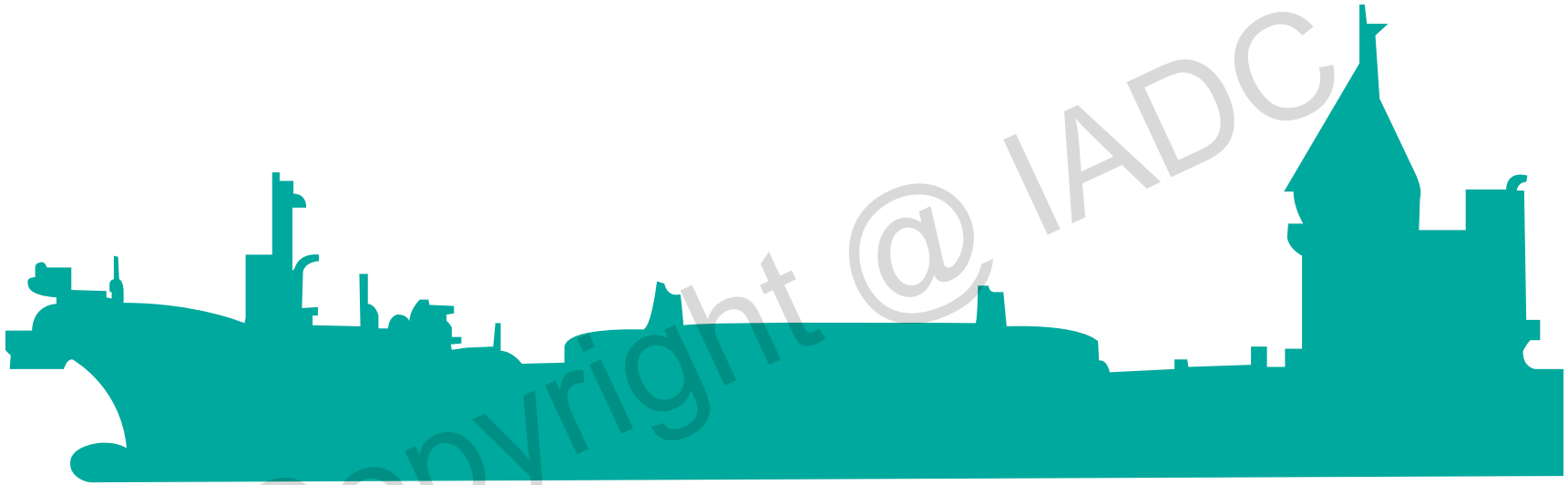
4. TRAILING SUCTION HOPPER DREDGER (TSHD)

EMBOODHOO LAGOON DEVELOPMENT – MALDIVES

TRAILING SUCTION HOPPER DREDGER

BASED ON HOPPER CAPACITY IN CUBIC METRES



Mega
30,000m³ and above

Jumbo
15,000-30,000m³

Large
8,000-15,000m³

Mid-size
4,000-8,000m³

Small
Under 4,000m³

TRAILING SUCTION HOPPER DREDGER

- Small & Jumbo, 975 m^3 & 23,000 m^3

- Mega >30,000 m^3

- Mid-size, 4000 m^3

MAIN CHARACTERISTICS

MOST IMPORTANT PARTS OF THE DREDGER

PROCESS DESCRIPTION

PRODUCTION LIMITING FACTORS

SOME CHARACTERISTICS FIGURES

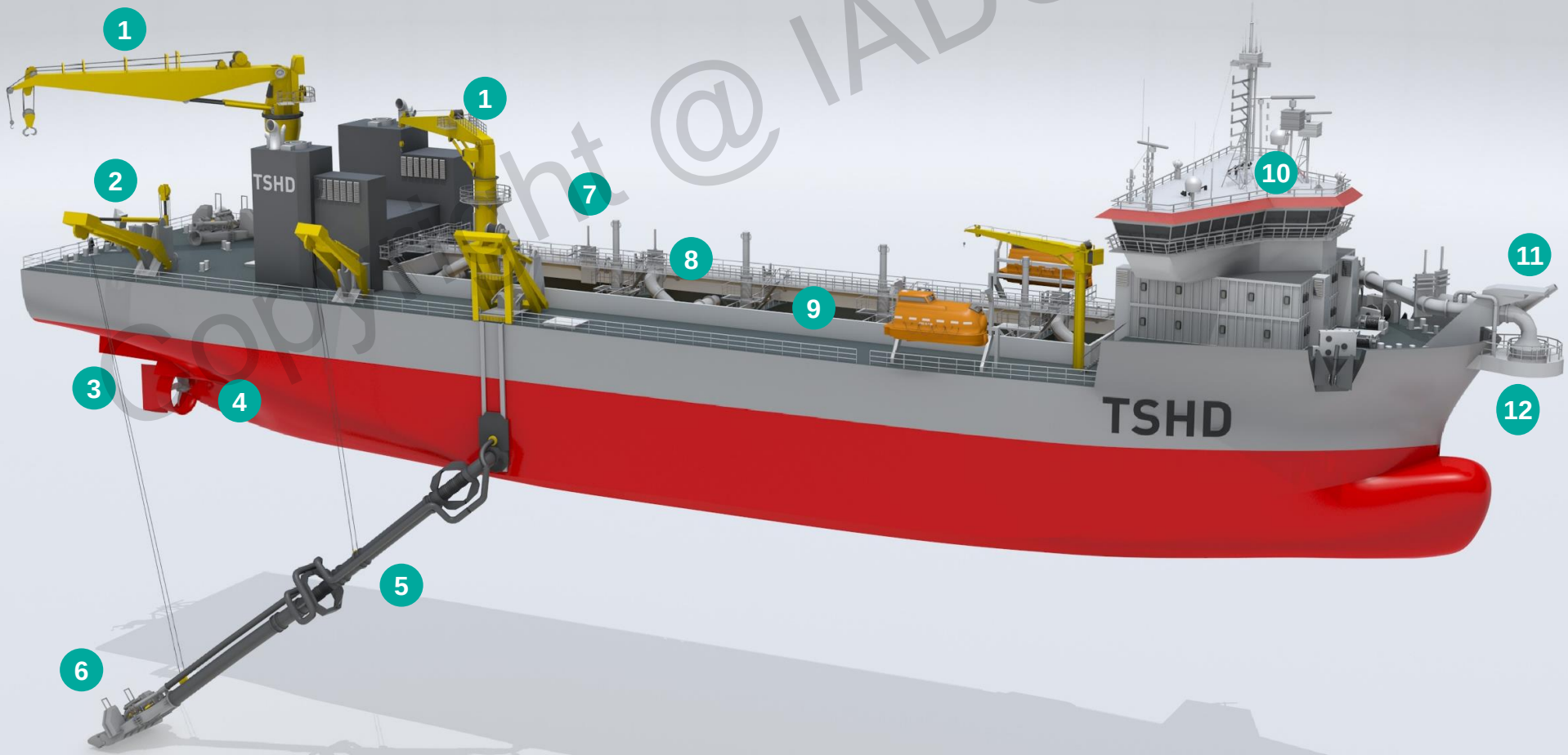
TRAILING SUCTION HOPPER DREDGER

MAIN CHARACTERISTICS

- Free sailing
- Self-propelled
- Self-loading when trailing
- Self-unloading or -discharging
- Seagoing or inland waterway vessel
- All “non-rock type” soils
- Relatively insensitive for waves
- Not vulnerable for shipping

TRAILING SUCTION HOPPER DREDGER

1. Service crane
2. Heave compensator
3. Propulsion
4. Engine room
5. Suction pipe
6. Drag head
7. Adjustable overflow
8. Loading chutes
9. Hopper
10. Wheelhouse
11. Rain bowing jet-nozzle
12. Bow coupling for pumping ashore

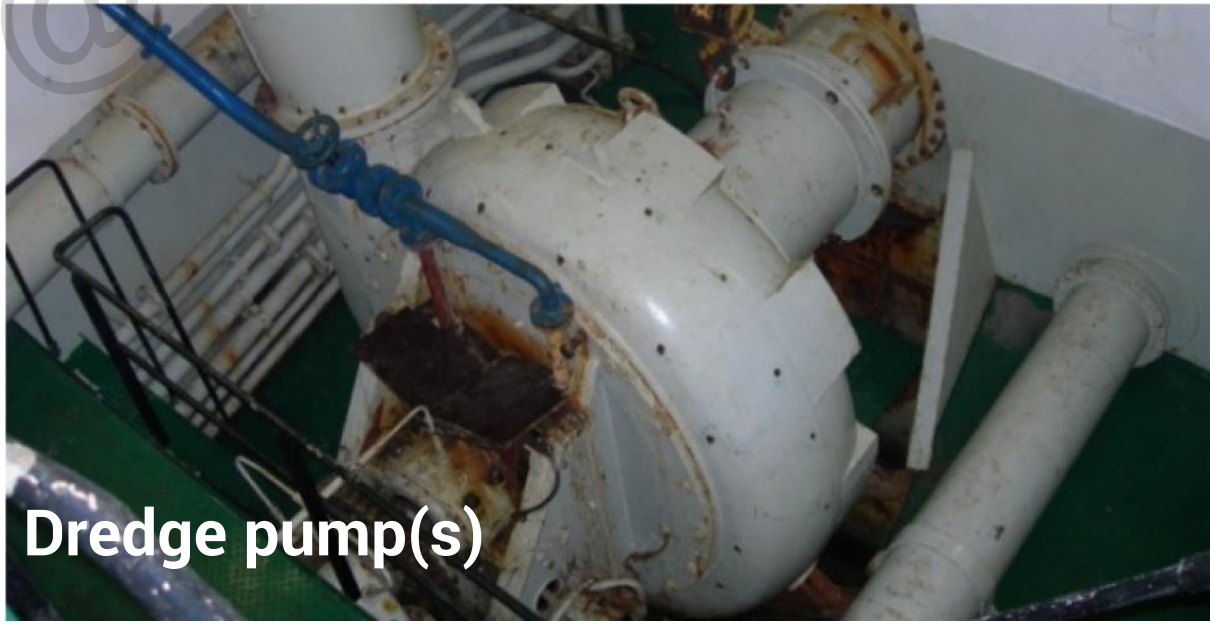


TRAILING SUCTION HOPPER DREDGER

MOST IMPORTANT PARTS, MACHINERY

Hopper, loading and unloading system

Drag heads



Dredge pump(s)

TSHD PROCESS DESCRIPTION

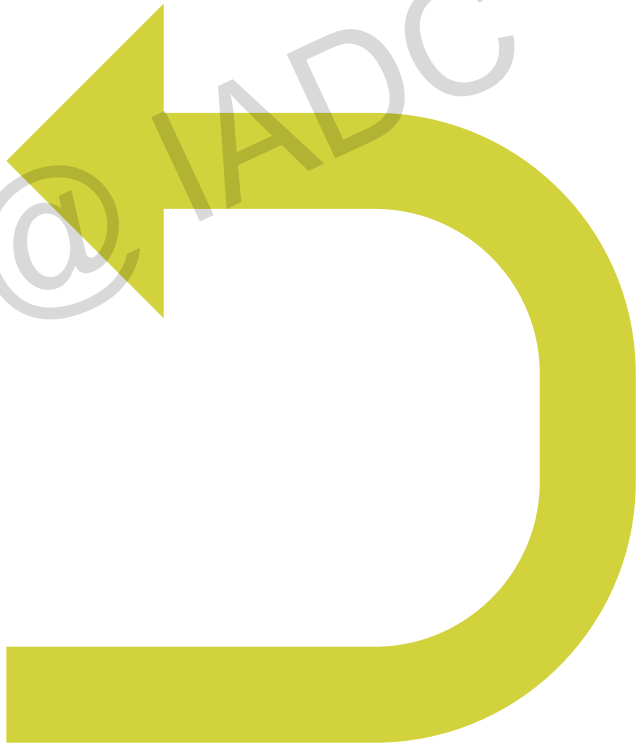
DREDGING CYCLE

Loading at the dredging- or borrow area

Sailing (loaded) to the unloading area

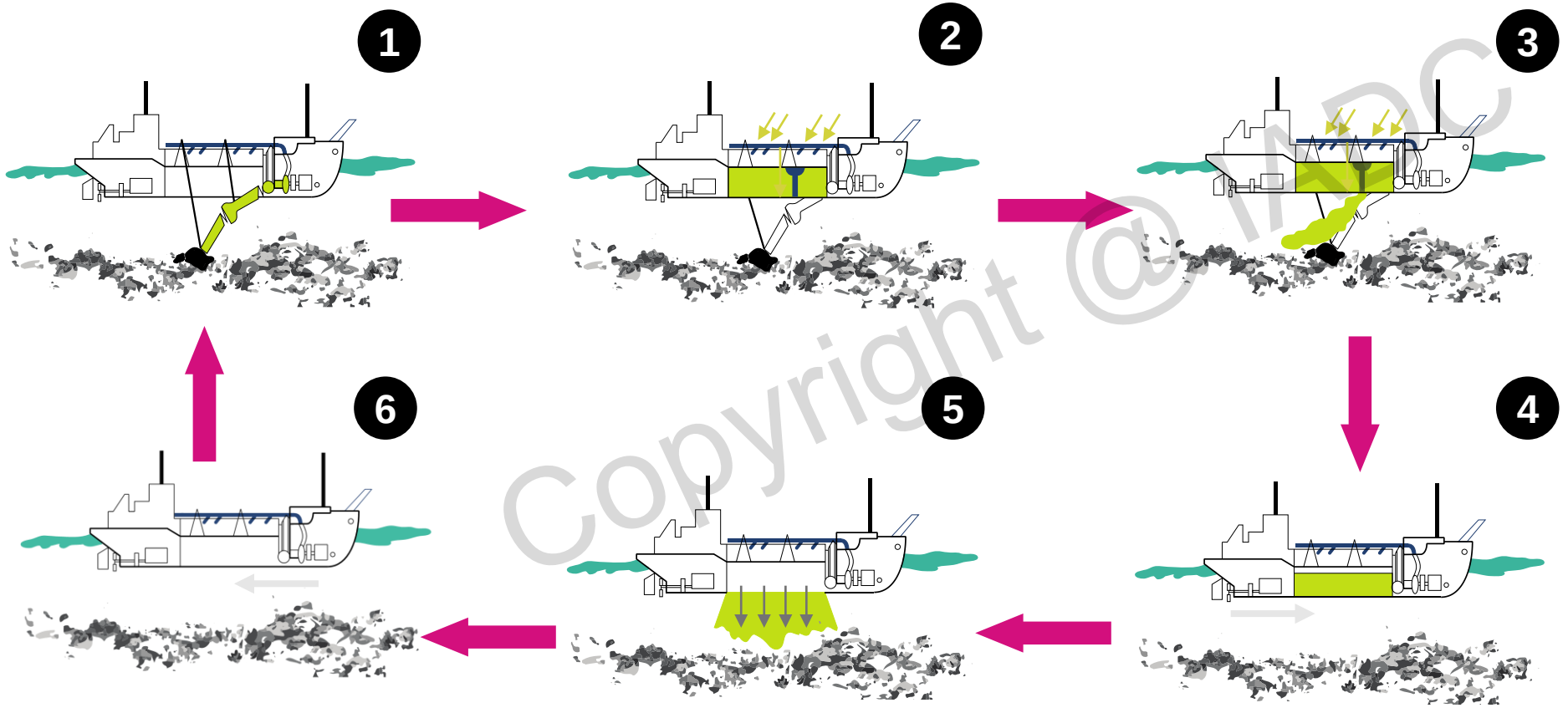
Unloading (bottom opening or pumping)

