Like clockwork

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What are the factors that have to be taken into account when chartering self-discharging cement carriers? Practical experience gained during a substantial hydropower dam construction project in Panama provides the answer. Ad Ligthart of Cement Distribution Consultants, who was responsible for the purchase of 260,000t of cement and flyash and the logistics to transport them to the concrete dam site, reports.

Changuinola River, Panama

Between the end of 2007 and 2011 a large construction project on the Changuinola river on the Caribbean side of Panama, close to Costa Rica, was realised by Changuinola Civil Works, a joint venture between E Pihl & Son and MT Højgaard, the two largest contractors in Denmark. The project consisted of a large concrete dam of 100m high and 600m wide at the top for which about 900,000m^3 of concrete were required. From the dam, a tunnel of over 4km was blasted through a hill cutting off a bend of the river and adding another 40m of water pressure above two 105MW turbines in a powerhouse at the end of the tunnel. A mini powerhouse of 10MW was added at the base of the dam to maintain an environmental flow through the river bend which was cut off by the tunnel. The project also consisted of 22km of permanent roads, including four bridges. A description of the project was provided in ICR August 2010 when building work was in full swing.

The construction of the dam was realised in 17 months from December 2009 to April 2011. This meant that between November 2009 and March 2011 a total of 220,000t of cement and fly ash had to be transported to the project. Before the construction of the dam could start, two years of preparations were required. These included the construction of roads to the project, realising an 8000kW power plant, a crushing plant, aggregate and sand mining operations, two ready-mix plants, a huge workshop and two camps for personnel (one of them for expatriates). During this period work on the tunnel, powerhouse and foundation of the dam also took place. About 40,000t of cement and fly ash were imported in Big Bags during this period.

During these two years the preparations for the bulk cement and fly ash supply were also made and this was no small issue. The project was located in a remote province in Panama with only a single road connecting it to the rest of the country. The road was in such a condition that a bulk truck required a three-day roundtrip to transport a cement load to the project. It was clear from the beginning that cement and fly ash had to come in by sea.

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The only port facility in the neighbourhood of the project was the small banana port of Almirante. The port was too small and too busy to establish a shore-based terminal facility. It did, however, offer deepwater access (11m draught), a sheltered berthing area as well as pilot, agent, customs and immigration facilities. The decision was made to put a floating terminal in the port which would provide a combined storage facility and floating dock to receive the ships.

For this purpose, the floating terminal had to be positioned about 100m offshore. To convey the cement and fly ash to shore it had to be fitted with a floating pipeline. As no existing floating terminals were suitable or available the 23,000t barge Lavioletta was purchased in Canada and converted in Costa Rica (see panel).

When the preparations for the import facility were made, the suppliers of the cement and fly ash had not yet been selected. It was clear, however, that these materials would have to be sourced from within the greater Caribbean area, which meant that the transportation of the materials would be in ships with a size ranging between 4000-9000dwt and the floating terminal and related facilities were developed based on this.

The Lavioletta

Originally a Great Lakes bulk carrier built in 1961, the Lavioletta was converted into a floating terminal, designed to operate totally independent of any port facilities.

The Lavioletta has changed usage a number of times during her life. In 1997, her machine room section with deckhouse and bridge were cut off and used for another ship. The remaining five holds and bow were converted into a barge by fitting a new transom and a ballast system. The vessel was used as a grain storage barge near Quebec on the St Lawrence River until 2008 when Changuinola Civil Works JV bought her.

Table 1: vessel technical specification

Storage capacity (t)	23,000
Holds (no.)	5
Length (m)	151.3
Width (m)	22.9
Depth (m)	11.0
Draught (m)	8.6

A new start

The acquisition marked the start of her life as a floating terminal. After being towed to Limon in Costa Rica – a three-hour drive from the dam project site – she was converted into a floating terminal while at anchor. This work involved:

- shot blasting and painting of the hull (above the waterline)
- repairs to hull and ballast system
- new gantry for ship unloader
- installation of a Van Aalst Bulk Handling pneumatic unloader with a capacity of 180tph
- cement and fly ash conveying pipelines
- fuel, water and waste water pipelines
- installation of two heavy spud poles.

Floating terminal with a difference

The Lavioletta is different to other floating terminals because of two large spud poles each with a 22m length. This gives her the ability to be totally independent of any port facilities. When both spud poles are lowered, the vessel is secured firmly in place in water depths between 10-14m and becomes not only a floating storage but also a floating dock. By means of a floating pipeline the cement and fly ash then are conveyed to shore truck loading silos. The vessel can be provided with fuel, water and (if needed) electricity via the floating pipeline as well.

