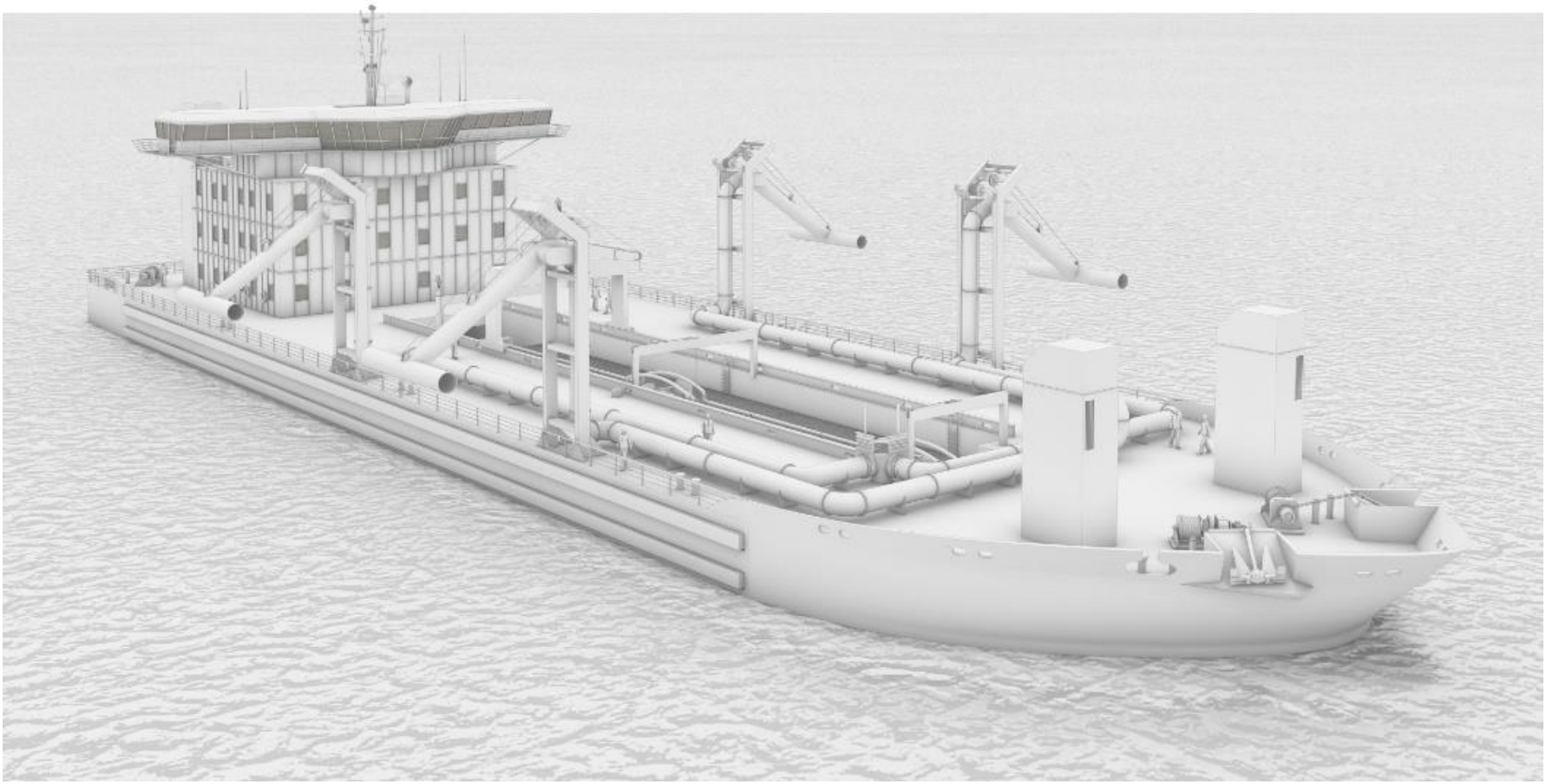
Patented
and
utility model-protected dredger with the associated methodology

