Mission accomplished

Last year saw the successful completion of ACC's new 9000tpd clinker line at its Jamul works in India, expanding capacity at the plant by 3Mta. With stringent design criteria and timelines, main supplier KHD details its successful project journey with a particular focus on performance results from the raw material grinding and pyroprocessing sections.

■ *by **Vaibhav Dixit**, ACC-Jamul Cement Work, India & **Ashok Kumar Dembla, Deepti Varshney & Prakash Patil**, Humboldt Wedag India Pvt Ltd, India*

LafargeHolcim group company ACC Ltd is one of India's foremost cement and ready-mixed concrete manufacturers with a nationwide network of plants and offices. Established in 1936, the company has been a pioneer and trendsetter in cement and concrete technology. Among the first companies in India to include a commitment to environmental protection as a corporate objective, ACC has won several awards and accolades in recognition of the numerous environmentally-friendly measures undertaken at its plants and mines.

KHD details the journey of the new line for ACC's Jamul plant, India

Expanding Jamul

When ACC decided to construct a new line at its Jamul cement plant in Chhattisgarh, India, the producer selected KHD as its chosen technology partner to expand the plant and help realise its corporate vision. Over its 160-year history, KHD has continuously and steadily delivered on cement projects across the world and serves as a sterling example of a company committed to fulfilling its responsibilities as a leading technology supplier. Continuous development based on industry needs has steered the company's forward-thinking approach to provide state-of-the-art technology that integrates innovations aimed at ensuring the long-term sustainability of plants. With depleting resources, concerns over increased greenhouse gas emissions and the need to implement sustainable practices, KHD believes that supplying the latest technology should be based on the sustainable life-cycle.

As a result, Humboldt Wedag India (HWI) was awarded the contract to supply ACC's new 9000tpd clinker line in 2012. Discussions for the new project had started two years earlier. The selection was based on stringent LafargeHolcim and ACC design criteria and the need for an optimised layout with a special focus on environmental and safety guidelines. After a series of long and intense discussions with a number of LafargeHolcim and ACC experts, KHD was selected as the preferred supplier due to the performance benchmark of its technology.

Overall scope of supply

HWI's contract included the design, engineering, supply, installation and commissioning of the 3Mta clinker line with an integrated cement capacity of 1.5Mta. KHD Customer Service Center (CSC) India, together with McNally Bharat

Table 1: KHD's main scope of supply and capacities

Equipment	Capacity
Limestone crusher (tph)	1500
Corrective crusher (tph)	240
Additive/coal crusher (tph)	1500
Limestone stacker (tph)	1800
Limestone reclaimer (tph)	850
Corrective tripper (tph)	1800
Additive/coal stacker (tph)	1800
Corrective/additive/coal reclaimer (tph)	400
Raw material grinding (tph)	2 x 350
Blending silo (t)	16,500
Pyroprocessing line (tpd)	9000
Clinker storage (t)	75,000
Coal mill – VRM (tph)	90
Cement grinding – OPC/slag (tph)	195/157
Cement silo (t)	2 x 6000
Packing plant – provided by client (tph)	2 x 240

Engineering (MBE) as consortium partners, built the plant starting from the crusher up to the packing plant. The complete civil, structural, electrical, instrumentation and automation works was also set up as part of the EPC order. Table 1 shows KHD's main scope of equipment supply and capacities.

Raw material grinding and pyroprocessing

While the scope of the project included the crushing section, stacker/reclaimer, raw material grinding, pyroprocessing line, cement grinding, packing and dispatch, the focus of this article is on the system design, guarantees, execution and performance of the raw material grinding and pyroprocessing sections.

Considering the requirement for higher raw material grinding capacity, KHD offered its ComFlex-Double mode system (ie, two roller press systems with a common dynamic separator) comprising:

- 2 x Roller Press RPS 20-220/180 – the biggest machine supplied by KHD in India
- 2 x V-separator VS 620
- Sepmaster SKS dynamic separator (SKS – VC 5000).

