From Concept to Completion: the City Cement Project

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Introduction

Utilising resources and constructing a plant scientifically are the key considerations for optimising cement process design, and reducing capital investment and energy consumption.

M/s City Cement Company Limited, promoted by Al Abdullatif Group, is constructing a 5000 tpd greenfield cement plant in Marat, about 150 km from Riyadh, the capital of Saudi Arabia. The Al Abdullatif Group of Saudi Arabia was established in 1950 and has grown into a professionally managed organisation, with listing in the stock exchange, represented worldwide as a leading supplier of carpets and related products, exporting its products to well over 56 countries. The combined turnover of the group is approximately US$1 billion.

The City Cement project has been conceived to harness the growing potential of the cement market in Saudi Arabia. The country is one of the most populated in the Gulf and among the richest in the world, with sizeable oil reserves. It has achieved a great degree of economic stability in recent times. Cement consumption, especially since 1999, has grown at a rate of 8% p.a. over the last six years. Key drivers for this growth are housing and infrastructure.

City Cement chose Holtec Consulting Pvt. Ltd., India as consultants for the project. Duties ranged from geological investigations and feasibility studies, to project execution services. Founded in 1967 in collaboration with the Holcim Group, Holtec is an ISO 9001 certified, 100% Indian company, catering primarily to the cement and mineral based industries. Commencing operations in 1967 as an engineering consultant, the company has grown over the ensuing period to become a full-service, engineering and management consulting firm offering in its product portfolio all services required by the cement industry. Employing over 460 people, Holtec has delivered

