

## RELATIONS OF DISTRIBUTION OF THE LOW SULPHUR SHIPPING FUELS IN REGION OF THE BALTIC SEA IN THE BUNKERING BOAT-SHIP SUPPLY

Mariusz Matejski<sup>1</sup>, Tomasz Szczepaniak<sup>2</sup>

<sup>1</sup> Department of Heat Equipment and Engine Rooms, Faculty of Maritime Technology and Transport, West Pomeranian University of Technology in Szczecin, e-mail: matmar@zut.edu.pl

<sup>2</sup> ul. Gdynńska 48, 72-600 Świnoujście, Poland.

Received: 2012.10.29  
Accepted: 2012.11.28  
Published: 2012.12.21

### ABSTRACT

The article presents relations of distribution of the low sulphur marine fuels as result of being in force the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78, especially the record establishing the region of the Baltic Sea and the North Sea as sulphur emission control areas (SECA). There are presented obligatory regulations and their influence on sale of the particular kinds of fuels in this region. There are also presented chosen procedures of care about cargo in relation bunker boat-harbour-ship, the delivery fuel procedures in relation bunker boat-ship and the quantitative analysis of distributed fuels on an example of chosen bunker boat.

**Keywords:** vessels, marine fuel oils, fuel transport, ecology.

### INTRODUCTION

Since 1970s, when MARPOL 73/78 (Marine Pollution) was introduced, IMO has been introducing regulations aimed at protecting natural environment. These regulations pertain to the prevention of oil spills, maritime disasters, reduction of emission of greenhouse gases and sulphur and nitrogen oxides. From the point of view of the present paper, regulations regarding sulphur oxides' emission seem fundamental, as the emission is closely related to the type of fuel, thus exerts influence on the volume of individual types of fuel sold.

The regulations refer to the so-called Emission Control Area. Previously, these were called SECA (after a time, their scope was expanded so as to encompass nitrogen oxides' emission). Since May 2006, exhaust fumes have been under control in the Baltic area. In November 2007, the North Sea, including the English Channel, was joined to the area. Fig. 1 presents the north-western limits of the control area. Vessels operating in

the area are obliged to use low sulphur fuels i.e. those whose contents of sulphur does not exceed 1,5%. Such limit was in force until 1<sup>st</sup> July 2010. Since then, until 1<sup>st</sup> January 2015, 1,0% limit will be enforced. The next step will limit the threshold down to 0,1%. When the limit was introduced, the sales of high-sulphur fuels in the Baltic area dropped noticeably. However, protest in the EU have risen the issue of discrimination as regards the north and south of Europe.

In the area under discussion, the average daily sea traffic amounts to at least 2000 vessels. The number does not encompass yachts and small fishing vessels, but only merchant vessels. The structure is presented in Fig. 2.

### THE STRUCTURE OF FUEL DISTRIBUTION IN THE EVALUATED WATERS

Various types of fuels are used to power marine engines. These fuels differ in physicochemical properties, the origin and price, which is of

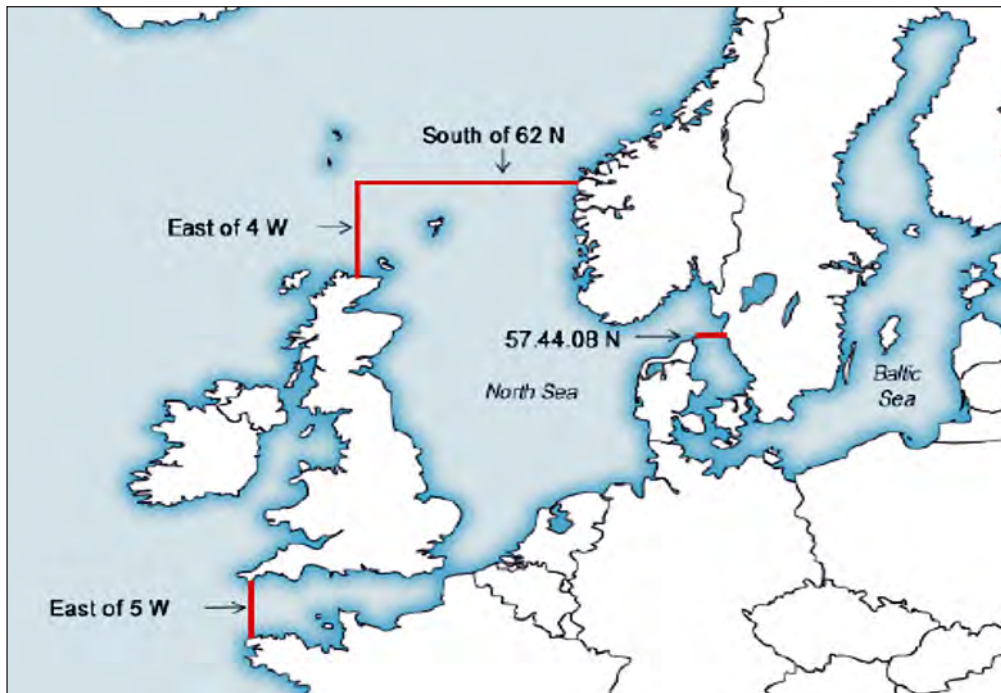


Fig. 1. Borders of sulphur emission control areas SECA [4]