The advantage is that the higher capacity requirements are met with lower power consumption. Also, the construction costs and space requirements are lower compared to opting for two independent circuits. The system offers many innovative design features including an inclined V-separator to reduce the overall building height, the latest-generation SKS dynamic separator, reduced recirculation load on the bucket elevator, less dust nuisance with the orientation of the roller press above the V-separator, etc.

For the pyroprocessing line, the best of KHD's latest generation equipment was selected. The salient features of the preheater system include highest dust collection efficiency, lowest exhaust gas temperatures at optimum pressure drops (PRZ 9572/6), a PYROCLON® Low NO_x alternative fuel (AF) calciner, PYROTOP® compact swirl chamber, PYROBOX® calciner burner, PYROLOOP® tertiary air entry, Low NO_x PYRO-JET® kiln burner, segmented dip tubes, new generation cooling flaps for bottom cyclones, etc. The three-tier kiln line (ϕ5.6m x 82m) with pendulum cooler was selected for the production of 9000tpd of clinker.

Design and engineering phase

The key concept when designing the plant was to incorporate efficient, environmentally-friendly and state-of-the-art technology that optimises energy usage. The roller press technology supplied by KHD is ideally suited to these requirements as it is designed for low energy consumption, has zero-water consumption (which results in a lower volume of hot gases to dry the product) and also has a considerably lower specific wear rate which in turn leads to lower maintenance and downtime.

For the pyroprocess system the sole criteria was to implement technology with efficiency at the core of every stage. KHD's preheaters are designed to be efficient because of the high-efficiency cyclones attributed to the increased dip tube ratios, and the use of high-quality material to prevent maintenance as much as possible.

The kiln was designed for operating loads of 5-7tpd/m³. The low-NO_x calciner

Figure 2: design concepts

Figure 3: pre- and dry-commissioning workflow

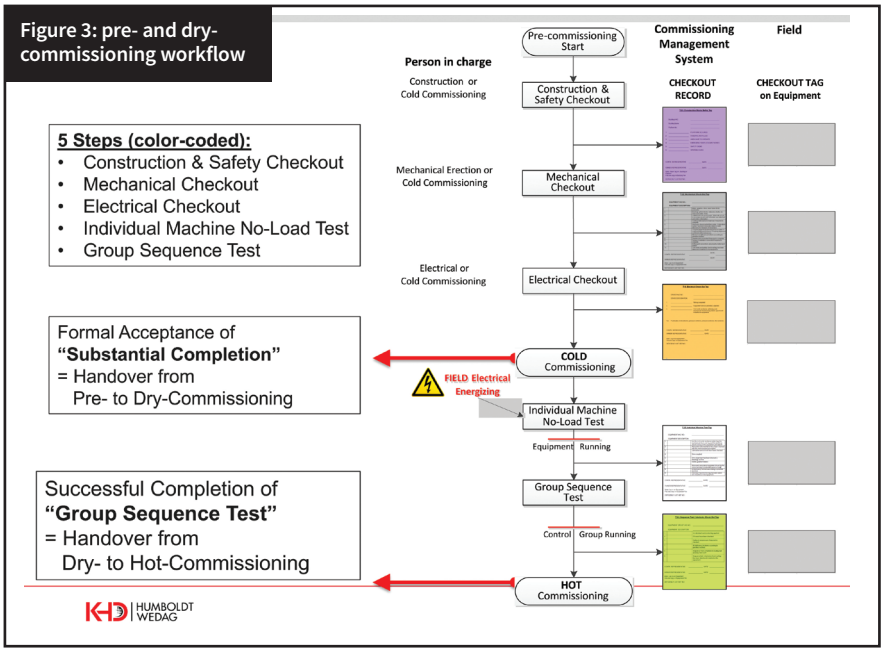

Table 2: overview of civil and structural design*

Equipment	Concrete (m^3)	Erection weight (t)	Plate fabrication weight (t)	Structural fabrication weight (t)
Up to pyroprocessing	123,630	37,880	6010	11,200
Up to clinker grinding and storage	38,990	6110	690	3420

**Quantities include the plant process as well as non-process buildings, roads and boundary walls but exclude the packing plant and dispatch section, plant colony and guest houses and switch yard*

was designed for AF use and reduced emission standards. The pendulum cooler also has low dust emissions. The complete pyroprocessing system was designed to extract the highest possible preheater and cooler mid-air heat recovery potential.

