Self-discharging ships

- Pneumatic loading and unloading
- Rates from 100 tph to over 1,000 tph
- 100% weather-independent, fully-enclosed ship unloading
- Minimum manpower requirement both during loading and unloading
- Easy to install either on shore or on board ships
H.W. Carlsen has been a supplier of self-discharging ships for more than 30 years. During this period the Carlsen systems have proved extremely reliable and easy to operate and maintain. Worldwide, more than 100 ships and barges have been equipped with H.W. Carlsen loading and unloading systems.

To meet specific project requirements H.W. Carlsen supplies both pneumatic and mechanical loading and unloading systems. The unloading capacities may range from 100 tph for barge unloading systems to over 1000 tph for large self-discharging ships.

One of H.W. Carlsen’s specialities is fluidised ships with the actual unloading system on shore. This has proved to be the ideal solution when several ships or barges deliver cargo to one terminal. The system is particularly popular in Southeast Asia where 20 terminals are using this kind of equipment.
One customer purchases eight ships
From 1987 to 2002 Ta Ho Maritime Ltd. in Taiwan purchased eight H.W.Carlsen loading and unloading systems in succession. These ships represent state of the art technology, developing from 300 tph on the first M.V. Jui Ho in 1987 to 1000 tph on the largest M.V. Jui Ho delivered in 1999.

The ships built for Ta Ho Maritime Ltd. are used on short trade routes in Asia. Due to their high loading and unloading capacity they carry over one million tonnes of cement per year.

M.V. Jui Ho, 1987
17,000 dwt, 300 tph unloading capacity

M.V. Yung Ho, 1989
9,700 dwt, 350 tph unloading capacity

M.V. Jui Ho, 1999
22,000 dwt, 1000 tph unloading capacity

M.V. Shine Ho, 1992
17,000 dwt, 600 tph unloading capacity

M.V. Thai Ho, 1994
17,000 dwt, 600 tph unloading capacity

M.V. Sheng Ho, 1996
17,000 dwt, 600 tph unloading capacity

M.V. Ken Ho, 1998
20,000 dwt, 1000 tph unloading capacity
Key to success:

**The fluidised bottom**
The fluidised bottom is one of the keys to the successful H.W.Carlsen unloading systems. The inclined steel bottom of the hold is covered with fluidising fabric sections that are bolted to the steel bottom. Air that is blown in underneath the fluidising fabric sections passes through the fabric and fluidises the cement or any other powdered material above it. The fluidised material then flows towards the trench along the centreline of the hold. From the trench it continues to the centre of the hold, which is the pickup point for the pneumatic or mechanical conveying system.

**Diamond shaped bottom**
The H.W. Carlsen diamond shaped bottom is a refinement of the fluidised bottom system. The inclined bottom slopes eight degrees both across and along the hold. This creates a diagonal slope of 13 degrees towards the centre of the hold. The increased slope combined with separate fluidisation of each section provides absolutely superior cleanout and full control over the trim and list of the vessel during unloading.
Overall systems capability

**Pneumatic systems**
The H.W. Carlsen pneumatic systems vacuum the cement or other powdered material out of the holds. The DR type system blows the material through a pipeline to the storage facility. The CSP system mechanically discharges the material to an onshore belt conveyor. The Carlsen pneumatic systems are suitable for both conversion projects and new ships.

**Mechanical system**
The H.W. Carlsen mechanical system carries up the material by vertical screw conveyors from the fluidised floor to deck level where it is picked up by airslide conveyors or horizontal screw conveyors. The material is then carried on shore either mechanically or by a pressure tank system. The H.W. Carlsen mechanical system is suitable for conversion projects as well as new ships.

**Screw pump system**
The Screw pump is the world’s most commonly used pneumatic conveying system. In self-discharging ships an Screw pump is installed in a tunnel underneath each fluidised hold. Cement or other powdered material is then conveyed through pipelines to the onshore storage facility.
H.W.Carlsen pneumatic systems

Loading
The H.W.Carlsen single point loading system enables uninterrupted high-capacity loading of self-discharging ships. The shore-based shiploader feeds into the central receiving bin on the ship. On deck, the cement or other bulk material is distributed across the holds of the ship by a fixed airslide system operating at capacities up to 1200 tph.

Unloading
The H.W.Carlsen DR system vacuums the material from the holds and then blows it on shore through a pipeline system. Only a hose connection is necessary between ship and shore.

The H.W.Carlsen CSP system vacuums the material from the holds and then conveys it on shore by an outloading boom. The material proceeds onto a belt conveyor or directly into bulk trucks.
The DR system

The DR (Double Reloader) system consists of two tanks that alternate between being filled by vacuum and emptied by pressure. The cement or other powdered cargo is fluidised in one of the holds and flows toward the pickup nozzle. The vacuum pumps create a negative pressure in the reloader tank and the material/air mixture is vacuumed through the suction piping to the reloader tank (1). Filters in the tank clean the conveying air before it enters the vacuum pumps. When the reloader tank is full, the vacuum valve to the tank closes and the vacuum valve to the other reloader tank opens (2). The other reloader tank is then filled by vacuum while at the same time in the first reloader tank, the cement is mixed with air from the compressors and blown through a pipeline to the storage facility on shore (3). When one reloader tank is empty and the other is full, the two tanks alternate (4). In this way a nearly continuous conveying process is achieved of very high unloading efficiency and low operational costs. In the port only a pipeline to the storage facility is necessary. All other equipment is on board the ship.

