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Cement Supply to Remote Construction Sites

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Zementlieferungen an entfernt gelegene Baustellen
Approvisionnement en ciment des sites de construction éloignés
Suministro de cemento a obras de construcción remotas

遠隔地にある建設現場へのセメントの供給

远距建筑场地的水泥供应

إمدادات الأسمنت لمواقع الانشاء النائية

Summary

This article describes how the problem of shipping and storing of cement in large quantities has been solved in two particular installations.

1. Introduction

Large construction projects such as harbours and airports usually consume enormous quantities of concrete, requiring thousands of tons of cement a month. As long as these sites are situated within easy reach of one or more cement factories, such deliveries present no difficulties. Bulk transporter lorries either equipped with direct pneumatic discharge or else discharging via a stationary pneumatic conveying plant into storage silos, are generally used for delivering the cement. A well organized delivery schedule will minimize the storage silos. In most cases a storage capacity of a few hundred tons will suffice and this can be obtained by installing a number of small storage silos of about 100 tons capacity each.

The problem is entirely different where the construction site is some distance from a cement plant and transport of the cement can be achieved economically only by ship. In many such cases the cement is shipped in bags, at relatively high cost. The packing of the cement involves high costs, and stowage and lighterage of bagged cement is a slow process. It is of particular importance to note that the transport of bagged cement results in an average loss of 10% of the quantity shipped, since a number of bags will be damaged and their contents spilt or ruined. If the bags are transferred several times, losses can amount to 25%.

It has been proven in practice that the transport of bulk cement by ship is by far the more economical solution. Time spent in storage and lighterage can be kept to a minimum and losses are practically eliminated. This article describes how the problem of shipping and storing of cement in large quantities has been solved in the two particular plants quoted as examples (Figs. 1 and 2).

The Bamburi Portland Cement Company operates a cement works near Mombasa, in Kenya, with an annual capacity of about 700,000 tons, it is considered to be one of the most important cement plants in that area. In order to deliver the cement over the great distances involved, BPCC operate a fleet of eight bulk cement tanker vessels of different capacities.

Fig. 1: A silo terminal with floating rubber feed pipe at port site in Oman

Fig. 2: Feed pipe lines to blow cement into silo station in Venezuela

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2. Discharge and Storage Facilities at Dubai

The discharge and storage facilities at the port of Dubai in the Persian Gulf are situated partly in Dubai harbour and partly some six miles inland. Since the draught of the CEMENTIA prevents her from entering Dubai harbour, a floating silo and packing plant is used to receive 2,000 tons of bulk cement from the ship riding at anchor. The floating packing plant is then towed into harbour and the cement is either packed into bags and loaded via a conveyor belt directly on to lorries or pumped into silos of 2,000 tons capacity by two Fuller pumps.

The floating silo, and packing plant is then towed back to the bulk cement tanker still riding at anchor to take off the remainder of the cargo. The discharge capacity of vessels of the CEMENTIA class with four Fuller 11 in. pumps is roughly 800 tons/h, giving very fast unloading times.

Bulk cement is transferred to various sites from the storage silos in the harbour. The largest construction site is situated about six miles inland and consumes some 5,000 tons of cement a month. On the basis of this consumption and an average round voyage of 22 days for the bulk tankers, the storage was designed with a capacity of 5,000 tons. This is divided into 1,000 tons storage on the site, 2,000 tons in the silos in the harbour and the balance in the floating silo and packing plant.

Storage on the site is provided by a Doubrava plate-type silo as shown in Figs. 3 and 5. The cone of this silo consists of nine elements which are bolted together during erection. The cone itself is fixed to a carrying ring which in turn forms the base of the cylindrical part of the silo. The cylinder consists of plate elements, measuring about 1 m x 2 m, which are bolted together. The roof is also divided into segments which have to be assembled. All parts are sealed with a plastic sealant during erection to ensure watertight and airtight assembly.

Fig. 3: Silo terminal for 10,000 tons cement capacity in erection. The photo shows the erection scaffoldings and the electrical hoist which runs on the upper edge

The advantage of this unit-type construction and assembly lies in the fact that pre-assembly of elements can be carried out on the ground to suit the lifting capacity of the crane facilities available. After the erection of the cone it is possible to dispense with the crane altogether and assemble the cylindrical part of the silo by means of an electrical hoist. The silo is filled pneumatically from bulk transporter lorries travelling back and forth between the harbour and the site. The excess air from the pumps on the vehicles is cleaned in an automatic filter situated beside the silo. Level indicators show high and low levels in the silo.

The cement is discharged from the silo by a screw conveyor of 270 mm diameter and 10 hp installed power. At an inclination of 45° the hourly discharge rate is 25 tons. An annular aeration pipe with jet-shaped nozzles and charged with compressed air at about 1 kg/cm² prevents bridging of the cement. Compressed air is generated in Roots-type compressors. The cement is discharged from the silos into bulk lorries by an adjustable telescopic hose mounted at the discharge end of the screw conveyor.

3. Discharge and Storage in the Seychelles

Fig. 4 shows the location of a future airport in the Seychelles in the Indian Ocean. The position of the runway and the storage facilities has been superimposed on the photograph (Fig. 4). Assuming a monthly cement consumption of about 3,000 tons and an average round voyage of 15 days for the bulk vessel, the storage capacity has been designed at 2,600 tons (including reserves).

