OVERALL INCREASE IN EFFICIENCY IN RAW MEALS

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Abstract

This paper deals about the quality improvement in Raw Mill – 2. In order to increase the efficiency of production and greater quality of cement, table feeder is replaced with weigh belt feeder. The weight belt feeder helps to weigh the amount of raw material composition and to maintain the constant TPH which is feed to the raw mill. This load cell transfer electrical signals to the electronic unit which is proportional to the load pressure exerted by the raw material. The replacement of existing coin burner with multi channel burner result in increased clinker quality. It is observed that the flame geometry is improved with new burner. Also there is enhanced nodulization and improved strength. Hence a thorough investigation was done on the problems relating to raw mill – 2 and quality improvement is carried out. This dissertation work reports the successful completion and implementation of the same.

Keywords: *TPH, Raw Mill, table feeder, nodulization.etc*

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1. LITERATURE

The ACC story begins in 1936 with one man undaunted by the times was building a vision for the future. The man was P.E.Dinshaw a man of tremendous foresight and outstanding initiatives. The result was amalgamation of the existing cement companies belonging to four large industrial houses of that time viz, the house of Tata Khatar, Dinshaw and Killick Nison to form the nucleus of what is known as ACC. The Wadi cement Works of ACC was set up in the year 1968 with two Kilns of 600TPD(Tones Per Day) clinker production. In 1982 with addition of first 1MPA(Million Tones Per Annum) plant of India and subsequently capacity expansion of 1968 Kilns, [1]the installed capacity of Wadi Cement Plant (WCW) increased to 1.95 MTA. In the year 2001 an independent New Wadi Cement Plant (NWCP) of 4MTPA Kiln capacity was commissioned. The NWCP uses fly ash a waste generated at the Raichur Thermal Power Station (RTPS) as a raw material to produce fly ash based cement.

ACC was formed when ten existing cement companies came together under one umbrella in a historic merger. ACC's full name [2], the Associated Cement Companies Limited, itself indicates the company's origins from this unique merger.

1.1 Cement Manufacturing Process

The process of manufacturing cement involves basically the following sequential unit operation and processes.

- ❖ Limestone mining
- ❖ Limestone crushing.
- ❖ Stacking and reclaiming.
- ❖ Raw material grinding (Raw Mill).
- ❖ Storage and homogenization of raw meal in continuous blending silo.
- ❖ Coal crushing, stacking and grinding.
- ❖ Clinkerization.
- ❖ Cement grinding and storing (Cement Mill).
- ❖ Cement packing and dispatch.

1.1.1 Limestone Mining

Mining is the first phase of Cement manufacturing process. Here is the open cast, Mechanized Mining is done. After removing 2 to 3 meters of over burden clay, grades will be classified then drilling and blasting will be done. The material will be loaded by shovels and transported to Crusher by dumpers.

1.1.2 Limestone Crushing

To crush limestone or shale to required size, there are two crusher units, one for existing plant and one for expanded plant. The limestone is raised by Dumpers and fed to these crushers.

The crushed limestone/shale from existing plant crusher is fed to secondary crusher where the limestone/shale size is further reduced to 10mm. Then the crushed limestone/shale is transported to Raw Mill overhead hopper or to reclaimed through a series of belt conveyors. [3]The crushed limestone/shale, from expanded plant crusher is transported to stacker and reclaimer through series of belt conveyors.

1.1.3 Stacking

The stacker travels to and fro on a runway between two defined limits, while building up stockpile. The material is always discharged constantly above the middle of the stockpile. With this method piling can be done uniformly with required grades.

1.1.4 Reclaiming

A triangular structure called harrows move to and fro across the stockpile width and scraps the material. Scrapped material slides down from face of the stockpile to get blended limestone. The blended limestone, [4]which slides down, is scrapped and conveyed by buckets to belt conveyor, which in turn will be transported to raw mill hoppers.

By means of stacking reclaiming, the homogenization of limestone will take place.

1.1.5 Raw Mill

Grinding operation is the second stage of operation in unit operation after crushing stage. In this stage, crushed material is to be ground into finer material, for this Ball Mill is supplied by ABB are in operation. The capacity of mills is 70,70,75,135 and 135TPH.