Sailing (empty) to the dredging



TSHD

PROCESS



1. 2. 3.
Loading at the dredging /borrow area

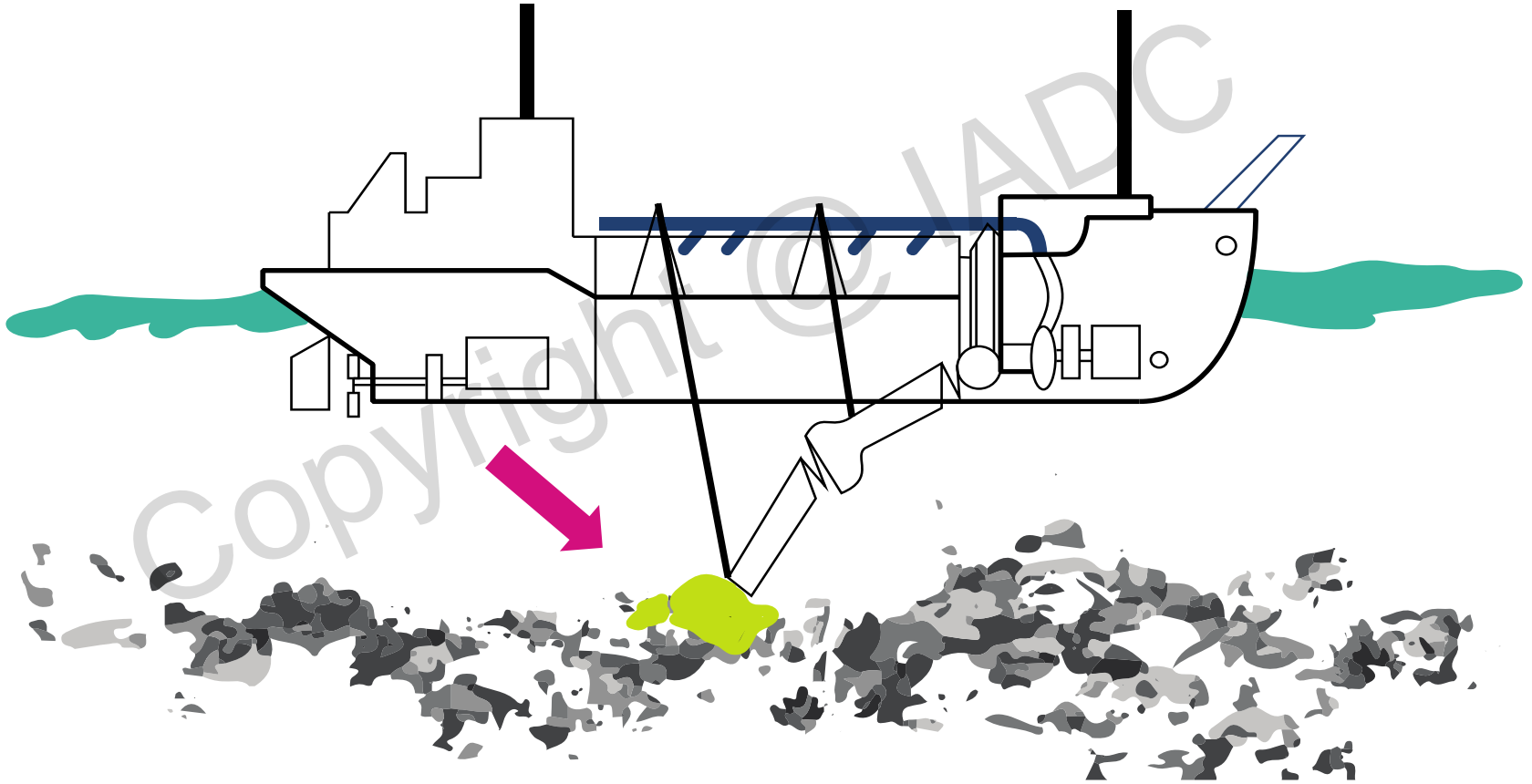
4.
Sailing (loaded) to the unloading area

5.
Unloading (bottom doors or by pumping)

6.
Sailing (empty) to the dredging area

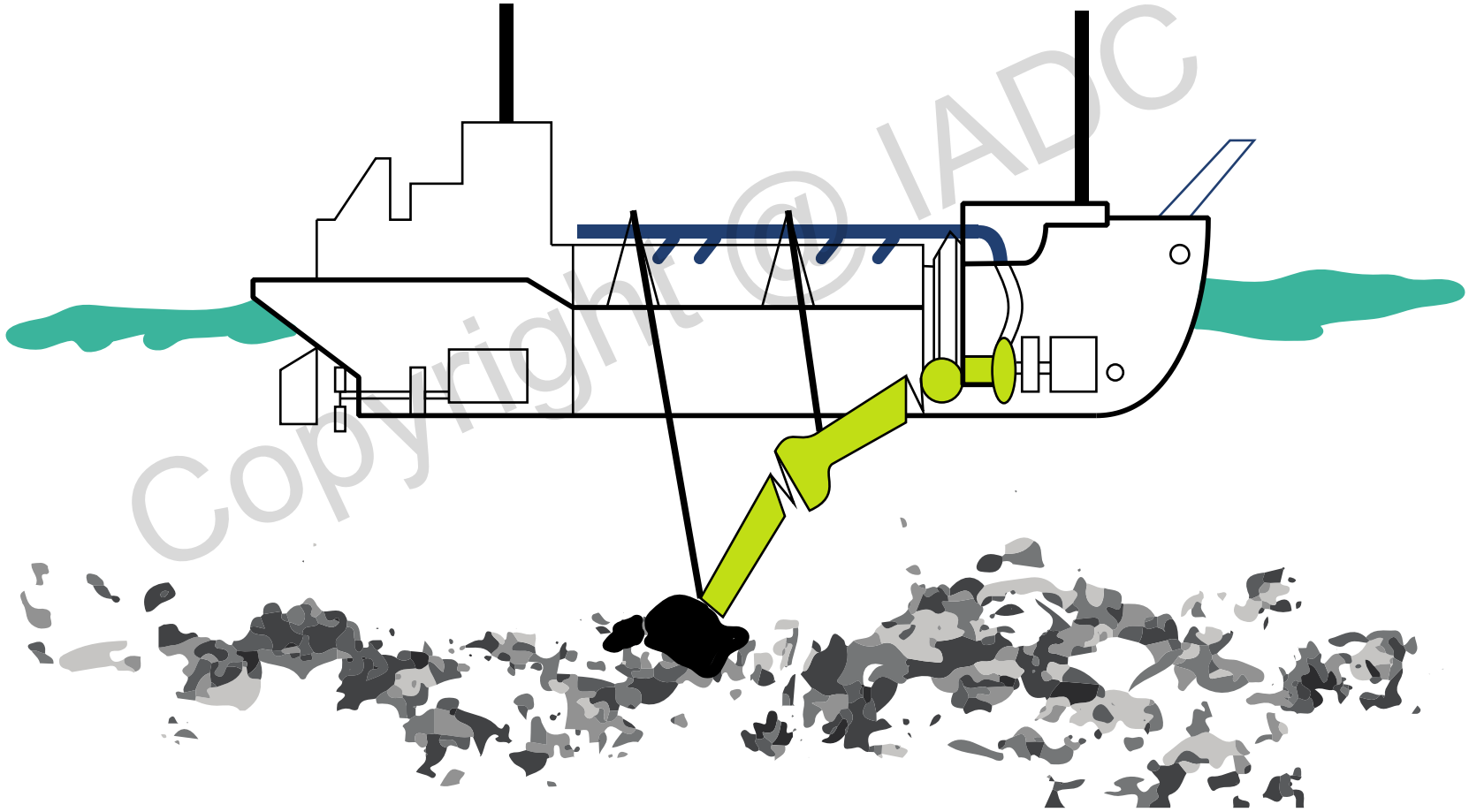
TSHD PROCESS DESCRIPTION

EXCAVATION (EROSION & CUTTING)



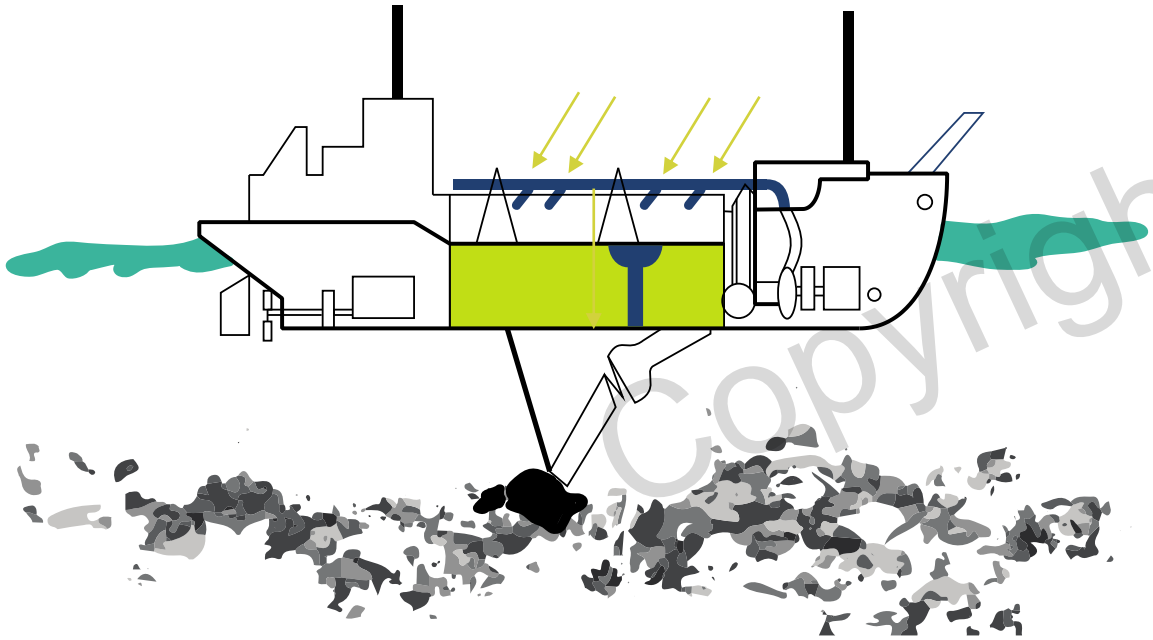
TSHD PROCESS DESCRIPTION

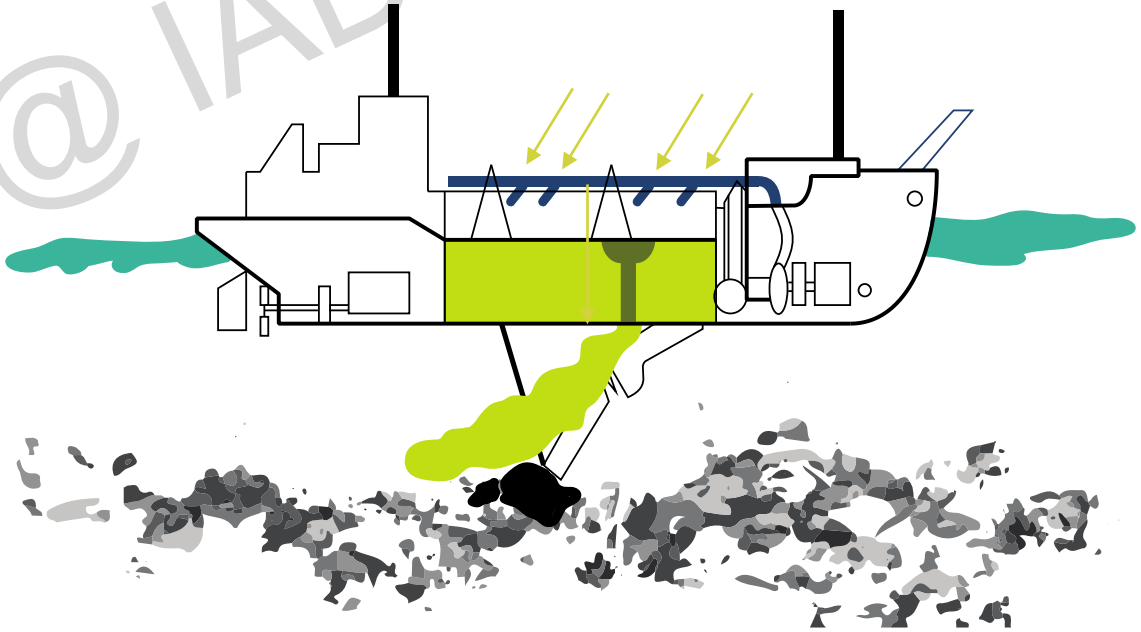
SUCTION



TSHD PROCESS DESCRIPTION

LOADING – LOADING (OVERFLOW)



