The Aerated Concrete Industries Project – Eleven months to realise a complete low reactivity lime plant

Eng. Paolo Accinelli, President, Società Impianti Calce S.r.l.

In June 1999, S.I.C. (Società Impianti Calce S.r.l. – Milano, Italy) signed a contract with Aerated Concrete Industries Co. K.S.C.C. in Safat, Kuwait, to deliver a complete, low reactivity lime plant for use in the production of calcareous silica bricks.

The principal contract aims were:

- Kiln capacity: 40 t/d
- Limestone size: 50 – 100 mm
- Lime reactivity: T60 20 – 30 min.
- Fuel: LPG
- Net heat valve : 21.650 Kcal / Nm^3
- Milled lime production: 2 t/h
- Final lime granulometry: R 90 micron < 6%

In addition to the above-mentioned technical details, during the plant selection phase, the customer specified some other critical requirements:

- A low investment cost (naturally !!!)
- Simplicity of maintenance and management of the plant
- The plant supplier not to stop at 'test running', but to continue to make himself available and develop a real future relationship as the customer's technical partner
- For local commercial reasons, to complete the plant in less than ten months.

Analysing the milestones fixed by the customer, S.I.C. selected the following principal elements for the plant realisation: a S.I.C. CBK 40 lime kiln and a S.I.C. microniser auto selecting S 60.

The CBK (Central Burner Kiln) lime kiln series are single shaft kilns in counter-current, round section.

They have an exterior burner series and an inside central burner, embedded in the material.

The kiln's typology is put in depression by a fan that extracts from the top of the kiln the combustion gas and CO_2 generated in the dissociation process.

The negative pressure created from the fan sucks up, through the kiln lime discharge, the combustion secondary air, which in turn, climbing in counter-current, absorbs the lime heat. Arriving in the proximity of the burner, it mixes with the fuel and participates in the combustion process.

Following combustion, the air, now poor in oxygen (2%–3%), together with the dissociation CO_2, climbs the kiln again and transfers its heat to the descended limestone.

Having transferred its heat to the limestone, the gas leaves the kiln and through an exchanger cedes an ulterior heat part to the primary air combustion exiting from the stack at a temperature of about 190°C.

Some of the combustion and dissociation produced gas, with a median composition of 2% O_2 and of 30% CO_2, is recycled by the burners, both the peripheral ones and the central one.

This recycling system, together with the special burner concept, permits control of the heat thermal level and its combustion lag, changing the inside kiln section penetration capacity and the thermal gradient between the flame and the dissociation limestone.

The ability to change the thermal gradient between the flame and the dissociation limestone makes it easy to increase and decrease the reactivity of the produced lime.

The central burner is installed in the quite cold kiln zone so that it doesn't require an expensive refrigerated system to guarantee its stability.

The central burner facilitates other technological functions in the plant economy:

- It permits the distribution of fuel, in the central kiln zone, around the shaft area, which could not otherwise be reached by the peripheral burners.
- It reduces the necessity to have an elevated thermal charge developed by every single peripheral burner, which has significant benefits on the lifespan of the refractory.
- It gives the opportunity to change the burning area in the direction of the vertical kiln axis so as to have

a short combustion zone with air temperature for the production of low reactivity lime. Alternatively, it allows a wide combustion zone, in which heat is supplied to the limestone in a gradual and progressive way, the low temperature thus obtained gives specific thermo dynamic benefits in equal current kilns, producing high reactivity lime with low thermic consumption.

The interior of the kiln is round, without projections. It is easily maintained by semi-skilled staff, and can easily support frequent operations caused by the kiln starting and the blowing-out.

The simplicity of the CBK kiln as well as its functional stability mean that it can continue to work without employee intervention.

The principal functional characteristics of the CBK family of kilns are:

- Production: between 40 and 120 t/d
- Fuel: all the gaseous fuels
- Caloric consumption: < 950 Kcal/Kg. CaO (with high reactivity lime)
- LOI: < 1,5 %
- Electric power consumption : < 10,5 Kwh/Tonn. CaO
- Lime reactivity: from T60 < 2 min to T60 >20 min
- Limestone size: from 40 – 80 mm to 60 – 120 mm

In the ACICO Company plant, apart from the kiln installation, there is a requirement for a conventional hammer mill which works with a grate of 15mm, reducing the produced lime dimensions from 50-100 mm to a size anywhere between 0 and 15 mm.

The milled lime is stocked in a silo from which it is dosed to the microniser auto selector SIC S 60 mill.

We usually call our S 60 machines 'mills', when in reality they contain a small complete production unit because in addition to milling the product, they also select it and transport it to the stocking point.

Our S 60 'plant' constitutes a milling and product selection unit and a pneumatic transport system consisting of a bag filter and a fan.

The milling and selection unit comprises two rotors including high velocity and counter rotary hammers in the inferior mill part and by a selector basket in the superior machine part.

The material to mill is fed to the machine by a variable capacity screw, positioned between the milling rotors and the selector basket.

The more rough material parts fall in the milling rotor's zone while the smaller particles 'float ' toward the selector basket .

The granulometric material is partly milled by being knocked against the hammers and the mill armours but much more so by the reciprocal knock between particles, caused by the hammer's high velocity.

All the material that has reached the desired size is sucked up by the air current generated by the fan to the superior mill discharge door, where it is deposited in the selector.

The selector constitutes a rotary basket in the form of a squirrel cage. An inverter allows its velocity to be changed, so that the product granulometry discharged by the mill can be altered whenever necessary.

On the operating mill small pieces, two forces operate in contrast; one is the drag force generated by the air current produced by the external fan, which sucks up the small pieces that have obtained the desired and prefixed granulometry and which are afterwards recovered with the bag filter; the other is the centrifugal force generated by the rotary selector basket, which moves in an opposite direction from the drag force and the particles' mass function (M) and from the basket's rotary velocity (Omega) (Fc = M Omega 2R).

It's clear that by changing the selector rotary basket velocity, it should be easy to modify the top cut of the produced material.

Apart from the machines and key equipment, all carpentry parts have been assembled and fitted by local staff under the vigilant eye of Mr. Göttling, the company's production manager.

Mr. Göttling, far from having been a 'tormentor' in imposing on us a working rhythm more suitable to a 'Formula One pit stop' than to a plant realisation, has actually collaborated with us really well in his professional capacity, to help us to achieve the objectives that we imposed on ourselves.

Today, eleven months after signing the contract, and despite more than one month wasted due to problems with sub-contractors, the plant has successfully completed its 'cold test' and is ready to start its production. ■

The CBK Lime Kiln