Cement and fly ash supply

The selection of the fly ash and cement supplier in the early phase of the project looked difficult but the global economic crisis opened up new possibilities. The collapse of the construction market in Florida meant not only an end to the substantial cement imports into this market but also caused a surplus production capacity of both cement and fly ash.

Titan America became the supplier to the project for both materials. The fly ash was sourced from Separation Technologies fly ash production facility at the Big Bend power plant in Apollo Beach and could be exported via the port of Tampa. The cement was supplied by Titan Americas' Pennsuco plant, just north of Miami, and could be exported via Port Everglades. In the agreements for the cement and fly ash supply the following issues were covered:

- **quality specifications**
- **quantity definitions**
  - guaranteed minimum
  - possible maximum
  - penalties for non performance
- **price**
  - basic price
  - escalation over time
  - payment conditions
  - financial guarantees
- **delivery conditions**
  - FOB Incoterms 2000
  - definition receiving capability of ships
    - – loading connections
    - – dust collector capacity
    - – guaranteed loading rate
    - – penalties for non performance
- **supply obligation**
  - definition of supply source
  - an alternative supply source in case of problems
  - keeping sufficient stock
    - – maximum ship size
    - – minimum interval between ships
    - – maximum possible deviation from schedule
- **scheduling**
  - rolling schedule updated monthly and after big changes
  - ordering procedures
  - notification obligations
- **use of general port facility**
  - obligations of supplier to fix dock availability
    - – options when dock is not available and corresponding responsibilities
  - remedies, force majeure, termination and other general conditions.

Both the cement and fly ash supplier had no previous experience in exporting their product in bulk ships. The use of ships means that a large quantity of material has to be delivered in a very short time. The possibility of two ships arriving to load material within a few days further complicated the logistics. The fly ash logistics required special attention in particular. The production capacity of the fly ash plant was 20,000tpm. The peak export requirement could be three shipments per month of about 7500t each (giving a total of 22,500t of which two ships could arrive right after each other).

The fly ash plant in Apollo Beach had a product silo of 10,000t which was clearly insufficient. The solution was to use one silo of 14,000t of Titan's large cement import terminal in Tampa which was idle. This silo could be filled on a regular daily basis from the fly ash plant. When a ship arrived for loading, a fleet of up to eight bulk trucks was used to move the fly ash from the silo to the adjacent dock and to blow the material into the holds of the ships at a guaranteed rate of over 4000tpd.

For the cement exports the logistics were simpler as the production capacity of the Pennsuco plant was over 2Mta and cement silos with a total capacity of over 60,000t were available. However, as the cement plant was located about 30km from Port Everglades, a fleet of up to 25 bulk trucks had to be mobilised for every ship loading operation to reach the guaranteed daily loading rate.

Realising the supply chain

With the supply of the cement and fly ash firmed up and the floating terminal and shore-based truck loading silos well underway in their construction, the focus of the supply chain could now move to the ships required to transport the cement and fly ash from Florida to Panama.

In the feasibility study for the cement and fly ash logistics in 2007 it had become clear that self-discharging ships would provide not only a more economical solution than regular bulk carriers but also a more secure supply given the tropical rain climate at the discharge port. This study was made with shipping prices at top level and only a limited availability of self-discharging ships on the market. By the end of 2008 and during 2009, this changed completely and shipping rates dropped steeply. By August 2009, when the negotiations for the first vessel started, there were a good number of vessels available of the required size.

For the dam construction an overall consumption of 220,000t of cement and fly ash was required over a period of 16 months. However, the cement and fly ash consumption were far from evenly distributed. In the early phase of the dam construction a consumption of about 10,000tpm was foreseen. This would build up to an expected peak production of 30,000tpm when construction was going at full speed. At the end of construction (when the top of the dam was becoming too narrow for full-speed concreted placement) consumption would drop to below 10,000tpm again. Based on the project schedule and the sea distance between Tampa or Port Everglades and Almirante two self-discharging cement carriers with a cargo capacity of about 7500t were required. One vessel was required for the full duration of the project (about 16 months) and the second vessel was required for about 8-9 months during the period when concrete placement was at full speed.

To evaluate the various ships on offer, a spreadsheet was prepared, comparing the capabilities of each vessel in respect to the transportation distances and the project schedule. During this exercise, the following factors were taken into account:

- actual cargo capacity (deadweight minus anticipated fuel, fresh water and general stores)
- fuel consumption (sailing under various conditions, daily generator use, cargo

UBC Cork and UBC Cartagena

The self-discharging cement carriers UBC Cork and UBC Cartagena, owned by United Bulk Carriers (USA/Cyprus and brokered through RG Jones Price (now RGJP Shipping Ltd), were chartered for the project.