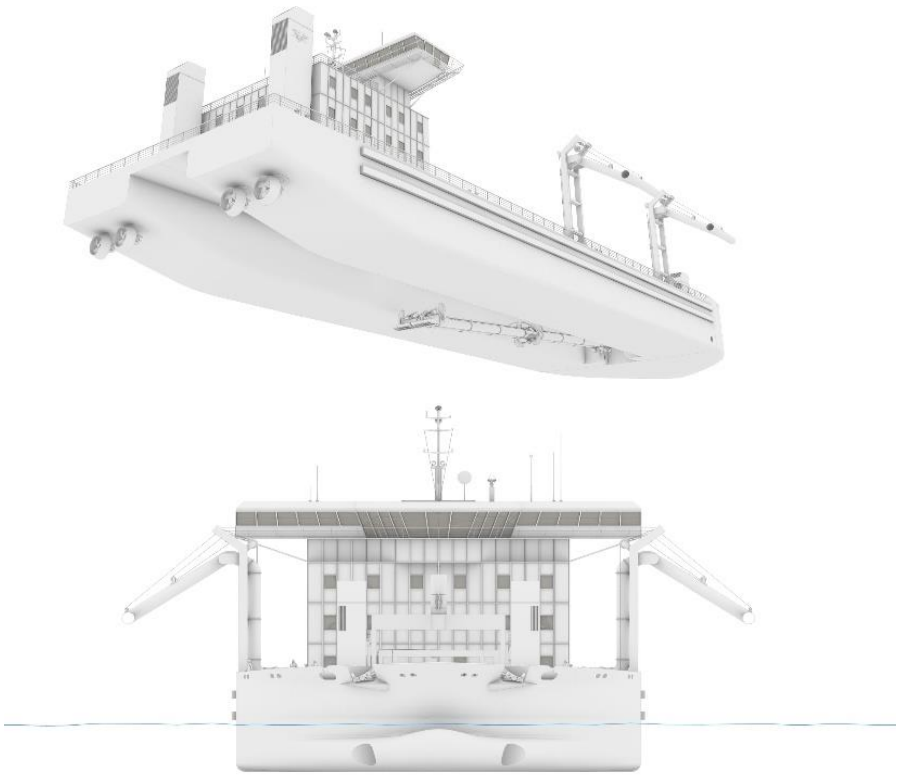
EP 2 236 679 B1
DE 20 2022 100 959 U1

Suction dredger without cargo hold



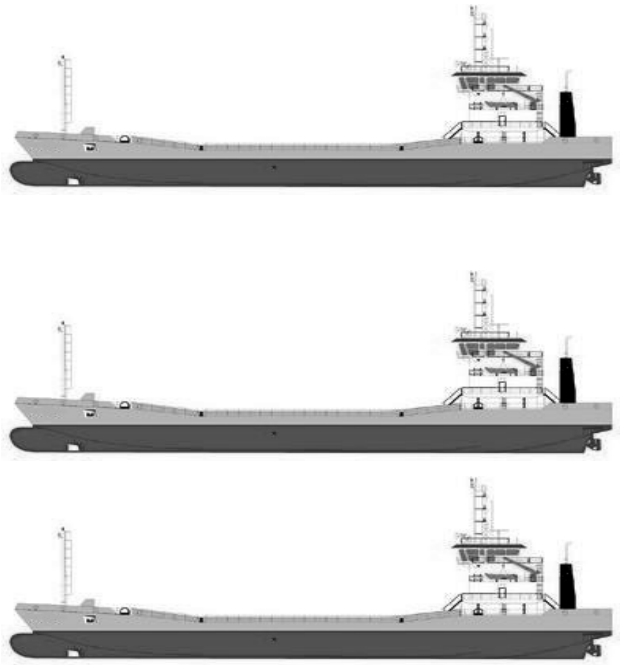
The fleet

Suction dredger without cargo hold (approx. 4.00 m draft)



2 barges 3,700 m³ (5.80 m draft)

1 barge 2,000 m³ (4.50 m draft)