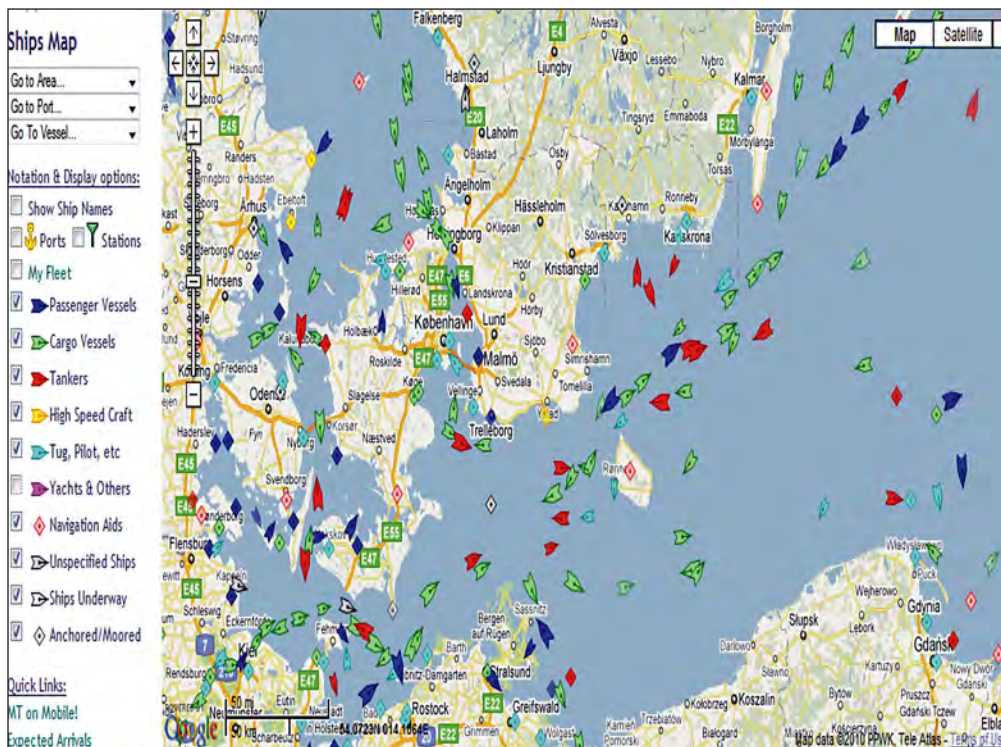


Fig. 2. The movement of ships on the Baltic Sea on 14<sup>th</sup> May 2010 [ 6]

considerable importance for the shipowner. Exemplary prices of fuels sold in the Copenhagen roadstead in April 2011 were as follows:

- IFO 380 HS = USD. 636/t
- IFO 380 LS = USD. 685/t
- IFO 180 HS = USD. 671/t

- IFO 180 LS = USD. 710/t
- MGO 0.1% = USD. 947/t
- MGO 1% = USD. 922/t

The fundamental physicochemical properties of selected low-sulphur fuels are presented in Table 1 and Table 2.

**Table 1.** Properties of fuel oil of FO LS 180 and FO LS 380 type [3]

Specification	FO LS 180	FO LS380
Kinematic Viscosity in 50 °C	<180 cSt	<380 cSt
Density in 15 °C, kg/m <sup>3</sup>	960 – 999	960,0 – 999,9
Water Contents	<0,1%	< 0,1%
Sulphur Contents	<0,95%	<0,95%
Flash Point	≈ 115 °C	≈ 115 °C
Vanadium Contents, mg/kg	≈ 80	≈ 110
Ash Contents, %	≈ 0,02	≈ 0,02

**Comments:**

FO LS 180 and FO LS 380 (Fuel Oil – Low Sulphur) belong to the category of low-sulphur diesel residual oils.