The CSP system

The CSP (Continuous Suction Pump) system is a continuous conveying system that vacuums the material from the fluidised hold into the CSP unit. Filters in the CSP unit clean the air before it enters the vacuum pumps. A vacuum lock screw conveyor conveys the material at high capacity to a vertical screw conveyor which deposits the material into the outloading boom of the ship. The outloading boom with flexible bellows discharges the material onto an onshore conveying belt or directly into trucks.
H.W.Carlsen pneumatic systems

System components

1 Cement is loaded at high capacity and without interruption by connecting the shore-based loader to the loading inlet of the ship.

2 Loading screw conveyors
The cement flows via an airslide to the loading screw conveyor and is carried up to the receiving bin.

3 Loading airslides
From the receiving bin the cement is distributed along the ship by loading airslides.

4 Distribution valves
The cement is guided by a system of distribution valves to the holds of the ship.

5 Dust collectors
The dusty air in the holds created during the loading and unloading process is vented and cleaned by dust collectors.

6 Machine room
Blowers, vacuum pumps and compressors for the unloading process are placed in a machine room.
7 Fluidisation system
The blowers provide the air for the fluidisation system. Piping and valves distribute the air to each section of the system.

8 Fluidised bottom
The inclined steel bottom is covered by fabric. Fluidising the fabric sections one by one ensures a controlled flow to the centre of the hold.

9 Suction pipe
The vacuum pumps in the machine room suck the cement from the centre of the hold to the pneumatic system.

10 The D.R. system
Having sucked the cement from the holds, the pneumatic system conveys it under pressure through a pipeline to the shore-based storage facility. The Double Reloader tanks alternate between being vacuumed full and blown empty.

11 Control room
The loading and unloading operations are automatically controlled from the control room.

12 Unloading outlet
Outlet pipes from the unloading system are located on both port and starboard side. Only a rubber hose connection to the shore is needed.
Conversion projects
The H.W. Carlsen system is extremely suitable for conversion projects because it requires minimum changes to the ship structure. The fluidised bottom is easily fitted onto the existing tank top and the remaining equipment is installed above deck level.

New ships
The H.W. Carlsen system is also very suitable for new ships. The equipment is integrated into the ship structure resulting in shorter suction distances and less energy consumption. The ship’s main engines used for driving the propeller during voyage power the generators for the unloading system while in port.
The daily costs of a ship are high. So the time it takes to convert a bulk carrier into a self-discharging ship is important. The H.W. Carlsen systems enable short conversion time.

The sloped bottom is prefabricated in sections, complete with piping, valves etc. This enables rapid installation.

All other equipment is located above deck. The machine room is prefabricated complete with piping, appendages, etc. Shipyard work is reduced to a minimum.

Within 8 weeks after arriving at the shipyard the M.V. Thai Ho (17,000 dwt) was equipped with a 1,200 tph loading system and a 600 tph unloading system.
The H.W. Carlsen mechanical system uses screw conveyors for vertical transport and airslides or horizontal screw conveyors for horizontal conveying. The holds are equipped with fluidised bottoms. The material flows from the fluidised bottom through a flow control gate into a vertical screw conveyor. From the vertical screw conveyors the material flows through airslides or horizontal screw conveyors on deck to the centre of the ship. From here the material is conveyed on shore either by a mechanical outloading boom or by a pneumatic pressure system.

H.W. Carlsen offers a wide range of mechanical systems for self-discharging ships. All systems have the fluidised bottom and vertical screw conveyors in common. However, layout, individual screw conveyor capacities and redundancy may vary depending on customer requirements. For horizontal conveying either airslides or horizontal screw conveyors are used, depending on the loading and unloading characteristics.

H.W. Carlsen has built screw conveyors for many years covering a wide range of applications: Mechanical ship loaders and unloaders, fixed and mobile screw conveyors, self-discharging ships, etc.

A 1000 tph vertical screw conveyor on board the M.V. Shine Ho ensures reliable high capacity shiploading.
**System components**

1. Loading system receiver
2. Loading airslides
3. Fluidising bottom
4. Equipment casing
5. Vertical screw conveyors
6. Unloading airslides
7. Receiving hopper
8. Pressure tank system
9. Dust collectors
10. Machine room with fluidisation blowers and conveying compressors
11. Control room
Screw pump system

The screw pump is the world’s most widely used pneumatic conveying system, with more than 10,000 pumps having been supplied. The pumps can be used for many materials and applications. Capacities up to 700 tph and conveying distances up to 1,500 metres are available.

The material is conveyed to the vent hopper of the screw pump. The high speed screw conveyor compacts the material (effectively forming an airlock) and pushes it through a non-return valve into the mixing chamber. In the mixing chamber the material is mixed with compressed air and the mixture is conveyed through a pipeline to its final destination.

A very high number of screw pumps have been used for self-discharging ships and river barges. Notable examples are cement distribution barges on the big rivers in the USA, self-discharging ships on the Great Lakes between Canada and the USA and ocean going vessels. The screw pump system is best suited for new ships, as the pumps have to be positioned below the fluidised bottom of the holds. The system is simple and reliable although its energy consumption may be higher than other systems.
System components

1. Loading receiver
2. Loading airslides
3. Fluidised bottom
4. Tunnel below and between holds
5. Vent hopper
6. Screw pumps
7. Conveying pipelines
8. Machine room with compressors
9. Dust collectors
10. Control room