Suction dredger with cargo hold

Current procedure

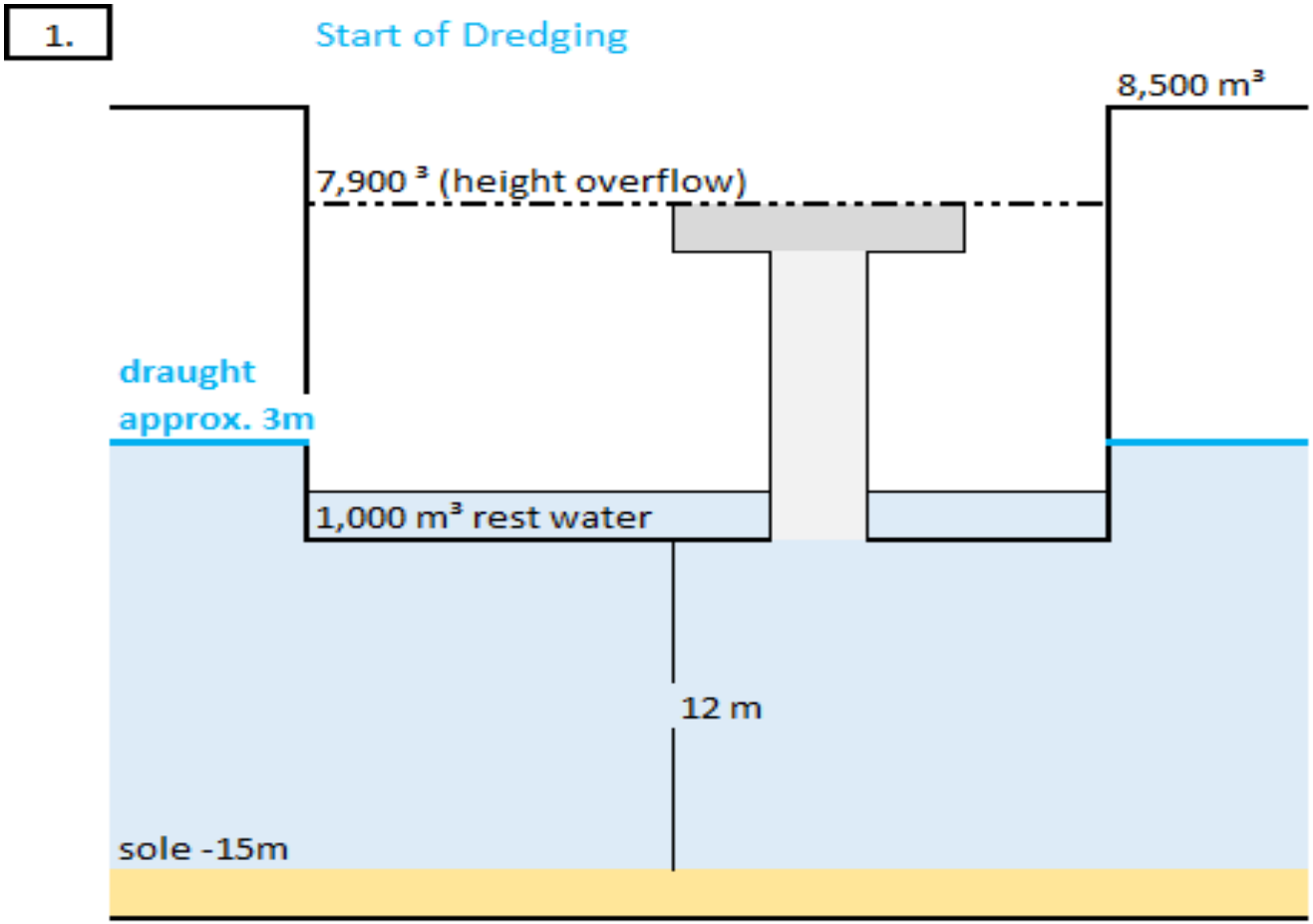
Previous methods

So-called “hopper dredgers“ have been used for maintenance dredging on the Elbe for over 50 years. Hopper dredger soak up and then transport the load to the delivery point and relocate it.

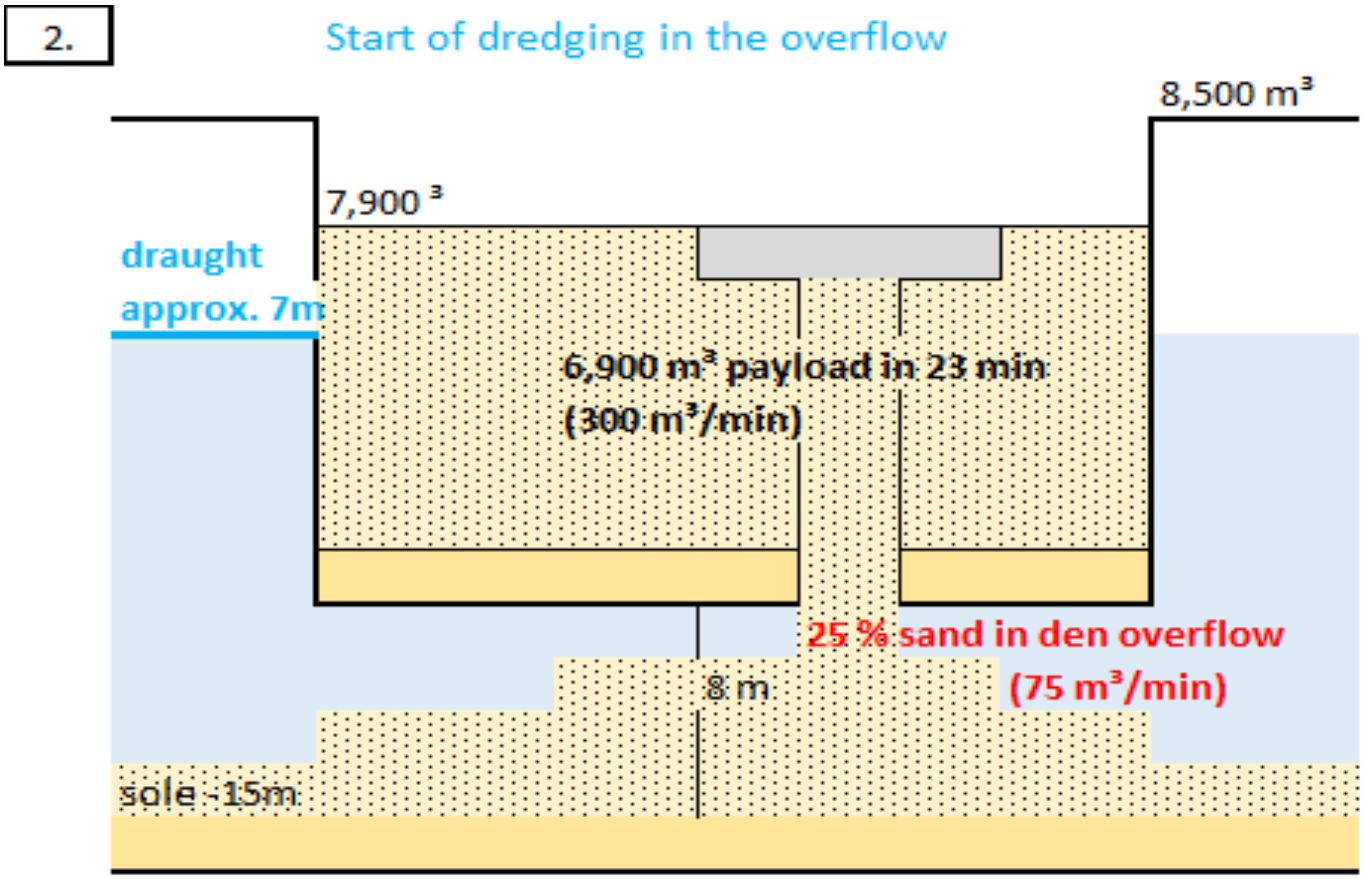
Furthermore so-called water injection devices are also used on the main Elbe. With this method, mainly single shoals are processed. Because these machines only work the tips of the dredging sites, success is short-lived.

Both methods are extremely expensive and cause massive damage to the environment.
The following slides explain how expenses, environmental impact and effectiveness can be improved.

