Choosing a ship unloader should be about making an informed decision

Selecting a shipunloader

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Manufacturers of shipunloaders have witnessed a great period of change within the industry over the last year and a half, resulting in increased competition and greater consumer choice. With the two largest groups now involved in providing mechanical and pneumatic shipunloaders, both systems are capable of serving different purposes within the market. Here, Ad Ligthart of Cement Distribution Consultants, suggests that there exist some specific guidelines that owners and operators of shipunloaders would do well to observe when looking to select the most suitable system for an application.

After a few years of relative quietness, the last 18 months has seen a lot of changes for manufacturers of shipunloaders. In October 1998, Fuller Bulk Handling acquired Docksider, and with that move basically only two large groups manufacturing cement shipunloaders remained - the FFE group (including Fuller Bulk Handling, Fuller Kovako, Docksider and HW Carlsen) and the BMH group (with BMH Marine as its key shipunloader supplier).

This duopoly did not last very long, when in February 1999, Gert van Aalst (former owner of Kovako) re-entered the market with his new companies Mulder Boskoop and Van Aalst Bulk Handling. Within a short period of time, orders were received for pneumatic unloaders, dome extraction equipment, terminal conveying equipment, etc. In 1999, IBAU continued to make a strong comeback with a re-engineered range of mechanical unloaders, sales of four roadmobile machines and one large 800tph unloader.

A few years ago, the FFE group made the decision to develop into an all-round terminal equipment supplier by adding mechanical unloaders to its equipment range. The results of their first mechanical unloader are presented in this article. BMH is now taking a similar step, introducing pneumatic unloaders to its strong line of mechanical unloaders.

In light of these recent developments, the following guidelines seek to assist the selection of the best possible type of unloader for a specific application, ensuring that the right choice is made through careful evaluation of individual projects.

Do you need a shipunloader or shipunloading system?

This is an important question due to the different characteristics between mechanical and pneumatic conveying systems.

Mechanical shipunloading systems are basically a series of conveyors which run between the hold of the ship and the storage facility of the terminal. When only a shipunloader is needed (ie a machine to get the cement out of the ship, but no further) then all the conveyors between the ship unloader and the storage facility can be omitted. This is the case when ships are unloaded directly into bulktrucks, without the use of a storage facility. Under such circumstances, mechanical unloaders are normally less expensive than pneumatic unloaders.

Pneumatic unloaders are different in that they have a combined system which vacuums the cement from the ship and blows it through a pipeline to the storage facility. All the equipment (with the exception, sometimes, of compressors) is mounted on the unloader, making it difficult for them to be competitive for direct ship-to-bulk truck situations. However, it makes them very competitive in situations where the unloader is used at two or more terminals. Therefore, at each terminal only a pipeline is required from the dock to the storage facility, whereas a mechanical unloader would need a complete mechanical conveying system at each terminal. This is one of the reasons why pneumatic unloaders are so popular for roadmobile and barge-mounted applications.

The differing characteristics of pneumatic and mechanical shipunloading systems result in a different ratio between capital cost and operational cost. Generally speaking, pneumatic shipunloading systems have a lower capital cost than mechanical ones, especially in the small and medium size shipunloader range. On the other hand, the energy consumption of mechanical shipunloading systems is substantially lower than pneumatic ones. In order to benefit from lower energy costs you need to unload and convey a lot of cement. In terminals with a low annual throughput, the lower capital cost of the pneumatic unloading system offsets the higher energy cost. At terminals with a high annual throughput the lower energy cost of the mechanical unloading system will offset the higher capital cost. This is clearly reflected in the market where pneumatic unloaders are stronger in the smaller unloader market, and mechanical unloaders are stronger in the larger unloader market.

The selection of a shipunloading system is not so much a choice between mechanical or pneumatic but more a choice of application. The selection of the application will then strongly favour the actual type of unloading system.

