ANALYSIS OF HAZARDS OF SEA ENVIRONMENT FROM WEST POMERANIAN SEA FISHING FLEET

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Abstract: *The paper presents analysis of hazards of sea environmental pollution by lubricating and hydraulic oils based on the west Pomeranian Sea fishing fleet. The analysis of hazards of environmental pollution has been presented here while on lubricating and hydraulic oils are used. The purpose of the Paper is to provide additional controls mitigate potential hazards.*

Keywords*:* ENVIRONMENT, POLLUTION, OIL, FISHING FLEET

1. Introduction

Factors influencing sea environment could be formally divided into 2 groups:
influencing sea waters and influencing atmosphere.

All the wastes from fishing crafts sent to sea waters directly or indirectly, intentionally or unintentionally can be included in group 1. The quantity and type of these wastes depend on many factors, such as:

- technical equipment,
- size of the craft,
- craft equipment with fishing devices,
- craft equipment with accommodation equipment,
- crew members number,
- pro-ecological education of the crew

Following the subject of the paper the hazards analysis for the environment as a result of oils disposal on cutters and fishing boats has been presented.

2. Hazards associated with lubricating oils

Engine lubricating oils pollute the environment while being produced and on every level of their usage: being transported to the users, being stored, during engine operation and during their disposal and recycling after their time of operation. Each of the mentioned levels presents different type of hazard and depends on the following factors:

- possibility of the recycling of oil wastes or the used oil,
- working conditions of the device in the diesel engine,
- chemical compound of the oil,
- possibility of the oil biodegradation,
- way of using the oils

Working conditions of the engine oil determine its consumption and quality (temperature influences the intensity of physic-chemical processes mainly, e.g. oxidation.)

Chemical compound of oil is a decisive factor for the environment and it also determines the most ecological and economical way of oil recycling.

The level of toxicity is different and it depends on the components structure, yet they are generally hazardous to soil and water.

There are installed engines of total power 31827 kW [7,8] on cutters and fishing boats on the west Pomeranian Sea fishing fleet.

It is estimated that the quantity of the required lubricating oil during normal operation of engines amounts from 0,3- 0,5 kg of oil/engine power in kW.

Considering the fact that there are old generation engines on cutters and fishing boats, their operating consumption should be estimated for 5g of oil/kWh. For new generation engines the consumption of oil is about 3g/kWh.

The consumption of oil in the fishing float can be calculated according to the algorithm:

$$C = (3 \text{ or } 5) \cdot P \cdot UP \cdot FD \cdot 24 \cdot 10^{-6} \text{ [ton]}$$

Where :

C – Consumption of lubricating oils in fishing fleet
P – Total power of the installed engines on fishing crafts
UP –Simultaneity coefficient of the used power for the installed engines
UP = ∑ used power during fishing days /total installed power
FD – Number of fishing days

3. Hazards associated with emission to atmosphere.

Quality, composition and physic-chemical properties of the engine oil are an important operating factor of the engine which may influence highly the composition and level of toxic emissions being created during the engine operation process. Oil influence on the m/a factors is a complex phenomena and not totally known. The research was done by Manni, Flori and Gommellini [4,5].

Toxic components emission is connected strictly with oil consumption by the engine. The relation of cause and effect between the intensity of oil consumption and the level of toxic compounds emission has been described in publications [2,3]. It refers mainly to hydrocarbons (PAH as well) and diesel particulate filters.

The increased consumption of the engine oil is connected with many processes inside the cylinder and their effects, such as: [1]

- Scraping oil by a set of rings to the combustion chamber.
- Increased and thicker oil layer remaining on the cylinder after piston movement and average temperature rise of this layer.
- Absorption and desorption processes of fuel vapours and oil.
- Adsorption by soot (or other particles) of fuel vapours.
- The increase of vaporized oil because of cavitation

The main influence on the harmful factors emission coming from lubricating oils to atmosphere is caused by technical equipment such as:

- Type of the oil used,
- Engine construction
- Technical condition of the engine

From 50 % to 70 % of the used oil is emitted to the atmosphere. Having in mind the m/a data it is possible to calculate the quantity of toxic substances emitted to atmosphere (E) from lubricating oils of fishing boats engines, applying the given below algorithms.

$$E= (3 \text{ or } 5) \cdot 0.5\ P \cdot UP \cdot FD \cdot 24 \cdot 10^{-6}\ [ton]$$

Where :

E – quantity of harmful substances emitted to atmosphere from lubricating oils
P – Total power of the installed engines on fishing crafts
UP – Simultaneity coefficient of the used power for the installed engines
UP = ∑ used power during fishing days /total installed power
FD – Number of fishing days

Taking into consideration the received calculated values of toxic substances emissions from lubricated oils used by fishing fleet to atmosphere, it should be noted that the quantities are frighteningly huge, despite the fact that they are calculated as minimal ones and they can be higher practically. The errors in real calculations come from difficulties of coefficients practical determination for calculated algorithms and that is why the received calculated coefficients could be regarded quite optimistic. Due to their peculiar toxicity, atmosphere pollution coming from this source is extremely high. The quantity of emission depends strictly on annual average number of engines working hours.