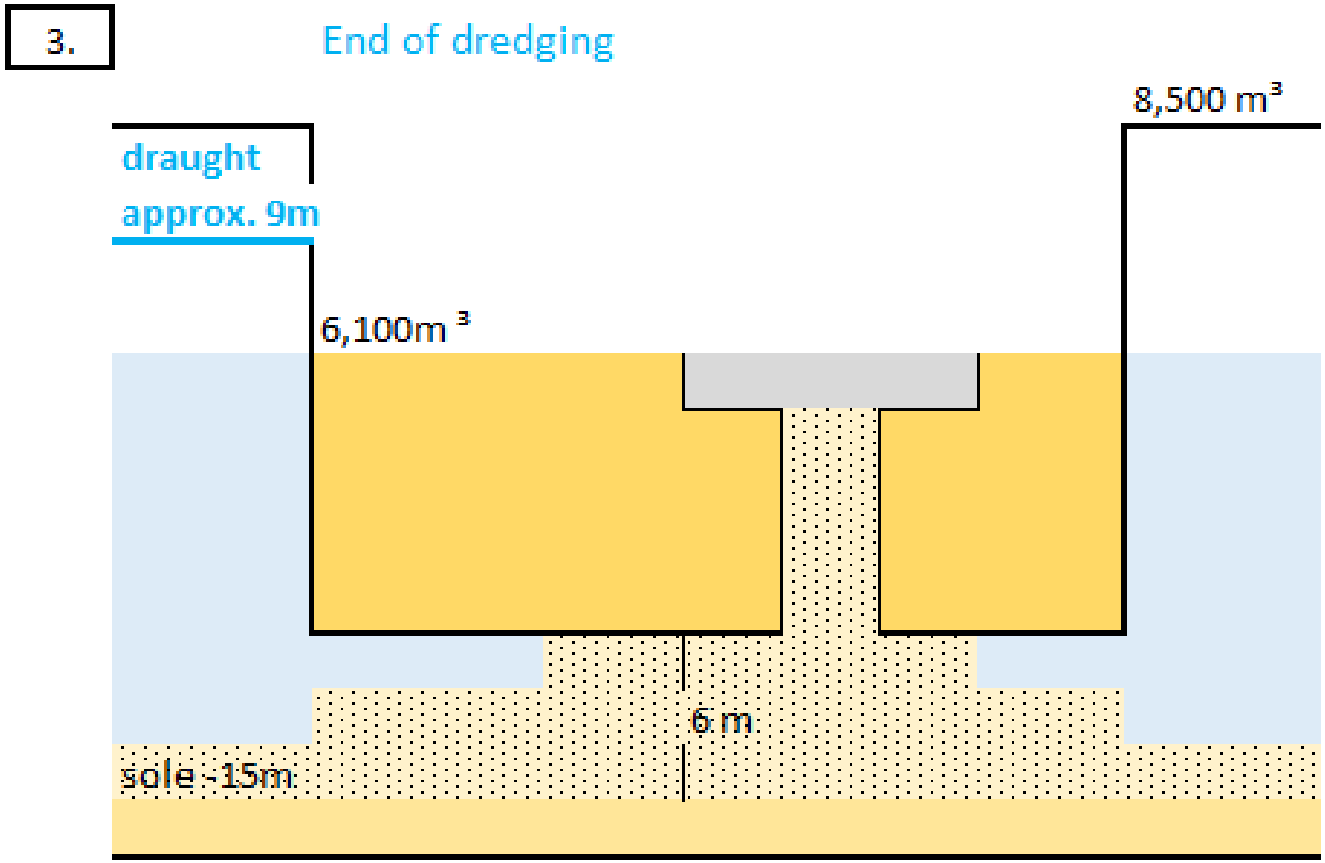
Workflow " hopper dredger"



Workflow „hopper dredger“



Workflow „hopper dredger“



"Turn-round times hopper dredger" – conveyance path 27 km

Empty run:	80 min
Dredging with maneuver time:	115 min
Maneuver time:	24 min
Full ride:	80 min
Flaps:	15 min
Turn-round time:	290 min

- Capacity = ca. 5 turn-rounds per day ~ 30,500 m³

Loading until overflow:	22 min
Dredging without maneuver time:	91 min
Loading in overflow:	69 min

Dredging route:	2.50 km
Conveyance path:	27.00 km

Whereabouts of dredged sediments “ hopper dredger“

Dredge pump class 5 (300 m³/min)

When dredging work starts, there is still around 1,000 m³ of water in the cargo hold. After approx. 23 minutes of loading time (6,900 m³) the dredged water-sand-mixture begins to flow into the overflow. Thus, the overflow is at height of 7,900m³ hopper volume.

With an effective dredging time of 69 minutes, 20,700 m³ of water-sand- mixture flow back into the river through the overflow.

The average sand content is 25% = 5,175 m³.
(In the case of fine sand, 40% is to be expected)

Conclusion:

This means that 27,600 m³ of water-sand-mixture has to be dredged up for each load. 6,100 m³ of solids remain in the hold. 5,175 m³ are flushed back through the overflow in the water-sand-mixture and have to be dredged up again.
For 6,100 m³ of cargo, a turbidity cloud is generated for 69 minutes.
In addition, about 25 minutes when relocating (liquefaction and dumping).

Fuel consumption and CO^2-emission " hopper dredger"

The daily consumption of marine diesel is around 33,000 l /day.

A " hopper dredger" thus consumes around 6,600 liters of marine diesel per turn-round.