The raw materials (limestone, Hematite and bauxite) are fed to the hoppers by belt conveyors. The material from hopper is fed to the mill in required proportion by weigh feeders. The ground material is conveyed to the static separator. The separator separates the ground material into the finished product and coarse material. The coarse material goes back to the mill, while fines are carried by Air slide, belt conveyor and Bucket Elevator to Blending Silo. The hot gases coming out of the Kiln are being utilized for drying the material and entertainment of raw meal at required temperature.

1.1.5.1 Continuous Storage and Homogenization of Raw Meal in Blending Silo:

Continuous flow into the silo (24000MT) is being used for storage and blending of Raw Meal. Continuous homogenization can be performed in this silo to maintain uniform desired quality.

1.1.6 Coal Mill

The raw coal, received by rail/road is stored in yard and crushed to 30 mm size by Reversible Impact Hammer and roll crushers. Crushed raw coal is fed to the coal mill for grinding before firing in the Kiln and Precalciner. The coal grinding takes place inside the mill. The ground material (fine coal) is carried by the hot gasses drawn by fan.

The hot gases are used to remove the moisture from coal. The ground coal is carried by hot gas stream through static separator in which the coarse material will be returned to the mill and fines will be conveyed to the fine coal bins by series of screw conveyors.

1.1.6.1 Quality of Coal Received

Parameter	Min	Max
Fixed carbon (%)	33.72	46.21
Ash content (%)	24	30
Volatile matter (%)	24.27	29.78
Calorific value (Kcal/Kg)	4200	5225
Moisture content (%)	4.5	6.5
Sulphur content (%)	0.4	0.6

1.1.7 Cinkeriztion (Kiln)

It is combined process made of Pre-heating, Calcining, Burning and cooling operation. Rotary Kiln is the main equipment for clinkeriztion. The ACC Wadi Cement plant consisting of Kiln (Size 4.8 Mts. Dia x 74.0 Mts. Length) from ABL with 3000 TPD.

After blending and homogenization process, the raw meal is conveyed to the Preheater through SFM system (solid flow meter system is for weighing and feeding the raw meal) and bucket elevator/air lift from Silo. Kiln feed is fed into the Cyclone duct. Preheating and Calcination takes place in various stages of Cyclones due to heat transfer.

Fine Coal is fired from Kiln outlet and through a Burner pipe. The hot gases generated due to fine coal firing are taken out by ESP Fan through Preheater and ESP.

Heat transfer takes place in Preheater as Kiln feed moves downward and flue gases move upwards causing co-current flow in gas ducts. Kiln feed after preheating (around 90% calcined material) enters at Kiln inlet. Then such decarbonized material will flow to the burning zone due to the inclination and rotation of the kiln in the direction of the hot zone (burning zone). The temperature of the burning zone is maintained at about 1400deg C for proper clinkerization. After this stage the material is known as CLINKER. This clinker gets cooled in the cooling zone, where it cools down from 1250deg C to 100deg C temperature by cold incoming air from the cooling fans connected to the cooler. Finally clinker will be conveyed to the stockyard by DPC (Deep Pan Conveyor).

1.1.8 Cement Grinding (Cement Mill)

Cement grinding is the final unit operation of cement making process. They have a closed circuit and open circuit Ball Mill. The material to be ground is extracted in desired proportions of clinker and gypsum from storage hoppers by means of weigh feeder and fed to the mill by conveying belt. In cement mill the material will be ground into fine material by means of impact and attrition. The material is pre-crushed in I chamber and fine ground in II chamber. The final product i.e., cement will be conveyed to the silos through bucket elevator.

To manufacture Portland Pozzalana cement and to meet the marketing requirement, 1000 MT capacity fly ash silo with storage and feeding arrangement has been installed.

1.1.9 Packing and Dispatch:

Cement is extracted from the silo and filled in packer hopper from where the material will flow to the packer machine through bucket elevator. 12 numbers of L & T Spout packers of 60 TPH capacities are employed for the packing purpose. Finally the 50kg-cement bag is transported by belt conveyor and stacked inside the wagon/truck with the help of wagon loading machine and truck loading machine.

2. REVIEW OF LITERATUER

2.1 History of Cement

Cement, first developed in the early 19th century, today stands as the second biggest consumer product in the world, just after water. Cement is an artificial hydraulic binder, which binds the particles of sand and aggregates together.