Table 2: vessel technical specification

Length oa (m)	117.0
Width (m)	19.7
Depth (m)	8.5
Draught (m)	6.4
Deadweight (t)	8600 (resulting in a cargo capacity of 7800t)
Cargo hold volume (m^3)	6740
Fuel consumption	
– Sailing	19tpd IFO 380 at 14.5kn
– Generators	1tpd MDO
– Discharge	9tpd IFO 380 at 600tph
Two main engines each driving propeller and generator	
Discharge system	Cargotec – Nordströms
Extraction from hold	Mechanical
Discharge to shore	Pneumatic
Capacity (tph)	2 x 300
Dust collectors	6 x 1200 – 7200m^3/h

Loading cement in port

equipment during loading and discharge operations)
- daily charter rated over the anticipated duration of the time charter period
- loading and discharge capabilities
- positioning issues (duration of travel from the vessels locations to the project area)
- hold volumes. As the majority of the material to be transported was fly ash, which requires about 25-30 per cent more volume than a cement cargo of the same weight, the hold volume of the ship was very important.

The vessels that were taken into time charter were the UBC Cork and, three months later, the UBC Cartagena (for technical details see panel). The vessels were chartered from United Bulk Carriers. The broker was RG Jones Price Co (now RGJP Shipping Ltd). Both vessels were brand new and came straight from the shipyard in China. A trip of 35 days was required for each vessel to reach the first loading port of Tampa.

The charter party was the BIMCO uniform time charter (Baltime 1939, Rev. 2001) with additions.

The standard agreement covers the following issues:
- contract partners
- ship specification
- fuel consumption
- charter period and possible extensions
- charter price/payment terms
- place of delivery and redelivery
- notification issues
- trading limits
- off-hire situation
- general conditions.

Self-discharging vessels are quite specific in use and also the trading route had some specific issues. In this respect a number of additional clauses were added to the standard time charter agreement. These additional causes covered:
- loading conditions/capabilities (must match with supply contract and actual situation in port)
- discharge conditions/capabilities (must match with receiving terminal and actual situation in port)
- equipment availability definitions
- vessel to comply with US regulations!
- various issues regarding trading in the Caribbean.

Already before departing from China, each vessel was fitted out with 12 truck loading points (four per hold). A lot of preparation went into the organisation of the first fly ash and cement ship loading operations. The excellent cooperation between fly ash and cement suppliers, ship owner, port representatives, agent and charterer resulted in a flawless clockwork operation on all 32 voyages. The vessels were loaded consistently in two days. The combination of bulk trucks loading self-discharging vessels allows for a continuous operation independent of the weather conditions and it is completely dust free. In Port Everglades the cement loading operations were carried out alongside the big cruise ships.

Table 3: inputs and outputs of calculation model as base for shipping schedule

Inputs
- Concrete placement forecasts
- Trucks loaded at terminal
- Silo and floating terminal hold levels
- Silo levels at concrete plants
- Terminal operating values
- Ships positions and tank levels
- Ship loading information
- Payments

Outputs
- Terminal operations scheduling
- Ship scheduling
- Stock situation
- Internal invoicing
- Cost overview and projection
- Cost per tonne calculation
- Cash flow projection
- Day-to-day historical overview

Managing operations

Most of the management work of the chartering of two self-discharging ships is in the setup and preparations of the complete logistical chain between the fly ash and cement supplier in Florida and the concrete production plants at the project site in Panama as described in this article.

When the ships begin moving the operations management largely consists of coordination and scheduling. The activities encompass the following:
- loading port arrangements (via agent)
  – tugboat
  – pilot
  – dock
  – documents
  – customs
- interaction between charterer, agent, port, supplier, ship and shipping owner
- fuel scheduling
  – optimal quantities
  – supplier situation
  – price hedge possibilities
- ship charter interaction
- discharge port arrangements (via agent)
  – pilot
  – documents
  – customs
- interaction terminal – ship
- crew arrangements discharge port
- security in discharge port.

These activities can easily be combined with the management of the floating terminal which consists of:
- loading – discharge operations
- trimming of floating terminal
- truck loading (adapt shifts to project operations)
- interaction terminal – ship
- keeping cement and fly ash separated!
- supplies, repairs, etc
- safety and security.

A key feature of operations management is scheduling. As the shipping schedule was completely dependent on project progress and related developments a spreadsheet was set up with 14 interactive pages covering all logistical and economical activities (concrete placement, trucking terminal operations, shipping, personnel, payments, etc). Every day, the forecasted values were replaced by actual figures and the forecasts were recalculated.

The calculation model (see Table 3 for inputs and outputs of this model) and the resulting scheduling enabled decisions to be taken well in advance and to prevent problems. It also provided all necessary logistical and economical information

Arrival at Almirante

Left: berthing at floating terminal
Below: ship, floating terminal and silos

regarding the complete supply chain on a daily basis.