Calculation of turn-round:

6,600 l * 2.65 kg = 17,490 kg CO^2
6,600 l * 1.15 kg = 7,590 kg water

Calculation day (approx. 5 turn-rounds):

5 turn-rounds approx. 33,000 l * 2.65 kg = 87,450 kg CO^2
5 turn-rounds approx. 33,000 l * 1.15 kg = 37,950 kg water

Expenses " hopper dredger"

The expenses for dredging work are structured as follows.

(assumed mean values)

Digging soil per m³		= approx. 1.20 €
Conveying soil per m³		= approx. 1.80 €
Total		= approx. 3.00 €
Expenses per turn-round	6,100 m³	= approx. 18,300 €
Expenses per day	30,500 m³	= approx. 91,500 €

Capacity " hopper dredger"

Calculation for 1,000,000 m³ order quantity

Turn-rounds: **164**

Days: **32.8**

Conveyance path: **8,856 km** Dredging line: **410 km**

Turbidity cloud dredging: 11,316 min
Turbidity cloud transport: 3,280 min

10.14 days

Marine diesel: approx. 1,082,400 liter

CO^2 emission: approx. 2,868,360 kg

Expenses: approx. 3,000,000 €

Turbidity cloud " hopper dredger"

Turbidity cloud mixture at 1,000,000 m³ order quantity

Dredging: 164 loads times 20,700 m³ =	3,394,800 m³
Flaps: 164 loads times 6,000 m³ =	984,000 m³
Total	**4,378,800 m³**

Dredged sediments that flow back into the fairway 25%

5,175 m³ are returned per charge

164 loads times 5,175 m³ = 848,700 m³

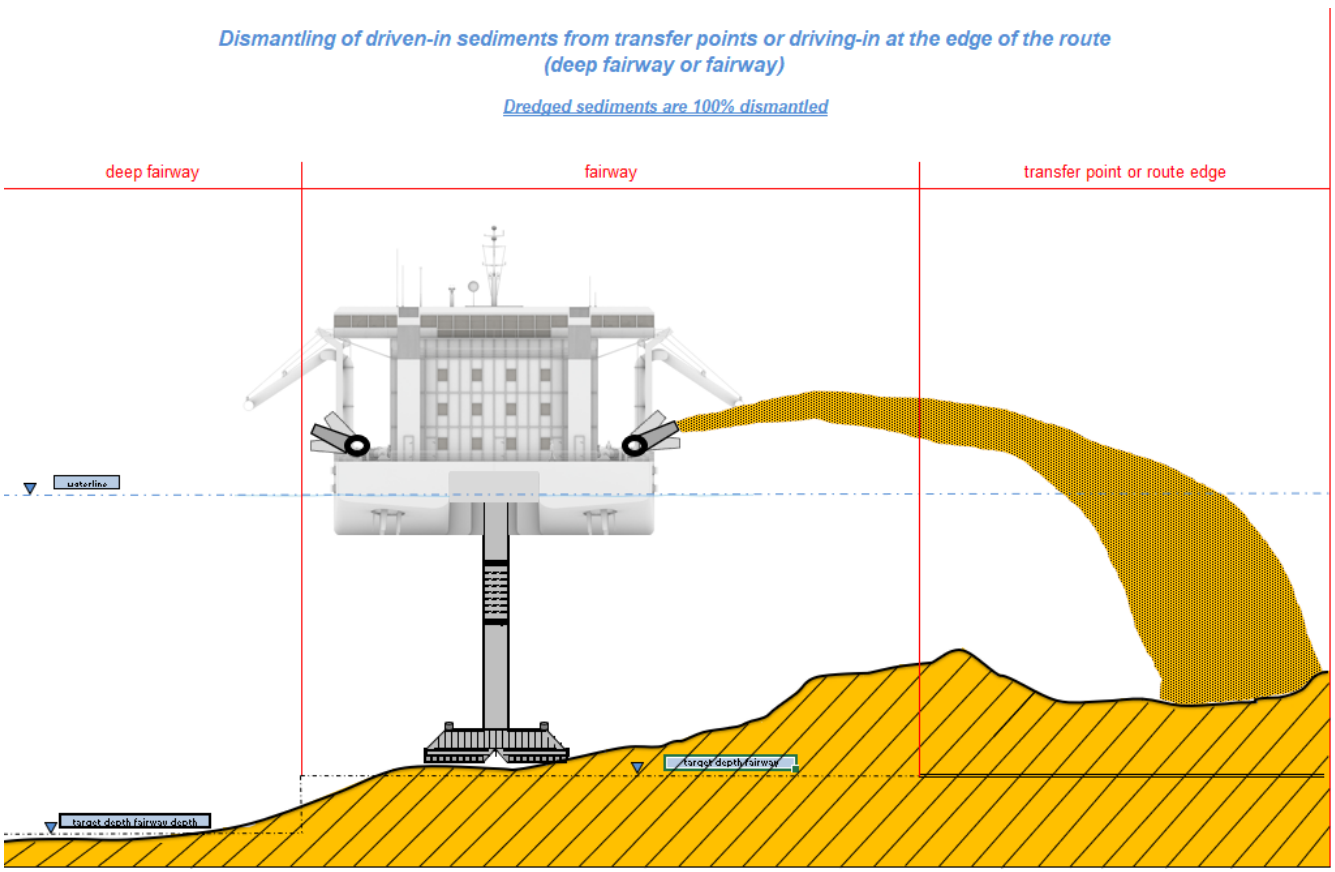
Again and again, these sediments are unecessarily dredged up, mixed up and transported and pollute the ecosystem.