As mentioned above, when an unloader has to be used at two or more terminals the pneumatic unloader has a strong

A roadmobile pneumatic system can be used at several terminals

advantage, as only a pipeline is needed at each terminal. This makes it a more favourable choice of unloader for stevedoring companies that utilise their unloaders for several customers, or are on short term contracts. Such unloaders will either be barge-mounted (or on a self propelled vessel) or roadmobile. A roadmobile unloader can move over the road without special permits or much (dis)assembly, while a road capable unloader requires a special permit and (dis)assembly.

On major US rivers the difference in waterlevel throughout the year can be as much as 9m. The economic solution is to put the equipment on a barge to go up and down with the waterlevel. It is both easier and more cost effective to have a rubber hose connection between conveying pipelines, rather than a mechanical conveying system that can cope with this water level difference. Almost all unloading systems on the big rivers are pneumatic.

However, when it comes to large import terminals with a high annual throughput and an infrastructure where rails exist or can be installed at a low cost, the mechanical unloader is almost a natural selection. The combined high unloading capacity and high unloading efficiency of the rail-mounted, large mechanical unloader cannot be matched by existing pneumatic unloaders. Savings in energy and shipping costs compared to other unloader configurations can be substantial.

What is the real capacity of the shipunloader?

Operators/owners of shipunloaders want to know the time between the moment the pickup head or suction nozzle of the unloader is lowered into the cement of the first hold, to the moment the last hold is empty and clean. This requires an average through-the-ship capacity, including all aspects of the unloading operation.

Shipunloader manufacturers claim they cannot guarantee the average through-the-ship capacity, as there are a number of factors they have no control over. Some of these factors are obvious. For example, nobody can blame the shipunloader manufacturer when it rains, or when the silo is full, or when the power supply fails.

Unloading the top half of a hold is something that every shipunloader manufacturer will be prepared to give a capacity guarantee for. This will be the maximum capacity for the pneumatic shipunloader and rated capacity for the mechanical unloader.

Discharging the bottom half of the hold is where the real differences occur. Here, clean-up should be taken into account. This largely corresponds to the reach and pickup capability of the unloader. It is mainly dependent on whether the unloader is railmounted or has to operate from a more fixed position. A railmounted mechanical unloader which can move during unloading has an excellent reach and can therefore maintain a high capacity for a long time. Combine this unloader with a large front-end loader for clean-up and it will have an average through-the-ship efficiency which is better than any other type of shipunloader. However, put the same unloader in a more fixed position, such as a barge-mounted or dockmobile application, and its efficiency decreases substantially. From one position the unloader cannot reach the whole hold. The solution is either to move the unloader several times (which takes time) or to use a large front-end loader to move the cement that the arm cannot reach to the middle of the hold, which is slow and dusty.

The pneumatic unloader is built to operate from a fixed position because of its hose connection to the shore-based pipeline — but its efficiency cannot match the efficiency of a railmounted mechanical unloader. The pneumatic shipunloading system has a better efficiency compared to mechanical unloaders in fixed, barge-mounted or dockmobile applications. This is because in these situations the pneumatic unloading arm has a better reach than the mechanical arm and does not need to be moved, nor does it need the assistance of a large front-end loader.

In order for the right decision to be made when selecting an unloader, it is important that manufacturers provide a guarantee for the "bottom half of the hold" capacity of the unloader. To provide such a guarantee, the manufacturer of the shipunloader needs to work with circumstances he can control. He should be able to use his own personnel and request the specific equipment and crew that he requires for an effective clean-up. The ship should comply with reasonable conditions, such as hatch-opening dimensions, an agreed minimum deadweight and cargo quantity, etc. Stoppages should be excluded except when they would be required to move the unloader to give the arm a better reach.

Depending on the type of shipunloader and its configuration, the "bottom half of the hold" capacity can vary greatly. In this respect it is reasonable to expect the manufacturer of a shipunloader to give accurate information on the capability of their unloaders, in the form of a guarantee. In this way, a manufacturer who is willing to give a good performance guarantee has an extra sales advantage.

