Translation

INSTRUCTION SHEET

Floating Oil Barriers for Inland Waters

On requirements for, and tests of, prefabricated floating oil barriers for inland waters. Official notification of the Federal Minister for the Environment, Nature Conservation and Nuclear Safety (BMU) of 30 June 1992 – WA I 3 – 23074/18 – Joint Ministerial Gazette (GMBl) 33/1992, p. 802.

This publication replaces the instruction sheet for the use of prefabricated floating oil barriers on inland waters (Merkblatt für den Einsatz vorgefertigter, schwimmender Ölsperren auf Binnengewässern (last revision: 1/1992). Official notification of the Federal Minister for the Environment, Nature Conservation and Nuclear Safety (BMU) of 31 August 1992 – WA I 3 – 23074/18 – Joint Ministerial Gazette (GMBl) 33/1992, p. 814.

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1 General information

This information sheet is intended for personnel involved in combating oil spills in inland waters; it provides information to help such personnel use oil barriers effectively. Please note that manufacturers' instructions should also be followed. In addition to describing the practical use of oil barriers, the information sheet also focuses on preparatory technical measures.
Attention is called to the official notification of the Federal Minister for the Environment, Nature Conservation and Nuclear Safety (BMU) of 30 June 1992 (Joint Ministerial Gazette (GMBl) 1992, p. 802) "Requirements for, and tests of, prefabricated floating oil barriers for inland waters", on which the present information sheet is based. That official notification contains information about materials and material requirements, hydraulic principles and conditions for testing oil barriers.

2 Area of application

This information sheet describes retention of mineral oil and mineral-oil products floating on the surface of standing and flowing inland waters. It is also applicable to retention, with barriers similar to those described here, of other floating pollutants that behave similarly to oil.

It should be noted that other types of oil barriers, in addition to mobile oil barriers, are also used. These include floating barriers, non-mobile barriers and permanently installed oil barriers such as stop gates and other barrier types.

3 Preparatory measures

Use of oil barriers, if it is to be effective, must be based on emergency alert and response plans that have been prepared in advance. Preparation of such plans should comply with the principles described in No. 4.
A response plan should contain the following details:

- Bodies of water in the area in question
- Sites of potential hazards
- Suitable deployment points, taking the following into account:
  - The flow direction and rate
  - The breadth and depth of the water body and the characteristics of its banks
  - The available time for response (from alert to deployment)
  - The access routes, work areas and access to the water itself

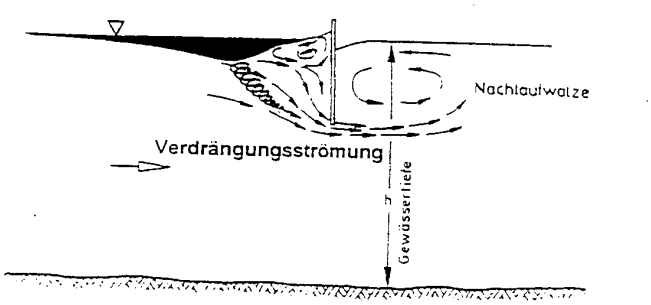
- Additional information:
  - Aids for deployment and placement (such as boats, cables, anchors, gripping equipment, lifting equipment)
  - Collection (pumping, binding, interim storage)
- Mandatory safety and accident-prevention regulations for response near and on the water:
  - Safety (explosion and fire prevention)
  - Wearing of life vests

The emergency response plan must be prepared in co-operation with all authorities and agencies responsible for damage prevention and control.

4 Basic principles

4.1 Damming of oil, and oil flow under barriers

When confronted with a barrier, oil tends to dam up unevenly. The oil layer is thickest not directly at the barrier itself, but in the head wave. This is where suction equipment should be placed. The figure shows how oil with an approach speed of more than 0.3 m/s can escape under an oil barrier when oil drops break off from the head wave.

