

## **EKOLOGICKÉ HAVÁRIE NA VODE. PRÍPADOVÁ ŠTÚDIA OHĽADOM TECHNICKÉHO VYBAVENIA NA ICH LIKVIDÁCIU – PRAKTICKÉ SKÚSENOSTI**

### **ECOLOGICAL DISASTERS ON WATER. CASE STUDZ ABOUT TECHNICAL EQUIPMENTS FOR THEIR LIQUIDATION – PRACTICAL SKILLS**

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DOI <http://doi.org/10.24040/actaem.2018.20.1.6-16>

**Abstract:** The author is in article oriented to the specific activities of fire fighting units, which became a part of their activity just in last 15 years. They are ecologic disasters on water flows. Liquidation of those disasters is difficult regarding the environment, which is for the human unnatural for his free movement. For liquidation of those disasters are necessary the special means that need some helping of skills and knowledge from various branches, which are different from current fire fighting activities. In last part of the article are described the most familiar means for catching the leaking materials on water flows. Author describes each types of oil barrier and put them in order according to pretension of their installation. Every oil barrier gets some name. The least pretentious oil barrier from the view of installation is oil barrier filled by the foam. Oil barrier filled by the air is the most in use. The last walls are metal and are the most stable and the most existing

**Key words:** Oil barrier, Hydrophobic absorptive material, Degreasing means, Pumps in explosion - proof

## Introduction

Article describes knowledge about technical equipment's and systems for liquidation of ecological disaster on water. A the method of laying and applying sorption systems is described by Fabian, Slezák (2014) and Coneva (2005).

To the basic equipment's for providing of works during the liquidation of ecological disasters on water - course belong:

- 1/ oil barriers of different construction and hydrophobic absorptive snakes
- 2/ bulk hydrophobic absorptive materials for absorption of petroleum substances
- 3/ hydrophobic absorptive carpets and hydrophobic absorptive mats
- 4/ degreasing means for chemical decomposition of hydrocarbons
- 5/ pumps in explosion proof version for collection of leaked substances from water level

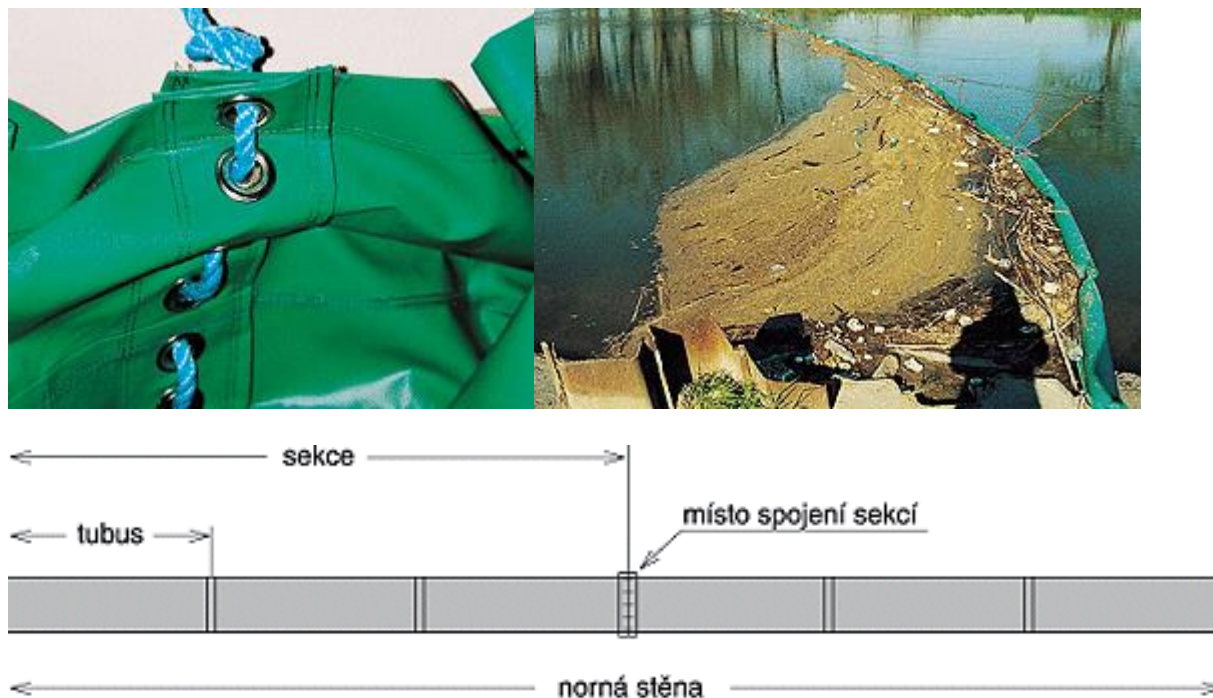
To the subsidiary means for providing of safety works during the liquidation of petroleum disasters on water - course belong:

- 1/ lifeboat – the best if is equipped with powerful hanging ship engine
- 2/ fixing portable basins for temporary storage of contaminated material taken from water level
- 3/ mobile means for transport of contaminated material taken from water level

## Description brief of individual means for Oil barriers

a/ Oil barriers - filled with a foam

The barrier is designed for creating barriers on the water level during liquidation of ecological disasters and for their prevention. (Lauko, 2005) The barrier (Fig 1) is practically non-sinkable. It observes its functions even after partial destruction. It has very good physically mechanical characteristics, chemical resistance and is resistant to solar radiation. Even without maintenance, it can be in used for several years.



**Fig 1** Example of Oil barriers (Lauko, 2005)

The barrier consists of firm covering filled with lightweight foam, equipped with steel rings for anchorage of a guide rope and for linking the barriers together. At the bottom of the barriers there are weight bars (Fig 1). The length can be adjusted according to the customer requests. Used materials are friendly to the environment. Particular segments are joined by connecting PP rope at a diameter of 4 mm or by using plastic needle.

#### b./ Inflatable floating oil barriers

They are used for catching of petroleum substances from the water level. It is an air hose in cylinder-shape (Fig 2) with diameter of 30 cm, which is equipped with cleaning doctor of 48 cm (height). Produced length of the barrier is 5 and 10 m. Separated parts can be connected.



**Fig 2** The cylinder-shape barrier (Photo autor)

Details of connecting the barriers (Fig 3):

- The barrier cleaning doctor is reinforced along full length with polyamide strap creating also catching eyes for fastening booms to the bank or anchorage
- At both ends of the barriers the reinforced textile strips are made to enable mutual connection with the help of fast locking device
- Galvanized chain is used as a weight element
- The barriers are transported in textile packaging



**Fig 3** Details of connecting the barriers (Photo autor)

We can reckon this oil barrier as a basic barrier, which has to absorb the biggest quantity of leaked substance. It is the most massive barrier, which we use and the advantage is good storage, in emergency state takes a little place.

c./ Metal oil barrier for high flow speed

Is made from zinc-coated iron with non-dip float. Segments are equipped with handles and length of segment is 4 m. Producer offers segment according to the customer's requests.

Special design ensures excellent fixation of danger substances on the water courses with high flow speed. Sealing rubber slips prevent the penetration of petroleum substance between segments, thanks to solid metal construction is able to stand higher strain.

This oil barrier is suitable for long time intervention or as a preventive wall on the places, where is expected up rise of ecological disasters and may be used for absorbing of contamination on smaller water courses. During the installation, we do not need the inflating or stretching by the bearing petroleum (Fig 4).



**Fig 4** Practical skills during the installation metal oil barrier (Photo autor)

d./ Layer oil barrier

Layer oil barrier is the best-sophisticated barrier. It is high stable and solid metal construction. They are two parallel metal barriers to which it is possible to install grillage settee on which it is easily to walk. It is possible to connect the segments by the pins, length of the segments is 3-5 m. For the manipulation with segments it is necessary to use the lift techniques. This barrier is suitable for long time intervention and for collection of contamination and petroleum substances. Purchase of this barrier is advantageous investment on the placed where are repeated disasters. Individual segment can be used as an improvise float with loading capacity to the 150 kg.





