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Loading and Unloading Equipment of a Bulk Cement Carrier

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Die Be- und Entladevorrichtungen eines Zement-Frachters
Equipement de chargement et de déchargement d'un transporteur de ciment en vrac
Equipos de carga y descarga de un buque de transporte de cemento a granel
粉体セメント運搬船のローディング、アンローディング装置
一家散装水泥承运公司的装料和卸料设备
معدات تحميل وتفريغ سفن نقل الأسمنت السائب

1. Introduction

The transportation of bulk cement by sea utilising an exclusive carrier with specially designed loading and unloading equipment and facilities was first undertaken some years ago by Onoda Cement Co. Ltd. (ONODA) in Japan. Since that time a number of similar exclusive carriers for the transport of bulk materials including cement clinker, alumina, calcium carbonate powder and limestone have been designed and built by ONODA, supported in this work by an extensive and broad based on going research and development programme.

The design and manufacturing work involved is undertaken by and is the specific responsibility of Onoda Engineering and Consulting Co. Ltd. (OEC), a subsidiary of ONODA Cement. To date OEC have successfully designed and commissioned 50 bulk material carriers, during which time they have amassed a wealth of experience and expertise.

The largest bulk carrier in ONODA's fleet is the Shuyo-Maru, which has a cement carrying capacity of 20,000 metric t (Fig. 1).

Fig. 1: The Shuyo-Maru: ONODA Cement's largest bulk carrier which has a carrying capacity of 20,000 metric t

2. Bulk Material Loading and Unloading

The loading and unloading system of the Shuyo-Maru is shown in Fig. 2.

2.1 Loading

The carrier loading equipment consists of a closed circuit air slide system designed so that bulk cement can be loaded from both the port and starboard sides of the ship.

The loading capacity of the Shuyo-Maru was designed and specified at 2,000 t/h matching exactly the installed loading capacity of the equipment at ONODA's shipping ports.

Before the bulk cement can be brought on-board and the loading operation begun, the port equipment and the air slide on the carrier naturally have to be connected; this is facilitated by a simple flexible canvas chute, which swings into place and takes a matter of minutes to connect.

Any dust emitted during the loading process is collected through two sets of dust collectors which are installed within the carrier.

The equipment utilised and operated during the loading operation are:

— Two sets of blowers for the air slides
— Two sets of fans for the dust collectors and
— A generator which is installed in the engine room of the carrier.

In order to balance the carrier on an even keel during the cement loading operation the flow and distribution of the material is controlled by dampers.

2.2 Unloading

The unloading equipment of the carrier consists of:

1. **Open type are slides:** These are located at the bottom of the cement holds and are settled with a 10° to 12° inclination in the cutting section, crossing the longitudinal axis of the carrier.

2. **Trough chain conveyors:** Within the carrier there are four sets of trough chain conveyors each with a capacity of 300 metric t/h and located within a steel tube tunnel.

The bulk cement in the holds is extracted by the air slides and discharged onto the trough chain conveyors which then conveys the cement from the holds to the carrier's centre space where a bucket elevator completes the first stage in the unloading sequence.

Devices for controlling the flow rate are located at the discharge section of each trough conveyor.

Cement deadstock within the holds is negligible, making the percentage live capacity of the carrier high.

3. **Bucket elevator:** The bucket elevator which has a capacity of 1,400 metric t/h lifts the cement smoothly to a two way chute located at its discharge point.

Cement which is conveyed to the two way chute can then go to either the pneumatic conveying system or to an air slide which can then be connected by a telescopic chute to a further air slide on the port quay.