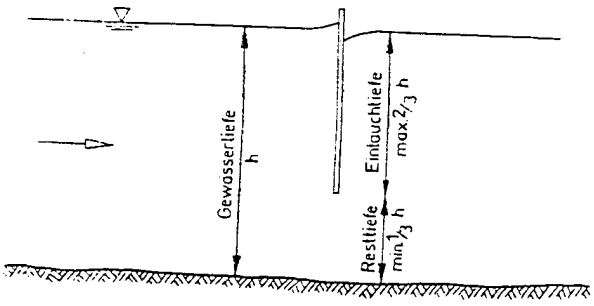


[Verdrängungsströmung = displacement current
Nachlaufwalze = wake circulation Gewässertiefe = water depth]
Figure 1: Damming of oil with an oil barrier and oil flow under the barrier

4.2 Immersion depth

Commercial oil barriers for inland waters have immersion depths of 0.2-0.4 m. When barriers are used in shallow flowing waters, it must be ensured that the cross-section of the water flow continuing under the oil barrier is not reduced too strongly, so that the flow under the oil barrier does not become too fast. About 1/3 of the original water depth should remain under the barrier.

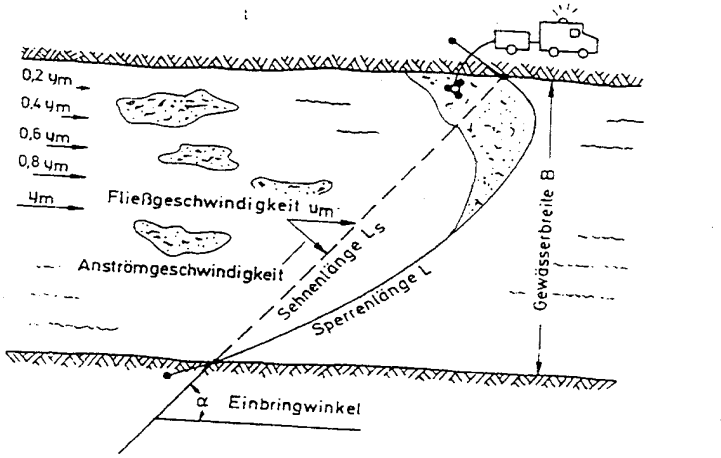
<u>Note:</u>
When choosing the site for the barrier, determine how much depth will remain once the barrier is in place



*[Gewässertiefe = water depth
Eintauchtiefe = immersion depth*

Resttiefe = remaining depth]
Figure 2: Immersion depth

4.3 Placement angles, barrier lengths and anchoring tension for various flow rates



[Fließgeschwindigkeit = flow rate
Anströmgeschwindigkeit = effective approach flow rate
Sehnenlänge = chord length
Sperrenlänge = barrier length
Einbringwinkel = deployment angle
Gewässerbreite = width of river or stream]
Figure 3: Definition sketch

For a floating oil barrier to be effective, the approach flow rate at right angles to the barrier must not exceed about 0.3 m/s. As the water's approach flow rate increases, the oil barrier's ability to trap oil is reduced by oil underflow.

The effective approach flow rate can be reduced by placing the oil barrier at an angle to the direction of flow ($\alpha<90^\circ$). The smaller the angle α, the lower the effective approach flow rate.

When the barrier is placed at an angle, it diverts the approaching oil towards the bank, where it can be trapped and skimmed off more effectively. For this reason, this type of placement is always recommended.

To ensure that the tension on the barrier and its anchors does not become too large, it is recommended that the barrier not be pulled too tight; instead, it should be left loose enough so that the ratio between the actual barrier length L and the shortest distance between the anchor points (chord length L_s) is between 1.15 and 1.45, depending on the placement angle.

