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# ADVANCED TECHNOLOGY FOR SELF UNLOADING CEMENT TANKERS

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# Biography

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Mario Rämmele studied Process Engineering and Plant Operation at
Technical College Flensburg and graduated 1991. He started his professional career at Krupp Polysius in the technology department. In 1994 he joined IBAU HAMBURG where he is head of the design department with technical responsibility for ship unloaders and mechanical mixers. He is 37 years old and married.

## Advanced Technology for Selfunloading Cement Tankers
**by Mario Rämmele, IBAU HAMBURG, Germany**

### Introduction

Selfunloading cement tankers need no shore based shipunloading equipment and have a totally enclosed cargo handling system. They have a fluidized system in the cargo holds in common but are different in the loading/unloading technologies and the adaption to the terminal facilities. The world fleet comprises 245 units between 4000 dwt and 30000 dwt for seaborne cement transportation. Additional about 250 units exist in the <4000 dwt range for coastal, lake and river transport (river barges).
Especially the cement tankers in the upper range require advanced systems which are fully automated and possible to achieve high loading/unloading rates.

### Applications

Selfunloading systems have to be adaptable for the different ship sizes and different grades of cement. For seaborne transport high loading and unloading rates up to 1200 t/h, automatic operation and advanced control are required, beside 100% reliability. The MV Goliath (Fig. 1) of Australian Cement is a very good benchmark on advanced design and economical operation. The 15000 dwt cement tanker, built in 1993, is transporting over 1.1 million tonnes of cement per year from the Railton Plant , resp. Devonport Harbour in Tasmania to Port Melbourne, Glebe Island (Sydney) and Newcastle in Australia. What makes the difference to other large cement tankers is the loading and unloading concept. Loading and

*(Fig.1 MV Goliath in Devenport Harbour)*

unloading procedures of the MV Goliath are very simple and only one pneumatic conveying system is used to cover even more than 500 m distances from the ship to the shore terminals. The unloading terminals have the same design than conventional cement distributions terminals with truck loading lines. No own shipunloading or transport equipment is required and therefore the installations are highly independent and cost effective.

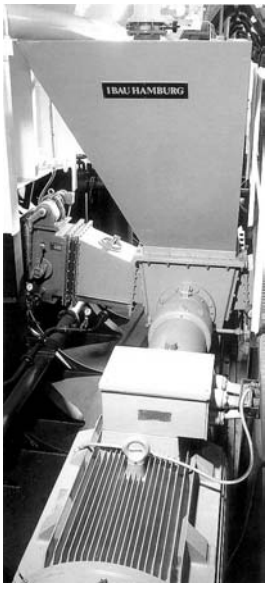
River barges and small cement carriers below 4000 dwt have different requirements and with loading/unloading rates up to 400 t/h other technologies become important. Fig. 2 shows a photo of one river barge for Lafarge Cement with fluidized cargo holds for 2200 dwt and a mechanical loading/unloading system. Lafarge operates three such barges since 1997/98 along the River Seine. In Le Havre the barges are loaded via a mechanical shiploader while in Paris barge unloading is effected into an existing downstream conveyor of a terminal.

*(Fig. 2 Lafarge cement barge)*

**IBAU Technology**

Integral part of all cement tankers and river barges is the IBAU fluidization system for fitting ship sizes from 1000 dwt to 30000 dwt. Up to 16 cargo holds can be equipped with a fluidization system (Fig. 3). Such a system comprises inclined aeration panels, which cover the complete hold bottom. Only top fabric quality is used and the fabric is specially designed to the cement characteristics. Cement flows to the lowest points in the holds, where IBAU flow control gates are installed, which allow an adjustable and computerised flow. While other solutions use an intermediate vacuum or mechanical system with downstream pressure vessel conveyors for transporting the cement from the holds to the shore terminal, IBAU uses the pump concept for direct ship to shore transport. Fig. 4 shows the special designed IBAU pump with lateral feed from left and right hand side, which has a very low feed point. One pump transports up to 300 t/h cement. Conveying distances of more than 600 m can be

*(Fig. 3 IBAU fluidisation system)*




*(Fig. 4 IBAU pump in cement tanker application)*

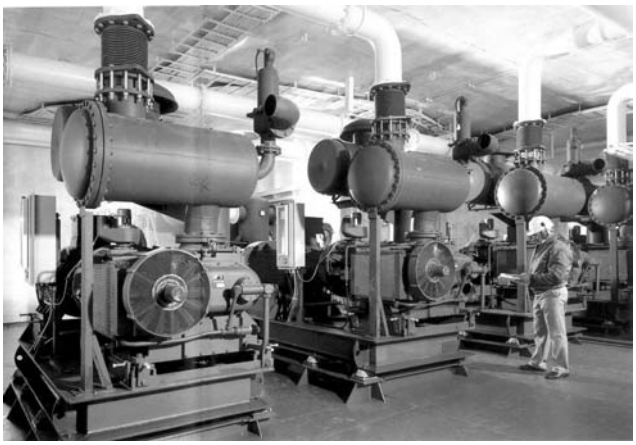
achieved. For barges and ship sizes with smaller capacities and shorter conveying distances IBAU screw conveyors are used (Fig. 5). Unique is the space saving IBAU midship tunnel concept for integrating the discharge equipment. The midship tunnel eliminates an additional bottom to deck hold for the discharge equipment.

Cement loading from the terminal into the ships holds can be directly or indirectly. For direct loading with high capacities IBAU screw pumps are used, which pneumatically convey the cement through one or more pipelines directly into the cargo holds.

