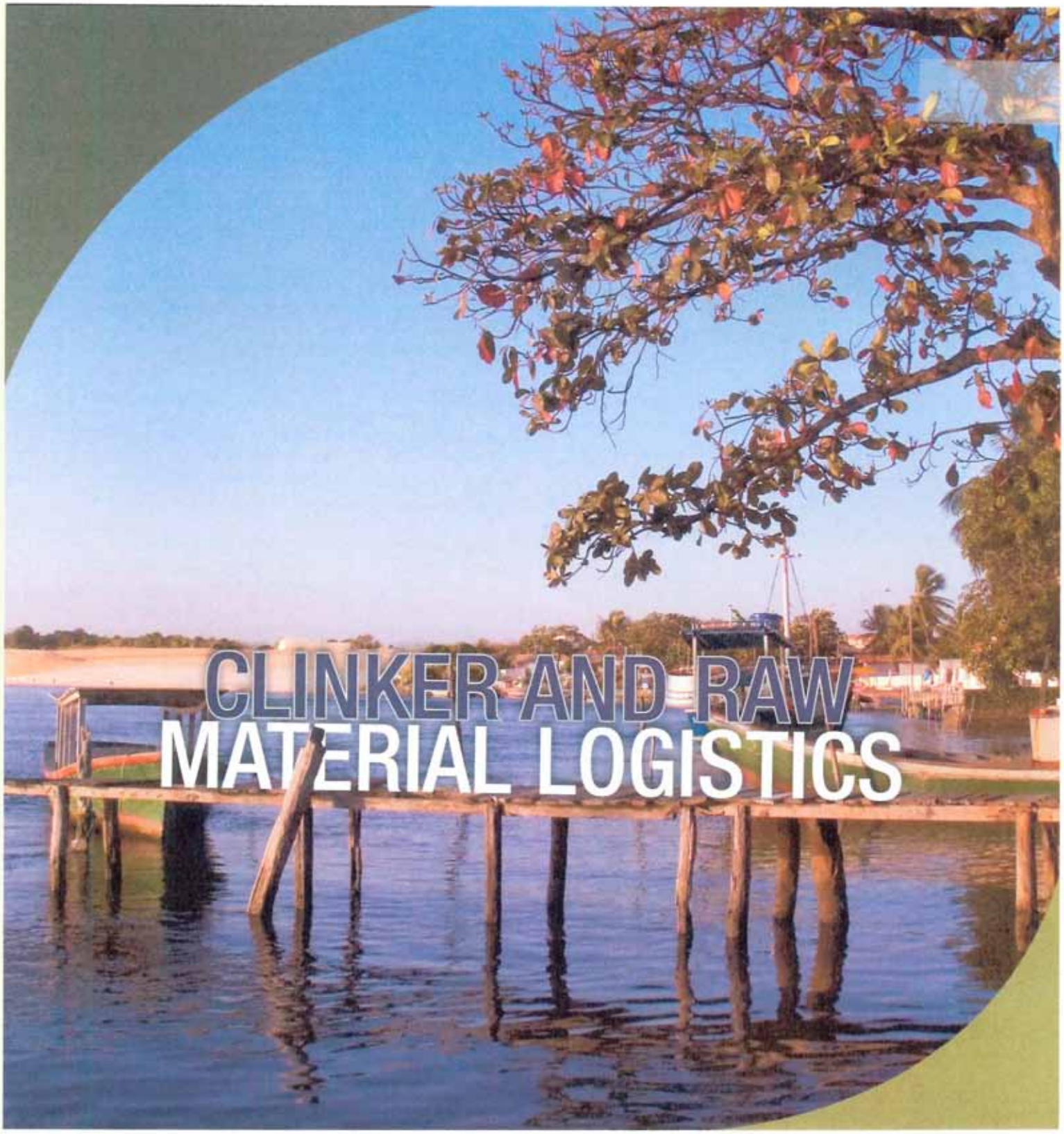

CLINKER AND RAW MATERIAL LOGISTICS

Barry Woodbine, Aumund Group, tells of the Group's involvement in Cimento Apodi's new plant projects in northeastern Brazil.

Introduction

Cimento Apodi is located in the northeast region of Brazil in the state of Ceará, which at present is enjoying a fast developing business economy, urbanisation and associated infrastructure projects. This is generating a rapidly expanding local demand for cement products.

Cimento Apodi plans to develop the market in two stages. The first stage is based on a new grinding plant at the Port of Pecém, which will be followed in around two years time by a new integrated cement plant at Quixeré with the associated limestone mining developments. The new grinding plant will have a production capacity of around 1500 tpd of bagged cement, while the new kiln line has a designed capacity of 3500 tpd. It is anticipated that the

output of the grinding plant will be sufficient to stabilise the local demand/supply situation at least until the new production plant comes online.