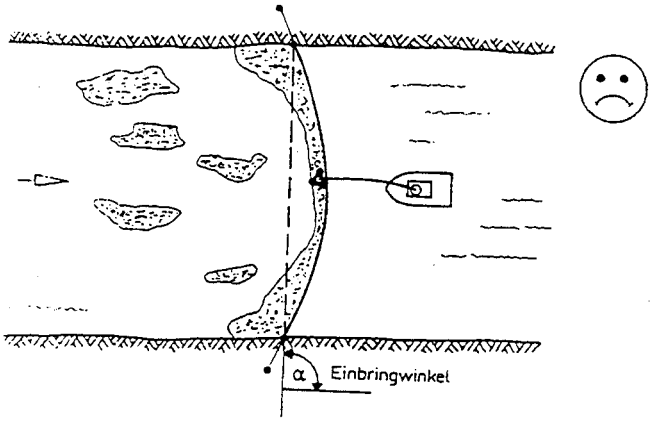
Recommended length ratios

for α = 90°-70° : $L/L_S = 1.45$
α = 70°-60° : $L/L_S = 1.25$

α < 60° : L/L_S = 1,15

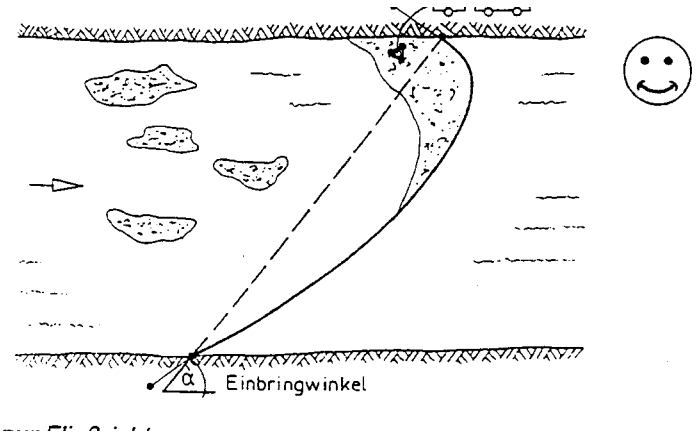
All of the following sketches are schematic and intended only as sample illustrations.

<u>Note:</u> *In flowing waters, never place a barrier at right angles to the direction of flow.*



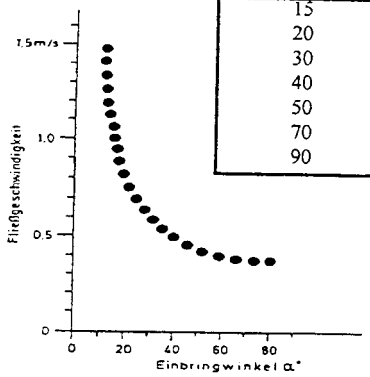
[Einbringwinkel = deployment angle]
Figure 4: Oil barrier at a right angle to the direction of flow

<u>Note:</u>
The faster the water is flowing, the smaller the placement angle α should be.
The oil should always be diverted to the bank with the smaller rate of flow (cf. figure 8).
Arriving oil should always be skimmed off immediately.



[Einbringwinkel = deployment angle]
Figure 5: Oil barrier at an angle to the direction of flow

Figure 6 shows the required placement angle
<u>Note:</u>
Flow rates > 0.5 m/s necessitate placement angles α < 50°

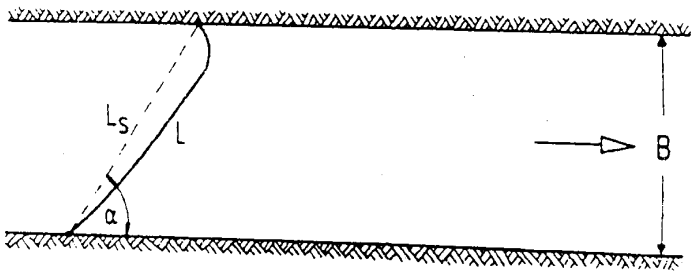


Einbringwinkel α	Fließ-geschwindigkeit m/s
15	1,50
20	1,00
30	0,70
40	0,55
50	0,45
70	0,40
90	0,38