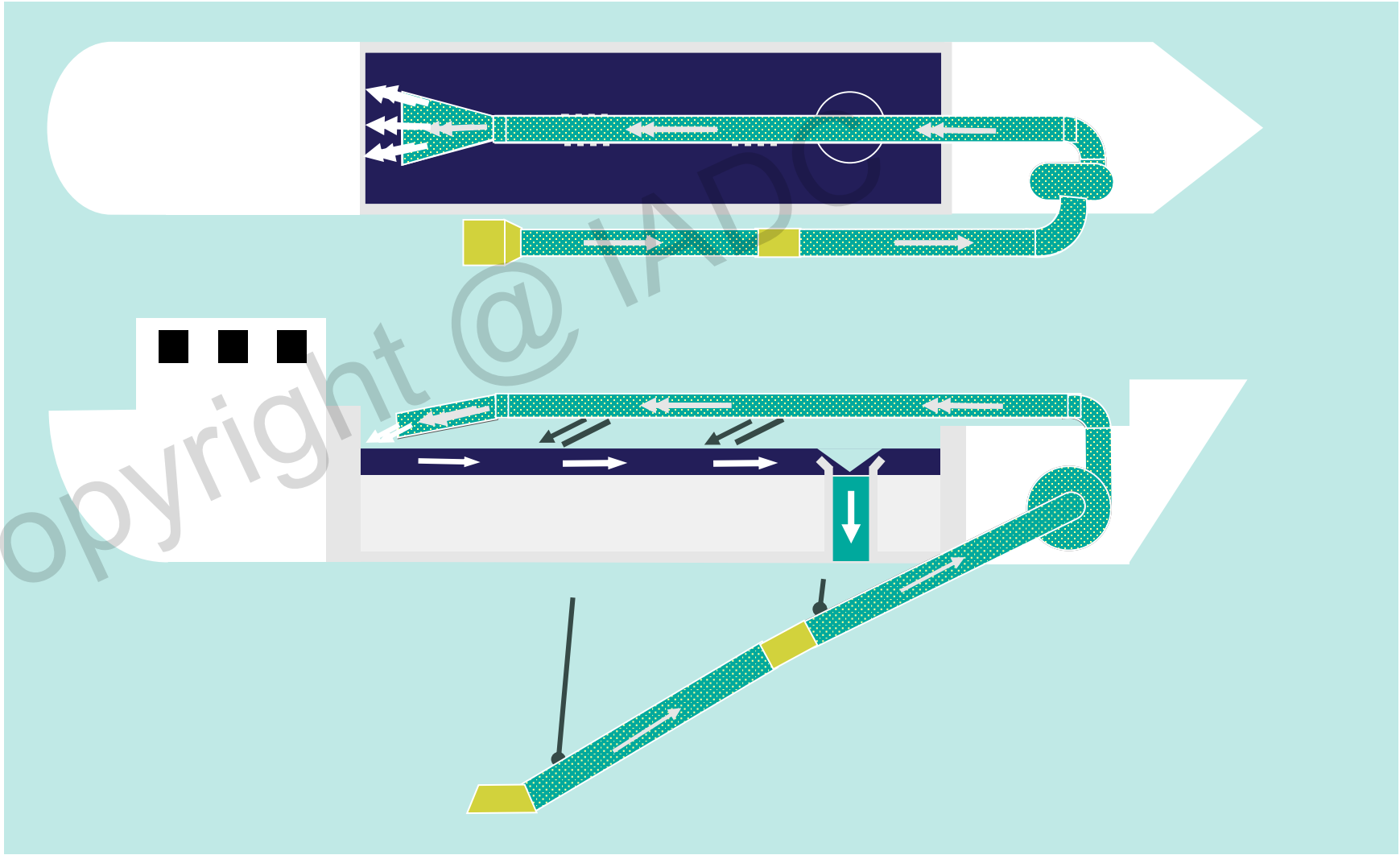


TSHD PROCESS DESCRIPTION

LOADING: BASIC PRINCIPLE

Top view hopper

Longitudinal section

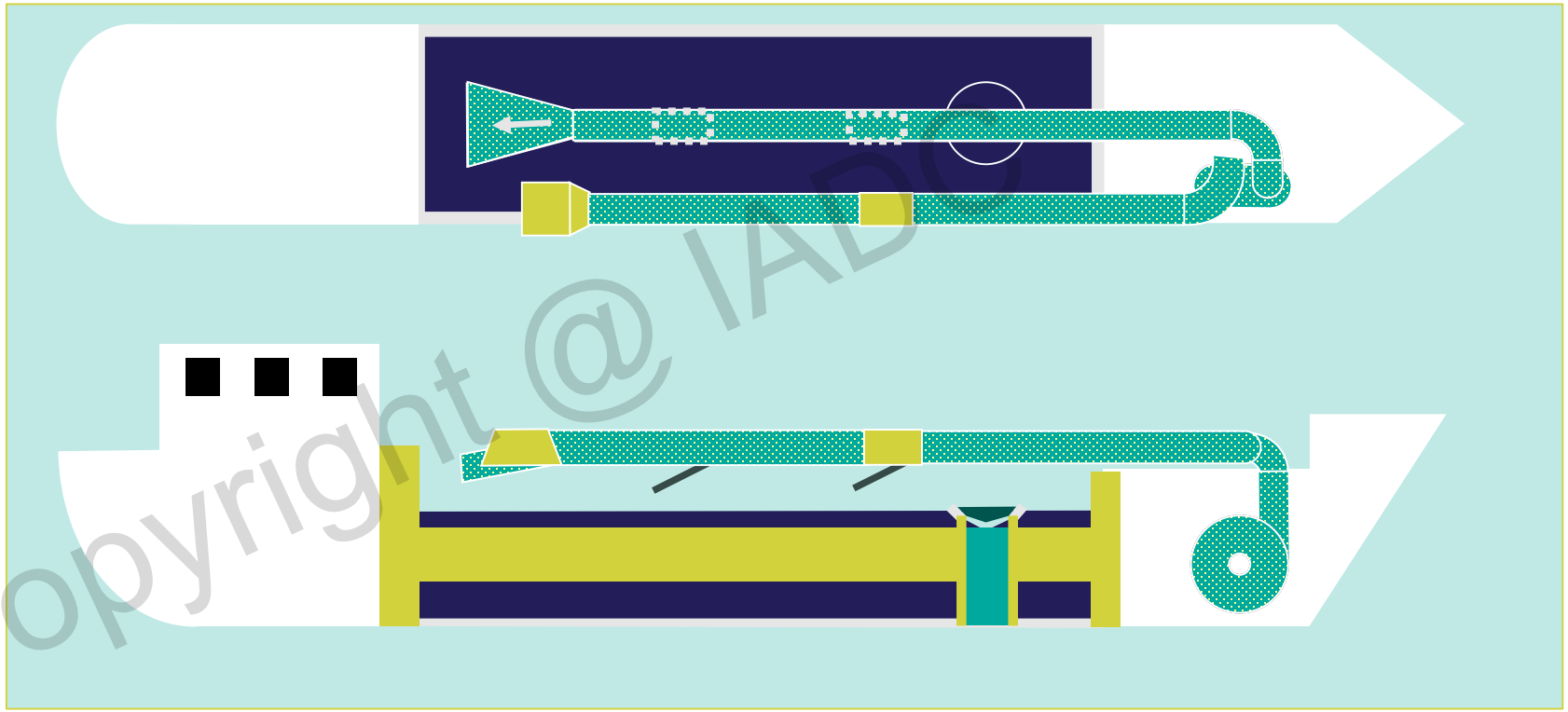


TSHD PROCESS DESCRIPTION

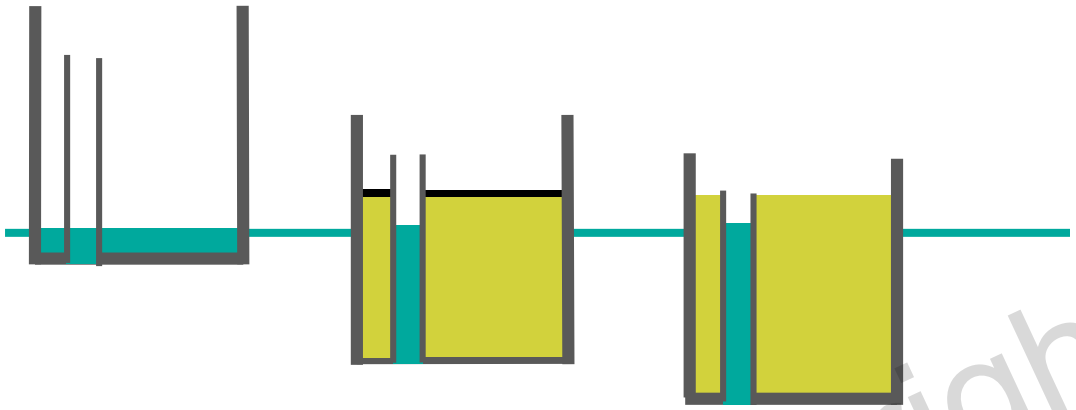
FULL LOAD: BASIC PRINCIPLE

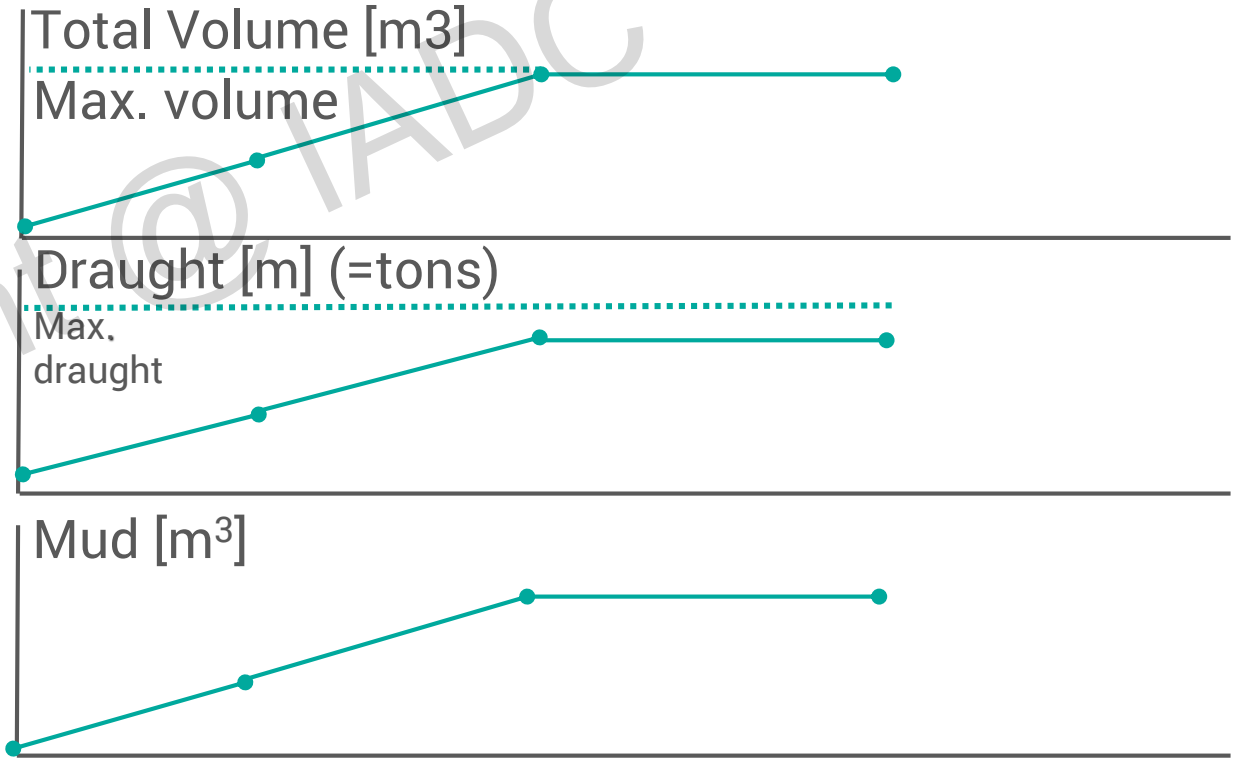
Top view hopper

Longitudinal section

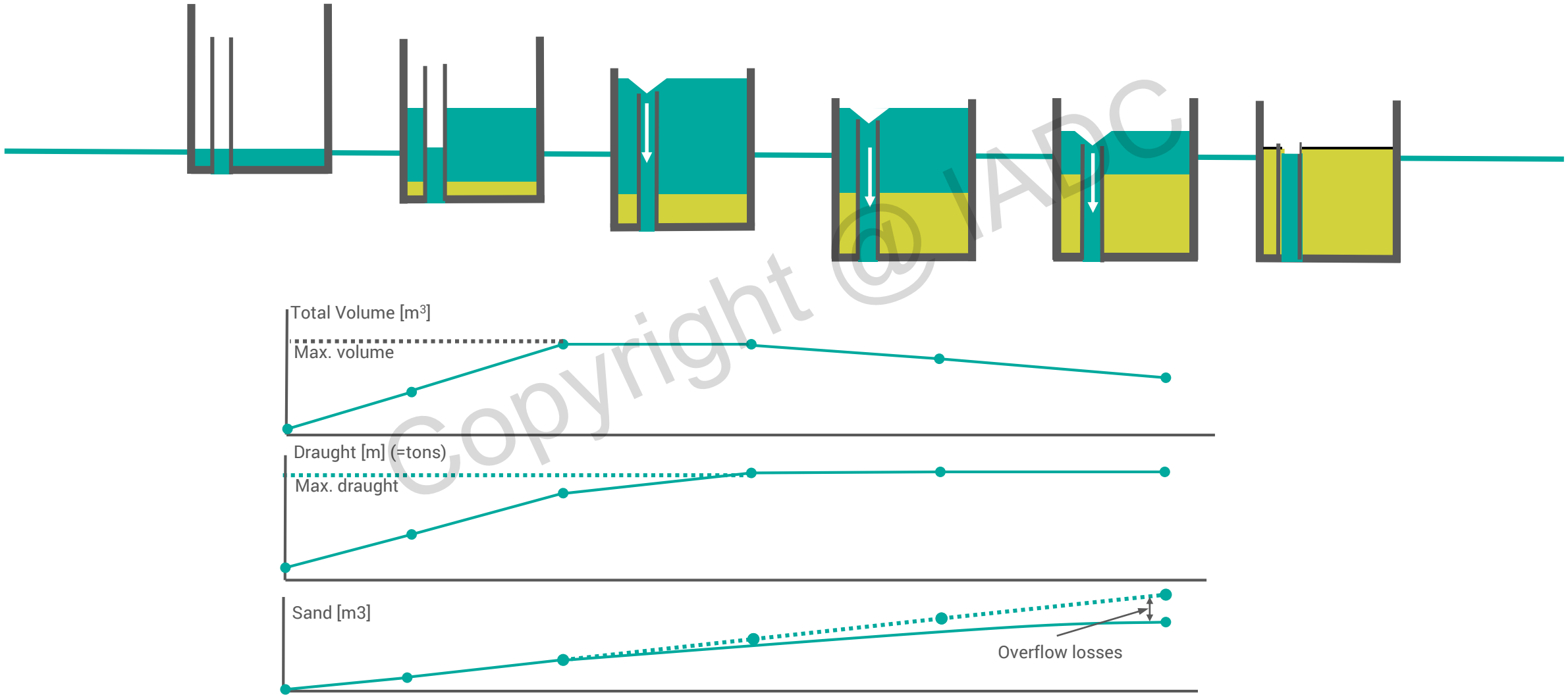


HOPPER LOADING (MUD)



