A TEC

World Leader in Cement Pyroprocess Technology

Improving Clinker Cooler Collection

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Please note:
In the following article A TEC GmbH could also be mentioned as A TEC Advances Process Technologies GmbH, PMT; PMT-Zyklontechnik GmbH, Zyklontechnik GmbH
(= company name before 1st June 2005).

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Improving Clinker Cooler Collection

Leonardo Antonio di Mare Pareja, PMT-Zyklontechnik GmbH, looks at how the cement manufacturer Colclínker approached the problem of reducing dust emissions on its clinker coolers*.

Introduction

Colombian Clínker Company was founded in 1974. Its 1.15 million tpy production capacity ranks it as the second most important plant of the Caribe Group on the Colombian Atlantic Shore. Since its creation, its main concern has been the foreign market, and accordingly more than 90% of production is exported.

Environmental commitment has become an important issue for all companies in the Mamonal industrial area. The location close to the Cartagena Bay as well as the importance of tourism for the city's economy mean that the impact of industry on the environment cannot be ignored. Colclinker is situated in the industrial zone which has now become part of the tourists' landscape. As part of the 'Mamonal Foundation', these companies have developed a strategy for dealing with environmental issues.

As part of these environmental efforts, Colclínker has taken steps to reduce the emissions from its main sources. The electrostatic precipitators are to receive attention first, followed by the clinker coolers. The high temperature and low humidity of the gases make this one of the most difficult areas.

Solution search

Taking the lead from the Mamonal Foundation's commitment cleaner production goals and the growing stringency in legally authorised emission levels, trials were implemented to improve the collection efficiency in the existing devices. The managers quickly realised that the minimum expected emission from the multiclones would not meet the environmental regulations. Accordingly, it was decided to consider other control devices already in use in other plant applications. However, lack of room and higher investment costs precluded the use of most of these devices.

During evaluation, it was found that the HURRICLON® design met many of the desired characteristics: compact design, low-pressure drop (it allowed the use of the same draft fan), high efficiency, good wear and high temperature resistance, absence of gas conditioning, almost maintenance free and reasonable investment cost. Table 1 shows some of the main characteristics of the devices evaluated.

How does it work?

The inertial forces act in solids when they are suspended in rotating gases, and the elimination of the vacuum effect found in conventional cyclones and multiclones produces beneficial characteristics.

This vacuum effect caused by the change in the gas moving enables that part of the dust that has already been separated to re-enter the gas stream, increasing gas emission. Gas flow does not suffer any pattern change when entering the outlet duct; it has only

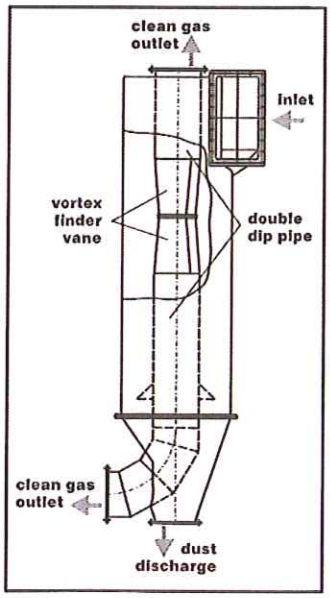

Figure 1. The HURRICLON®.

Table 1. Main characteristics of evaluated devices

	Size (m³)	Pressure drop (in. of WC)	Expected efficiency	Auxiliary devices	Usual troubles	Installation costs (US$)
Multiclone	180	4 to 6	89%	None	Clogging, wearing	30 000 (rebuild), 80 000 (new)
ESP	400	2	99.7%	Conditioning tower, screw conveyors	Electronic failure, lack of humidity	1.1 million
Baghouse	250	5 to 8	99.9%	Gas cooler, larger fan	Bag burning and wearing	850 000
HURRICLON®	140	3.5 to 4.5	97.6%	None	Covers wearing	165 000

* *Based on a paper presented at the 17th APCAC Technical Conference, Puebla, Mexico, October 2000.*