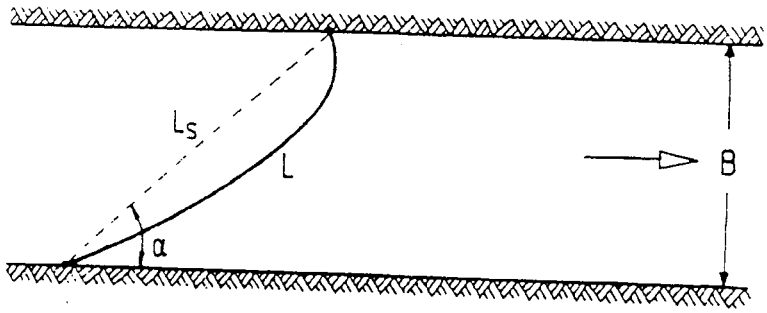
[Einbringwinkel = deployment angle
Fließgeschwindigkeit = flow rate]
Figure 6: Placement angle as a function of flow rate

The following lists provide guideline values for the placement angle α, the barrier length L (m) and the tension F (N) at the anchor points, as a function of the water-body width B (m) (10 N correspond to a weight of 1 kg); the figures are provided for four different flow-rate ranges. The tension figures are based on an assumed oil-barrier immersion depth of 30 cm.

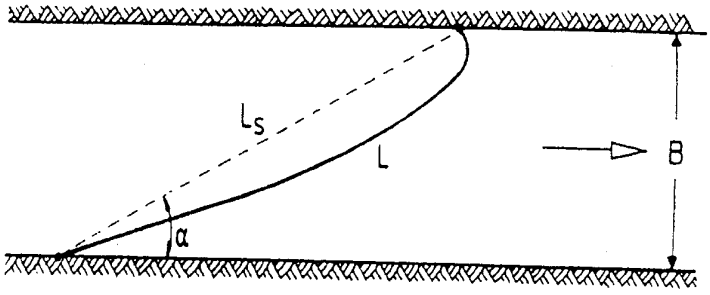
Compliance with the relevant listed placement angle ensures that the approach flow rate does not exceed 0.3 m/s.



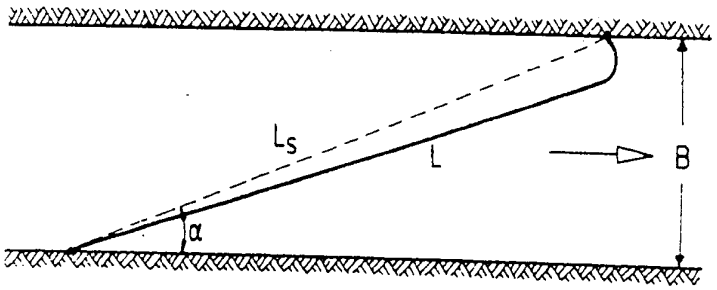
Flow rate	0-0.5 m/s
Placement angle	α ~ 45°
Barrier length	L ~ B x 1.5 (m)
Tension	F ~ L x 60 (N) or
	F ~ B x 90 (N)



Flow rate	0.5-1 m/s
Placement angle	α ~ 30°
Barrier length	L ~ B x 2 (m)
Tension	F ~ L x 60 (N) or
	F ~ B x 120 (N)



Flow rate	1-1.5 m/s
Placement angle	α ~ 20°
Barrier length	L ~ B x 3 (m)
Tension	F ~ L x 60 (N) or
	F ~ B x 180 (N)



Flow rate	1.5-2.0 m/s
Placement angle	α ~ 15°
Barrier length	L ~ B x 4 (m)
Tension	F ~ L x 60 (N) or
	F ~ B x 240 (N)

Bild 7: Placement angle - barrier length - tension

4.4 Deployment in river bends

In river bends, the oil barrier must be installed in such a manner that arriving oil is diverted to the bank with the slowest flow rate.

