# Flexible Clinker Ship Loading

**Ricardo González, Global Bulk Technologies, presents a guide to mobile clinker ship loaders.**

The international clinker trade represents a small fraction of world cement production, in the range of 70 million tpy, with an imported value of approximately US$4 billion, according to ITC. Most of this trade is done through waterways.

Few cement plants are designed for export or with exports as one of their core markets. The large majority of producers target domestic customers and, eventually, some plants will redirect part of their production abroad, as a means of compensating for the periodic fluctuations of internal demand.

**Figure 1. Africa, clinker production balance.**

**Figure 2. Mobile ship loader (Samson).**

The secondary nature of export markets helps to explain some of the usual difficulties that are found in clinker export operations and which will be reviewed in this article.

There is an interesting geographic pattern in the international clinker trade, and two indicators can be used to show it. African yearly imports of clinker amount to 25% of the international clinker trade, although its consumption of cement only represents about 6% of global production. Figure 1 shows a detailed balance of locally manufactured clinker in Africa. Areas in yellow and orange have a deficit of locally produced clinker capacity compared to their cement consumption (and therefore need to import cement or clinker), while areas in green have an excess of locally produced clinker capacity (and will have to export it or reduce their production). This map quickly identifies two large, potentially exporting areas in North Africa and Nigeria, as well as a corresponding import region on the West Coast of Africa.

New plants are appearing in some countries at a rather quick pace, even though installed capacity is already exceeding domestic consumption. Indonesia, Algeria, and Nigeria, as with China in the past, have large potential for development. However, in the coming years they may suffer a glut of clinker production that will have to be exported.

## Ports for clinker exports

International ports are crucial for modern economies, as 90% of all trade is done by vessel. Yet ports are relatively scarce: in Algeria, for instance, it is estimated that less than 25% of the installed cement capacity is suitably located for exports, if the features of the nearest ports, plant capacity, and road transport are counted. Thus, few plants in Algeria have an advantageous option to compensate a weak domestic market with exports of significance.

Because most factories focus on their domestic markets, export facilities are not designed to the performance standards that are usual in, for instance, the ore minerals industry. Loading a ship at a rate above 20 000 tpd is common for mineral ores, but this is practically unheard of in the cement industry.

Clinker plants with private ports or dedicated terminals are not common, so public ports and general berths are used instead. Because of their economic importance, commercial ports are, or should be, busy with other products that create a steadier throughput. This compounds with the fact that clinker is seen as a ‘dirty’ product, which further reduces the available berths that port authorities allow to handle clinker. In a recent assessment conducted by Global Bulk Technologies (Globbulk), less than half of the suitable berths handling bulk or general cargo were allowed to manipulate clinker.

In this frame of factories without direct access to the water front, public ports, multi-user berths, and rapidly fluctuating exportable volumes of clinker, a specialised niche of machines has developed: the mobile clinker ship loader.

## Mobile clinker ship loaders

The main features of mobile clinker ship loaders (see Figure 2) are as follows:

- They are fed by dumper trucks and conveyor belts. This is probably the most distinctive characteristic of the loader, complementing the flexibility of road transport. The clinker factory, or at least the intermediate storage, can be kilometres away from the port, provided there is a steady supply of product once the ship arrives. This separation can seldom be achieved with belt conveyors.

- Form follows function. The clinker is received at the truck discharge station(s) at ground level, transported with an inclined belt conveyor towards the ship's hatches, and discharged through a chute. The ship loader also needs to shift among holds. The machine is designed around these basic functional requirements.
- They are mounted on tyres or can even be on crawlers. There are rail-mounted ship loaders that can handle clinker, but they belong to a different breed. Ship loaders on tyres are typically owned by the exporting company, or a logistics service provider separate from the port, and they are moved away and parked when there is no ship to load.

## Manufacturers

Although this type of ship loader can be used for other bulk products (e.g. gypsum, sand, or fertilizers) it is a relatively small niche market. It has been developed in the last decades by a reduced group of companies specialising in port bulk handling equipment. The core of the sector is European, but some competitors have appeared in East Asia.