Further details relating to the structural design of the plant are shown in Table 2.

Project implementation phase

The timelines to complete the project presented a major challenge and to streamline the execution processes a highly dedicated team was engaged with regular supervision from senior management.

Equipment ordering was planned meticulously with target dates in mind. During this process there were hurdles both internally and externally as the LafargeHolcim and ACC standard design guide norms were new to certain local vendors. Therefore, extensive documentation requirements combined with review meetings called for the continuous engagement of all stakeholders. The coordination process, which also involved various parties and approvals, needed special care and attention from the execution team.

Commissioning phase

The plant was commissioned in phases. First clinker and cement production were achieved in May and December 2016, respectively. HWI planned the installation and commissioning phases well in advance in light of the quantum of work involved. A dedicated installation and commissioning team was located at the site to thoroughly execute the job and minimise errors during the initial stages given LafargeHolcim's and ACC's stringent safety norms. A workforce from HWI was also on site for a significant amount of time. The pre- and dry-commissioning workflow presented in Figure 3 shows how preplanning was executed on parallel fronts.

Journey's end

NOP test

A major milestone in terms of plant performance was linked to the Normal Operation Period (NOP) test, ie to achieve 85 per cent of guaranteed clinker production for a duration of 15 days. The clinker production guarantee was 9000tpd and the average NOP test value was calculated to be 7650tpd and above.

Following the initial start-up and after teething troubles were addressed, the commissioning team, in discussion with LafargeHolcim and ACC, decided to carry out the NOP test in September 2016. During the NOP test, the average clinker production value achieved was in fact 90 per cent of guaranteed clinker production – ie, 8116tpd. The results proved to be the 'litmus test' for preliminary acceptance of the plant by the customer.

Performance guarantee test and hand over

HWI completed the performance guarantee test for the core sections of the raw material grinding and pyroprocessing systems along with the complete plant in the stipulated time frame. All the aforementioned attributes of KHD's technology helped deliver the required performance and performance guarantee test figures of the system.

Tables 3 and 4 summarise the results achieved for the raw material grinding system and from the pyroprocess performance guarantee (PG) test, respectively.

Following the successful completion of performance tests, the plant was handed over to LafargeHolcim and ACC in 2017.

KHD's Jamul journey began with many challenges and much anticipation given the specific project criteria stringent timelines. Embracing the challenge, HWI accomplished the mission with continuous support from all stakeholders involved in this vast venture. ■

Table 3: summary of raw grinding performance test – average of 15 days

Parameter description	Performance data	
	As per contract	Achieved during PG test
Total running hours	1 test x 72h	1 test x 72h
Average production rate (tph)	700	730
Average product fineness (% R on 90µm)	15	15.9
Product moisture (%)	0.5	0.5
Specific power consumption* (kWh/t) **RP-1, RP-2, separator drive, separator fan, re-claimer to raw mill hoppers, limestone reclaimer, raw mill auxiliaries, main bag house auxiliaries, compressor, water treatment and product transport*	17.50	18.40

Table 4: summary of pyroprocess system performance test

Parameter description	Performance data	
Preconditions	**As per contract**	**Achieved/prevailing during PG test**
Heat of reaction (kcal/kg clinker)	418	416
Kiln feed moisture (%)	<0.5	0.4
Kiln feed residue (% R on 90µm)	15.0	15.0
Petcoke NCV (kcal/kg)	-	7885
Fuel fineness (% R on 90µm)	2.5	5.9
Fuel moisture (%)	2.0	0.88
Performance guarantees		
Clinker production (tpd)	9000	9235
Running time (h)	72	72
Specific heat consumption (kcal/kg clinker)	708	706
Specific power consumption – excluding water treatment (kWh/t clinker)	23.0	22.1
Clinker free lime (%)	1.5 to 2.0	1.44