Note: The oil-removal site should always be located on the inside of the river bend. While inlets and other still-water zones should always be used wherever possible, biologically valuable areas of the river must be protected.

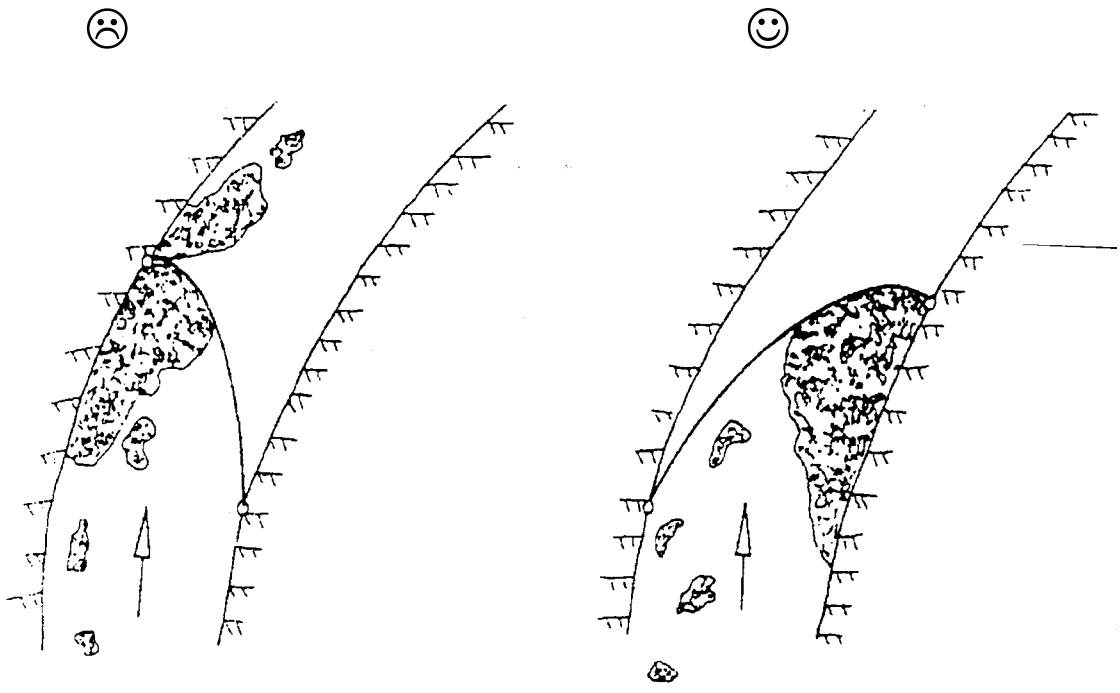
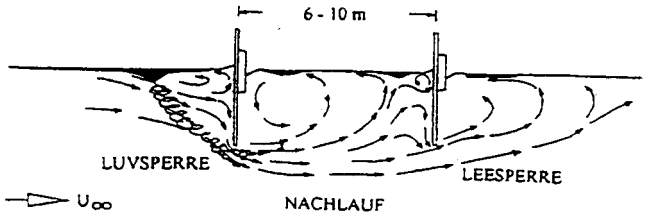


Figure 8: Installation in river bends

4.5 Arrangements of more than one barrier

Floating-oil retention can be improved by placing several oil barriers in series. The space between two such oil barriers in series should be at least 6 m, to ensure that oil that has flowed under one barrier has a chance to resurface in front of the next downstream barrier.

Note: Oil that has overcome a first barrier will not be trapped if the distance to the next barrier is too small.



[Luvsperre = upstream barrier
Leesperre = downstream barrier
Nachlauf = flow and circulation]
Figure 9: Arrangement of several barriers in series

5 Deployment of oil barriers

Oil barriers must always be adjusted to the local conditions (flow rate, water depth, water breadth, etc.). Access routes and bank characteristics must be suitable for placement and anchoring and thus may have to be prepared in advance. The necessary tools for such preparation must be available.