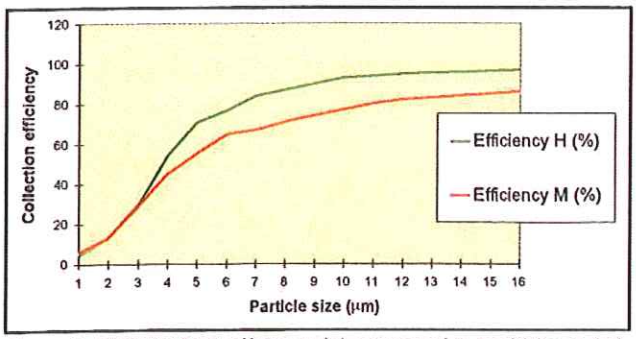

Figure 2. HURRICLON® efficiency (H) compared to multiclones (M).

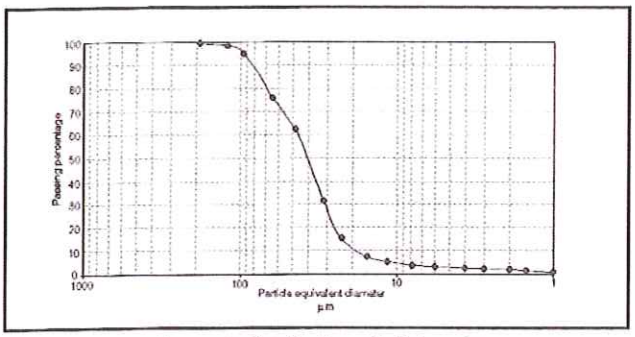

Figure 3. Granulometric distribution of clinker dust.

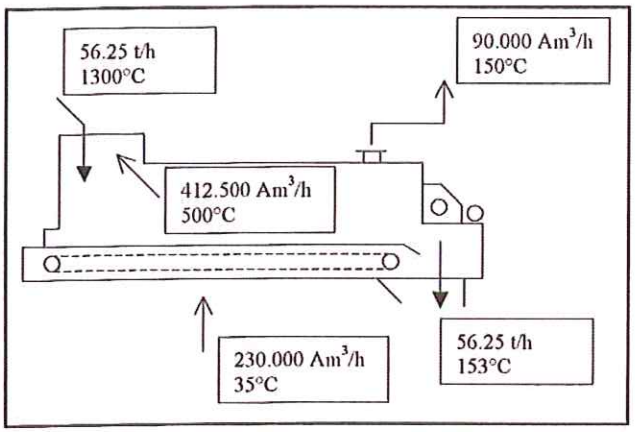

Figure 4. Flow balance in line three clinker cooler.

Table 2. Installation information

Process type	Wet
Process step to improve	Cement clinker cooling
Equipment	Stoker cooler
Production capacity	1350 tpd
Gas flow in operation conditions	90 000 Am³/h
Usual temperature in operation conditions	150 °C
Gas flow in off set conditions	130 000 Am³/h
Usual temperature in off set conditions	250 °C
Maximum off set duration	30 min
Dust load	15 g/Nm³ (assumed)
Special conditions	New equipment should not need any additional place
Gas density	0.8557 kg/Am³
Material density	1.382 kg/m³

*** Cementos del Caribe is the main company in the holding that owns Colclinker.*

to rotate in a smaller diameter, increasing further inertial forces responsible for dust separation.

Double outlet also helps to reduce the tendency of dust to re-enter the gas stream as it rests in a virtually air free environment and gently settles to the cone. Dust goes out of the cone by a rotary valve at the bottom, and this valve avoids false air in the line. All these advantages increase overall efficiency as shown in Figure 2.

This configuration has a higher flow with the same velocity than in a cyclone. The pressure drop is then reduced for the same velocity level which reduces power consumption by the draft fan and consequently energy costs.

Installation

This process began by determining the physical characteristics of the equipment to install. It was necessary to choose one of the three clinker lines for first installation. Line 3 was selected because of its larger capacity and larger dust emission.

Table 2 shows the basic operation parameters required by the designer as well as the granulometric distribution of the dust to be collected.

Special attention was paid to gas flow patterns because of its importance to the collector size. Figure 4 shows flow balance in the existing cooler.

