



## **CHANGES IN WATER TRANSPORT STANDARD REQUIREMENTS AND THEIR EFFECT ON ECOLOGY**

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### ***Abstract***

*In recent years, there is tendency to adjust domestic petroleum products to European and global standards that establish high requirements regarding environment protection. Meanwhile it's tendency to use more biocomponents resulting in decrease of harmful effect on environment. One of the goals of European Directives is to introduce ecological trends in water, inland and sea transport. The intensity of fuel „ecologisation” concept introduction can be watched basing on example of change in standard requirements, regarding mostly the reduction of carbon dioxide emission from combustion of specific liquid petroleum fuels. This is achieved by employing acceptable levels of sulphur content in such fuels as the condition of their use on state territory, territorial sea waters, exclusive economic zones, and pollution control zones of Member Countries.*

**Keywords:** *environment protection; biocomponents; biofuels - alternate fuels; greenhouse effect; gas emission*

### **1. Introduction**

There were a lot of changes that took place in refinery industry, enforced by increasing requirements regarding fuels, especially in terms of ecological aspects.

Development trends aimed at harmful emission to the environment have been noticed. There were several ways to achieve this goal.

One of them is to ensure relevant high quality of fuels. It could be achieved by the following:

- chemical composition optimization aimed at ensuring proper combustion conditions while using as few as possible toxic components (e.g. aromatic compounds content limiting, using oxygenates etc.);
- discarding environment harmful components (e.g. benzene, lead, sulphur, PNA);
- searching alternate energy sources;

Recent use of fuels in Poland is the result of this occurrence in Europe. The EU has determined relevant requirements in EU directives regarding, among others, quality of fuels used in water transport (e.g. 1999/32/EU, replaced by 2005/33/EU, and the next 2009/30/EU). The aim of these Directives is to reduce sulphur dioxide from combustion of some liquid fuels, thus reduction of harmful effect of such emission on human and environment.

## **2. Water transport (inland and sea)**

The sea transport results in c.a. 4 % of global carbon dioxide emission due to human activity. This transport supports over 70 % of international trade. There were no significant environment losses until the first tankers have appeared. Increasing demand for crude oil and petroleum products resulted in sudden demand for oil tankers. Vast quantities of crude oils, oils and other harmful materials enter waters causing huge losses in ecosystems. Vast areas of sea, especially coastal ones near harbors, become "dead waters". Inland water transport also causes great losses. Water life in rivers and other inland water bodies is destroyed by harmful chemicals leaking. Sea transport is the most friendly to environment in terms of greenhouse gases emission. In order to prevent climate change as well as threat to human health, it's very important to reduce pollution caused by sea transport, and other sources. In comparison to other means of transport, the sea transport has the lowest carbon dioxide emission coefficient related to one ton-kilometer, however it's expected that greenhouse gases emission caused by this type of transport will increase from current 1 Gt by 150-200 % in next 40 years. The goals for Europe 2020 strategy cover obligation to lower greenhouse gases emission by at least 20 % in comparison to 1990 or, in case of favourable circumstances, even by 30 %. The scope of this obligation is described in EU regulations regarding climate and energy. The water transport is also the source of air pollution. It was expected that in case of not taking relevant measures, taking into consideration estimated increase of sulphur dioxide emission by 10-20 %, air pollution at main sea routes could increase in recent two years (2010-2012). The sulphur content in fuels used in sea transport is high, in the range from 10000 ppm for Sulphur Emission Control Areas (SECA) to 27000 ppm for world average. New regulations regarding naval fuels significantly lower air pollution and its effect on human health. Air pollution caused by sea transport is transferred at big distances, resulting in increasing problems regarding air quality in many cities. In case of no countermeasures, sulphur emission from EU sea vessels would exceed emission level from all land sources by year 2020. Altered regulations lower such tendency, lower not only sulphur emission, but also particulate emission, that means significant progress in terms of human health and environment protection. The Directive that took effect in December 2012 basing on standards developed by International Marine Organisation (IMO), would take to gradual reduction of max. sulphur content in naval fuels from 3,5 % to 0,5 % by year 2020. In case of very sensitive ecosystems (thanks to agreement within International Marine Organisation), vessels sailing on Sulphur Emission Control Areas, such as Baltic Sea and North Sea including English Channel, would have to switch to fuel containing only 0,1 % sulphur by year 2015.