The Aumund Group companies are involved in these projects from the port to the finished cement storage. The scope of supply includes an Eco-Hopper, belt and chain elevators, plus clinker transport and stacker and reclaimer equipment for the large-scale storage and blending of limestone and additives.

Mobile Eco-Hopper with mobile harbour crane imports clinker and slag from 70 000 t gearless Panamax bulk carrier.

Eco-Hopper with towing tractor and 'Ackermann' linkage to steering wheels with integral supporting jacks to take the operational load.

One of four Eco-Hopper dust filter units positioned along each side of the grab hopper inlet; Panamax vessel berthing in the background.

The new Apodi projects are a joint venture partnership between three parties: Group M. Dias Branco (50%), the Cooperative Enterprise of Construction-COOPERCON Ceará-CE (25%) and mining entrepreneur Juscelino Sarkis, Sarkis Group (25%).

For the grinding plant Apodi will import both cement clinker and granulated blastfurnace slag through the Port of Pecém with the cooperation of EC-Coopercon, using a new deep water jetty and berth with mobile harbour cranes for grab discharge from gearless Panamax sized vessels. Protected by the 1770 m long breakwater and connected to land-based storage warehouses by a road bridge, the facilities are currently being expanded with the aim of handling a total of 5.6 million t of cargo in 2012, nearly twice the amount handled in 2010. This is a multi-purpose port and will handle any combination of bulk, break-bulk and containerised cargo. Flexibility of operation is fundamental to the port development to achieve maximum berth utilisation with minimum fixed infrastructure. The mobile Eco-Hopper concept is ideal in these circumstances, requiring no additional port facilities or fixed port infrastructure. It offers fast track availability with minimum disruption, as well as fewer permission challenges linked to local government (which often lead to delays) than an equivalent fixed plant would.

Ceará state's GDP grew nearly 8% in 2010 and the northeast as a whole has enjoyed higher economic growth than the national average, reinforcing the argument for expanded cement manufacturing capacity both in the short and longer-term.

Clinker and slag import

At present the imported materials are trucked from the berth to the new grinding plant storage located in the industrial zone some 6 km inland from the port.

Both clinker and slag will be imported in shipments of around 70 000 t and discharged direct by grab fitted mobile harbour cranes to the fully mobile B&W Eco-Hopper, including a telescopic loading chute to deliver the clinker to the tipping truck floor with the absolute minimum amount of fugitive dust. Controlling dust emissions from grab discharge handling cement clinker is notoriously difficult and, for this operation, the Eco-Hopper is equipped with an integral dust extraction system built into the hopper structure. Multiple filter bags are installed on all four sides of the hopper leading to four plenum chambers, each with separate extraction fan sets. In this manner, the pressure drop across every filter bag is optimised and maximum filter performance is ensured without excessive filtered air velocity. The filter bags incorporate reverse jet air cleaning using compressed air from an on-board compressor and reservoir with electronically operated valves to give a cleaning pulse at controlled intervals. By incorporating the air filters into the fundamental hopper design, integral to the structure, the filter area is 60% greater than would be possible with conventional designs.

In addition to effective filtration, it is essential to minimise the escape of dust laden air displaced by every grab discharge. In this case, 20 m^3 capacity grabs are

employed and therefore at each discharge 20 m^3 of air is displaced at high velocity. In a traditional hopper this displaced air is allowed to escape into the atmosphere, creating significant windblown pollution over a large area. To control this effect and to minimise the size of the required dust extraction system, the hopper inlet includes a retention system acting as a non-return valve

Multiple filter bag housings shown within one of the four plenum chambers located on all sides of the 7.5 m square hopper inlet.

Schade travelling and luffing boom stacker stockpiling additives and gypsum to segregated storage areas.

Schade bridge reclaimer with single sided reciprocating harrow for recovery and blending of limestone from a single stockpile.

to allow clinker into the hopper but to substantially prevent the reverse flow of dust laden air out of the hopper. The system also allows air flow into the hopper to draw dusty air from the area between the open grab and the hopper inlet to control dust emissions from grab to truck.

Of course, granulated slag is another matter. Whilst not at all dusty when wet, it is extremely abrasive and therefore all internal hopper surfaces and chutes are lined with replaceable wear resisting steel plates.