One interesting feature is the balance between standardisation and prototyping. The manufacturers have a set of building modules that can be combined and modified to suit the client's requirements. In this way, they reap advantages from some standardisation, while retaining the ability to adapt the offer to the specific needs of a project. This is achieved without entering into the expenses of fully tailored design.

## Key aspects to consider as a buyer

Selecting a suitable ship loader requires a special blend of specific knowledge about port operations, the cement industry, machinery, and logistics. It is not highly sophisticated equipment or extremely expensive, but it is a critical link in an important operation. It is recommend that the client assesses its specific knowledge and seeks external advice if necessary.

The starting point in the selection of any ship loader is set by the geometric constraints of the port and ship. The client should select a berth and specify a ship design with the full range of positions, such as on-ballast and fully-loaded, or at low and high tides, etc. (see Figure 3). It is not enough to define the ship by its type (e.g. a Handymax) and often not even by its cargo capacity (for instance 35 000 DWT), because ships have a relatively broad range of dimensional variations. For example, the average breadth for bulk carriers between 30 000 DWT and 40 000 DWT is 27.3 m, but the 90%

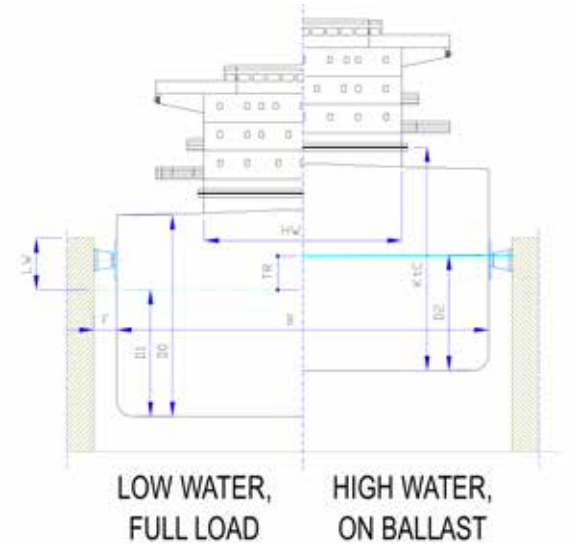


**Figure 3. Ship and port basic dimensions.**

**Figure 4. For narrow quays (Samson).**

**Figure 5. Mobile ship loader (Bedeschi).**

range is between 23.2 m and 30.5 m. Ship loading requires that the product is adequately distributed, so that the vessel does not list (incline port or starboard), and there is too much uncertainty in the range of breadths just mentioned.

The machine also needs to place the loading tip over the ship's hatches. The standard solution is to use a conventional inclined belt conveyor (other solutions such as elevators and pocket belts have been tested without much success). Due to the maximum inclination restrictions of the belt, even if chevroned, the footprint of these ship loaders can be large, and

even more so if the space required for truck manoeuvring is also considered. This makes it difficult to use this equipment in traditional ports, with transit sheds very close to the berth line or in narrow platforms.

For such specific cases, some manufacturers have developed solutions in which the main conveyor is split, with the first part laying parallel to the ship so the trucks discharge along it (see Figure 4).

The adequate definition of the ship loader capacity is crucial. The client typically expects a capacity that at least matches the charter-party rate of the vessel, so it is a 'through-the-ship' figure. On the other side, the supplier knows the design capacity of the machine. Both capacities are not the same for several reasons, and if the differences are not clarified in advance this may lead to trouble on the quay.

One basic discrepancy arises from the unit weight of the clinker. This seems too basic to be important, but quotations have been received with differences of more than 25% on this value.

A key aspect is the time between consecutive trucks at the discharge station, and the selection and management of the truck fleet is crucial. There is a tendency to underestimate this cycle time, but the trucks need to discharge in reverse, and ports are often congested and have space limitations, meaning that there is a learning curve even for experienced drivers.