**Fig 5** Practical skills during the installation layer oil barrier (Photo autor)

Basic rules for installation of oil barriers on the water - course:

- If we have in intervention perimeter the water - course, it is good that we have choosed some places for installation of this oil barrier
- If we choose the place, we have to connect the barrier to the length, which will be enough for dam of water - course
- If we have enough of those oil barriers, we can make more of those sets (it will speed up the intervention)
- It is good if every oil barrier has blast valve as is on the tire of vehicle (clever fire men can do them very easy)
- It is good to have to every segment one pressure bottle e.i. from the breathing apparatus, and it is good to have on the bottle tube for blowing of oil barrier

For blowing of one segment and putting on the water level is one fire man enough:

- It can see unbelievable, but five fire men can blow 50m of oil barrier in 2 minutes
- In case that the barrier consists from more than two segments it is good if on every joint of segments is attached rope, which is anchored on the shore and helps the barrier as a whole to keep the requisite form.
- The barrier before the putting on the water level must be very good anchored on the shore
- The barrier must be put on the water level parallel with the shore so, that the anchored of barrier on the bottom must be in flow of water course

Barrier is installed so, that at first on the top end we tie solid and sufficient long rope, which we carry over to the opposite side of water course and we place to the shore the suitable anchor element around which we by one or two twine we wrap the rope

When is everything ready we can step by step to relieve the ropes and the barrier is by the pressure of water raft to the opposite side of water course

This description seems to be longwinded, physical difficult but I can guarantee that well organize teams of 10 firemen will make the installation of 50 m barriers in not more than 10 minutes.

The conditions is that you have prepared all necessary means: Connected oil barriers, Pressure bottles with air + filling valves, Anchorage ropes, anchorage pins, big hammers.

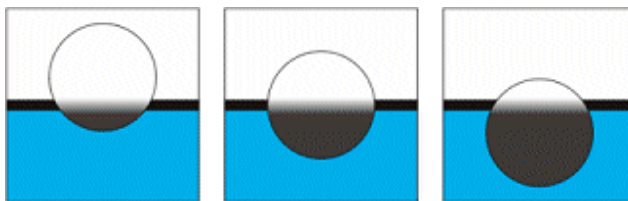
#### e./ hydrophobic absorptive snakes

Those equipment's for liquidation of petroleum disasters are on the interface between barriers and absorptive materials. Their shape reminds oil barrier and working quality are as in absorptive materials. I can say that it is genial combination of function and purpose of use. When I met them first time I though that they are assigned for using in "first line" but life convince me that their place is on the back and in my practice I used them on the last place where the water was clean and our task was to take the last petroleum spots

After them was nothing just chemical elimination of petroleum substances. I treat their using in first line as a waste of money because the absorptive snake can very quickly absorb big quantity of petroleum substances. I recommend to use absorptive snake just one time and after using to do the special liquidation. Absorptive snakes have against the oil barriers advantage that they float on the water level and dip step by step with absorptive substances and they do not make resistance on the water level.

#### Hydrophobic absorptive snakes

Unobjectionable from the point of health in contact with drinkable water (Fig 6). Do not change nature of absorbed substances. Resistant to climatic effects, moulds, micro-organisms and solar radiation. They are high absorption capacity (Fig 7).



**Fig 6** Scheme Gradual absorption of petroleum substance, the snake does not sink



**Fig 7** Examples of Hydrophobic absorptive snakes. Legends: a) The stripes improve permeability and increase capture of pollution, b) Simple connecting of the snake during elongation of the barrier, c) Various diameters of the snakes

#### Loose absorptive materials for absorbing the petroleum substances

For absorbing of leaked substances on the water level we must use hydrophobic absorbent, which do not suck water but just petroleum substance. From the side of material origin we know 2 types of absorbents. Natural base (mainly peatbog) and second type synthetic materials makes on the base of textile fibre (polypropylene and polyethylene).