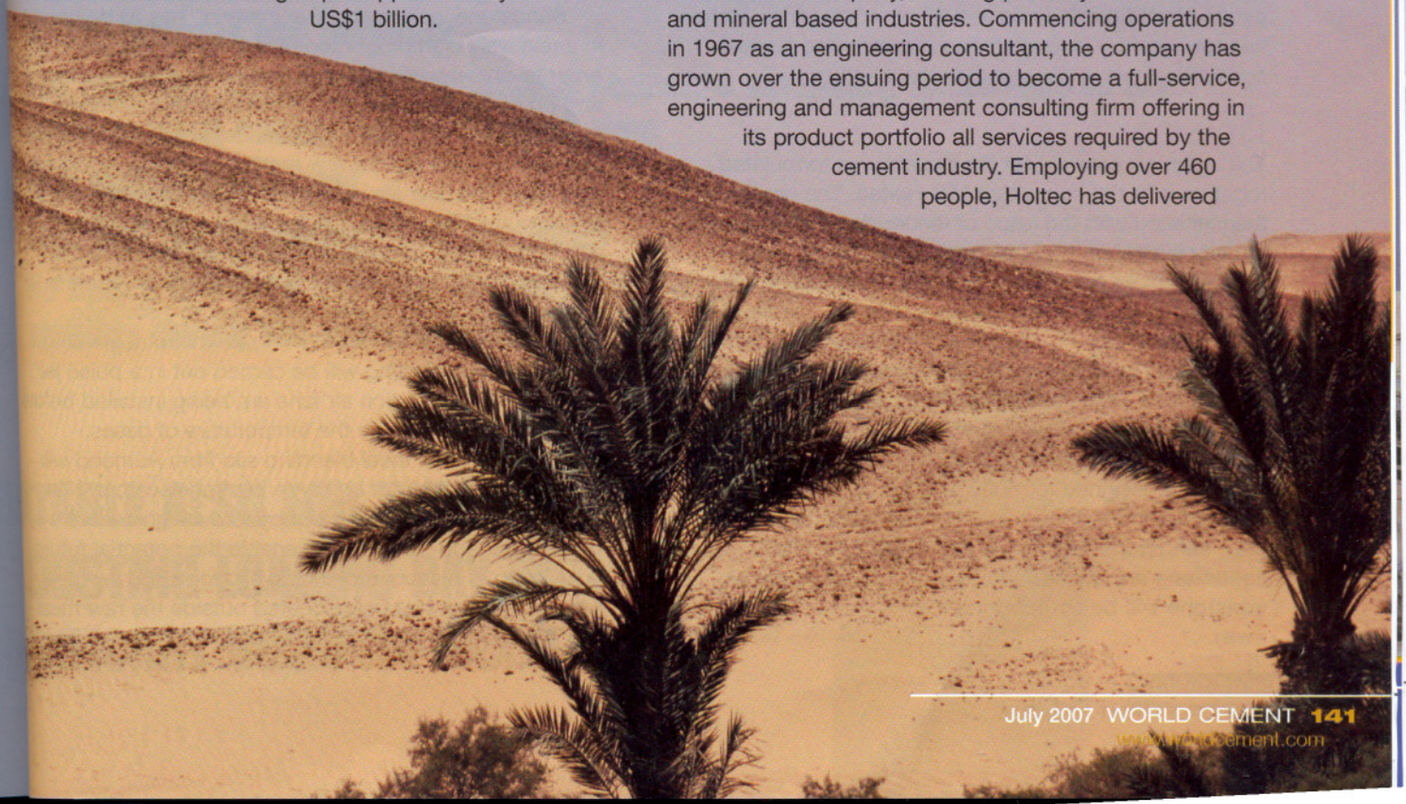


Table 1. Plant system specifications

S. No.	Equipment	Type	Capacity	Manufacturer
1	Limestone crusher	Hammer	1000 tph	ThyssenKrupp
2	Limestone stockpile	Linear and covered	2 x 35 000 t	Sinoma
3	Corrective crusher	Roll type	300 tph	Sinoma
4	Additive crusher	Hammer	300 tph	Sinoma
5	Common corrective and additive storage	Linear and covered	Ironstone: 1 x 2000 t Sandstone: 2 x 3000 t Clay: 2 x 4500 t Gypsum:1 x 5000 t	Sinoma
6	Raw material grinding	Close circuit ball mill	2 x 225 tph	Sinoma/LVT/Renk
7	Raw meal blending	Silo	1 x 20 000 t	Sinoma
8	Preheater/precalciner	Twin string five stage suspension preheater with precalciner	6000 tpd	Sinoma
9	Kiln	3-pier rotary	5000 tpd	Sinoma/KCP, India
10	Clinker cooler	Pendulum type grate cooler	6000 tpd	IKN
11	Clinker storage	RCC Silo and open clinker stockpile	1 x 50 000 t, 1 x 25 000 t	Sinoma
12	Cement grinding	Close circuit ball mill	2 x 150 tph	Sinoma
13	Cement storage	RCC Silo	4 x 10 000 t	Sinoma
14	Bulk loading	Telescopic chute under cement silos	4 x 200 tph	IBAU
15	Packer	Rotary electronic	4 x 120 tph	Ventomatic
16	Truck loader	Automatic (6 nos.) / manual (2 nos.)	8 x 2500 bags/h	Ventomatic

over 2500 multi-functional consulting services to its 450-strong client base in India and 75 other countries. Holtec has successfully innovated and implemented several consulting firsts in the global cement industry.

Project basis

The technical concept for the project was formulated together with the consultant M/s Holtec. The project was then initiated with the issue of tender documents for the turnkey supply of the 5000 tpd cement plant.

The project engineering concept concentrated on reducing investment and energy saving for a state-of-the-art cement plant. The project envisaged production of ordinary Portland cement (OPC) and sulfate resistant cement (SRC) with a total annual cement production of 1.75 million tpa. The guaranteed clinker production capacity is 5000 tpd although the preheater and clinker cooler are designed for 6000 tpd.

In addition to limestone, the raw materials include clay, sandstone and ironstone. While clay and sandstone are available locally from captive mines, ironstone will be sourced from a mine about 1000 km away.

The fuel for the project is envisaged as either crude oil or heavy fuel oil. However, the system design will enable firing of fuel oil, gas and/or solid fuels.

The source of electric power for the project will be a heavy fuel oil based captive power plant, and the water source for the project is underground.

Project concept

The limestone deposits in the mines of City Cement are shallow and the mine is spread linearly. Keeping in view the unique configuration of the mine area, a semi-mobile type of limestone crusher has been envisaged for the project. This would facilitate relocating the crusher at periodic intervals as the mine face moves forward. The crusher is a 1000 tph double rotor hammer type that facilitates adjustment for wear.

A linear covered stockpile of 2 x 35 000 t capacity is being considered for limestone. The luffing boom type side stacker will have a capacity of 1250 tph, while the bridge type reclaimer will be 600 tph. All raw material stockpiles are covered for environmental reasons.