In a time charter agreement the ship owner is responsible for the ship and the crew. Moneywise, this includes the (return on) capital cost of the vessel, the cost of crew and provisions and the cost of maintenance for the vessel. The charterer pays a daily charter rate in return which is fixed for the duration of the charter period. The charterer is also responsible for the fuel costs and the port costs of the ships. When looking at cost-saving possibilities there is little that can be done at the charter rate except to use the ships as effectively as possible.

Port costs are also quite fixed and can be improved only marginally. However, there are ways to save shipping costs:

- Load ships to the very maximum
  – Keep bunker levels to a (safe) minimum
  – Overcome volume problems (especially for fly ash)
- Focus on fuel (big savings possible)
  – Reduce ship speed
  – Use one unloading system instead of two
- Keep track of 'off-hire' situation and actual port costs
- Prevent delays.

Purchasing cement and fly ash in the quantities required for the project and the transport from Florida to the project port in Panama created substantial money flows that required precise timing:

- Payments for cement and fly ash cargo
  – Partial one day before loading
  – Partial three days after loading
- Port costs
  – Paid in advance (two days) based on estimate. Correction for actual costs later
- Bunker costs
  – Paid in advance (36 hours). Correction for actual costs later
- Chartering costs (monthly).

In this respect it is essential that cashflow projections are always up to date and that the financial department is fully aware of the absolute necessity to transfer money on time.

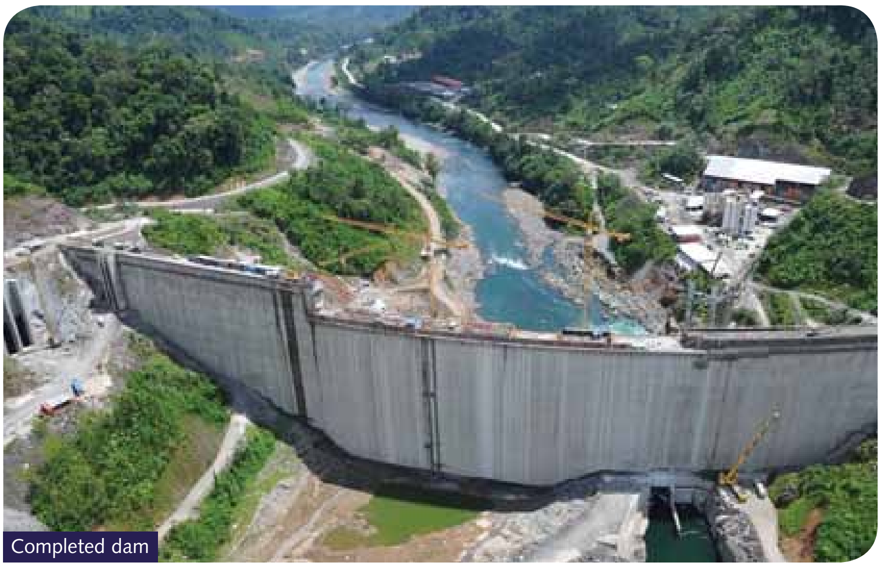
Conclusion

Between December 2009 and March 2011, a total of 220,000t of cement and fly ash was transported from Florida to the port of Almirante in Panama for the construction of a large-mass concrete dam. Two self-discharging vessels were used, which made a total of 32 trips. The whole operation went like clockwork and without any serious disruptions. This could be achieved thanks to a preparation period of two years in which the complete logistical chain was set up (including the construction of a floating terminal) as well as the excellent cooperation between the project contractor (charterer), ship owner, broker, agents, port authorities and cement and fly ash suppliers.

Managing such an operation is not just a rewarding job. It is difficult to describe the deep feeling of satisfaction when, standing on a hill in Panama to look down and see one of the self-discharging cement carriers arriving at the floating terminal and the bulk trucks leaving the port and then, turning around, to see bulk trucks descending into the rainforest valley through the aggregate mining and construction area to the dam rising up 100m above the river bed.

About a month before the completion of the dam and the closing of the river diversion tunnels the last ship was redelivered to its owner. After that the floating terminal was emptied and cleaned and prepared for a future sea voyage. The floating pipeline and truck loading silos were disassembled and loaded into the holds of the floating terminal. The floating terminal and its shore components have been purchased by Cementos Argos and will be used for other Caribbean projects of this group.

The lake behind the dam had filled up by July 2011 and after that, the tunnel and the large generators were commissioned in phases. The project has been supplying electric power to the Central American Grid since September 2011. Finalising the project, demobilisation of all plants and returning the construction site to nature will take well into 2H12. After that, very little will remind of the beehive of construction work and the logistics required to supply it with building materials.



Completed dam