The following points relate to capacity. A mechanical unloader is based on stan-

For large import terminals with a high annual throughput and an infrastructure with existing rails, the railmounted mechanical unloader (pictured above and below) is almost a natural selection

dard size screw conveyors. For cement, this basically means you can get small unloaders with a rated capacity of 300tph and large unloaders with a rated capacity of 800tph. Therefore asking a manufacturer of mechanical unloaders for a 500tph unloader does not make much sense. You will basically get the 800tph model with smaller motors and gear boxes.

Pneumatic unloaders are less dependent on standard components and therefore are available in a wider capacity range. This gives them an advantage, especially in the small unloader range, where they can offer low capacity unloaders (140-180tph) for low throughput European coastal and river terminals, and high capacity unloaders (400tph) for high throughput US river terminals. For midsize import terminals receiving ships in the 12,000-25,000Dwt category, with annual throughputs smaller than 400,000t, the pneumatic shipunloader is able to fill the gap in the available mechanical unloader range.

As mentioned previously, the combination of a mechanical unloader with a pneumatic conveying system is not optimal from a pure equipment viewpoint. In terms of capacity, there is a disadvantage to this configuration. Mechanical unloaders have a peak capacity approximately 15 per cent higher than their rated capacity. This is important when selecting the equipment that goes behind the shipunloader. For example, for an 800tph mechanical shipunloader, it would be advisable to put a conveyor belt with a capacity of 900-950tph behind it. But when the mechanical unloader is combined with a pneumatic conveying system, this system is taken at the rated capacity of the unloader. It cannot meet the peak capacity of the mechanical unloader, thus reducing the whole efficiency of the shipunloading system.

How much does an unloading system cost?

The capital cost of a shipunloading system consists of all costs required to get the cement from the ship into the storage facility. When all equipment for a shipunloading system is quoted by a manufacturer, on an ex-works basis, the following has to be added to get the full capital cost of the system:

- transportation of unloader and conveying system to the terminal site
- erection of unloader and conveying system, including support construction and electrical/mechanical installation
- electrical power supply
- dust collection system of storage facility
- start-up, commissioning, testing
- possible cost of local supply and local manufacturing parts.

The sum of the above can be quite significant, making it quite difficult to determine all these costs. One solution is to ask for turn-key quotations. When the owner/operator is convinced that he could do this additional work himself, for a lower cost, he should ensure that a careful evaluation is made.

There are other costs as well. When buying a railmounted unloader, there should be rails and a dock. When these are not present, the cost of building rails and/or a dock have to be added to the cost of the unloading system. When a barge-mounted ship-unloader is selected, the cost of the barge, barge modifications, mooring and warping arrangements has to be included in the cost of the unloading system.

In general, extended depreciation, high annual throughput and low financing costs are more favourable towards high capacity (mechanical) ship unloading systems with low operational costs.

The other side of the picture is that (again, in general) shorter depreciation times, lower annual throughputs and a higher cost of money are favourable towards lower capacity (pneumatic) systems with a lower capital cost which compensates for the higher shipping and operational cost.

Barge-mounted systems can easily cope with large differences in waterlevel. Due to the simple rubberhose connection with the shore, pneumatic systems are attractive for such applications

How important is energy consumption?

The energy consumption of a shipunloader is very important. It is one of the key differentiating factors between mechanical and pneumatic unloading systems. Shipunloaders driven by electricity face a monthly peak kW charge plus an actual consumption charge per kWh, making mechanical shipunloading systems favourable for high annual throughputs.

The situation is different for diesel driven equipment as the peak demand charge is not applicable. For diesel driven unloaders (especially in combination with a relatively lower annual throughput) the difference in the energy costs is less important.

Clean-up: a neglected factor

Clean-up of the cement from the hold of a ship is expensive. It requires a lot of labour and equipment and the work is very dirty.