5.1 Floating into position

The following procedure, which is referred to as "floating into position", has proven successful in fast-flowing waters with flow rates ≥ 0.5 m/s. The deployment tools for this procedure may include winches, gripping devices and boats.

1) Anchor point 1
2) Anchor point 2
3) Anchor point 3
4) Towing cable
5) Auxiliary cable
6) Planned barrier length

Step 1

- Deploy oil barrier parallel to the bank
- Anchor deployed barrier at anchor point 1
- Secure barrier at anchor point 2

Step 2

- Attach towing cable 4 to the barrier (point 2) – release connection at point 2
- Tension towing cable 4
- Pull oil barrier to anchor point 3

Step 3

- Anchor oil barrier at anchor point 3
- Release towing cable 4
- Oil barrier ready for operation

To retrieve oil barrier:

- Release anchor point 3
- The oil barrier floats to the opposite bank

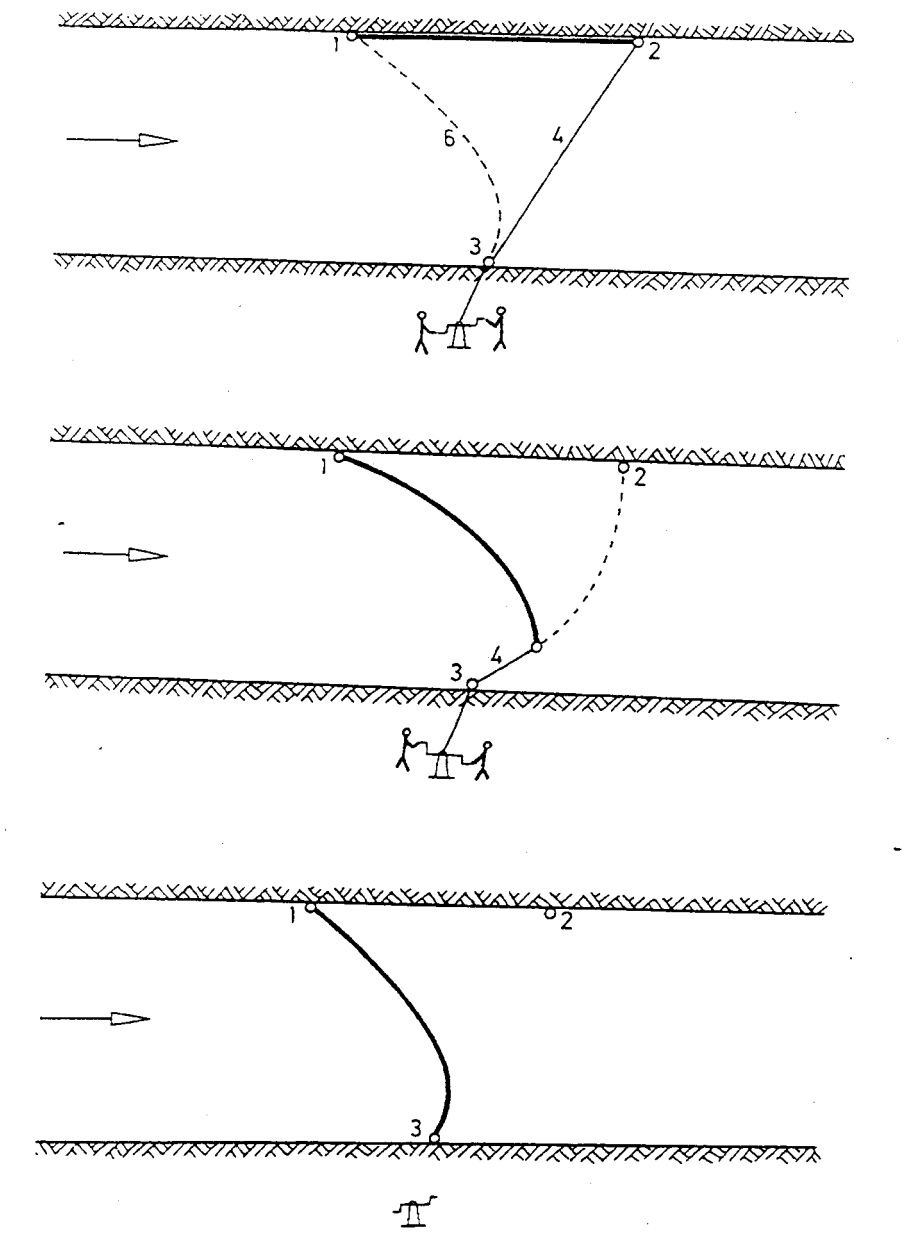


Figure 10: Installation in fast-flowing waters, against the current

From a position parallel to the bank, an oil barrier can also be pulled with the current to the opposite bank. On the other hand, if the current is strong, this should be done only with the barrier extended, to ensure that current forces can be kept under control.

Step 1:

- Deploy oil barrier parallel to the bank and secure it at anchor point 1 with an easily released connection
- Tension towing cable 4
- Tension auxiliary cable 5

Step 2:

- Pull oil barrier and auxiliary cable 5 to anchor point 2
- Adjust towing cable 4 at the same time

Step 3:

- Anchor oil barrier at anchor point 2
- Release towing cable 4 and auxiliary cable 5
- Oil barrier is now operational