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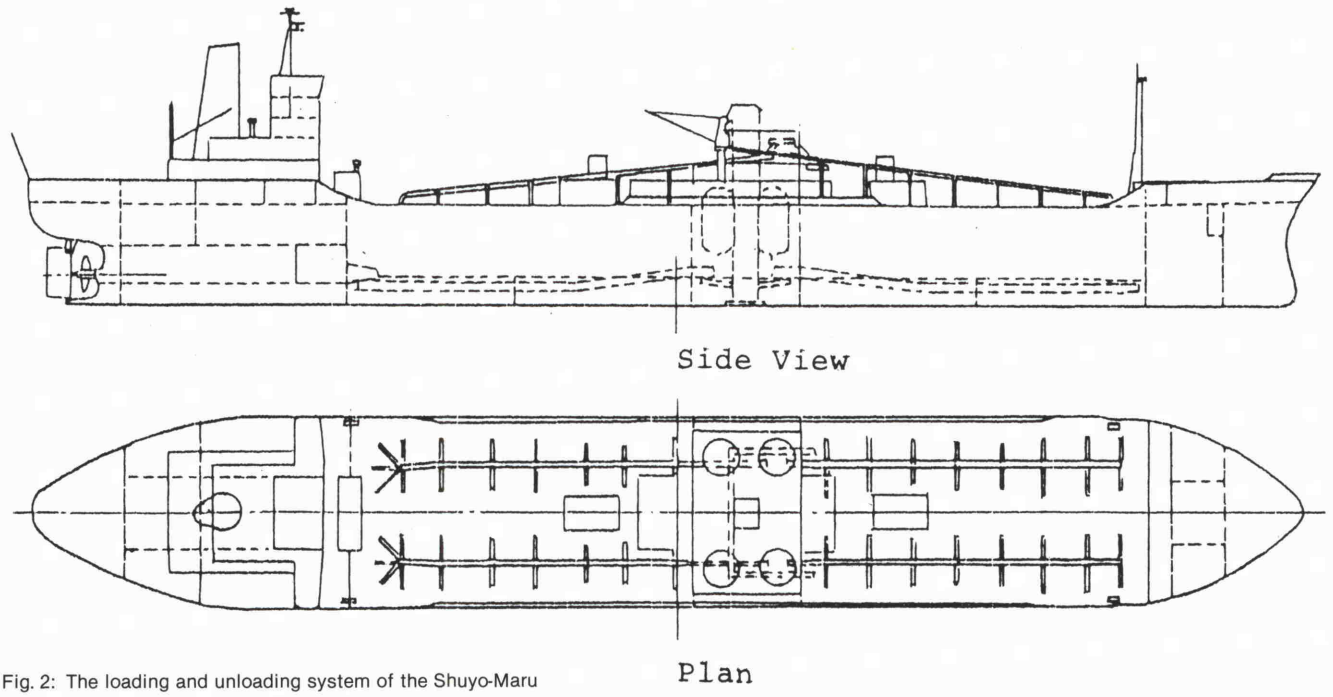

Fig. 2: The loading and unloading system of the Shuyo-Maru

4. **Pneumatic conveying equipment:** On this particular carrier there are two sets of pneumatic conveying systems each of which are located in the centre space of the carrier. Conveying pipes are connected to the quay bulk materials storage system via two 14 in. diameter rubber hoses.

The equipment has a capacity of 1,200 metric t/h which when expressed in terms of its maximum conveying capabilities, that is transport of bulk cement through a horizontal distance of 400 m and a vertical distance of 30 m, is the largest designed capacity to date in Japan.

The associated equipment for the pneumatic conveying system was manufactured and developed jointly by ONODA and HITACHI SEISAKU Ltd, Japan.

The compressor (250 m³/min) is powered by the main engine of the carrier, and all the power and air supply necessary for the total unloading sequence is supplied by the carrier itself.

5. **Mechanical unloading equipment:** In addition to the pneumatic conveying system, the carrier is equipped with a mechanical unloading system which has a capacity of 500 metric t/h. It is designed to facilitate unloading from either side of the carrier complementing the total system and adding to its flexibility and giving the carrier the operational advantage that it may be loaded and unloaded from just about any port in the world.

The efficiency of the installed equipment, enabling the loading operation to be completed in 10 h and unloading within 17 h provides for fast turn around, relaxing vehicle and carrier congestion at the quay and the minimisation of transportation costs.

3. Final Comment

The Shuyo-Maru has the following highly desirable operational advantages:

- High capacity pneumatic conveying system rated at 1,000 to 1,200 t/h.
- Very little operational noise.
- The carefully designed handling and conveying system ensures that the dust emmission and associated air pollution is minimised.
- High percentage live capacity.
- Dual unloading system — mechanical and pneumatic.
- One man control and operation.
- Low maintenance costs.