Natural materials are more ecological and after my experiences they have better absorptive abilities. Natural materials are more expensive, but are biological degrading – synthetic absorbents are cheaper, but they need to be liquidated by burning (Marková, 2007).

Hydrophobic absorptive loose absorbent (no woven textile) has (Fig 8):

- Very high absorption capacity; up to 77 l of liquid is caught by 5 kg of loose absorbent.
- Very quick absorption.
- Unlimited time of storage.
- Easy combustibility.
- Excellent floating.
- Profitable rate between the absorption capacity and price.



**Fig 8** Examples Hydrophobic absorptive loose absorbent (no woven textile)

Hydrophobic absorptive peat loose absorbent (Fig 9) has:

Liquidation of petroleum crashes both on the solid ground and water surface

- Refinement of petroleum leakages from hardly reachable places and uneven surfaces.
- Cleans out even small chinks.
- Active support of biodegradation of captured petroleum products.
- Low weight.
- Long-lasting storage.
- Liquidation in a refuse incinerating plants or on biodegradation fields.



**Fig 9** Examples Hydrophobic absorptive loose absorbent (no woven textile). Legends: a) Application on the solid ground, b) Application on the water surface

At the end of this section I would like to say that the loose absorbents belong to the basic equipment for liquidation of ecological disasters but I do not recommend them for liquidation of



those disasters on water - courses because their collection from water level is quite difficult and it is physically difficult with low effectiveness. I recommend using loose absorbents on the solid ground, where we can easily sweep them on the shovel and put them to the bag. For water level I recommend something else.

### Hydrophobic absorptive carpets and mats

I reckon the hydrophobic absorptive mats or carpets as the best means for collection of petroleum substances on the water level. Their advantage is easy application and easy collection from the water level. You can reach them from the shore. More easily is manipulation with hydrophobic carpet, which just uncurl and rip required quantity and put it on the water and next process is as with the mats.

Hydrophobic absorptive mats (Fig 10) have good properties, such as:

- High absorption capacity for petroleum substances.
- Quick capture and collecting of dangerous liquids both from the solid ground and water surface.
- Easy manipulation.
- Simple adjustment of the shape.
- Unlimited time of storage.
- Resistance to climatic effects.



**Fig 10** Examples of Hydrophobic absorptive mats

Hydrophobic absorptive mats are applied to absorb petroleum substances and oils. They do not absorb water (Fig 11), unlimited floating on the water surface. Resistant physical bond between captured liquid and absorbent, captured liquid does not release spontaneously.



**Fig 11** Examples of Applications Hydrophobic absorptive mats

### Degreasing means for chemical decomposition of hydrocarbons



In my fire fighting practice I met with two products, which totally liquidate the coloured greasy spots from water level - residue of petroleum substances, which float on the surface. Their thickness is 100 to 200 microns. I read from the information letter that the bio activator involved in the means causes extremely quick biological degrading of petroleum spots and residues, and at the end outgoing stuff is just H<sub>2</sub>O a CO<sub>2</sub>. By this is reduced danger resulted from leaked petroleum products. Activator is pH neutral and dermatological unexceptionable.

It is non-flammable non - toxic liquid made so, that she works as an active means, which does not have any effects as a classical cleaning stuff (organic solvent, etc.). It decomposes hydrocarbons molecules on shorter chains and supports bacteria activities during their next sour.

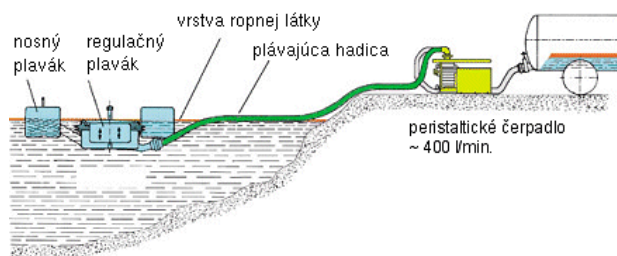
### **Pumps in explosion - proof environment for collection of leaked substance from water level**

I reckon the collection of liquids from water level as a top of art of liquidation ecological disasters. It is technical difficult activity, which we can use just in exceptional incidents. This intervention has its danger, sufficient thickness of substance on the water – course and other problem is ownership of those pumps. Because I do not know about the equipment's of fire fighting unit in Slovak republic by those means I would like to leave this part without comment. I think that the picture shows the possibility and ways of using.