Suction Dredger without cargo hold

Rainbow - Procedure

Rainbow Concept

With this concept, 2 to 4 million m³ per year can be processed on the Elbe



With the rainbow process, the sediments are picked up from the bottom of the water and conveyed back directly through the rainbow nozzle on the side of the ship up to a distance of 150 m.
In contrast to a hopper dredger:

1. Unnecessary turbidity cloud from the overflow.
2. Conveyor route to the transfer point, transfer and empty run to the excavator site.
3. CO^2- emission
4. Unnecessary expenses!

Rainbow Concept

Rainbow Concept

- Sediment transport system for suction dredgers – (application area up to 100m width in the deep fairway)

The aim of this invention is to make river maintenance dredging less expensive, more effective, more environmentally friendly and more sustainable.

With the rainbow concept, the dredged sediments are immediately directed to the Rainbow nozzle (starboard or port) attached to the dredger‘s side. Depending on the selection of the excavator pump, the nozzle‘s diameter and the degree of the nozzle‘s adjustment, a throw distance of up to 150m can be achieved here.

Compared to a hopper dredger this system drastically reduces many negative effects.
Between 2 and 4 million m³ of sediment can be processed annually on the Elbe with this system.
This system can also be installed on “hopper dredgers“ !

The “ Osteriff“ hopper dredger would be a good prototype.

Turn-round times - conveyance path omitted

Empty run:	omitted
Dredging with maneuver time for 6,100 m³	45 min
Maneuver time :	4 min
Full ride:	omitted
Flaps:	omitted
Turn-round time:	45 min

Capacity = theoretically approx. 32 turn-rounds/day ~ 195,200m³

Loading until overflow:	omitted
Dredging without maneuver time:	41 min
Loading in overflow:	omitted
Dredging line:	approx. 2.50 km
Conveyance path:	omitted

Whereabouts of dredged sediments

Dredge pump Class 5 (300 m³/min)

With this method, the sediments are picked up from the bottom and returned 100% through the rainbow nozzle outside of the deep fairway back to mudflat edges or embankments.

A dredging time 45 minutes (including maneuvering time) is required for a solids quantity of 6,100 m³. For this, a water-sand-mixture of 12,300 m³ has to be dredged up.

Conclusion:
12,300 m³ of water-sand-mixture have to be dredged up for each theoretical load.

For 6,100 m³ of theoretical load, a turbidity cloud is generated for 41 minutes.

Fuel consumption and CO^2- emission

The daily consumption of marine diesel is around 33,000 liters per day. (same quantity as hopper dredger)

Thus, a suction dredger without cargo hold consumes approx. 1,031 liters per theoretical turn-round.

Calculation of turn-round:

1,031.3 l * 2.65 kg = 2,733 kg CO^2
1,031.3 l * 1.15 kg = 1,186 kg water

Calculation day:

32 turn-rounds approx. 33,000 l * 2.65 kg = 87,450 kg CO^2
32 turn-rounds approx. 33,000 l * 1.15 kg = 37,950 kg water

Expenses suction dredger without cargo hold

The expenses for dredging work are structured as follows

(assumed mean values)

Digging soil per m³ = approx. 1,30 € (more wear and tear)

Conveying soil per m³ omitted

Total = approx. **1,30 €**

Expenses per theoretical turn-round 6,100 m³ = approx. 7,930 €

Expenses per day 195.200 m³ = approx. 253.760 €

Capacity suction dredger without loading space

Calculation for 1,000,000 m³ order quantity

Turn-rounds: theoretically **164**

Days: **5,1**

Conveyor path: **0 km** Dredging line: **410 km**

Turbidity cloud dredging: 6.724 min
Turbidity cloud transport: 0.000 min
4.68 days

Marine diesel: **approx. 168,300 liters**

CO^2 emission: **approx. 445,995 kg**

Expenses: **approx. 1,300,000 €**

Turbidity cloud suction dredger without cargo hold

Turbidity cloud mixture at 1,000,000 m³ order quantity

Dredging: 164 theoretical loads times 12,300 m³ = 2,017,200 m³

Flaps: omitted

Total 2,017,200 m³

Dredged sediments that flow back into the fairway 0 %

No sediments have to be dredged up, mixed and transported again and again.

Bank protection remains in place!!!

The ecosystem is significantly less burdened by this method.

Comparison " hopper dredger" – rainbow concept - order 1,000,000 m³

	hopper dredger	suction dredger without cargo hold	
Reduction			
Turn-rounds:	164	164 theoretically	0
Days of operation:	32.80	5.10	27.7
Conveyance path km:	8,856	0.00	8.856
Dredging line km:	410	410	0
Turbidity mixture m³:	4,378,800	2,017,200	2,361,600
Proportion of solids m³:	848,700	0.00	848,700
Turbidity days:	10.14	4.68	5.46
Marine diesel l:	1,082,400	168,300	914,100
CO^2 emission kg:	2,868,360	445,995	2,422,365
Expenses €:	3,000,000	1,300,000	1,700,000

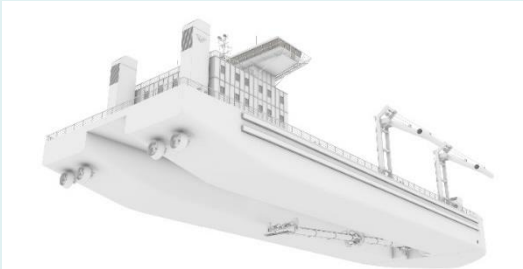
Suction Dredger without cargo hold

Procedure with 3 barges

Suction Dredger without cargo hold plus 3 barges

3 barges with a volume
of 2,000 m³ and 3,700 m³
for transport

Suction dredger without
crgo hold with barges
for transport



Concept with barges

With this concept, the suction dredger remains at the dredging site and the transport ships (barges) drive to the relocation points and deliver their cargo.