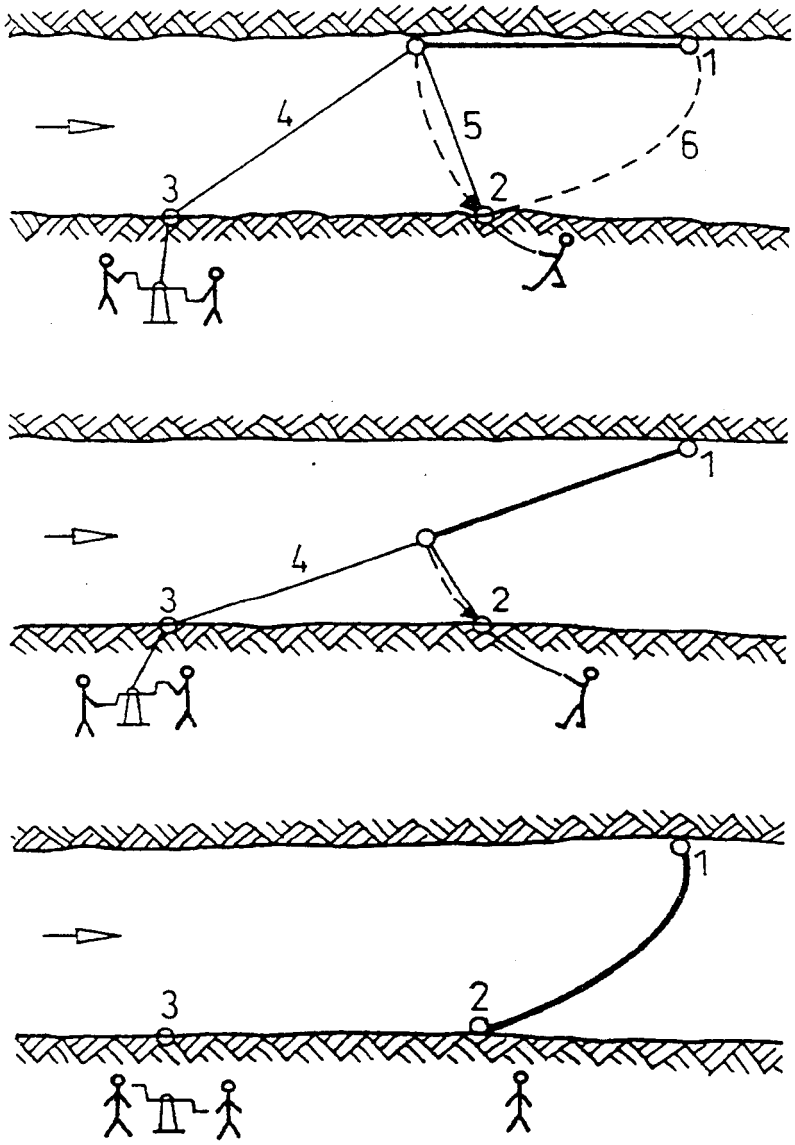


Figure 11: Deploying a barrier in fast-flowing water, with the current

Oil barriers can easily and safely be deployed at prepared locations with the help of wire cables stretched at an angle over the water. In this technically more complicated method, the cable withstands the current forces.

5.2 Anchoring

On the banks, the oil barrier can be anchored to available fixed points (trees, snubbing posts) or stakes, anchor plates etc.. The strength of the tension acting on the anchor (no. 4.1) should be kept in mind.

Note: Vehicles should never be used as anchor points.

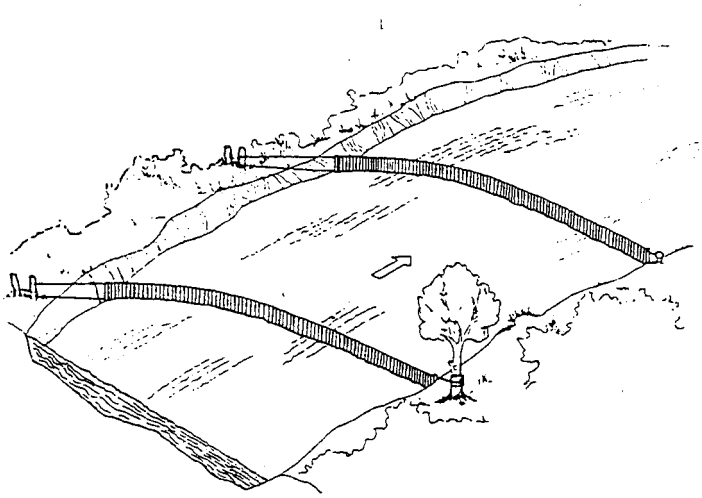


Figure 12: Anchoring

5.3 Sealing barrier ends at banks

