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NAVIGATION FROM THE FUTURE POINT OF VIEW OF GLOBAL CLIMATE PROTECTION

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Shipping is a branch of transport, the end products of which are various wastes and emissions of a number of substances into the atmosphere. The impact of shipping on the environment includes air pollution, water pollution, acoustic and oil pollution [1]. Modern shipping is responsible for more than a tenth of CO2 emissions (carbon dioxide, carbon dioxide, carbon monoxide) from maritime transport and is a major source of air pollution.

Shipping also contributes to climate change due to emissions of black carbon, tiny black particles formed during the combustion of marine fuel. Most of the particles of black carbon are produced by vessels burning fuel oil. Black carbon accounts for 21% of CO2 emissions from ships, making it the second most important factor in the climate's impact on shipping after carbon dioxide. Currently, there are no rules governing the emission of black carbon from shipping [2].

An alternative to decarbonization (reduction of CO2 emissions) may be the use of clean fuel in global shipping. Consider the possibility of using such fuels on ships.

1. Liquefied natural gas (LNG) is an environmentally friendly source of energy that emits less carbon dioxide than coal or oil. When using LNG, the least greenhouse gases are emitted, such as water vapor, carbon dioxide, methane and ozone (Fig. 1). The disadvantages of this fuel include the fact that unburned methane, which is the main component of LNG, generates emissions 20 times more powerful greenhouse effect than carbon dioxide CO2 [3].

Fig. 1. Left: "Ishin" − tugboat operating on LNG; right: LNG tank on board the vessel.

2. Liquefied hydrocarbon gas is a possible alternative to LNG. Liquefied petroleum gas is widely available and easy to handle and store, which leads to lower capital costs compared to liquefied natural gas. However, liquefied petroleum gas is a familiar problem: although it limits carbon emissions, it does not eliminate CO 2 emissions.

3. Methanol and ethanol. As an alternative fuel, they are easier to use than LNG and have a well-developed global network of terminals. At the same time, bunkering opportunities are limited, and vessels running on methanol and ethanol must be designed and operated with special care, taking into account the toxic and flammable nature of the gases.

4. Nuclear energy. Using nuclear energy and in the absence of accidents, ships will not emit any emissions as there are no SOx, NOx, CO2 or particulate matter.

5. Scrubbers. To clean the exhaust gases on ships use special devices − scrubbers.

Scrubber − device used to clean solid or gaseous media from impurities (see Fig. 2). When installing scrubbers, first of all you need to take into account fuel consumption − it is more

profitable to install a scrubber or it is better to use LS fuel with a low sulfur content < 1.0%). Due to the increased demand for LS fuel, its price will increase. In this regard, financially, will win ships with scrubbers.

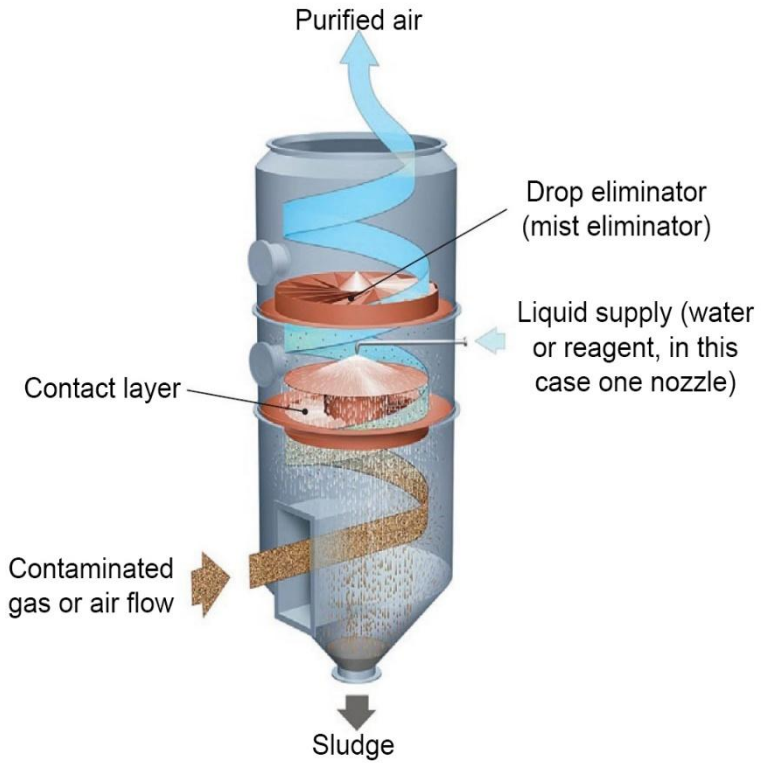

Fig. 2. Marine ship scrubber.

The age of the vessel is also an important factor. Does it make sense to install an expensive scrubber if the ship soon goes to scrap metal?

6. Electric motors. Battery-powered operation has environmental and operational benefits. Battery-powered provides more comfortable conditions for the crew (the ship does not make noise), as well as the absence of CO2 emissions and the unpleasant smell of spent fuel into the environment compared to ships running on fossil fuels. The cost of batteries still remains high, while their capacity is too low [2].

Conclusions

In the coming years, liquefied natural gas is likely to become one of the most popular fuels. The development of technologies for the use of nuclear fuel, hydrogen and ammonia is also expected. At the same time, the ships of the future are likely to use electric propulsion everywhere, including the use of "large batteries" (more than 4300 kW/h) as a source of energy, which as scientific and technological progress becomes more compact and efficient.

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