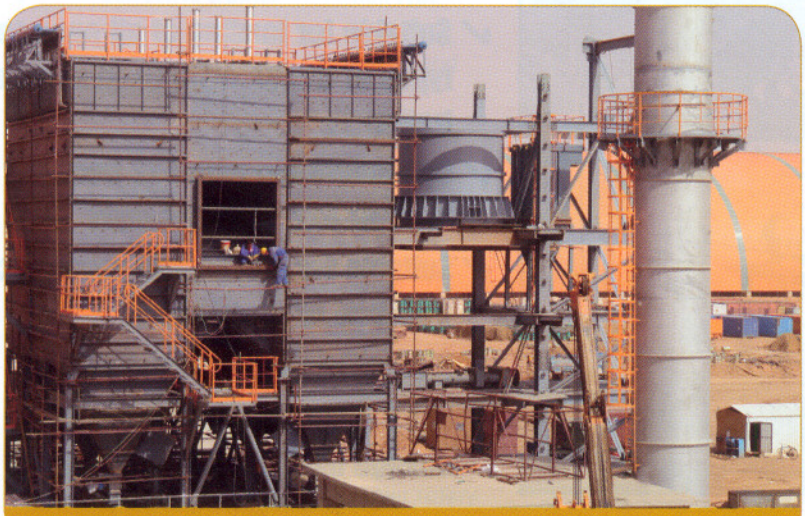
Sandstone, a very abrasive material, has to be used in a relatively high proportion of more than 10% in order to obtain a cement grade raw mix. The chemical and physical characteristics of the available materials indicated that with the feasible raw mix, the wear of liners in a vertical roller mill for raw material grinding would be very high. The liner life would have been in the range of only around 2500 hours. On the other hand, the low fuel and power costs in Saudi Arabia reduce the benefit of installing a vertical roller mill. Based on a cost-benefit analysis, the project therefore decided to install two 225 tph close circuit ball mills for raw material grinding. Raw mill/kiln dedusting will be carried out in a pulse jet type baghouse. Dilution air fans are being installed before the baghouse to reduce the temperature of gases.

A 20 000 t raw meal blending silo from Aumund will be fed with the help of belt type bucket elevators. Kiln feed dosing will be carried out by roto weighfeeders from Pfister and Schenck. To enable the potential future installation of a second blending silo for SRC raw meal, the kiln feed bin has been located outside the raw meal silo in a separate structure and not below the silo. This

bin will be used for OPC/PPC raw meal as well as SRC raw meal.

A 6000 tpd twin string, five-stage preheater with precalciner will be fed via belt type bucket elevators. The selected preheater offers an optimal solution with respect to heat economy and power consumption.

The feasible raw mix also required a bypass system to be installed to bypass excess chlorine from the system. The bypass percentage was determined at a level of 15%. Dilution of the bypass gases is achieved by dilution air fans, which are installed before the bypass baghouse. The bypass dust will be collected in a storage bin and provision has been made for its disposal.



Bypass baghouse and structure.

Deep pan conveyor for clinker transport.

Fuel tank farm and power plant.

The well-proven 4.8 m dia. x 74 m 3-pier rotary kiln is being installed. A new generation 6000 tpd pendulum type clinker cooler will also be installed. The cooler exhaust gases will be vented through an ESP. The preheater and clinker cooler have been designed for 6000 tpd in order to provide capacity for future expansion.

In addition to a 50 000 t clinker silo, a 25 000 t open clinker stockpile has also been provided for additional clinker storage.

Two 150 tph close circuit ball mills are to be installed for cement grinding. These were selected due to low maintenance requirements and low power cost in the KSA.

Four 10 000 t cement silos will be fed via belt type bucket elevators. One 250 tph bulk loading spout is being installed under each silo for loading into bulk cement tankers. Each bulk loading spout has been provided with a weighbridge for online weighing and filling of the tankers.

Four 120 tph electronic rotary packers have been installed for cement bagging. The bags will be loaded by six automatic truck loaders and two semi-automatic truck loaders.

Four 5000 m^3 fuel oil tanks have been installed to meet the requirements of the cement plant and the power plant. The fuel tanks are capable of storing either crude oil or heavy fuel oil. The piping arrangement is such that fuel oil tanks for both the cement and power plants can be interlinked as well as isolated, as and when required. The fuel heating system in the tanks and the heat tracing system along the pipelines are thermal oil based. A separate 1000 m^3 diesel oil tank has also been provided.

A 1000 m^3/day reverse osmosis plant is being provided for treating underground water. A complete sewage treatment plant is also being installed. Table 1 lists the main equipment that is being supplied.