The ends of the barrier should be sealed at the banks. This can be done by burying the ends of the barrier in the banks, by applying sheeting or by adding additional barrier sections. In addition, the banks must be protected from oil pollution (for example, with special mats).

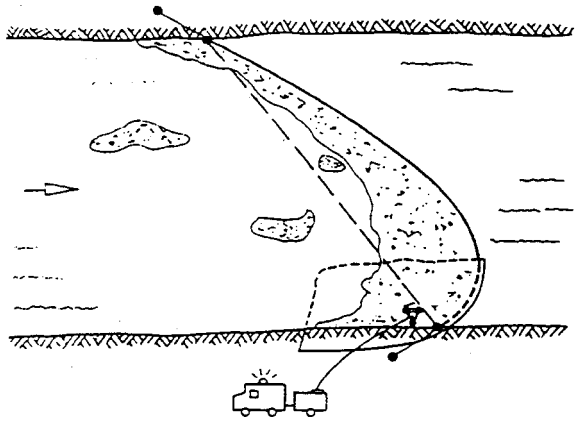


Figure 13: Sealing the oil barrier at the banks

6 Exercises

Frequent exercises must be carried out to ensure that barriers can be deployed quickly and effectively, even under unfavourable conditions.

Any exercises and tests with oil barriers on water bodies must be announced in advance to the relevant lower-level water authority. In cases involving Federal waterways, the responsible authority in charge of waterways must also be informed.