Flexibility of berth utilisation demands that the Eco-Hopper is mobile on rubber tyres allowing the complete unit to be moved off the berth for the discharge or loading of other cargoes. For this purpose, the Eco-Hopper is supplied with integral tow-travel and steering so that the appliance may be moved with a wheeled loader around the berth and along the jetty roadway between berths or port areas.

Both the clinker and slag are trucked inland from the Eco-Hopper to the grinding plant using a fleet of vehicles operating on a merry-go-round basis, with an overall transfer rate of some 700 tph. By using granulated slag as an alternative raw material, Apodi is able to reduce the plant's carbon footprint, as well as offer a range of blended cements in line with local market demands. Slag cement has many operational benefits, including resistance to sulfates (important in marine works); it is more durable and produces a brighter, more reflective surface to reduce heat absorption.

Raw material, cement and clinker conveying

Both at the new grinding plant and cement plant Aumund belt-bucket elevators will be used for the handling of slag cement and Portland cement and for the raising of raw meal to the preheater. Aumund central chain bucket elevators will be employed in the recirculation of material at the vertical mills used in both projects. Aumund is supplying the pan conveyors to transfer the clinker from the cooler to the clinker silos as part of the clinker transport system at the new integrated cement plant.

Storage and blending

The new Apodi cement plant mainly receives large volumes of limestone from the dedicated local quarry, which is currently under development. The limestone raw material, plus additives and gypsum, are stored and blended with two stacker/reclaimer systems housed in a common purpose-built, single span storage hall. The limestone section comprises a travelling luffing boom stacker designed to stack out at a continuous rate of 600 tph, which is able to create two 30 000 t blending bed stockpiles plus a third smaller stockpile for corrective limestone to be recovered in small quantities by wheeled loader to a fixed hopper/feeder unit.

The additives section will be serviced by a second smaller travelling luffing boom stacker programmed to create three similar sized discrete stockpiles for additives and a fourth larger stockpile for gypsum designed to handle 150 tph.

Materials from the additives and gypsum stockpiles are recovered automatically with a cantilevered

The Schade chain scraper conveyor shovels collect the limestone from the reciprocating harrow and raise it to the collecting conveyor running parallel to the stockpile.

A Schade cantilevered boom reclaimer recovering additives from segregated stockpiles.

luffing boom chain scraper reclaimer. Using the winch operated luffing system the reclaim boom may be raised up clear of the finished stockpile height to enable travel past the intermediate stockpile sections. In this manner material may be recovered from any discrete stockpile while the stacker services another section of the stockpile system. The scraper boom discharges over a concrete wharf to a collecting conveyor running parallel to the stockpile. This conveyor is reversible so that the gypsum may be directed to the cement mill section and the additives directed to the raw meal section.

At the limestone stockpiles, a single bridge reclaimer is provided with dual full width reciprocating harrows allowing bidirectional operation, meaning that one stockpile may be recovered whilst the second stockpile is being generated. The bridge reclaimer comprises a horizontal scraper conveyor mounted to a travelling bridge structure straddling two supporting rails, one each side of the stockpile at 35 m rail span. At the discharge the chain scraper conveyor is deflected upwards and the material is scraped up a steel trough forming part of the conveyor structure. The final discharge height is sufficient to transfer direct to the collecting conveyor mounted at rail level. A travelling feed boot supported from the bridge structure is supplied with integral impact idlers, eliminating the need for expensive close pitch idlers over the full collecting length of this fixed conveyor.

Material is delivered to the horizontal part of the chain scraper conveyor by the reciprocating harrows, which cover the full section face of the stockpile and are fitted with tines that, with the reciprocating action, encourage flow down the material repose angle and into the chain scraper shovels. For this unit each shovel is 2000 mm wide and designed to recover and blend up to 800 tph. The final discharge rate is controlled by the bridge travel speed, which may be set accordingly using VFD controllers.

True blending of the stored material is ensured by the effective control of the travelling and luffing boom stacker building incremental layers to form a 'Chevron' type stockpile combined with the harrows, which cover the full section face of the stockpile and deliver a homogeneous blend of all qualities.

Conclusion

In this two stage project Cimento Apodi has the benefit of fast lead time, offered by imported slag and clinker, by building a smaller grinding plant and using the existing berths available at the nearby Pecém Port. The company has elected to build a more substantial cement plant for the longer-term using the local limestone from the Apodi plateau. The flexibility and environmental benefits offered by the B&W style Eco-Hopper follow this philosophy by maximising the potential of existing port resources. At the same time, the high performance and reliability of the Aumund conveying systems and Schade stacker reclaimer equipment offer significant benefits in the fixed plant installations, all with the advantage of local support and engineering services coordinated through Aumund Brazil.