**Table 2.** Properties of fuel oils of Clear and GO 1% type [3]

Specification	CLEAR 0,1%	GO 1%
Kinematic Viscosity in 50 °C	≈ 2,0 cSt	≈ 2,5 cSt
Density in 15 °C, kg/m <sup>3</sup>	830,0 – 860,0	830,0 – 890,0
Water Contents	NIL	NIL
Sulphur Contents	≈ 0,10%	≈ 0,95%
Flash Point	≈ 65 °C	≈ 68 °C
Vanadium Contents, mg/kg	NIL	NIL
Ash Contents, %	≈ 0,002	≈ 0,002

**Comments:**

CLEAR 0,1% – light gas oil, very high quality fuel. It is used to power generator sets, boilers or main engines during manoeuvring. 0,1% sulphur contents makes it exceptionally clean. The fuel bears little harm to engines and natural environment. Due to density and viscosity values, the fuel ought to be categorized as DMX (ISO 8217 – standard for the classification of marine fuels). However, low-sulphur contents qualifies the fuel as much better. Flash point of 65 °C is more than 20 °C higher the DMX fuel types flash point. The fuel is a perfect example of how complicated the terminology and classification of fuels can be.

GO 1% – light gas oil. High-quality, low density and viscosity fuel. Only 1% of sulphur contents differs this fuel from the top types of fuels. According to ISO classification, the fuel ought to be ranked as DMX (however, it possesses a higher flash point).

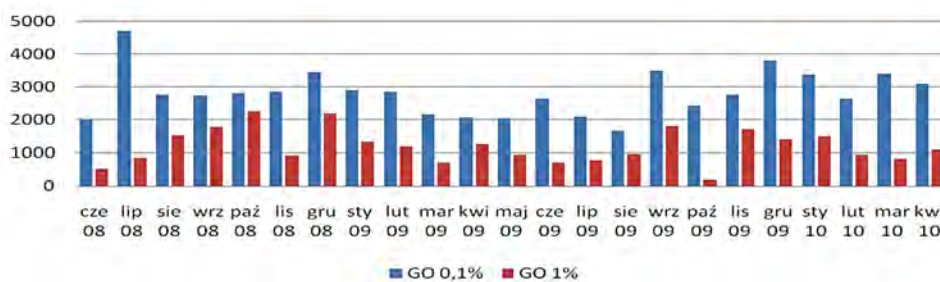
Residual fuels of non-standard viscosity – in case of fuels, viscosity of 180 cSt or 380 cSt is considered standard because these are mainly produced by refineries. This does not imply that other viscosity values are something out of the ordinary. However, demand for such types of fuels is too low for these to be produced directly in a refinery without a previous order.

In order to obtain a fuel of a particular viscosity, heavy residual fuel must be mixed with a light gas oil. Such operations are carried out directly at the bunkering boat. For example, a 5% addition of light fuel to a given volume of heavy fuel, decreases its viscosity by around a half. During each fuel supply to a ship, the Maritime Safety Data Sheet is supplied. It contains all important pieces of information about the product. When the product is loaded onto another ship or a terminal, the copy of the sheet ought to be handed over to the recipient.

**THE ANALYSIS OF THE VOLUME OF FUELS SOLD ILLUSTRATED WITH AN EXAMPLE OF A SELECTED BUNKERING BOAT**

Fig. 3 and 4 present data regarding the sales of heavy and light fuels between June 2008 and April 2010 realized by one bunker boat (typical for the evaluated waters) operating in the area of the Danish straits and the Copenhagen roadstead.

An exemplary vessel providing services for vessels sailing via the straits is the OW Copenhagen bunkering boat presented in Fig. 5, based in the area of the Danish straits – mostly the Copenhagen roadstead. It is a modern bunkering boat with the displacement of 5519MT. It is equipped



**Fig. 3.** Sale of fuel oils on analysed bunker boat [2]



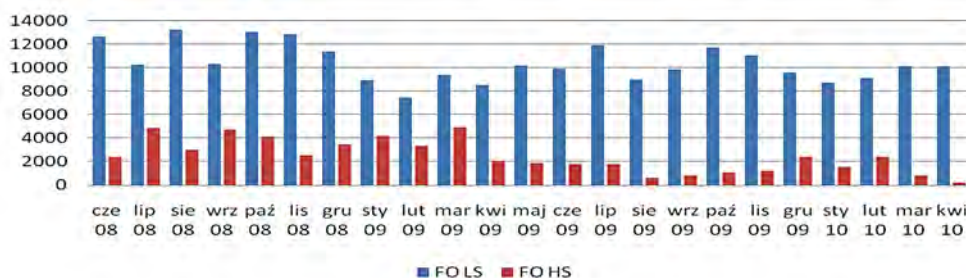


Fig. 4. Sale of heavy oils on the analysed bunker boat [2]



Fig. 5. OW Copenhagen during EMSA practices [3]

with 10 storage tanks, one slop tank and independent loading lines for each of these. The bunkering boat was reported to participate in the program of to EMSA European Maritime Safety Agency – an organization dealing with monitoring and safety of maritime transport and, in particular, preventing and combating marine oil spills.