*(Fig. 5 IBAU screw conveyor for loading/unloading)*

Flexible hoses for the connection of the shore and ship pipes are carried by an on-board crane (Fig. 6). Loading lines on deck are equipped with motor actuated IBAU two way valves for directing the cement by computer into the selected holds. The required compressed air is generated by the compressors on board (Fig. 7). For cement distribution on deck from a central receiving bin either fluidslides or horizontal screws can be used. IBAU fluidslides are used for capacities up to 1200 t/h, while IBAU screw conveyors are recommended for capacities up to 500 t/h. Such systems are very common if a mechanical shiploader is used.

*(Fig. 6 Board crane lifting flexible hoses)*



*(Fig. 7 Compressor room)*


In IBAU systems cement loading and reclaiming can be completely automated and computer controlled. During loading, cement is automatically directed into the holds, while the ship is balanced. Unloading rates can be preselected and the operator gets information about any hold and discharge equipment at any time

*(Fig. 8 Central computer)*

fit the computer systems with latest state-of-the-art technology to ensure highest possible through the hold capacity with the shortest laytime for the ship in port. The described loading/unloading technology optimal assists computer automation.

In cases where grey and white cement have to be transported with the same cement tanker after each another a 100% cement reclaim from the cargo holds is required.
The innovative IBAU vacuum cleaner (Fig. 9) assists the reclaiming process, to make a 100% cement reclaiming rate possible. The cargo holds are equipped with docking stations for the mechanical cleaner, which directs the remaining cement between aeration panels into the bin of an IBAU pump. Particle separation is effected in the pump filter and no additional cement transportation equipment is needed.

*(Fig. 9 IBAU vacuum cleaning)*

**System comparison**

Table 1 comprises the different characteristics for the main cement tanker unloading solutions. The IBAU pump is the only direct unloading solution that does not need any intermediate transport. Vacuum systems as well as screw systems mainly are combined with pressure vessel conveying for ship to shore transport. Space requirment in the ships hold is very low with IBAU pumps because the pumps have a very low feed point and all discharge equipment can be installed in a midship tunnel. The capacity range of IBAU pumps installed in parallel is as high as with the most advanced screw conveyor systems. The conveying distance can be up to 600 m, which covers the known terminal requirements. Here, screw systems have their main disadvantage. The specific power consumption that is required for an IBAU pump is not higher than for a combined vacuum/pressure vessel system and only slightly above screw systems for medium and long distance. Another strong point of the IBAU pump is the adaptability to latest automation requirements. When screw conveying systems are combined with IBAU pumps some special advantages are received compared to the vacuum/ pressure vessel solution, such as lower energy requirements and the long conveying distance.

**Unloading systems**

| Feature | IBAU pump | Vacuum /pressure system | Screw system |
|---|---|---|---|
| type of conveying | direct | indirect | indirect |
| space requirement | very low | medium | low |
| capacity range | high | medium | high/low |
| conveying distance | high | high | low |
| spec. power cons. | medium | high | low |
| automation | high | medium | medium |

**References**

IBAU HAMBURG has an intensive project experience and a high market share with 15000-20000 dwt cement tankers in the last 10 years. The IBAU reference list comprises new buildings as well as conversions. For smaller ship sizes such as river barges also mechanical screw conveyors are economical.

The 15700 dwt MV Goliath (Fig. 10) is 143 m long and has a 23.5 m width. Loading capacity is 1400 t/h with shore based 4 IBAU pumps, unloading is via 4 IBAU pumps with 1200 t/h and 300 m conveying distance.
The MV Koralia (Fig. 11) has 8 holds with 8500 dwt capacity. Loading capacity is 1000 t/h with shore based ? IBAU pumps, unloading is via 4 IBAU pumps with 500 t/h and 435 m conveying distance.


*(Fig. 10 MV Goliath)*

*(Fig. 11 MV Koralia)*

Kedah Cement operates 3 cement tankers built 1995 to 1996. Each carrier (Fig. 12) has 16000 dwt capacity. Loading is via IBAU fluidslide systems with 1000 t/h, unloading is via 4 IBAU pumps with 800 t/h and 550 m conveying distance.
The MV Magaretha (Fig. 13) is a conversion with 2200 dwt capacity and two holds. Loading is via ? with 300 t/h, unloading is via 1 IBAU pump with 150 t/H and 265 m conveying distance.

*(Fig. 12 Kedah Cement I-III)*

*(Fig. 13 MV Margaretha)*

The MV Cemstar (Fig. 14) is a conversion of the former MV Lisa Lehmann with 2000 dwt cement capacity and 2 holds. Loading is via a shiploader with loading chute with 300 t/h or directly from road tankers. Unloading is via an IBAU pump for 150 t/h and 265 m conveying distance. Cement is transported directly from the ship into the storage terminals. The complete conversion was effected in only 3 month.
Lafarge operates 3 cement barges (Fig. 15), which are 79 m long and have 11 m width. Loading is via 2 IBAU screw conveyors with 2*200 t/h, unloading is also with screw conveyors with 150 t/h.


*(Fig. 14 MV Cemstar)*

(*Fig. 15 Lafarge cement barge)*

**Conclusion**
Cement tankers have a fluidized system in the cargo holds in common but differ in the loading/unloading technologies. Advanced systems have to fit to the terminal facilities and require high throughputs up to 1200 t/h. These can very effectively
be met with the IBAU pump system, which fulfils the most stringent system requirements. The direct loading/unloading mode requires no intermediate transport
and transfer points as it is necessary with vacuum/pressure vessel systems. Another major advantage is the possible long conveying distance and the possible complete automation. The system can also be adapted to cement tankers, which alternatively transport white and grey cement.