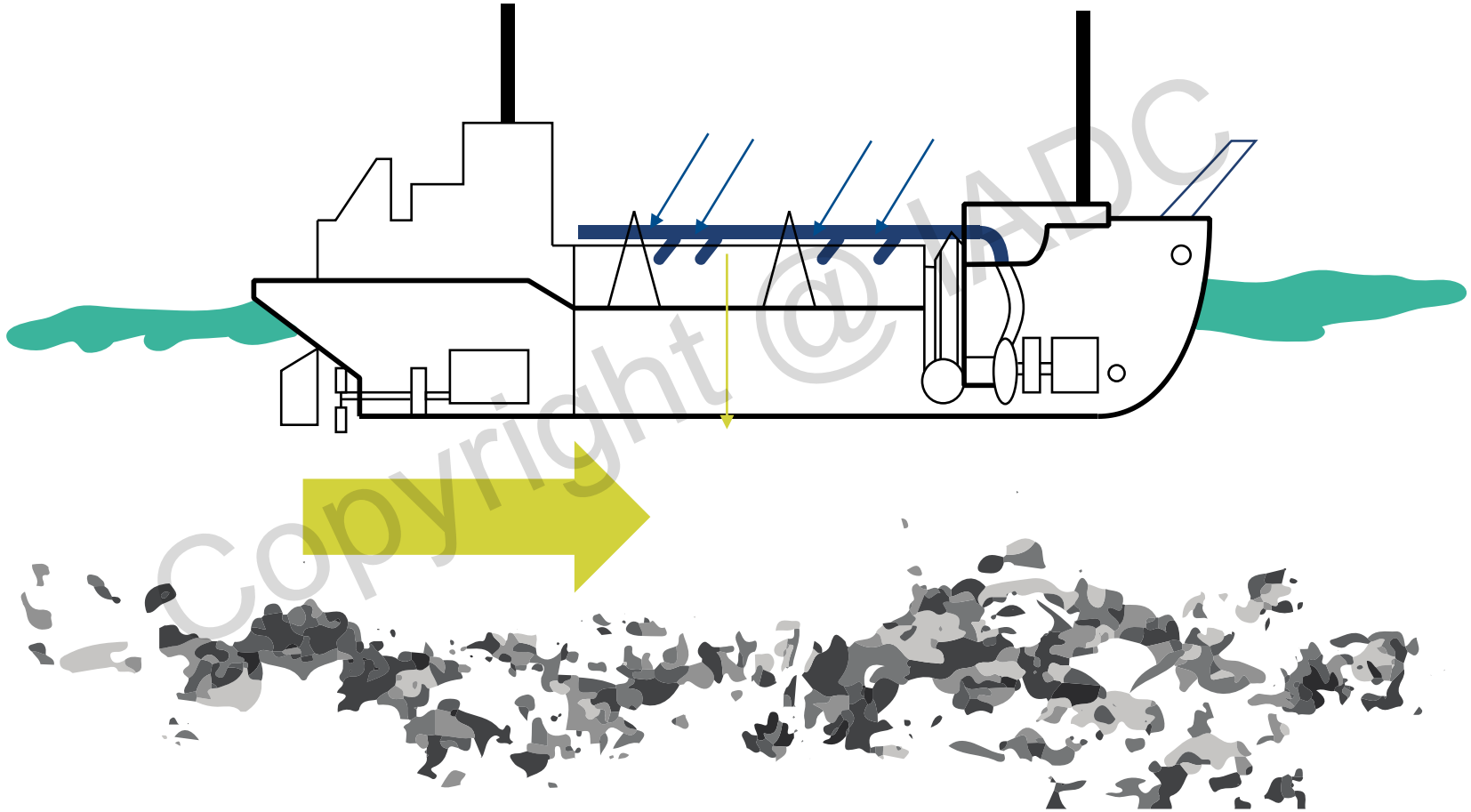


HOPPER LOADING (SAND)



