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Whitepaper

Screw-type Technology for Economical Ship Unloading

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Peter Göransson, sales manager for Siwertell AB explains how it is possible to achieve significant long-term savings through the use of high-capacity unloaders.

(From the archive of ”bulk solids handling", article published in Vol. 28 (2008) No. 7 , ©2008 bulk-online.com)Many cement import terminals today have based their shipping contracts on a daily discharge rate of 6000 t/d or less. However, with a 1500 t/h Swivertell unloader, this figure can be more than trebled to achieve a daily unloading rate of 21 000 t. This in turn reduces the unloading time in port by 119 days, compared with 167 days and leads to a shipping cost reduction of USD 3 570 000.These cost reductions, however, are only for the first year of operation. The maximum life time of a Siwertell unloader, for example, is still unknown; the oldest units are now more than 30 years old and still in operation. Increasing the unloading capacity with a maintained efficiency means a really considerable saving during the lifetime of the ship unloader and terminal.

Long-term Savings

In early 2005, Siwertell was approached by US company The Houston Cement Company LP, Houston, Texas to design a state-of-the-art cement import terminal, focusing on high efficiency and high unloading capacity. Following extensive

evaluation studies, a 1500 t/h cement unloader was ordered and entered into commercial operation in mid-2006.During the planning phase of the project specification for Houston Cement, the planned elevated annual intake of the terminal and the use of bigger ships had to be considered. It became obvious that high capacity, in the traditional sense, would not be the best economical solution for the customer. And after evaluating alternative solutions – one of them being to increase the unloading rate to 1500 t/h – the customer decided to opt for a second generation high capacity 1500 t/h Siwertell cement ship unloader as a part of the new cement import terminal.

New Trends dictate new Technology

Traditional cement shipping has in recent years suffered from disturbances that have resulted in a shortage of tonnage, but of equal importance have been increased freight rates. One of the drivers of the high freight rate level, according to some analysts, is a result of the imbalance between newbuildings and scrapping. Another reason may be that new dry bulk cargo ships are larger in dimensions compared with typical dry bulk cargo ships for cement transport, and cannot therefore be employed by existing terminals as their unloading equipment cannot handle the larger tonnage. This creates a shortage of suitable tonnage that may lead to permanently high freight rates at the prevailing level or even give rise to higher levels.

Reducing the Cost of Shipping

Shipping dry bulk cargo typically comprises the following three main phases:

- Loading the ship at the export terminal
- Ship on route between export terminal and import terminal
- Unloading the ship at the import terminal
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The terminal owner has little to do with the speed and efficiency at which the ship is loaded, and with how many days the voyage will take. What can be affected is how many days the ship will be kept at the berth; the ship cost for this stage. The first step in minimising ship cost at the berth is that basic elements of ship management, such as repairs and maintenance, are prepared in a professional manner before arrival of the ship in order to avoid any loss of time due to malfunctioning equipment. In addition to reliable and well-functioning equipment, there are other important main elements that can further reduce shipping costs:

- The rated unloading capacity of the ship unloading system
- The efficiency of the ship discharge system

It is obvious that the higher the ship unloading capacity, the faster the ship can be unloaded, thereby reducing the total number of unloading days in port. Just increasing the discharge rate of the ship unloader, however, is not the one and only solution to improve operations. To significantly enhance the daily ship discharge rate, the efficiency of the entire ship discharge system must be considered. There may be different definitions of efficiency, but Siwertell uses the following to define the efficiency of the ship discharge system:

$$\text{Efficiency} = \frac{\text{through-the-ship Capacity}}{\text{rated Capacity}}$$

The through-the-ship capacity is defined as the average capacity achieved when discharging the total contents of one ship with fully-loaded holds and is measured as the average capacity from the start of the operation down to a machine clean level in all holds. The rated capacity is defined as an average capacity achieved during a defined time period in the unloading procedure, when there is free access and product availability. The higher the hourly discharge rate and size of ship, the more difficult it is to keep up the efficiency figure. This is explained by the fact that the discharge rate during clean-up operations does not increase proportionally to the increased discharge rate. For Siwertell ship unloaders operating in ships up to Panamax size, and with discharge rates up to 1500 t/h, for example, it is possible to achieve an efficiency of 70 % to 75 % provided the design parameters for effective terminal design have been met.

Efficient Terminal Design

Effective terminal design is not only a matter of being able to design high-capacity ship unloaders. It is a matter of creating a system of equipment that is a cost effective as possible and works in harmony from A to B. During the terminal design process the following is of crucial importance in achieving a high throughship capacity and thereby high efficiency:

- the import terminal must include a rail-mounted unloader that can travel freely along the quay during operation, with a sufficient rail length to cover all the ship’s holds.
- the ship unloader arm system must be configured to allow operation at all angles and directions, with arm lengths reaching to the outer side of the ship as well as to the tanktop, including at low tide. This is shown in Fig. 1, where the reach is optimised to access the bottom in the first holds of a fully loaded vessel. This may seem like an insignificant detail, but it eliminates two

movements between holds and thereby reduces the total operation time by 30 minutes.