With this information collated and a personal inspection completed, PMT-Zyklontechnik was able to finish the preliminary design and submit a quotation for the job. Estimates were also given for the anticipated and granted emission efficiencies which sat at 98% and 96% respectively. These figures were significantly better than current multiclone statistics and granted an emission level lower than Colombian regulations. Current regulations allow no more than 2000 g/t (1936 mg/Nm³) while expected emission did not exceed 200 mg/Nm³. However, there is a strong trend towards emission reduction, with regulations for Bogotá, the capital of Colombia, allowing no more than 300 mg/Nm³, a limit which may well be extended to the whole country.

As all parties agreed the conditions, the process continued with the installation engineering. The Technical Department of Cementos del Caribe** carried out this procedure with the assistance of the supplier Engineering Department. Colclínker engineers also checked the designs and made suggestions to improve the installation.

Once the design was completed, Colclínker awarded the installation contract (including the manufacture of ducts and platforms) to a local company. HURRICLON® uses only part of the space required for the multiclone.

Table 3 shows some of the main characteristics of the device proposed by PMT-Zyklontechnik GmbH. Table 4 shows the weights of different elements of the project. Installation took ten days and assisted other repairs in the cooler.

Some alterations to the structure were made as well as minor corrections to the drawings and a crane was also brought in to assist. However, the lightweight new structure made this a straightforward process.

The HURRICLON® installed in the Colclinker plant.

Results

After four months in operation, three isokinetical tests have revealed excellent results. The emission levels reached were much lower than expected. Table 5 shows the tests result.

Even the designer considered first measurement as extraordinarily good, but the two other sets were also better than predicted. Process conditions were stable in every test, but dust feeding, raw material characteristics etc. could be responsible for the variations in dust emission level, and an overestimation of the dust load could explain the average results.

Conclusion

HURRICLON® is a good solution for applications in which space limitations make it hard to change multiclones. The cost saving of HURRICLON® is an advantage for any emission point with a dust load of less than 12 g/Nm³. If particle mean diameter is larger than 10 µm (percentage of particles smaller than 5 µm is very small), achievable efficiencies could be higher than 99% even with larger dust loads.

The reasons for very low emissions values in the first test are not completely clear, but it seems that it could be related with the absence of ESP dust feeding during the test.

Even though a progressive reduction in emission levels is expected, HURRICLON® is capable of meeting national regulations over the next ten years at least. Colclínker is now working on cooler improvements which would increase secondary air reducing dust load to the device.

On the other hand, alternative uses of the energy (temperature) in the exhaust gases are being considered, for example for drying coal or slag. By doing so, the gas temperature would be beneficial and dust content would be forced to pass through another gas cleaner (e.g. baghouse) which would reduce emission to less than 20 mg/Nm³.

Energy consumption has been reduced to an average of 15% because of a current draft reduction from 121A to 100A.

Table 3. Features of PMT-Zyklontechnik device

Amount of HURRICLON®	4
Cylinder diameter	1.250 m
Cylinder height	3.975 m
Total height	5.225 m
Inlet area	0.376 m²
Inlet gas speed	16.6 m/s

Table 4. Weights of elements

	Weight (kg)
Local manufacture	10 941
Imported manufacture	11 300
Dismantling	37 000
Installation	22 241

\Table 5. Results

Date	7th June	15th August	4th October
Production (tpd)	1326	1313	1350
Gas flow (Am³/h)	84 551	81 313	90 000
Temperature (K)	389	391.4	395
Static pressure in WC	0.2	0.14	0.21
Emission (kg/h)	4.3	9.54	6.58
Gas flow (scfm)	34.978	33.423	36.652
Gas flow (Nm³/h)	59.428	56.785	62.271
Emission (mg/Nm³)	73,98	118,13	105,62
Efficiency* (%)	99.5	99.2	99.3

**Calculated on a basis of 15g/Nm³ inlet dust load*

The low weight of HURRICLON® and reduced size made it possible to accomplish the installation in a very short time without any important change in the area. Grupo Caribe is now buying new HURRICLON® units from PMT Zyklontechnik Gmbh in Austria to improve collection in many of their clinker coolers.

Enquiry no: 9