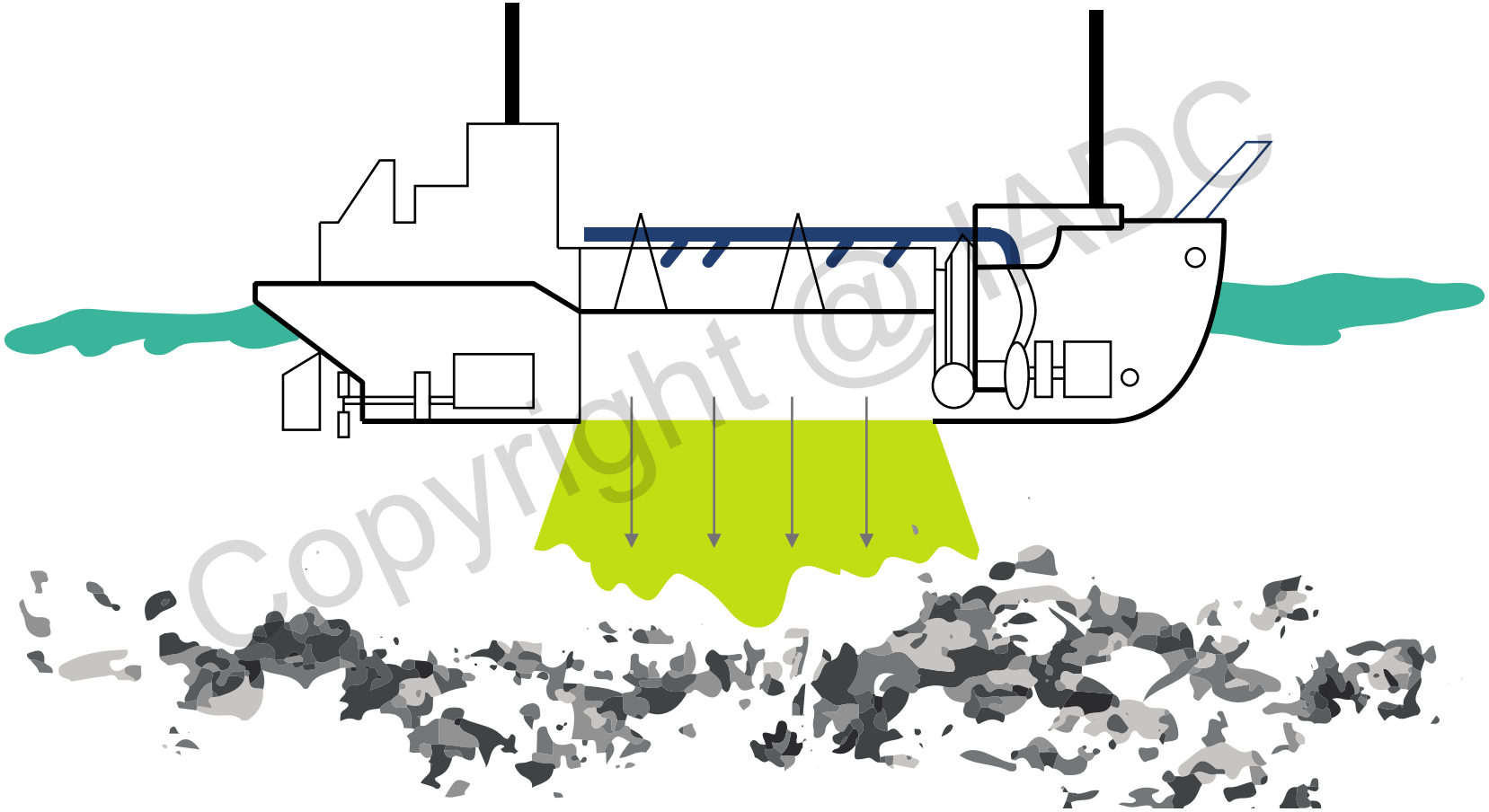
TSHD PROCESS DESCRIPTION

SAILING LOADED



TSHD PROCESS DESCRIPTION

DISCHARGE



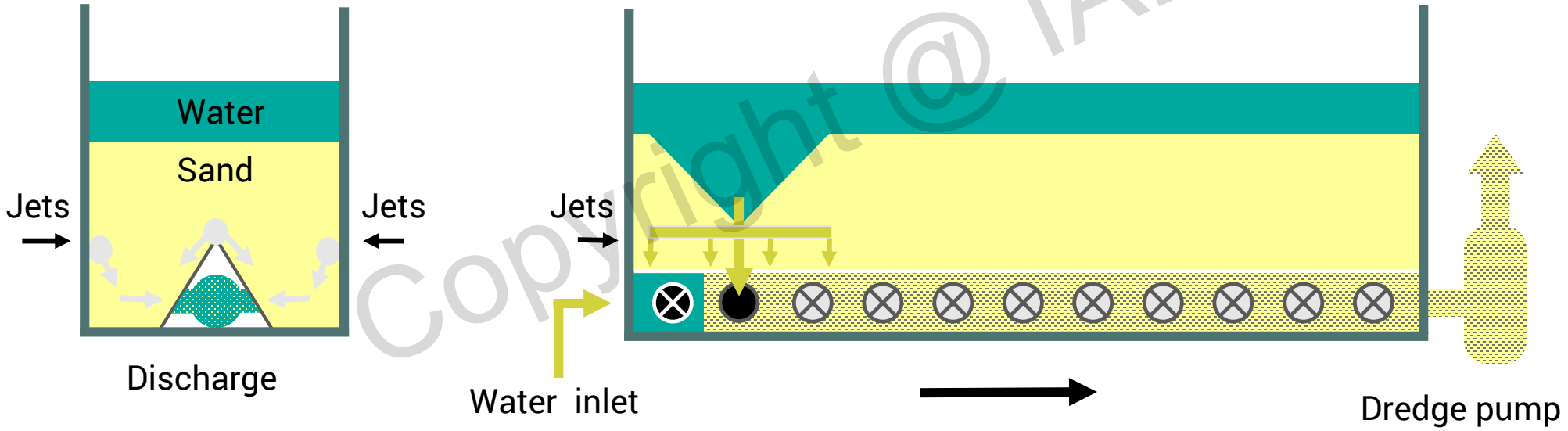
TSHD PROCESS DESCRIPTION

HOPPER BOTTOM DISCHARGE

Split-hopper

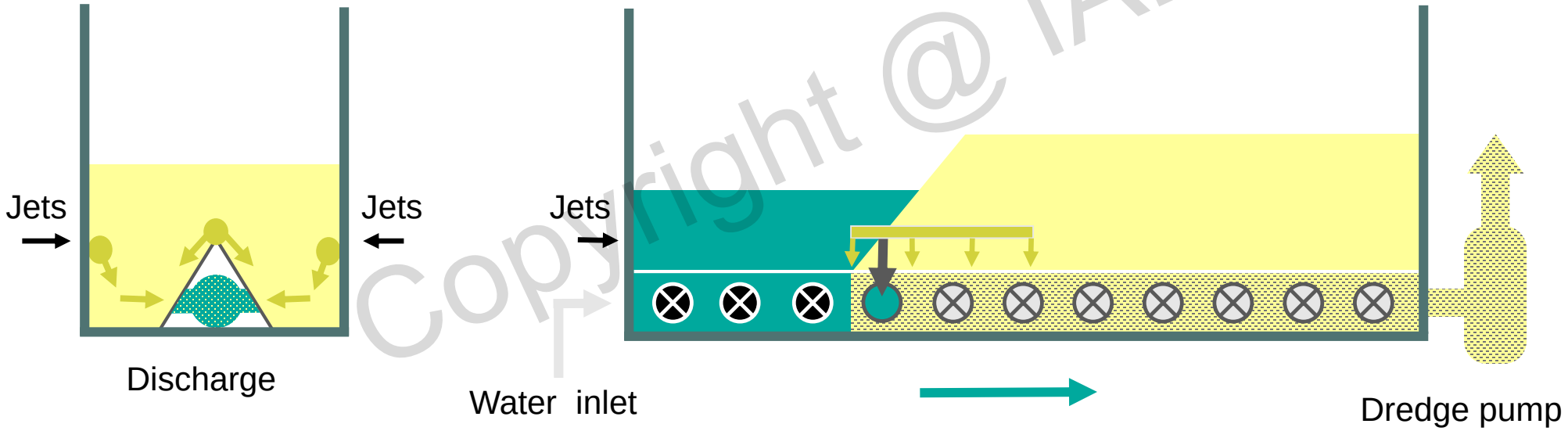
TSHD PROCESS DESCRIPTION

HOPPER SELF-DISCHARGE: SYSTEM



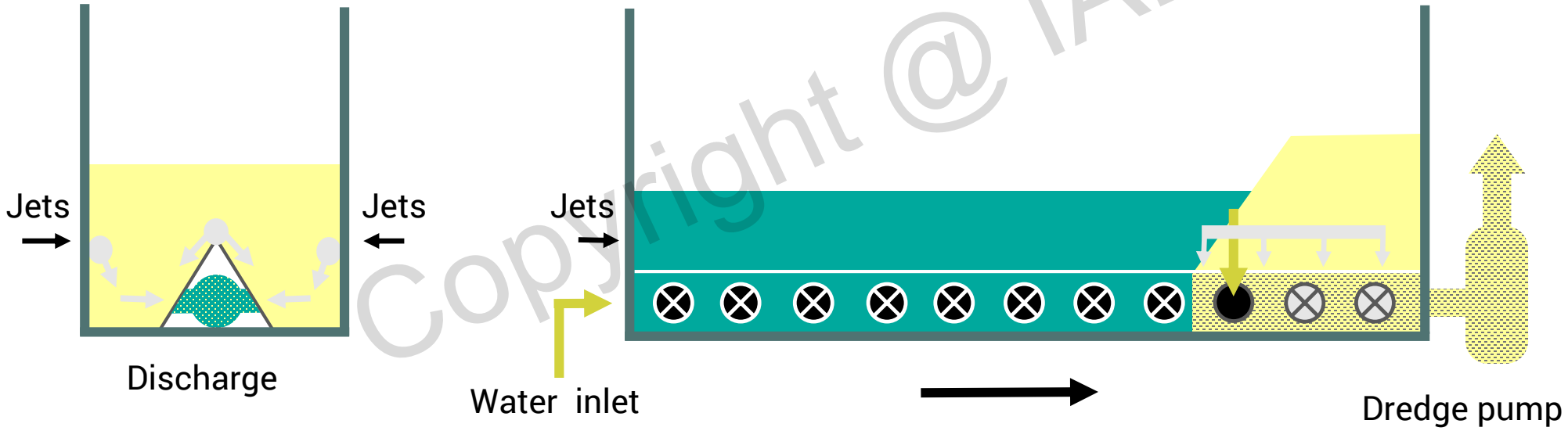
TSHD PROCESS DESCRIPTION

HOPPER SELF-DISCHARGE: SYSTEM



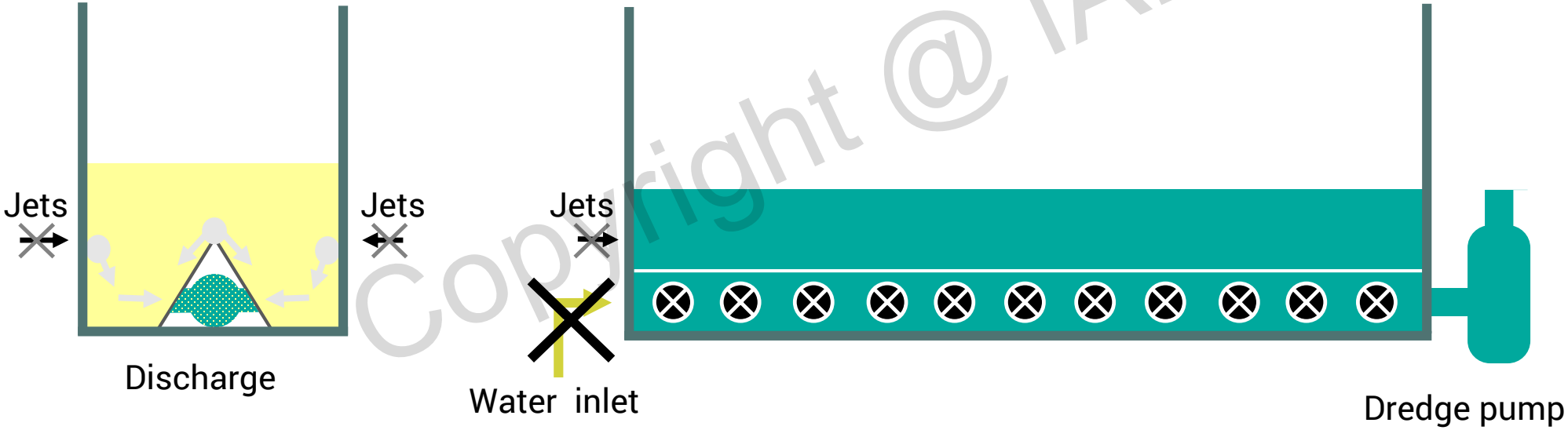
TSHD PROCESS DESCRIPTION

HOPPER SELF-DISCHARGE: SYSTEM



TSHD PROCESS DESCRIPTION

HOPPER SELF-DISCHARGE: SYSTEM

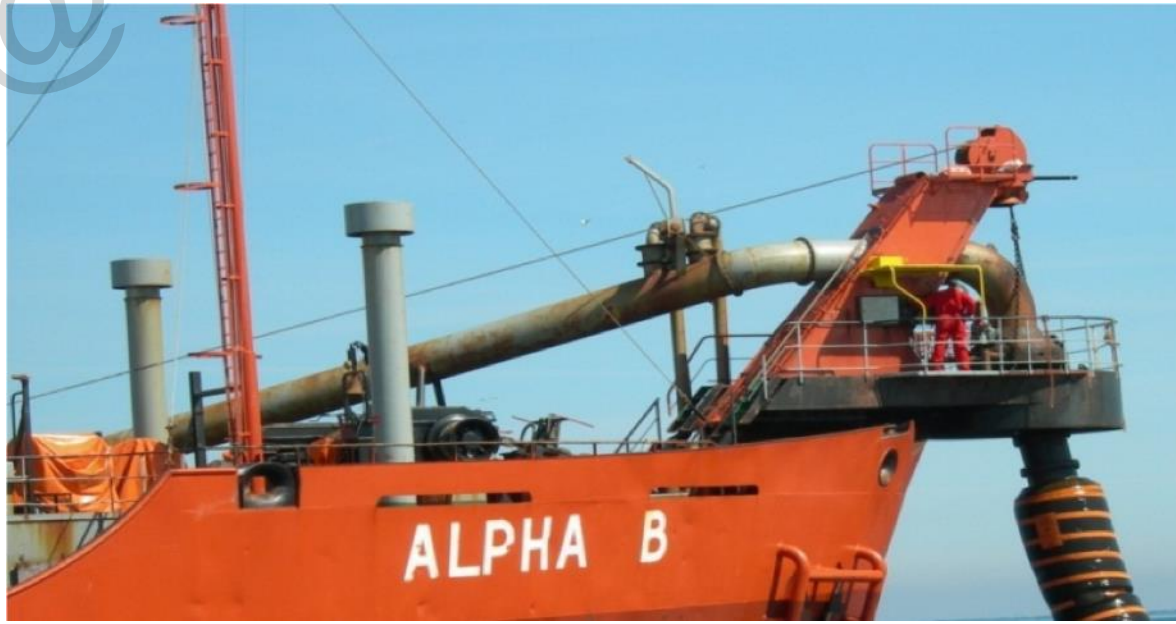


TSHD PROCESS DESCRIPTION

Hopper Self-discharge: rainbow

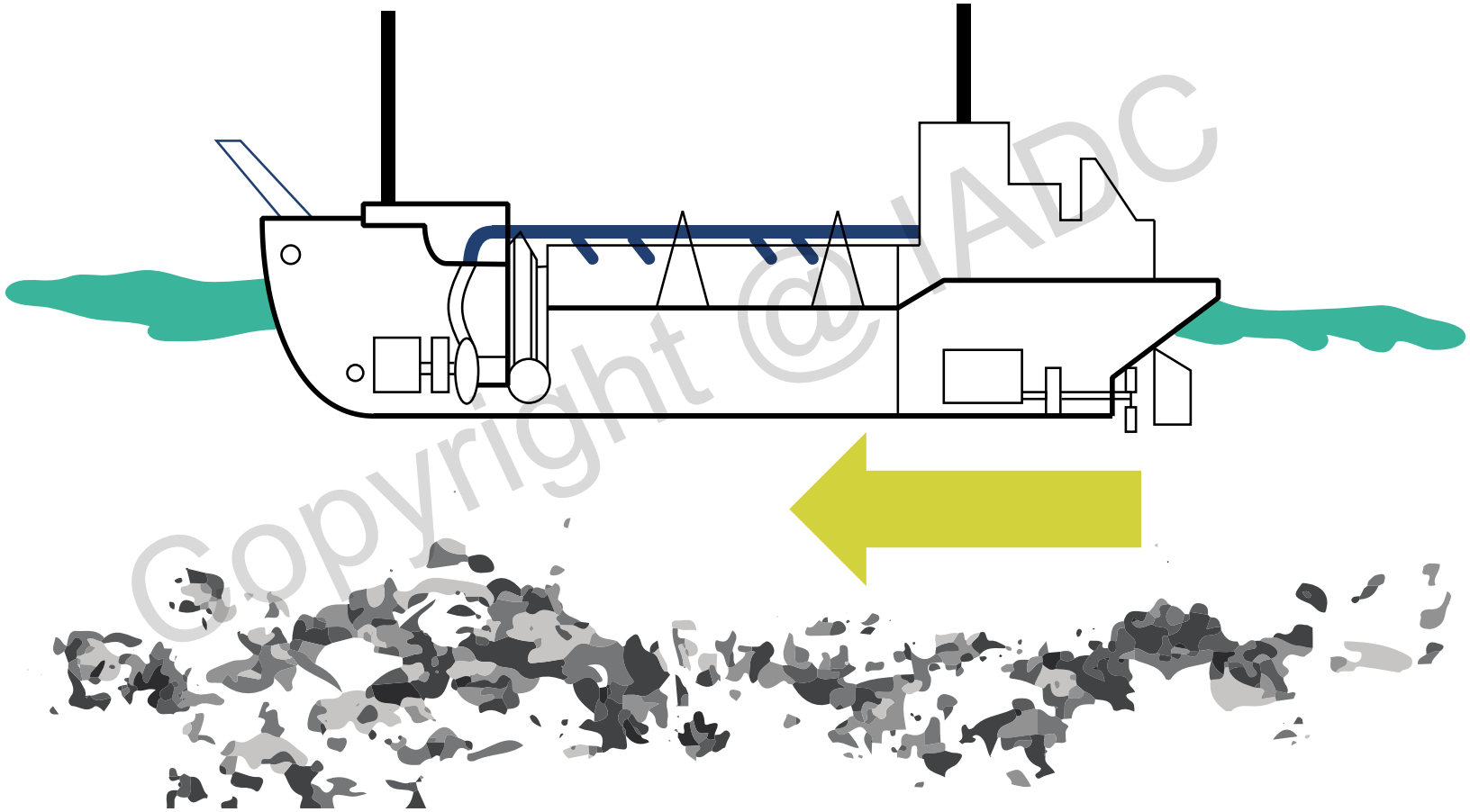
TSHD PROCESS DESCRIPTION

HOPPER SELF-DISCHARGE: PUMP ASHORE



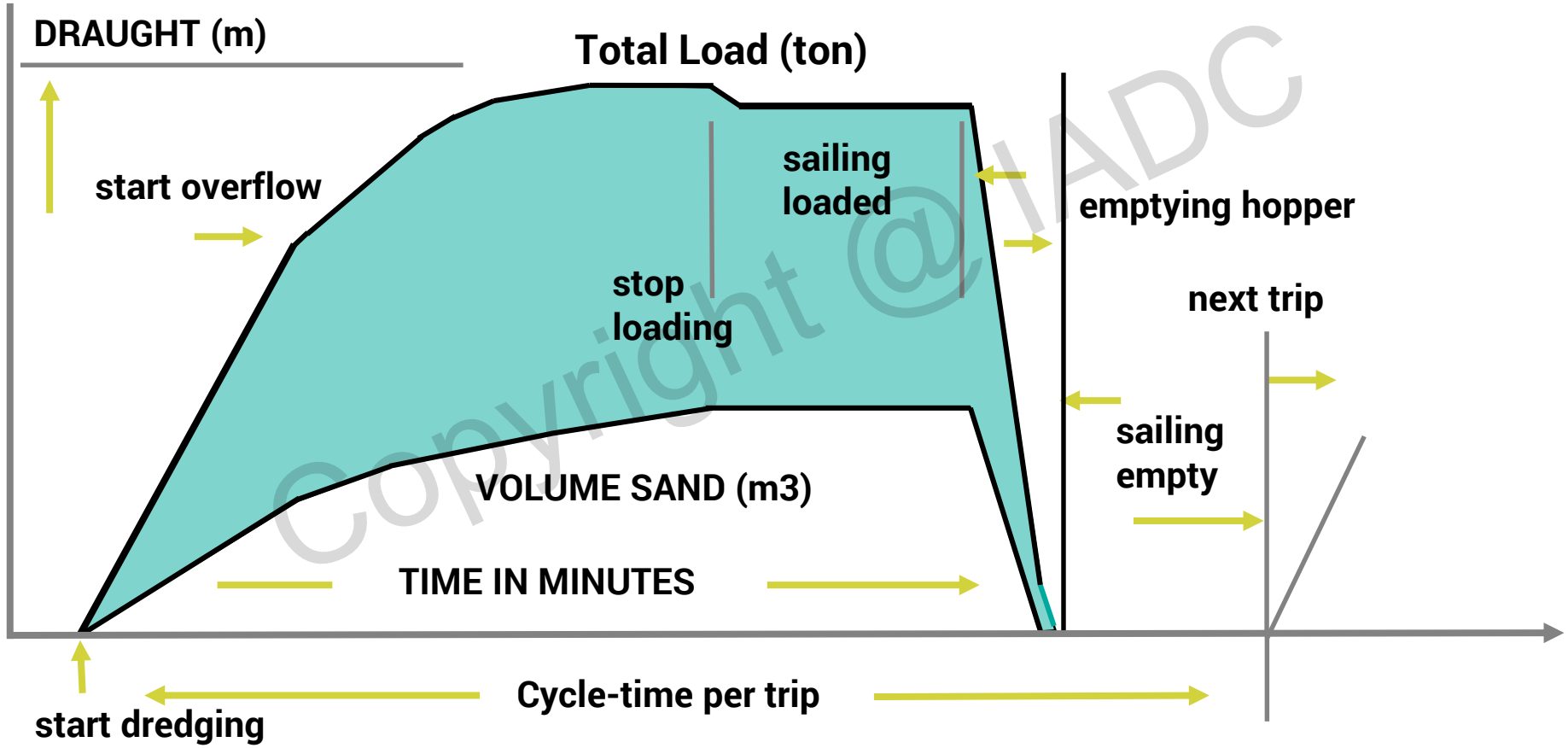
TSHD PROCESS DESCRIPTION

SAILING EMPTY



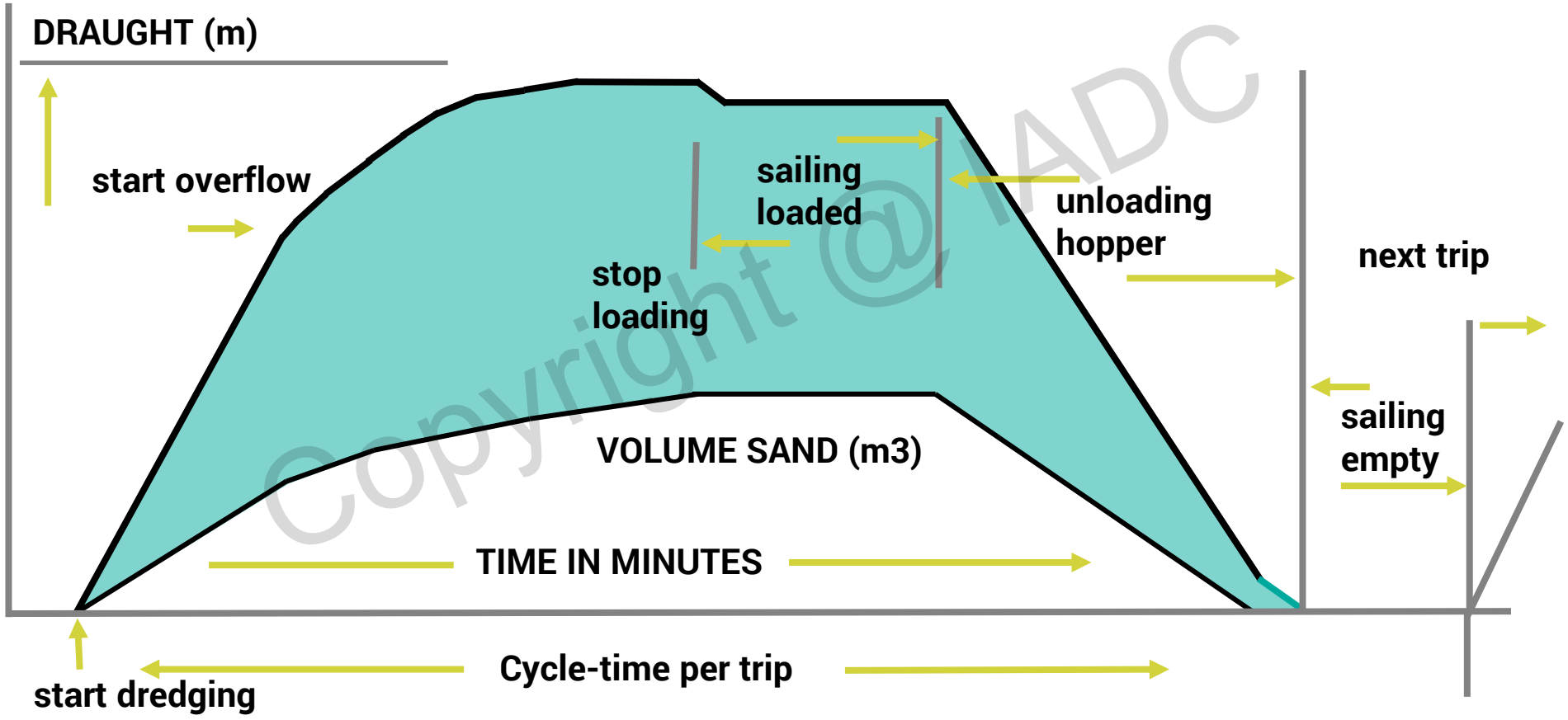