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Electrical Control System

With an increased discharge rate – particularly at 1500 t/h levels – for the best performance it is crucial that the ship unloader is equipped with an intelligent and sophisticated control system. For example: the inlet feeder (Fig. 2) is one of the key elements of the Siwertell ship unloader, picking up the product to be offloaded and feeding it into the screw conveyor. The feeder must interact with the conveyor, which is controlled by an automatic motor load-sensing system, and generate a steady discharge rate pre-selected by the operator in all operating positions. To operate efficiently at such a high rate as 1500 t/h, the control system must also interact simultaneously with other ship unloader motions; this is achieved via an automatic speed control system to ensure a high and steady capacity discharge with minimal surges.

Transfer Arrangement to Shore

The transfer arrangement between the ship unloader and the shore conveying system is one of the most underestimated features of import terminals today – most likely because its importance is not fully understood. An effective transfer arrangement must be able to comply with two basic requirements:

1.
2. The arrangement has to be able to transfer materials at all times when the ship unloader is in operation, and it should not delay or hinder the operation.
3.
4. Product transfer must take place under environmentally-acceptable conditions.
5.

To comply with these requirements Siwertell developed the movable transfer trolley (Fig. 3), which is a fully-enclosed device connected to the feeding conveyor and moved along the shore conveyor by the ship unloader. It is equipped with a set of wheels that travel on a rail profile attached to the shore conveyor. An open top conveyor is required, which must be sealed off by a specially designed rubber belt handled by the trolley.A dust collector is built onto the trolley, ensuring the transfer takes place under negative pressure to prevent emissions from escaping the system. This technology is unmatched by any other technology currently on the market and is the only way to achieve high ship unloading efficiency while maintaining environmental safety. The design of the trolley includes versions for screw or belt conveyor receiving systems.

Shore Conveyors

No ship unloader is ever better than the performance of the conveying system supporting that unloader. In practice, this means that the conveyor should be designed with a capacity of a minimum of 10% above the peak rate of the ship unloader with as few transfer points as possible between the ship unloader and the storage place. The conveying system design should consider the cement flow through the terminal to avoid multiple handling of material. A professional design by specialists results in substantially lower capital costs as well as lower operational and maintenance costs.

Economical Ship Unloading

As previously noted, many cement import terminals today have based their shipping contracts on a daily discharge rate of 6000 t/d or less. The reason may be that they operate equipment with lowdischarge rates or suffer from an ineffective terminal design that limits operations. Assuming an annual import of 1 million t/a results in approximately 167 unloading days per year based on a daily unloading rate of 6000 t. Based on a daily ship cost of USD 30 000 per day, this equals a ship cost at port of USD 5 010 000. Comparing this with the figures in Table 1, it is evident that investing in high capacity ship unloaders, with efficient 800 t/h or 1500 t/h discharge systems, at 70 % rated capacity, yields a highly profitable return.

	Other	Siwertell 800 t/h	Siwertell 1500 t/h
Annual throughput [t/year]	1 000 000	1 000 000	1 000 000
Ship size [dwt]	60 000	60 000	60 000
Rated unloading capacity [t/h]	430	800	1500
Through-ship-capacity [t/h]	300	560	1050
Ship cost per day [USD]	30 000	30 000	30 000
Number of unloading days	167	89	48
Ship cost at quay [USD]	5 010 000	2 670 000	1 440 000
Annual ship cost saving [USD]		2 340 000*	3 570 000*,1 230 000**
* Compared with Other** Compared with Siwertell 800 t/h			

With a 800 t/h ship unloading system it is possible to reach daily unloading rates of 11 200 t, thus reducing the number of unloading days by 78 days compared with the typical 6000 t/d case. This leads to a reduction in shipping costs of approximately USD 2 340 000. Taking it to the next level of 1500 t/h means a daily unloading rate of 21 000 t, reducing the unloading time by 119 days

compared with the typical 6000 t/d case, leading to a shipping cost reduction of USD 3 570 000. All of these cost reduction figures are based on the system’s first year of operation.

Conclusion

In view of the substantial savings that can be made when using a ship unloading system rated at 800 t/h or 1500 t/h, it is not advisable to focus only on the initial investment cost for equipment, as investment costs are only one of a number of factors. Also, it is important to note that if a system is designed properly, it can result in substantially capital savings as well as lower operational and maintenance costs.

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