These barges have a cargo hold of 2,000 m³ or 3,700 m³ with a draught of 4.50m or 5.80m.

For the Elbe the best alternative would be 2 x 3,700 m³ and 1 x 2,000 m³.

For example, the barges can transport behind the existing folding points.
Furthermore the unused folding site Medemrinne can be approached again.

No new folding sites have to be generated for many years. The conveying distances and the associated costs can be drastically reduced.
Likewise the environmental impact.

Concept with barges 27 km conveyance path

Turn-rounds

Turn-round time barge: 255 min — 5.6 loads / day

Capacity 3 barges: — 16.8 loads / day

Load m³

Capacity m³ 3,250 m³ times 16.8 — **54,600 m³ / day**

In comparison, hopper dredgers (8,500 m³) only have a daily capacity of approx. 30,500 m³. Monthly capacity could increase by 723,000 m³.

At times, 2 to 3 dredgers are used on the Elbe.

In combination with the rainbow method, the use of a 2nd or 3rd device might no longer be necessary.

Concept with barges Maintenance on German rivers

As an overall concept for maintenance dredging, 2 suction dredgers without cargo hold and 6-8 barges for 4 rivers (Port Hamburg) are recommended. In each of the main dredging areas of the Elbe and Weser, suction dredgers without cargo hold should be stationed. The barges can then be allocated to the individual rivers as needed. Possibly the port of Hamburg can also be included.

Sediment Transport Dredging

Replacement for Water Injection Devices

Sediment – Transport - Dredging

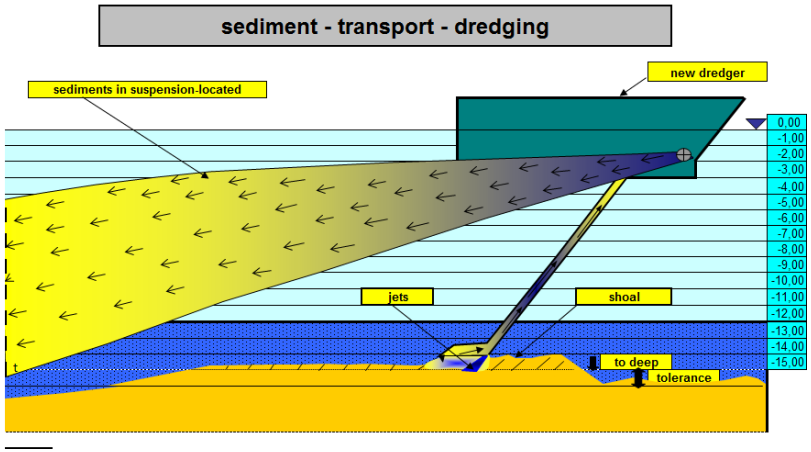
With this method, the currently active water injection devices in the main fairway on the Elbe should be replaced as completely as possible.

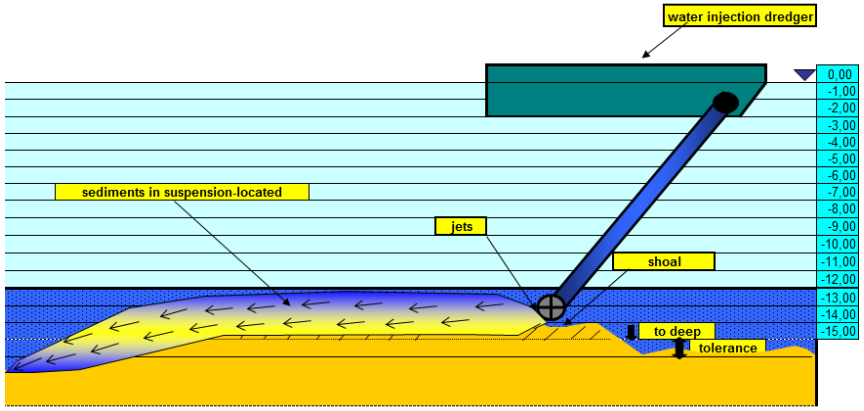
Since water injection devices only process the tips of the shoals to the target depth, the sediment-transport-dredging would be much more effective. Suction dredgers with and without cargo hold can detach the suction pipe and process the dredging site.

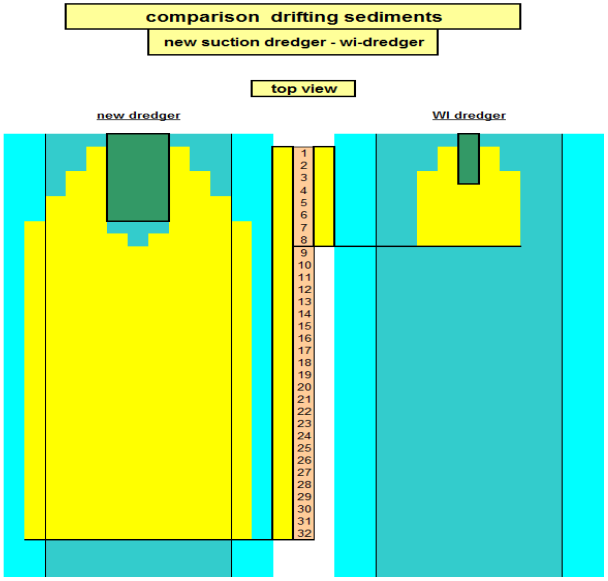
The sediments are flushed into the upper water layers at high pressure. The dredged sediments drift farther with the tidal stream. This method is much more sustainable.