TSHD LOAD GRAPH

(EMPTYING BY BOTTOM DOOR DISPOSAL)



TSHD LOAD GRAPH

DISCHARGING TO SHORE)



TRAILING SUCTION HOPPER DREDGER

PROCESS RELATED TOPICS

- The hull
- The hopper
- Drag heads, suction pipes and belongings
- Centrifugal pumps

TRAILING SUCTION HOPPER DREDGER

THE HULL

- **SAILING CHARACTERISTICS**
  - Resistance
  - Small keel clearance
- **MAXIMUM CARRYING CAPACITY VERSUS DRAFT, LENGTH AND WIDTH**
- **STRENGTH**
- **STABILITY**

TRAILING SUCTION HOPPER DREDGER

THE HOPPER

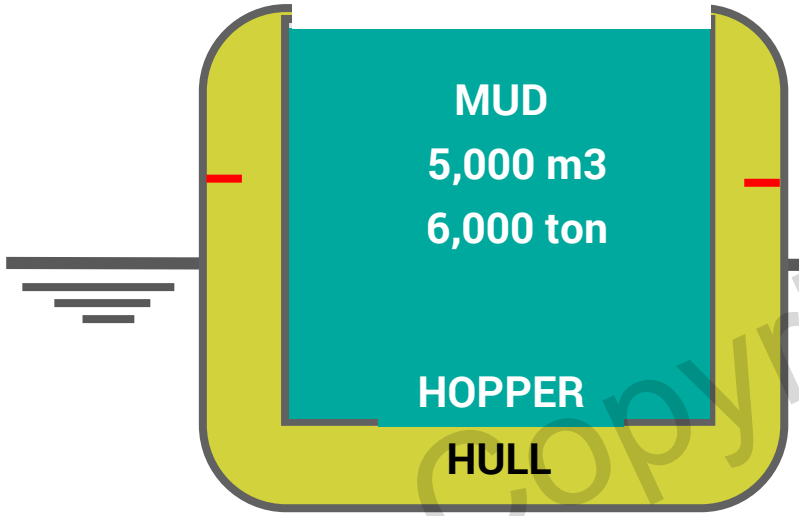
- **CARRYING CAPACITY**
  - Volume
  - Weight

- **FILLING SYSTEM**
- **OVERFLOW SYSTEM**
- **BOTTOM DOOR DISPOSAL SYSTEM**
- **SELF-DISCHARGE SYSTEM**

HOPPER

CARRYING CAPACITY

Restriction by volume (full hopper)

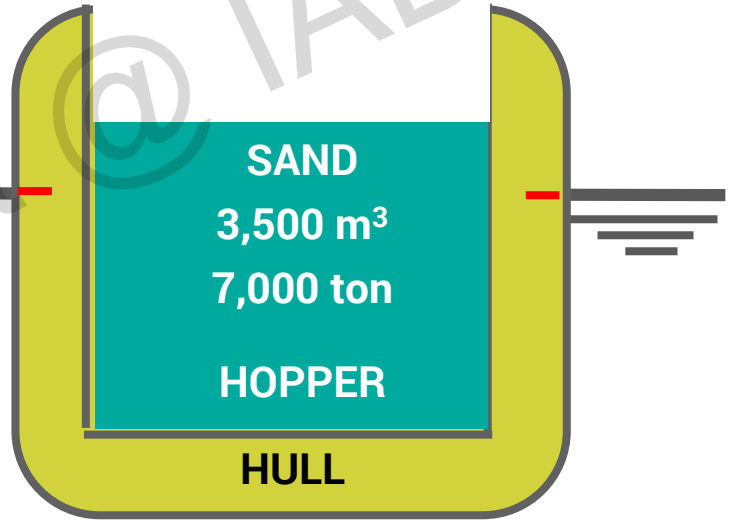


Low density soils

e.g.: Mud - 1.2 ton/m^3

5,000 x 1.2 = 6,000 ton

Restriction by weight (max. draught)