Two Doubrava plate-type silos of 1,000 m³ capacity each were chosen. In most respects these silos are similar to the one at Dubai, except that the supporting structures are made of steel. The filter has been installed on the roof of one of the silos, which are filled by means of two 11 in. Fuller pumps installed in the bulk cement tanker riding at buoys about 100 m offshore. Discharge pipes are mounted on pontoons and give a discharge capacity of about 300 tons/h. Compressed air is filtered through an automatic filter.

So that they can serve a nearby ready-mixed concrete plant and also load into bulk cement lorries, each of the silos is equipped with a double cone. One outlet on each double cone is fitted with a cement screw conveyor of 220 mm diameter. At 4 hp and an inclination of 30°, the rate of discharge is 2 x 25 tons/h. These screw conveyors feed a bucket elevator which in turn feeds the ready-mixed concrete plant. At an angle of 180° to this arrangement, each silo is equipped with a second screw conveyor of 270 mm diameter and 10 hp installed power. These screw conveyors are fitted with telescopic hoses and are used for loading bulk lorries.

The silos were erected by local personnel working under one supervisor each from the supplier and the construction company and using a 30-ton excavator fitted with crane equipment. Electricity was not available during most of the erection period and power for welding was supplied by petrol-driven generators. Under these conditions the plate-type construction proved a real advantage. The single elements

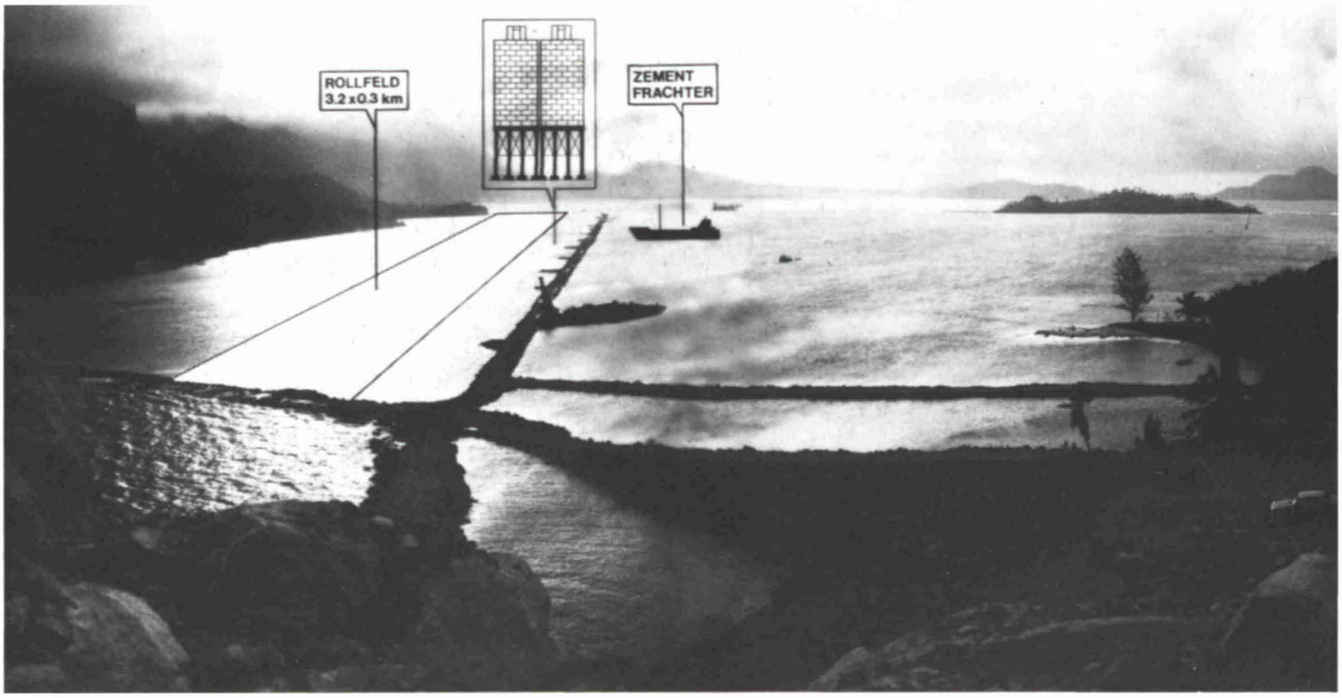

Fig. 4: A panoramic view of the new Victoria Airport in the Seychelles, showing the position of the runway and of the cement storage silos superimposed on the picture. Rollfeld = runway; Zementfrachter = cementfreighter

were pre-assembled on the ground and then hoisted into position. Although weather conditions were unfavourable, erection was complete within six weeks.

On construction sites where electricity is available use can be made of an electrical hoist for assembling the silo body. Once the erection of the heavy supporting structure and the cone has been completed, the electrical hoist runs on the edge of the plates and serves to lift the individual silo plates. They are assembled manually from conveniently mounted platforms which are raised progressively as erection proceeds. The whole of the silo up to the roof is assembled in this way, although a crane may be required to lift the roof for final assembly.

4. Conclusion

Experience on these two plants has shown that the transport of bulk cement tankers, with subsequent storage in large silos, gives the following advantages:

1. Loss of cement through damaged bags or theft is eliminated.
2. Cement reaching the construction site in bulk can be handled much more easily, since it is not necessary to carry or open any bags.
3. Cement stored in silos retains its properties, thereby eliminating problems caused by changes in the properties of the resultant concrete.
4. The pneumatic filling and discharge systems are connected to a filter plant which keeps the surrounding area dust-free and clean.

These results allow the conclusion that supplying cement to remote construction sites in bulk cement tankers is the most modern and economic solution.

Fig. 5: Cement terminal for 6,000 tons cement capacity