NEW SUCTION DREDGER

Sediment – Transport - Dredging



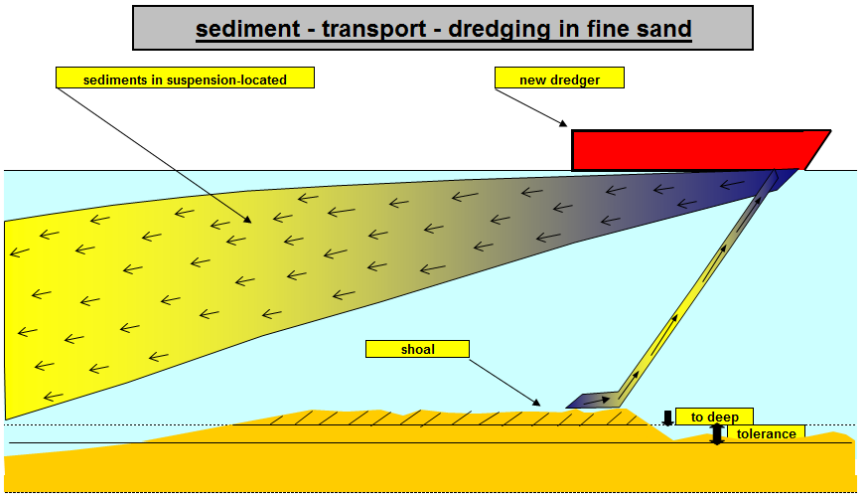


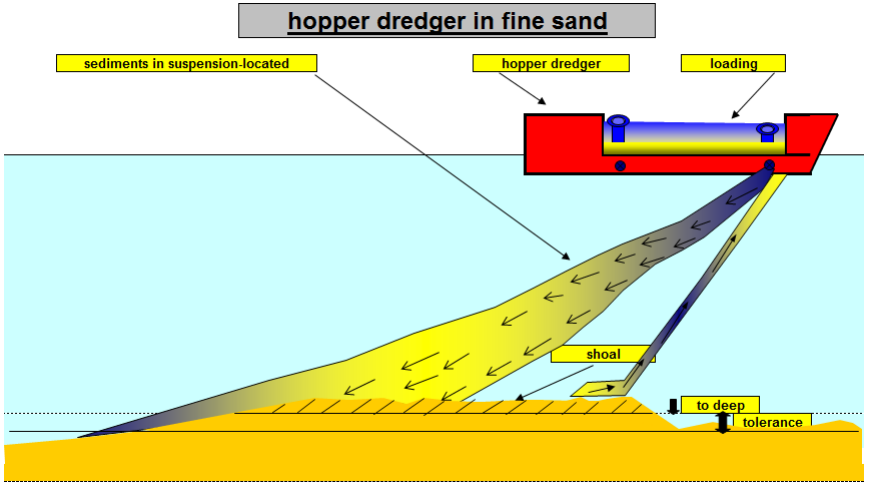


Sediment – Transport - Dredging

Sediment-Transport-Dredging
With this method, the sediments are picked up from the bottom and returned to the upper water layers at high pressure through the amob.
In this way the sediments can spread widely.

During dredging work in fine sand, hopper dredgers lose up to 2/3 of the sediment, which is flushed back into the water through the overflow.
These sediments are deposited again on the dredging field.





https://register.epo.org/application?number=EP10000914&lng=de&tab=main

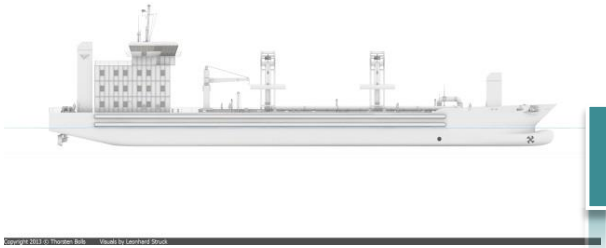
https://register.dpma.de/DPMAregister/pat/trefferliste

http://www.google.com/patents/EP2236679A2?cl=en

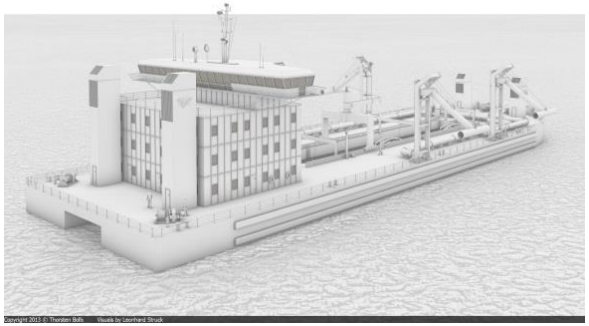
http://www.new-suction-dredger.com

https://www.linkedin.com/feed/?trk=guest_homepage-basic_nav-header-signin

https://www.german-dredger.com/



Thanks For Your Attention



http://www.new-suction-dredger.com/