High density soils

e.g.: Sand - 2.0 ton/m^3

3,500 x 2.0 = 7,000 ton

– *Max. draught line (dredge mark)*

HOPPER:
LOADING & DUMPING FACILITIES

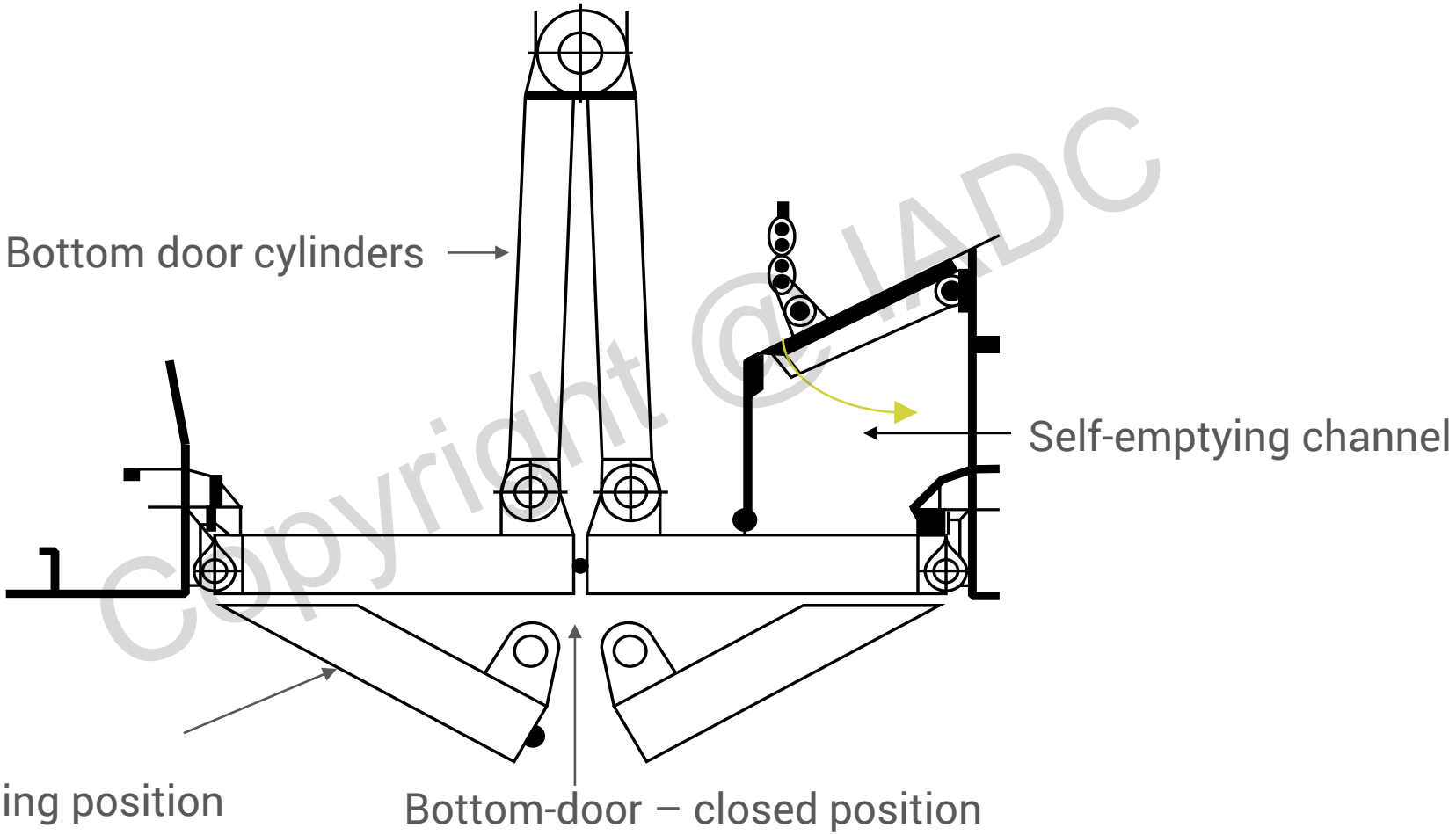
Conical bottom-valves

Overflow System

Bottom doors

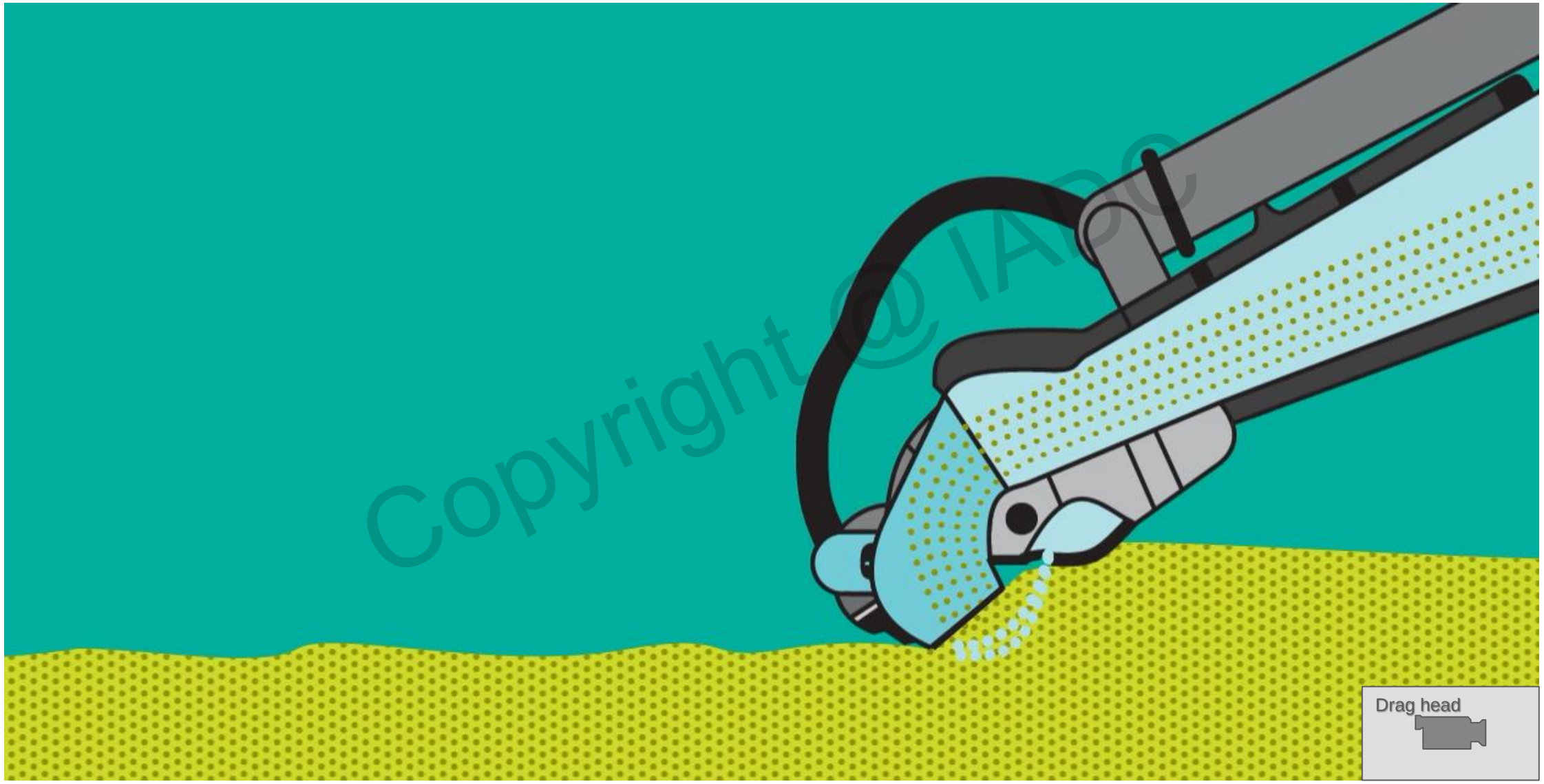
HOPPER: LOADING & DUMPING FACILITIES

BOTTOM DOORS

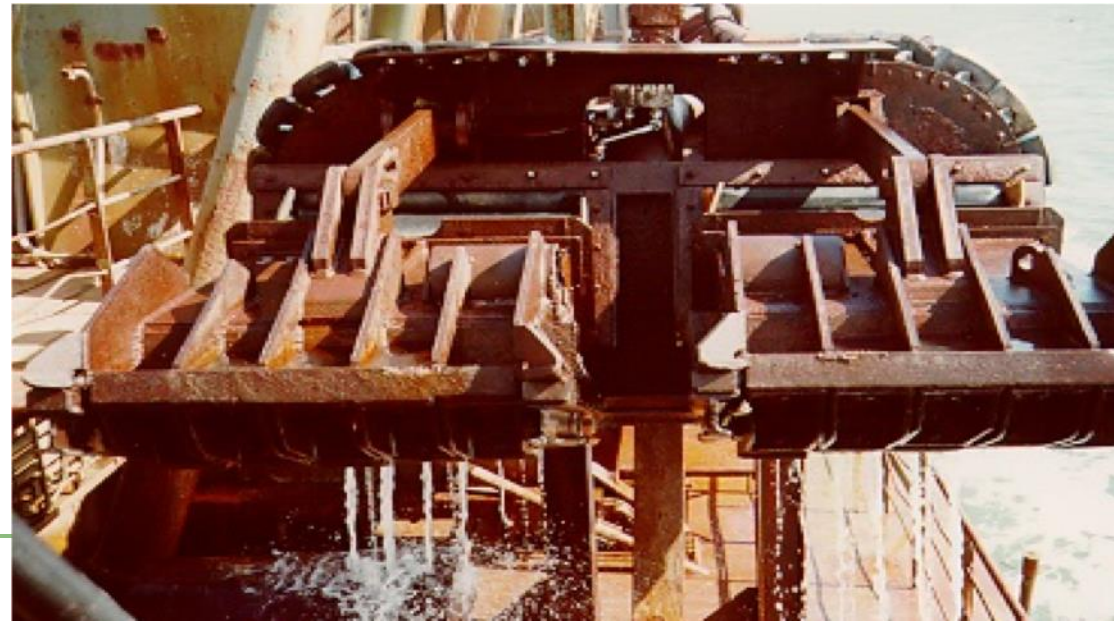


DRAG HEADS

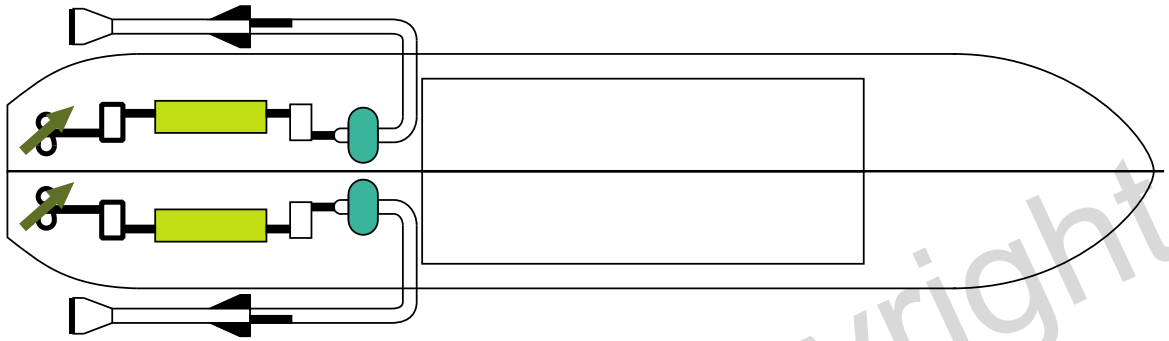
SAND DRAG HEAD



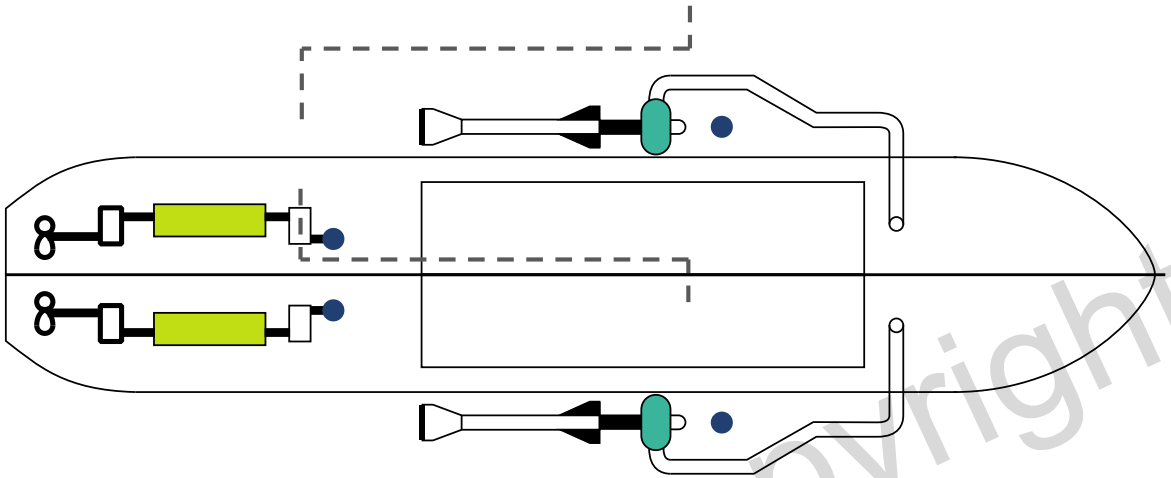
DIFFERENT DRAG HEADS



SUCTION PIPE

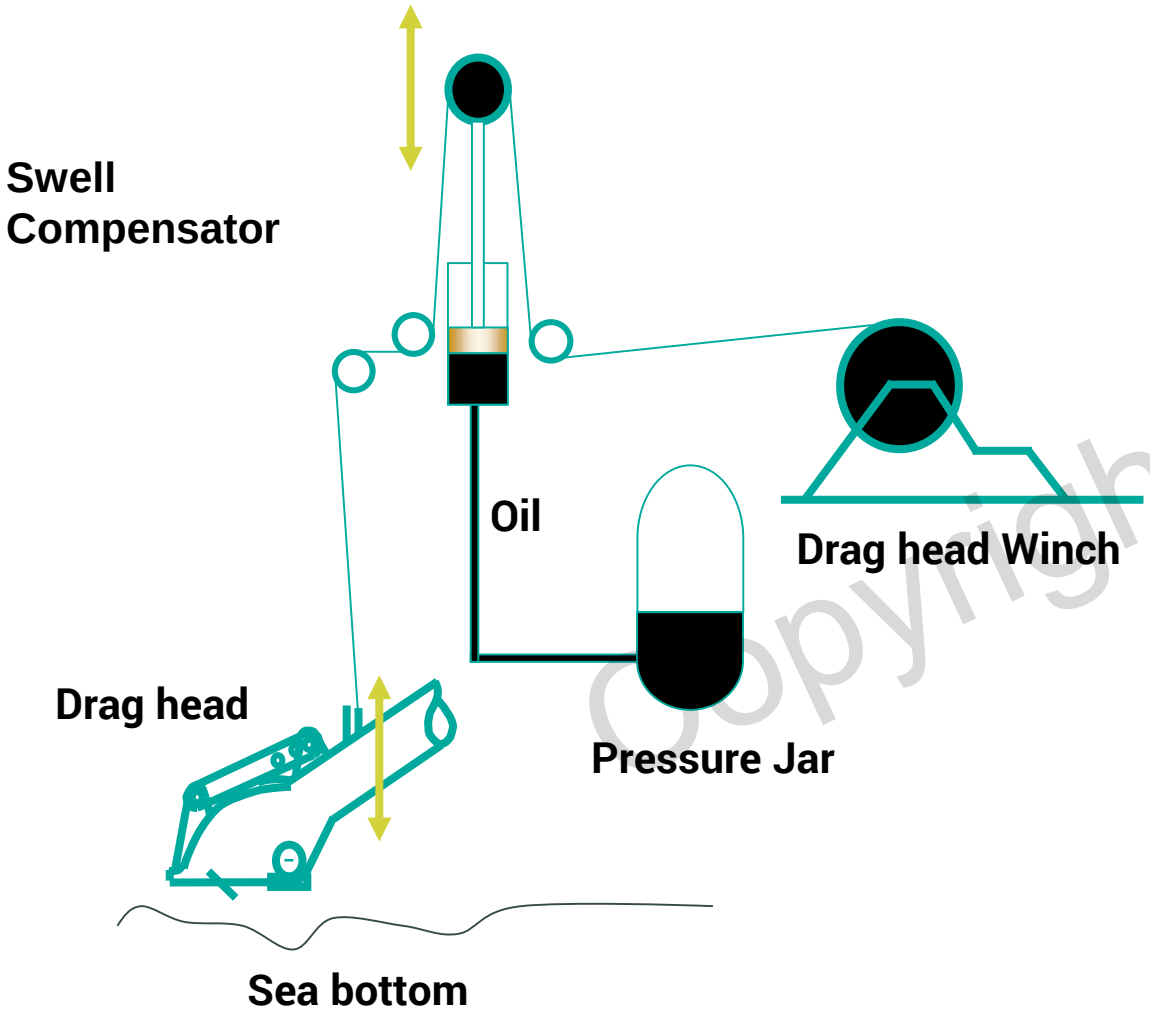


SUCTION PIPE



THE DRAG HEADS

SWELL COMPENSATOR



Centrifugal Pumps

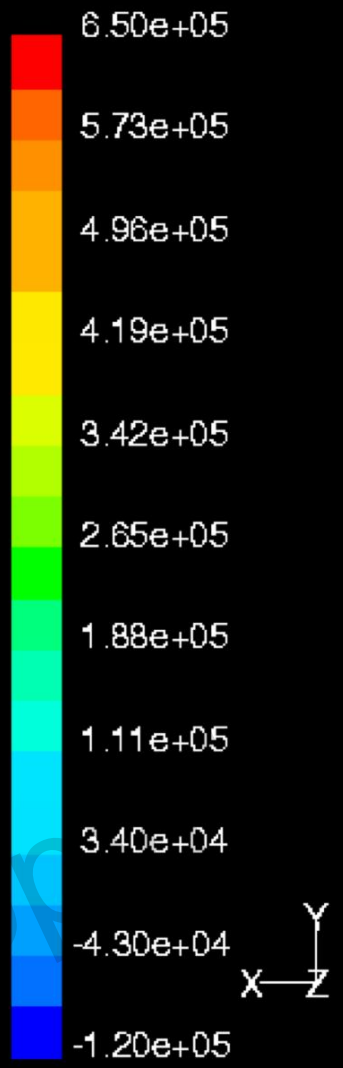
Working principle

6 Bar →

3 Bar →

0 Bar →

-1 Bar →



Contours of Total Pressure (pascal)

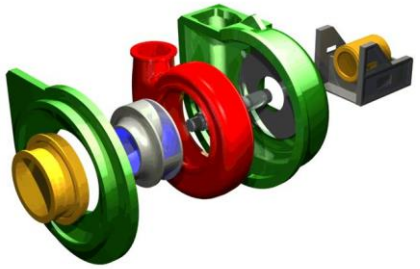
Mar 09, 2001

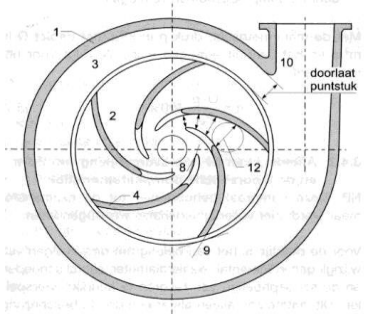
Fluent 5,4 (3d, segregated, rke)