## **3. Ecological and economical aspect of fuel for water transport**

The possibility of choice of equivalent methods for fulfilling the requirements, such as exhaust purifying systems or vessels powered by liquefied natural gas (LNG) is an alternative to low sulphur fuel. According to EC, the LNG is the most prospective alternate fuel for water transport.

The EC, in document connected with „clear energy for transport” package, has noticed LNG values, both regarding environment and economy. The environment value is connected mostly with lower emission of greenhouse gases but also with sulphur oxides emission. Decision of European Parliament dated September 2012, regarding this issue, establishes sulphur content limit in fuels for all vessels sailing baltic Sea, North Sea and English Channel, from current 1 % to 0,1 %, and from 3,5 % to 0,5 % in case of other EU waters.

The new standards that will be in effect from 2015 in practice will eliminate the most popular fuel so far, such as heavy fuel oil (mazout) generating large amounts of fuel dust and soot. The economical changes are equally vital. The cost of LNG is much lower than fuel oil, especially the one with low sulphur content. Therefore it's expected that in the long run, ship owners will trade at least the part of fleet for vessels powered by LNG. Proecological projects regarding marine area are currently funded by TEN-T and Marco Polo programs and European Bank of Investment (EBI). Moreover, the European Commission has initiated activities regarding use the LNG as naval fuel. Medium and long-term means aimed at supporting ecological technology of vessels, alternate fuels and development of „green” transport infrastructure in the context of setting tool of balanced water transport still will be implemented, with cooperation of business and member nations. Vessels sailing all other European areas will have to use fuel with sulphur content below 0,50 % starting from 2020.

The intensity of the „ecologisation” concept implementation could be traced basing on standard requirements changes regarding mostly sulphur dioxide emission reduction from combustion of specific petroleum liquid fuels which is achieved by implementing allowable sulphur content in such fuels as a condition of their use in Member Countries territory, territorial waters, exclusive economic zones, and pollution control zones.

#### **4. Trends in change of requirements for fuel oil**

The most noticeable changes took place in relation to sulphur content) (Fig. 1).

After the World War II Polish Standard PN/C-96048 dated 1949 required the sulphur content at maximum level of 1 % (*m/m*). In 1955 the requirements were changed for oils of category I (for high-speed engines) were changed to 0,1 % (*m/m*) max., 0,2 % (*m/m*) max. for category II, and 0,5 % (*m/m*) max. for category III. In 1967 the standard PN-67/C96048 appeared. It replaced two specifications, PN-61/C-96047 and PN-55/C-96048 for fuel oils DS and DZ and fuel oils respectively. It has been allowed to increase sulphur content up to 0,6 % (*m/m*) in light fuels from crude oils of medium sulphur content, and up 1 % (*m/m*) from high-sulphur crude oils. The reason is unknown at the moment. In case of winter fuels, sulphur content ranges from 0,2 % (*m/m*) to 0,6 % (*m/m*). Sulphur content in all types of fuel oil was limited to 0,3 % (*m/m*) in 1992 (PN-92/C-96051). Like in case of gasoline, the requirements basing on European standards were introduced in 1999. PN-EN-590 (implementation of EN 590:1993) allowed sulphur content at the level of just 0,20 % (*m/m*). Before implementation the sulphur content at the level of 350 ppm (0,350 % *m/m*), like in EN 590:1999, The Minister of Economy issued regulation (March 08 2002) restricting sulphur content to 500 ppm. As a matter of fact the fuel for CI engines with sulphur content up to 50 ppm already appeared in 2000. Fuel with sulphur content of 25 ppm and lower is also produced though PN-EN 590:2003 standard allowed 350 ppm until the end of 2004 and 50 ppm from the beginning of 2005. In order to market the fuels with sulphur content up to 10 ppm from 2009 the Directive 2003/17/EU demanded governments to take appropriate action aimed at implementation fuels with sulphur content of 10 ppm.