### SAFETY PROCEDURES REGARDING CARGO ON THE PORT-VESSEL-CLIENT LINE

Procedures apply both to light and heavy fuels. Below, the process of supplying fuel on the Copenhagen roadstead or in the area of Danish straits by OW Copenhagen bunkering boat will be outlined.

The process of loading the bunkering boat begins at the moment of receiving the “voyage order” by phone, and then confirmed by email. The order includes all crucial data required by captain and the crew. The following details can be found in the order:

- Shipping agency in the port of departure,
- Loading terminal and berth,
- Details of involved parties,

- Laydays – the deadline for loading,
- Volume and type of cargo.

Having received the order, captain and subordinate officers prepare the vessel for the voyage. Note of Readiness – having reached the pilot pick-up point or anchoring station in the port of destination, captain is obliged to submit the Note of Readiness (NOR). The document states that all conditions are fulfilled in order to commence loading.

Statement of Fact (SOF) – the document is also known as the time sheet. It is a chronological recording of all activities taking place from the moment of picking the pilot up until the loading has been finished. The same document is kept by the terminal staff. When all operations are complete, both parties sign each others SOFs.

After the vessel has called at the port, at least 3 people, whose job is directly connected with loading, board the vessel. The people are: shipping agent, who provides services for the shipowner, loading master i.e. terminal’s representative and surveyor i.e. the person or a company providing services regarding the volume and cargo’s properties.

Captain is the person who is completely responsible for all operations of the vessel. How-

ever, the chief officer is the one who directly supervises loading. The following details must be agreed upon: manifold's diameter, loading time. Ship/Shore Safety Checklist is also filled in. The list ensures that vessel's and berth's safety procedures are fulfilled.

The list encompasses 60 positions. Loading can commence provided that requirements contained in the list are met. The next step before commencing loading is consulting details with the surveyor. The details refer to the kind, volume of cargo, technical parameters (time, temperature, viscosity). Data given by the surveyor is only an approximate and serve only cargo planning purposes. Before loading commences, vessel's cargo load must be evaluated. After measurements, tables must be consulted in order to check the volume of cargo in individual tanks. On the basis of these measurements the Ullage Report is prepared, which, in addition, is printed in Cargo Log. Values obtained by this method should correspond with results of measurements carried out by means of sounding the tank with a tape measure. This also indicates that the system is reliable and that the surveyor can base his calculations on it. Next, the following operations commence: bunkering boat's loading, measurement of the volume of fuel in each tank, cargo temperature and its viscosity [1]. These operations are the basis for financial settlement with the terminal.

On the basis of the order, captain and subordinate officers plan the sequence which clients will be supplied in. Approximately 70% of orders are submitted a few days earlier. The remaining 30% are clients whose shipowners decided to order the "last minute supply".

For safety reasons, chief officer carries out unloading simulations for the coming several hours. On the basis of these simulations, instructions for the crew are developed. During the first contact with the bunkering ship, the volume of contracted fuel, estimated time of arrival at the anchorage and the moment of anchor dropping are confirmed. Approximately 30 minutes before the arrival, the bunkering boat is ready for bunkering. Transfer hoses are laid on the deck and fenders hung from sides in order to prevent damage to vessels' hulls. After the approach and safe mooring, the exchange of information between chief bunkering officer and chief engineer com-

mences. The volume and the type of required fuel is confirmed. Bunker Requisition Form constitutes the confirming document.

The second document to be filled in before bunkering operation is the checklist ensuring safety conditions. After all details have been agreed upon and transfer hoses attached, loading commences. After ensuring the proper operation of loading equipment, loading ratio can amount to 60 m<sup>3</sup>/h.

The vessel is subject to motions, thus the exact determination of cargo supplied is based on certified meters (separate for light and heavy fuels). After bunkering has been completed documents certifying the fuel supply are signed. Bunker Delivery Receipt is the most important one of these as it constitutes fuel receipt. The document is the basis for financial settlement between the supplier and the shipowner [1]. Having exchanged documents, ships part and the process is considered complete.

## CONCLUSIONS

Properties of fuels on sea-going vessels undergo constant changes. On one hand, engine producers allow for a worse quality fuel to be used. On the other hand, environmental protection regulations enforce the reduction of exhaust emission. Reconciling these two facts is difficult and entails additional financial expenses. At the same time, complicated procedures as regards bunkering operations, those occurring at sea in particular, must be dealt with. However, the enforcement of these procedures practically eliminates the danger of oil spills.

## REFERENCES

1. International Chamber of Shipping, Withberys Publ.: Ship to Ship Transfer (Petroleum), 2005.
2. Materiały przekazane przez dział ładunkowy OW Bunker.
3. Materiały eksploatacyjne udostępnione przez OW Copenhagen.
4. [sustainableshipping.com](http://sustainableshipping.com)
5. [www.bankier.pl](http://www.bankier.pl)
6. [www.marinetraffic.com](http://www.marinetraffic.com)