4. TRAILING SUCTION HOPPER DREDGER (TSHD)

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Trailing Suction Hopper Dredger
Based on hopper capacity in cubic metres

<table>
<thead>
<tr>
<th>Size</th>
<th>Hopper Capacity (cubic metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mega</td>
<td>30,000m³ and above</td>
</tr>
<tr>
<td>Jumbo</td>
<td>15,000-30,000m³</td>
</tr>
<tr>
<td>Large</td>
<td>8,000-15,000m³</td>
</tr>
<tr>
<td>Mid-size</td>
<td>4,000-8,000m³</td>
</tr>
<tr>
<td>Small</td>
<td>Under 4,000m³</td>
</tr>
</tbody>
</table>
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

Most important parts, machinery

Hopper, loading and unloading system

Drag heads

Dredge pump(s)
TSHD Process Description
Dredging cycle

1. Loading at the dredging- or borrow area
2. Sailing (loaded) to the unloading area
3. Unloading (bottom opening or pumping)
4. Sailing (empty) to the dredging area

TSHD Process

1. Loading at the dredging /borrow area
2. Sailing (loaded) to the unloading area
3. Unloading (bottom doors or by pumping)
4. Sailing (empty) to the dredging area
TSHD Process Description
Excavation (Erosion & Cutting)

TSHD Process Description
Suction
TSHD Process Description
Loading – Loading (overflow)

Top view hopper

Longitudinal section
Chapter 4 - Trailing Suction Hopper Dredger

TSHD Process Description
Full Load: Basic Principle

Top view hopper

Longitudinal section

Hopper loading (mud)

- Total Volume [m³]
- Max. volume
- Draught [m] (=tons)
- Max. draught
- Mud [m³]
Chapter 4 - Trailing Suction Hopper Dredger

Hopper loading (mud)

TSHD Process Description
Sailing loaded
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TSHD Process Description
Discharge

Split-hopper

TSHD Process Description
Hopper Bottom Discharge
TSHD Process Description
Hopper Self-discharge: system

Chapter 4 - Trailing Suction Hopper
Dredger
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)

VOLUME SAND (m³)

TIME IN MINUTES

DRAUGHT (m)

next trip

sailing empty

• 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**

- **MUD**
  - 5,000 m³
  - 6,000 ton

**Restriction by weight**

- **SAND**
  - 3,500 m³
  - 7,000 ton

**Low density soils**

- e.g.: Mud - 1.2 ton/m³
- 5,000 x 1.2 = 6,000 ton

**High density soils**

- e.g.: Sand - 2.0 ton/m³
- 3,500 x 2.0 = 7,000 ton

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**Hopper: loading & dumping facilities**

- Conical bottom-valves
- Overflow System
- Bottom doors
Hopper: loading & dumping facilities

**Bottom doors**

- Bottom door cylinders
- Self-emptying channel

**Bottom-door – opening position**

**Bottom-door – closed position**

**Drag heads**
Chapter 4 - Trailing Suction Hopper
Dredger
Suction Pipe

Suction Pipe
The drag heads

Swell Compensator

Swell Compensator
Drag head
Pressure Jar
Drag head Winch
Oil
Sea bottom
Chapter 4 - Trailing Suction Hopper Dredger
Centrifugal Pumps

Hardware
Types & Sizes – Basic parts

Inboard pump - Under water pump

Centrifugal Pumps

Working principle
- Energy Distribution
- Propulsion
- Pumps
- Board net
- Centrifugal pump
Chapter 4 - Trailing Suction Hopper Dredger
Trailing Suction Hopper Dredger
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

Production may vary a lot due to these factors

Limiting factors

A drag head grid damaged by boulders
## Trailing Suction Hopper Dredger
**Characteristic Figures**

<table>
<thead>
<tr>
<th>Trailing Suction Hopper Dredger</th>
<th>Small</th>
<th>Mid - size</th>
<th>Large</th>
<th>Jumbo</th>
<th>Mega</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimensions (L<em>W</em>Dr)</strong></td>
<td>55<em>10</em>4 m</td>
<td>90<em>18</em>7 m</td>
<td>130<em>23</em>9 m</td>
<td>180<em>32</em>13 m</td>
<td>225x38x 12-15.5 m</td>
</tr>
<tr>
<td><strong>Max. dredging depth</strong></td>
<td>10 - 35 m</td>
<td>25 - 55 m</td>
<td>25 - 75 m</td>
<td>50 - 120 m</td>
<td>55 - 155 m</td>
</tr>
<tr>
<td><strong>Hopper capacity</strong></td>
<td>&lt;4,000 m³</td>
<td>&lt;8,000 m³</td>
<td>&lt;15,000 m³</td>
<td>&lt;30,000 m³</td>
<td>30,000 - 46,000 m³</td>
</tr>
<tr>
<td><strong>Sailing speed</strong></td>
<td>8 knots</td>
<td>12 knots</td>
<td>14 knots</td>
<td>17 knots</td>
<td>16 -18 knots</td>
</tr>
<tr>
<td><strong>Propulsion</strong></td>
<td>400 kW</td>
<td>3,500 kW</td>
<td>8,000 kW</td>
<td>18,000 kW</td>
<td>26,000 kW</td>
</tr>
<tr>
<td><strong>Diam. Suction - pipe</strong></td>
<td>0.35 - 0.9 m</td>
<td>0.80 m</td>
<td>0.90 - 1.00 m</td>
<td>1.20 m</td>
<td>1.2 - 1.4 m</td>
</tr>
</tbody>
</table>