WORKABILITY – WEATHER DELAY

CENTRIFUGAL PUMPS

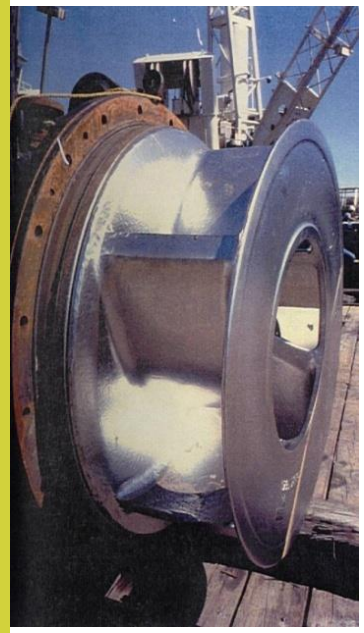
HARDWARE
TYPES & SIZES – BASIC PARTS





IADC

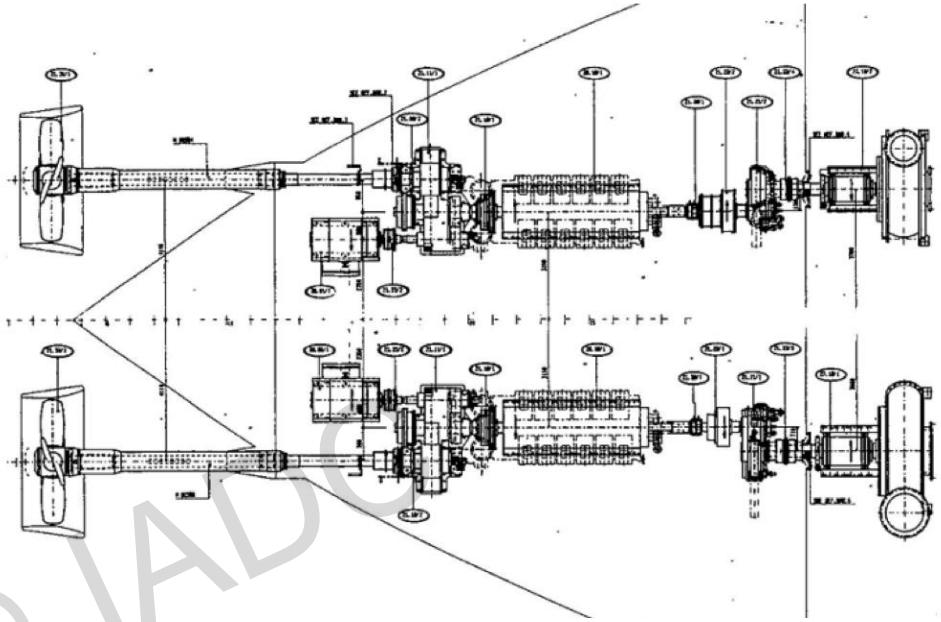
Inboard pump - Under water pump

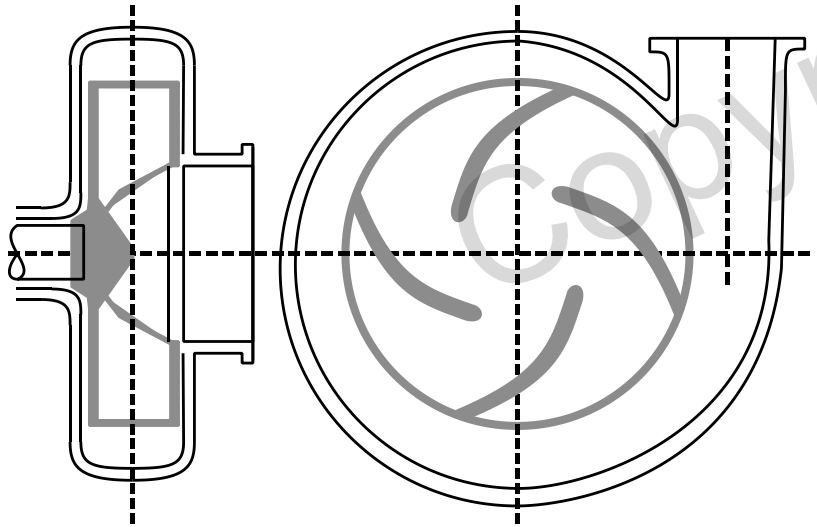


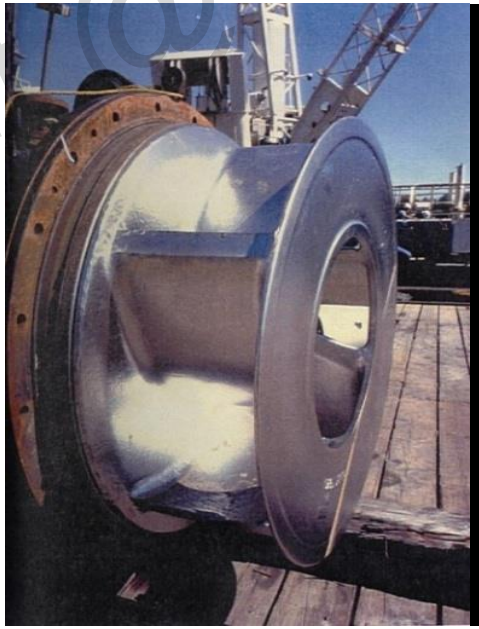
CENTRIFUGAL PUMPS

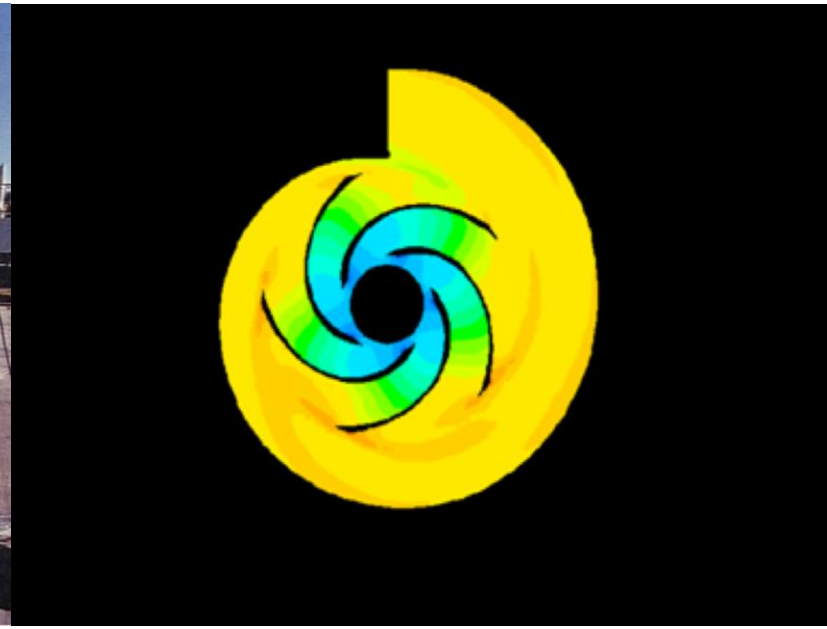
WORKING PRINCIPLE

- Energy Distribution
- Propulsion
- Pumps
- Board net
- Centrifugal pump

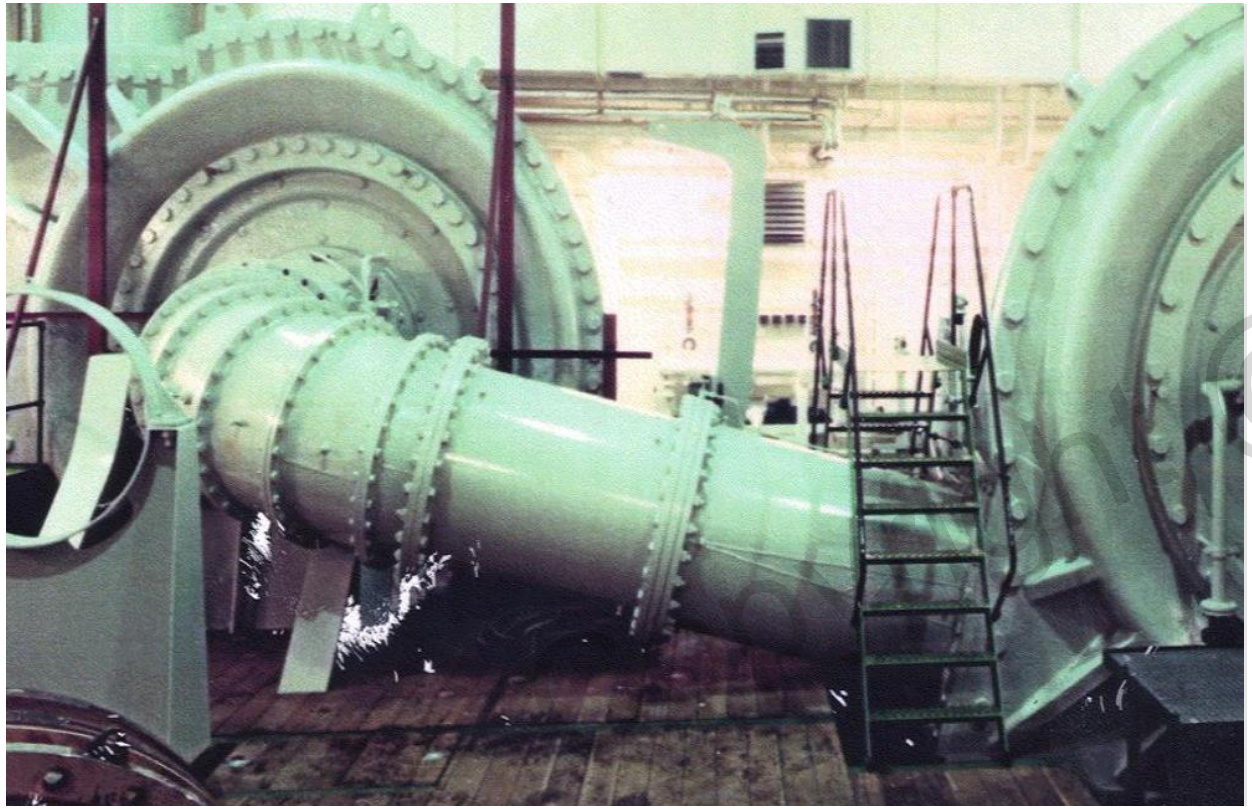




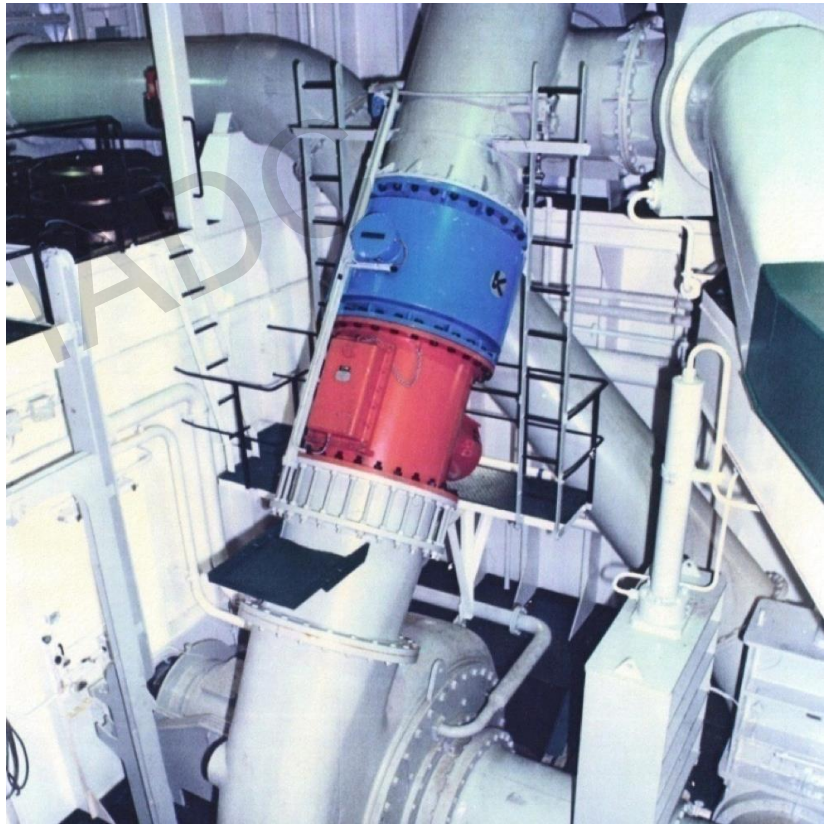




CENTRIFUGAL PUMPS



Engine-room with 2 pumps in line



Density & velocity meter

TSHD

PRODUCTION LIMITING FACTORS

- Soil characteristics
- Available propulsion power
- Drag head size and weight
- Keel clearance when loaded
- Dredging depth
- Pumping distance (pump- and pump drive characteristics)
- Waves and currents
- Dirt and debris

LIMITING FACTORS

A DRAG HEAD GRID DAMAGED BY BOULDERS

LIMITING FACTORS

DIRT AND DEBRIS

TRAILING SUCTION HOPPER DREDGER

CHARACTERISTIC FIGURES

Trailing Suction Hopper Dredger	Small	Mid - size	Large	Jumbo	Mega
Dimensions (L*W*Dr)	55*10*4 m	90*18*7 m	130*23*9 m	180*32*13 m	225x38x 12-15.5 m
Max. dredging depth	10 - 35 m	25 - 55 m	25 - 75 m	50 - 120 m	55 - 155 m
Hopper capacity	<4,000 m^3	<8,000 m^3	<15,000 m^3	<30,000 m^3	30,000 - 46,000 m^3
Sailing speed	8 knots	12 knots	14 knots	17 knots	16 -18 knots
Propulsion	400 kW	3,500 kW	8,000 kW	18,000 kW	26,000 kW
Diam. Suction - pipe	0.35 - 0.9 m	0.80 m	0.90 - 1.00 m	1.20 m	1.2 - 1.4 m

INTERNATIONAL ASSOCIATION OF DREDGING COMPANIES