Electrical and control systems

The latest technology MV switchgear and LV switchgear with digital relays having Profibus communication have been used. Intelligent MCC with profibus communication has been used for reduced cabling and more information in control rooms.

Table 2. Additional equipment suppliers	
Mill separators	LVT
Mill gearboxes	Renk
Kiln gearbox	Flender
Dedusting raw mill/kiln baghouse	AAF
Dedusting clinker cooler ESP	ELEX
Clinker cooler	IKN
Process fans	Reitz
Bucket elevators and pan conveyors	Aumund
Packing and loading equipment	Ventomatic
Online analyser	Thermo
Roto weighfeeders	Pfister and Schenck
Major quality control equipment	FLS Automation
MV VVVF drives	Siemens
MV switchgear, LV switchgear, MCC and other power distribution	ABB
Control systems	ABB
Kiln CCTV	Thermoteknix
Gas analysers	ABB
Field instrumentation	ABB, Endress+Hauser, Codel and Siemens.

A distributed control system integrated with expert system, information management system, CCTV, quality control system, etc. have also been installed and is serially interconnected by high speed ethernet and Profibus DP/PA field bus.

Profibus PA based smart instrumentation has been used for less cabling, remote configuration and calibration facility.

Captive power plant

Six 7.55 MW diesel generator (DG) sets, including one standby, have been installed for captive power generation. The DG sets shall be operated on heavy fuel oil. They can be accessed remotely for troubleshooting.

Environmental control

For environmental protection, the following measures have been taken:

- The outlet emission of all dedusting filters is to be less than 30 mg/Nm^3.
- A pulse jet type baghouse has been installed for most of the process applications including the raw mill/kiln, bypass, cement mill, etc.
- An ESP with microprocessor-based controllers has been installed for dedusting the clinker cooler.
- All material transfer points have been provided with nuisance bag filters.
- A modern burner, dosing system, emission monitoring and kiln control systems will be employed to minimise gaseous emissions from the combustion process.
- A state-of-the-art online emission gas analyser at the main stack will monitor SOx and NOx emissions. Online dust monitors will be installed on all main stacks to monitor dust density.
- A dust suppression system has been installed for dump hoppers.
- All raw material stockpiles are covered.
- Water treatment and re-circulation systems have been provided to reduce water wastage.
- Sewage treatment facilities have been installed.
- Noise levels will be maintained as per relevant ISO standards.

Preheater to clinker silo.

Quality control

The plant will feature systems and equipment to rigorously control the quality. Some of the key measures include:

- Online bulk material analyser installed before the limestone stockpile to control the pile formation.
- Auto-sampling and pneumatic transport of samples of raw meal, kiln feed and cement.
- Auto-sampling of clinker and manual transport.
- Automated laboratory system including automatic sample receipt, sample preparation, Robo-Lab and analysis.
- Multi channel X-ray spectrometer for analysis of elements.
- Complete physical and chemical testing facilities required for meeting SASO, ASTM and BS standards for cement plants.
- Testing facilities for water and oil.

Safety and maintenance

Adequate safety and maintenance provisions have been made, including:

- Safety guards at all possible points of physical contact with moving machinery.
- Safety railings and kick boards at all floors and stairs.
- Adequate man height clearance at all structures.
- Passenger lift for accessing preheater/ blending silo and cement silo/packing plant.
- Cranes and monorail hoists at major maintenance

Process duct arrangement in raw mill area.

Semi-mobile limestone crusher.

points.

- Well-equipped electrical and mechanical workshop.
- Sufficient storage for spare parts and consumables such as refractory.

Project execution

The contract for the turnkey execution of the project was awarded to M/s Sinoma International, China, in mid-2005. The exclusions were a limestone crusher, captive power plant and mining equipment. The limestone crusher was sourced separately from Thyssenkrupp and mining equipment was sourced from Caterpillar. A separate turnkey contract was awarded to Wärtsilä for a captive power plant.

The turnkey contract concluded with Sinoma International specifying a shortlist of well reputed suppliers for critical equipment (Table 2).

Project implementation

Under the dynamic leadership of Mr. Ahmed Abdullatif, the Vice Chairman of City Cement Company, the project is being implemented as per the envisaged plan. The plant is expected to be commissioned in the later half of this year.

Conclusion

Once commissioned, City Cement will be one of the most modern state-of-the-art cement plants in Saudi Arabia.

It will be a milestone in the Saudi cement industry and also a flagship company of the Al Abdullatif Group.