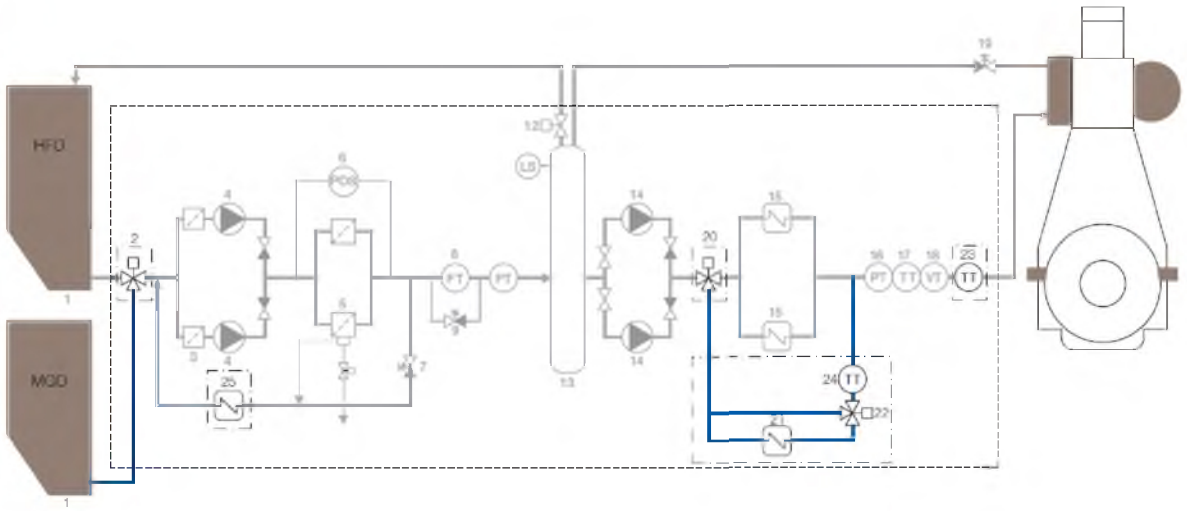

Fig 1 - Drawing of an automated fuel system

Designation of system devices

1. Expendable tanks for heavy and diesel fuel
2. Three-way diverter valve (V1)
3. Pump filters
4. Feed pump
5. Self-cleaning filter
6. Filter pressure drop switch
7. Supply pressure control valve
8. Flow sensor
9. Flow sensor bypass
10. Pressure sensor, feed pump
11. Level sensor
12. Automatic deaeration valve
13. Mixing tube
14. Circulation pump
15. Heaters
16. Pressure sensor, circulation pump
17. Temperature sensor
18. Viscometer
19. Engine pressure control valve.
20. Three-way diverter valve (V2)
21. ACS cooler
22. Three-way mixing valve (V3)
23. Temperature sensor (TT2)
24. Temperature sensor (TT3)
25. Cooler
26. Three-way changeover valve (V4)
27. Heating medium valve (V6)
28. Coolant valve (V7)

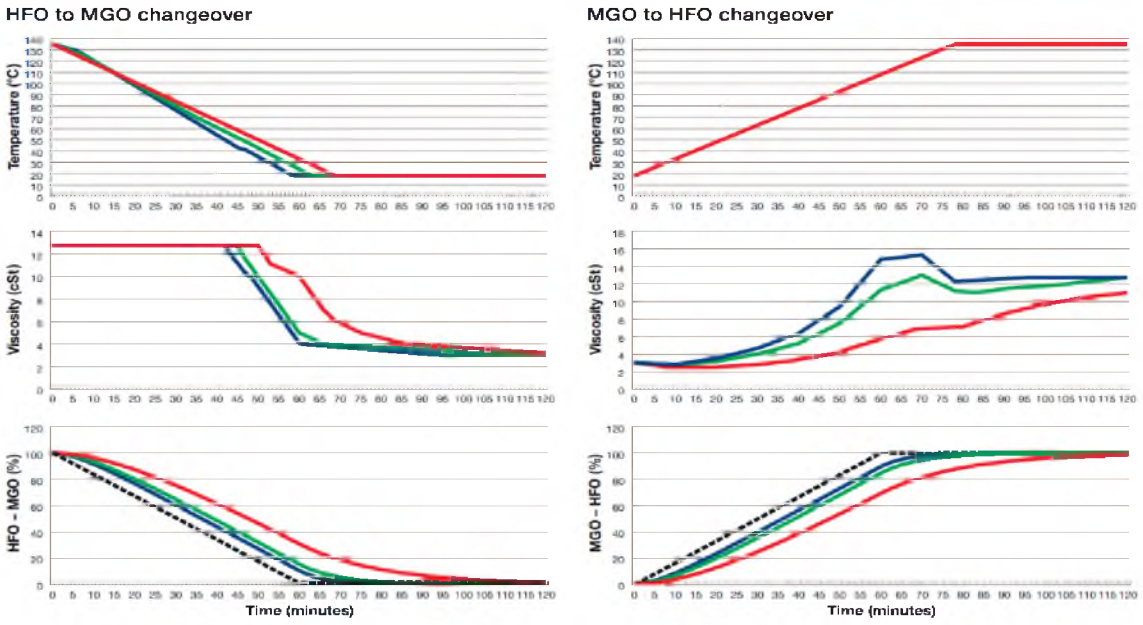

Fig 2 – Graphs of transitions from one type of fuel to another

Three way valve operation

Heavy fuel at load60%

Heavy fuel at 85% load

Heavy fuel at load30%

Conclusion:

Thus, automating the transition from one type of fuel to another makes it possible to speed up the transition process, achieve its smoothness through constant monitoring, abandon the costly installation of a scrubber and solve the problem of the human factor at this stage of work.

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REDUCING EMISSIONS TO THE ATMOSPHERE BY INSTALLATING OF ADDITIONAL PURIFICATION EQUIPMENT IN THE EXHAUST PIPING LINE OF THE MAIN ENGINE

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The growth and development of the fleet have a negative impact on the global environmental situation, and in order to reduce harmful emissions, the International Maritime Organization had made a decision according to which, from January 1, 2020, all maritime transport switched to low-sulphur fuel. The exceptions were ships