**Figure 6. Mobile ship loader (Taim Weser).**

**Figure 7. Mobile ship loader (render, Telestack).**

Another crucial requirement, often unknown or disregarded, is the need to move the loader in order to evenly distribute the clinker among and within the holds (this is due to the floating stability and structural safety conditions of the ship). The loader will not fill a given hold just once, but perhaps two to four times, and at each hold the filling point will also have to be moved. How to achieve this is one of the main operational differences between suppliers. There are several options for the movements of the loader: rotation around a fixed point in plan, perpendicular and transversal to the quay line, steered wheels, the inclination of the belt, or telescopic belts (see Figures 5, 6, and 7). There are a wide range of possibilities, from equipment that requires external towing, to fully steered and powered wheels. Needless to say, the additional features provide advantages but come at an extra cost.

Moving the machine implies stopping the loading operation, and often jacking-up to steer the affected wheels if a substantial change of direction is needed. All these operations take time and it is important that they are considered when the equipment is selected.

A particular case arises at the performance or acceptance test. Here, the client tends to consider 'normal' most of the incidences that lose time, while the supplier tends to classify as 'abnormal' most of the time that the machine is without product. Clearly, it is recommended that a performance test procedure is agreed in advance, preferably at the contracting stage. There can be information asymmetry as the supplier often has more experience than the client, but external advice can be obtained if required.

Eventually, the clinker may come at a relatively elevated temperature; if it is foreseen that this might happen, it is better to prepare the machine from the design board.

The weight of ship loaders can also be significant and it is recommended that an early verification of the bearing capacity of the platform is completed.

## Supply logistics

Although the supply of clinker to a port by truck is a quite straightforward matter, the fact is that basic principles are too often oversighted or not respected.

Ships are expensive vehicles, so their supply should have priority – for example, hiring a Supramax can easily cost US$10 000/day. Demurrages typically rise because of port congestion, but low performance due to lack of trucks at berth is a sad and classic occurrence in ship handling operations. There are many

potential reasons for this and a detailed assessment is recommended – better to do this before it is too late.

In a study conducted by Globbulk a few years ago, a simple time chart showed the client's management that truck drivers drove in groups, unnecessarily increasing queues and imbalances in the supply flow. In other pre-assessments, it has been found that the ports only worked in daylight hours or on a one-shift basis. This means that the foreseen export operations could hardly be economically feasible. In another case, close to a quarter of the trucks were not dimensionally fit to the discharge station, some at the bottom, others at the top.

What these examples show is clear: the capacity of the ship-loader is important, but the need for a continuous supply of product by the truck fleet is even more so.

Trucks with a larger payload may bring a sizeable advantage; for the same transport rate, it may be easier to shift from dumpers carrying 24 t instead of 18 t, rather than increasing the fleet size by 30%. Transport companies are typically paid by the tonne, while batch size is also important in these operations.

It should also not be forgotten that rain can interfere with clinker handling, which does not only happen at the port. In addition, seasonality may have to be considered when planning charter party agreements.

## Environment, health, and safety

As noted, clinker is often considered a 'dirty' product and the bulk handling of clinker for exports will generate dust if not properly managed, with risk of stopping operations. Qualified manufacturers include dust control measures in their supply, but it is important that the client provides his own specifications. Basic aspects to consider are the following:

- Truck discharge stations – these are to be fully enclosed at the end sides and protected at the tipping front with suitably integrated filters. Bottom spillages should not be disregarded.
- A belt conveyor – with adequately designed transfers, enclosed, dedusted, with cover all along the boom, and spillage protection.
- A chute – this should be telescopic, preferably of the cascade type, dedusted, and with a skirt.

Clinker loading operations involve safety risks, including working at height, with heavy vehicle traffic (both the company's own trucks and those of other users of the port), activities near the water, work at night, and fatigue in the case of extended working hours, etc.

A well-thought-out safety plan is required, including due coordination with other nearby workers. ■

## About the author

Ricardo Gonzalez is Senior Consultant at Globbulk, with 20 years of international experience in the cement industry.