It is worth-noticing that for new generation engines calculated average toxic substances emission from lubricating oils is more than twice lower in comparison with the old engines emission.

Oils coming from kerosene or esters which lost their operating properties and cannot be applied for their primary purposes any longer are considered the used ones, as well as oil – water mixtures.

According to Polish ecological law, the used oils are recognized as hazardous.

Fishing boats engine operation is the source of the used oil "production". The used oil can enter sea waters because there aren't any recycling devices for the used oils on fishing boats and there isn't any system for their disposal/collection in ports or fishing berths. Due to outdated engine construction and their sealing systems, we may say that the used oil as leakages enters bilges and it is next pumped out to sea waters. There are no oil separators because of the size and complexity of their installations. It is estimated that leakages amount up to 10% of the used oil. Fishing boats leakages could be regarded as simple drop to sea waters.

"The drop" with reference to toxic substances or outflows containing such substances means any, without any reason, discharge, removal, spillage, leakage, pumping out, emission or emptying.

The quantity of used oils coming to bilges as leakages is the function of engine working hours and their technical condition. The quantity of used oils coming to bilges as leakages on boats (B) can be determined according to the algorithm:

$$B= (3 \text{ or } 5) \cdot 0.1\ P \cdot UP \cdot DP \cdot 24 \cdot 10^{-3}\ [ton]$$

Where:

B – Quantity of lubricating oils leakages
P – Total power of the installed engines on fishing crafts
UP –Simultaneity coefficient of the used power for the installed engines
UP = ∑ used power during fishing days /total installed power
FD – Number of fishing days

It can be noticed that hundreds tons of oils coming from engines operation on fishing boats and cutters can enter sea waters. Such quantity of harmful substances coming into sea waters influences biological life development there very badly - because:

- It limits light access for the development of zoo and phytoplankton due to creation of oil film on the water surface.
- Living organisms, fish and zooplankton absorb harmful substances from lubricating oils (PAH).
- The quality of fish food gets worse (zoo and phytoplankton) with toxic chemical substances and leads to limited reproduction of fishes.
- Seaside areas get less attractive for tourists.

4. Hazards associated with hydraulic devices

West Pomeranian Sea fishing fleet crafts use hydraulic fishing devices –hydraulic winches. Hydraulic oils used in their hydraulic systems are a potential pollutant for the Baltic Sea. Hydraulic oil high working pressure, lots of load and often overload of hydraulic winches, outdated construction and the age of the devices are the reason of frequent pipeline, hydraulic joints or seals breaks leading to hydraulic oils leakages to bilges in the boats. The oil is a potential "drop", similarly as the used oil or the oil from operating engine leakages.

Having in mind the specific hydraulic systems described above, probability of the hydraulic system breakdown resulting in oil leakage can be estimated as 0.25. There is about 150 l of hydraulic oil on average in hydraulic systems of fishing boats and cutters. The average oil leakage quantity from the system due to a breakdown amounts to about 10% of the used oil volume in the hydraulic system. The quantity of the hydraulic oil used on fishing boats can be determined according to the algorithm:

$$CHO= 0.25 \cdot 0.1 \cdot N \cdot C \cdot HW \cdot FD/365\ [\text{litres}]$$

Where:

CHO – consumption of hydraulic oil by west Pomeranian Sea fishing fleet
HW – simultaneity coefficient of the hydraulic winches used
HW = ∑ crafts using hydraulic winches during fishing days/ total number of crafts with hydraulic winches (205 crafts)
FD – Number of fishing days
C – Average capacity of the hydraulic system (150 L)
N – Number of crafts with hydraulic winches

Summary

In order to improve the situation and reduce the risk of marine environment pollution, active and reactive policy of risk management should be introduced:

- Introduction of pro –ecological education for fishing crews.
- To modernize the fishing craft to match the eco-friendly standard.
- Effective introduction of the best accessible technology and the best ecological procedure.
- To modernize or exchange the propulsion engines to meet the requirements of emissions ecological criteria. It is extremely important to use proper constructions and materials for different sealing in engines, in order to limit the negative influence of lubricating oil on natural environment. The choice of elastomers used for sealing has to be exceptionally careful - having the working temperature in mind and the chemical composition of the used oils. At present, up-to-date elastomers provide proper interaction with basic mineral oils.

- Introduction of the disposal for used oils, bilges polluted with lubricating or hydraulic oils and the improvement of fishing ports and berths to match the standards determined by conventions.
- Introduction of understandable to fishing crews, ecological procedures for each operation and emergency procedures as well.
- Introduction of clear and effective control procedures for wastes and their disposal management by state administration
- The use of lubricating oils following EKO and Energy Conserving criteria, biodegradable.
- To exchange or modernize the existing hydraulic systems on the crafts - if applicable.

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