### **Oil Skimmer**

Floating oil skimmer for faster sucking of oil and other related pollutants from the water level of slack and flowing water. Advantages of the oil skimmer KAISER (Fig 12):

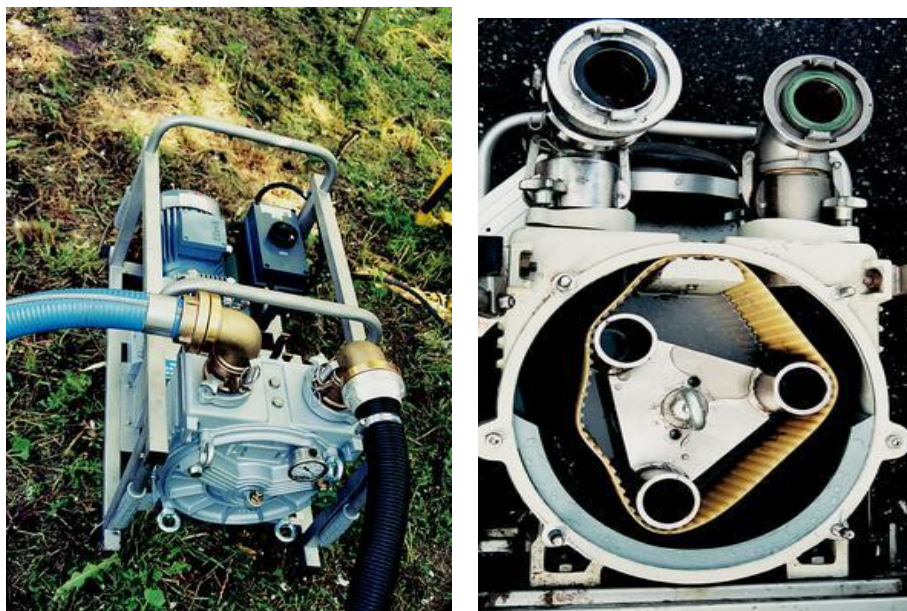
Versatile application on the water level, Easy to transfer - collapsible construction, can be successfully used with the vacuum pump and peristaltic pump system, Easy manipulation, trouble-free operation, Automatic regulating of skim edge, Flow capacity 100 - 400 l/min, Floating hose 10 m



**Fig 12** Application of Oil Skimmer (<https://www.reoamos.sk/sorbenty/c-1/>)

**Peristaltic pump and its application** (Fig 13) are followed:

Repump of water contaminated with petroleum substances, Does not generate water emulsions of hazardous substances, Pump for oil skimmer from water surface, Pump can tick-over, High chemical resistance of the pump, Engine: electrical, petrol, hydraulic, Rotation speed: 650 - 3 600 rotation/min. Power: 5 000 - 20 000 l/hour and Height of suction: 0 - 8 m



**Fig 13** Application of Peristaltic pump and its application (<https://www.reoamos.sk/sorpcne-norne-steny/c-247/>)

## Conclusion

This article is written with a view of the fireman, who encounters the problem of environmental accidents in his practice. Since this topic is very extensive, I have devoted myself in this contribution to only the general knowledge that has brought the reader to the issue.

The main message for the practice is that: environmental accidents are part of daily life and therefore do not need to be overlooked but need to be prepared for them. It is necessary to know your intervention space, you need to identify the platforms for intervention, to buy means to eliminate environmental accidents and then to practice and practice and to practice again. Only a ready fireman wishes luck.

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