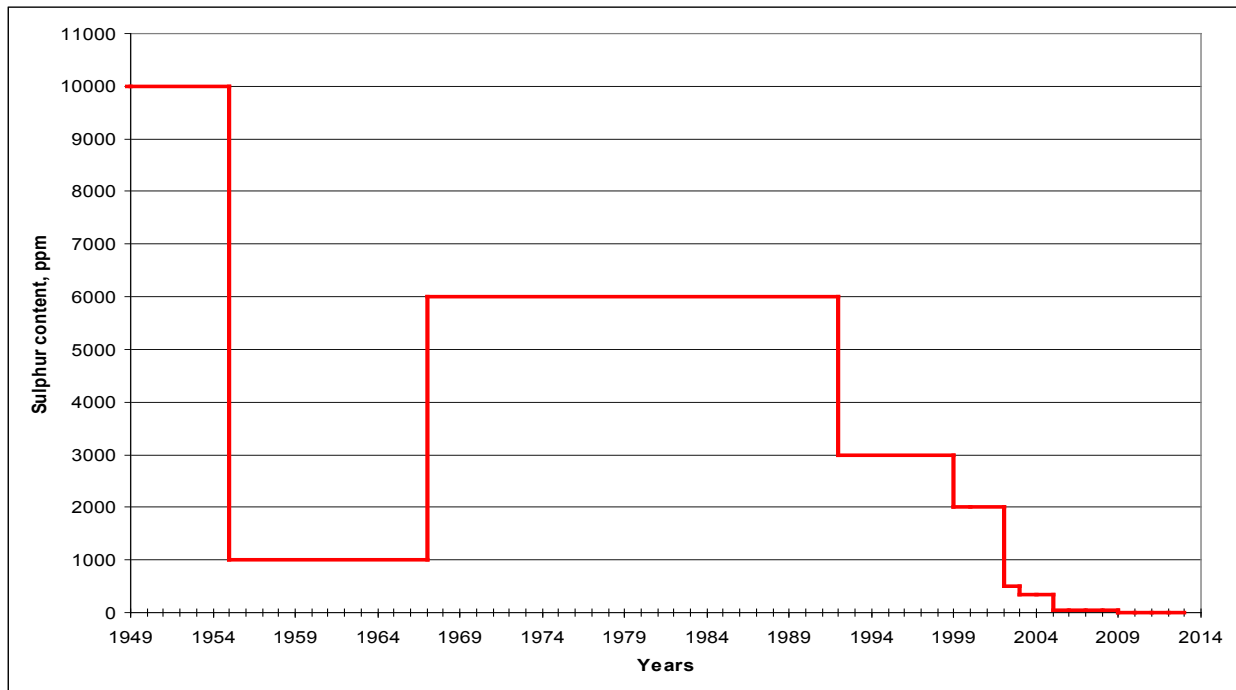


Fig. 1 Sulphur content in fuel oil according to national requirements in years 1949-2012

## 5. Marine fuels

The first specification describing requirements for fuels for low-speed marine engines (Class II acc. to PN-67/C-96048) was developed in 1967, and demanded sulphur content max. 1,2 % (*m/m*). It allowed even 2 % (*m/m*) of sulphur content, after agreement with contracting party. Sulphur content in DS fuels (high-speed engines) was max. 0,2 % (*m/m*). The above specification was replaced by PN-74/C-96049 standard in 1974.