The amount of clean-up is mostly determined by the reach of the arm. When the arm cannot reach into the corners of the hold and leaves 1000t per hold to be bulldozed to the middle, clean-up costs will be very high.

A shipunloader that can reach all through the hold will strongly reduce the cost of clean-up. This is not an issue of mechanical systems or pneumatic systems, but rather more a design and application issue.

Small portable unloaders can provide an effective discharge

Operators who work with mechanical unloaders prefer to work with relatively large front-end loaders. Pneumatic unloaders usually work with two relatively small skid steer (Bobcat type) front-end loaders. The pickup head of a mechanical unloader works best with a higher level of material. The pneumatic unloader is less sensitive to material height but to get 400tph or 600tph to the nozzle, at a low material height, two little, manoeuvrable skid steer unloaders can prove very useful.

For large unloaders it is very difficult to say whether pneumatic or mechanical systems have the lowest clean-up cost. This has more to do with the reach of the unloading arm. For small ships and barges the pneumatic system does have an advantage but it is not easy to accurately quantify this.

Calculating the costs

Having looked at individual aspects of shipunloading systems, how can these be put together in a single, conclusive, comparitive manner?

The solution is to calculate all these factors into a single "cost per tonne" figure. This then enables the overall capital cost of the complete unloading system to be determined. With this, and the chosen depreciation period, financing ratio, interest rate and required return-on-investment, a capital cost per tonne can be obtained.

To calculate the labour cost it is probably best to start with the time required to unload a ship. Using this, it is not difficult to determine the number of labour shifts that are required. A shipunloader can be operated by one person, but local labour regulations in general will require two people and sometimes even more. The local labour conditions will also determine the cost per hour (or shift) of a labourer. The total labour cost to unload a ship can then be calculated. When this is divided by the quantity of cement unloaded from the ship, the labour cost per tonne results.

There are many ways to calculate maintenance costs. Maintenance requirements will differ with the equipment configuration. The best way in which to get a figure for this is to talk to operators that have a similar unloading situation. For clean-up costs, the same applies. Witness a complete shipunloading operation from start to finish as a comparable unloading situation, and count labour and equipment required for clean-up. Calculate these costs and divide them by the quantity of cement unloaded from the ship. By adding up the cost per tonne for labour, energy, maintenance and clean-up, it is possible to calculate the operational cost per tonne.

The last item that has to be calculated is the ship cost per tonne. A ship has a cost per day which is defined in the shipping contract. With the unloading time, the cost of the ship over that period can be calculated. On top of that, Port charges should be given some consideration. The sum of this is divided by the quantity of cement unloaded from the ship, resulting in the ship cost per tonne.

By adding the capital cost, and operational costs on a per tonne basis, there exists a solid basis to help compare different shipunloading systems.

Changes within the market have encouraged more competition and choice

Roadmobile unloaders can be moved over the road with little or no disassembly

Conclusions

The choice of a shipunloading system can be empirically determined based on annual throughput, shipsize and the unloading situation at the terminal site as well as other factors. There are definitely situations where pneumatic unloading systems have a competitive edge on small roadmobile or barge-mounted systems. There are also situations including high throughput terminals with an infrastructure that supports rail mounted equipment where mechanical unloaders are more competitive. There are also large areas where equipment selection is unclear.

It is recommended that a careful evaluation of every individual project is made when comparing various configurations, unloader types and manufacturers. Non-empirical factors will also be part of that.

The currently strong market for cement unloading systems provides sufficient opportunities for all four shipunloader manufacturers. Increased competition will stimulate a move to more cost effective design and manufacturing, improved equipment, better guarantees and service.

The changes within the market have provided an excellent choice of shipunloader types and manufacturers. Competition will remain strong, which will prove advantageous for buyers of this equipment. With both the leading manufacturers involved with both pneumatic and mechanical shipunloaders it is clear that one type of unloader cannot cover the whole market competitively. Both unloaders have their own place in the market and consumers must be aware of manufacturer's equipment and technical support, in order to choose the most appropriate system for their needs. ❐