This standard allowed the following, higher sulphur content:

- class I for fuels from low-sulphur crude oils: max. 0,5 % (*m/m*),  
for fuels from sulphur crude oils: max. 1,5 % (*m/m*),
- class II for fuels from sulphur crude oils: max. 2,8 % (*m/m*),
- class III for fuels from sulphur crude oils: max. 3 % (*m/m*),

The standard sulphur content was lowered in the range from 0,5 to 1,5 % (*m/m*) for light fuel distillates and to 1,5 % for residual fuels just in 1993. In 1994, the company Rafineria Gdańsk S.A. started to produce DS fuel with sulphur content of 0,2 % (*m/m*). In case of marine fuels, decreasing the sulphur content is much slower. It's because of specific design requirements of engines.

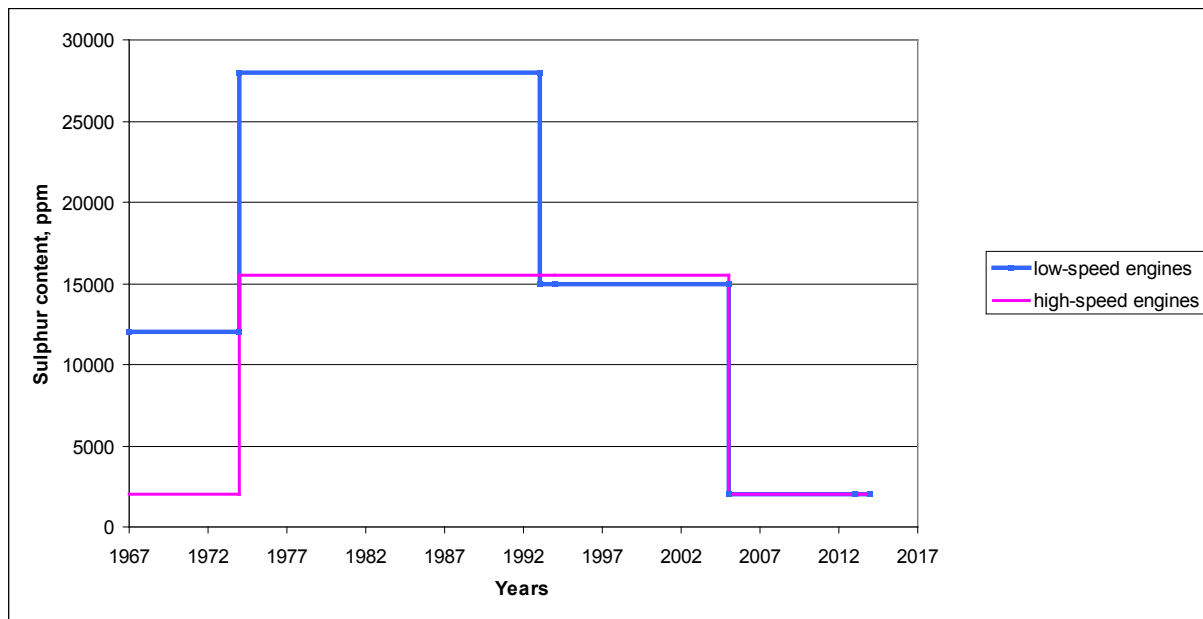


Fig. 2 Sulphur content in marine according to national requirements in years 1967-2012

## 6. Summary

- The trend towards permanent sulphur content in fuels lowering has been noticed both in refinery industry and on the fuel market. This is especially noticeable in recent years, after implementing international agreements.
- Apart from obvious advantages, significant sulphur content lowering enforces manufacturers to modify arrangement of additives. It consists mostly in necessity to ensure proper lubricity which has been achieved earlier by use of polar sulphur compounds.
- The trend towards sulphur voiding from marine fuels is noticeable slower. It's, among others, due to requirements set by marine engines and their environment of use.

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