The Invention of Cement was way back in the year 1817 and is considered to be the starting point for the revival of the construction industry. It was early in the 1800’s that Louis Vicat a young, 22-year old civil engineer conducted work on the hydraulicity of the “lime-volcanic ash” mixture. This binder, which had been used since Roman time, remained the only material known to set in contact with water.

Louis Vicat was the first person to accurately determine the proportions of limestone and silica required to make the mixture, which was then fired at a given temperature and crushed to obtain an industrializable hydraulic binder – artificial cement. By refining the composition of the cement developed by Louis Vicat, the Scotsman Joseph Asdin succeedee in patenting a slower-setting cement in 1824. He called this new cement Portland cement, due to the fact that in a appearance and hardness, it was similar to the upper Jurassic rock found in the region of Portland, in southern England.

In France, the first cement plant was opened in 1846 in Boulogne-sur-Mer, yet the very first cement was produced in Poully, in Burgundy.

2.2 Mining:

Wadi Cement Works Limestone Mines is fully mechanized opencast mines. Mining is done in the most scientific manner using heavy earthmoving machineries. The mining is done as per approved mining plan/scheme. The overburden is removed during dry seasons and dumped in the designated area. The topsoil is also used for plantation purpose.

The limestone bed is divided into two benches so as to have safety of the men and machines. During dry weather first bench is generally worked so as to expose the second bench for rainy days. The third bench contains low grade limestone and shale is used as corrective material in raw mix preparation.

2.3 Drilling:

Deep holes are drilled as per the blast design. The spacing and burden and depth and pattern are decided by the Dy. Manager Mines, In charge for drilling and blasting operations. Generally no sub-grade drilling is done.

2.4 Blasting:

Blasting is considered as one of the most dangerous operation in mining activities. Hence drilling and blasting is kept under the charge of Dy. Manager Mines. Blasting is done by using bottom initiation system to reduce ground vibration, air blast, flying fragments. Blasting is done taking all safety precautions to avoid any accident. Cap sensitive and non-cap sensitive explosives are used to charge the deep holes. Ammonium Nitrate Fuel Oil Mixture is also used in blast holes along with cap sensitive and non-cap sensitive explosives.

2.5 Loading and Transportation:

The blasted rock is loaded with hydraulic excavators/loaders into dumpers and transported to the crushers. This material is dumped in the crusher hopper. Haul roads are well maintained. Water sprinklers and Water tankers are used when required to suppress the dust.

2.6 Crushing and Conveying:

To crush limestone or shale to required size, there are two crusher units, one for existing plant and one for expanded plant. The limestone is raised by Dumpers and fed to these crushers. The crushed limestone/shale from existing plant crusher is fed to secondary crusher where the limestone/shale size is further reduced to 10mm. Then the crushed limestone/shale is transported to Raw Mill overhead hopper or to reclaimer through a series of belts conveyors. The crushed limestone/shale, from expanded plant crusher is transported to stacker and reclaimer through series of belt conveyors.

Inspection is carried out before starting the crusher for any defect. The abnormalities found will be informed to concerned in charge. Based on the severity, decision is taken and the same is rectified.

2.7 Secondary Breaking:

To avoid secondary blasting which creates more noise and fly rocks, hydraulic rock breaker is used for secondary breaking of oversize boulder.

2.8 Sub Grade Material Handling

As Wadi Limestone Deposit is horizontally bedded, simple and uniformly high qualities deposit. No sub grade mineral exists in top two limestone benches. But below high quality limestone bench, shale of low carbonate content (less than 70 %) exists in the contact zone of high quality limestone and low quality shale, shally limestone is present.

3. REPLACEMENT OF TABLE FEEDER WITH WEIGH BELT FEEDER

3.1 Problem Formulation

The existing Rotary table feeder devices consist of a rotary disc and a scrapper. The material fell on the rotary disc from the hopper and the material is discharged to chute by the action of scrapper. But in this feeder the amount of material is not accurately controlled, it is dependent upon the number of threads provided to the scrapper controller and only on assumption the material is passing to the chute. Hence it is not possible to decide what proportion of raw material components are flowing to the raw mill. Also, these feeding devices are of robust in construction and require large layout area to install. The raw mill quality using this feeder is poor. Hence, the cement strength also poor.

3.2 Experimental Observations

The following problems are faced due to the use of "Table Feeder"
Raw Mill quality is poor.
Resulting poor cement quality and strength.
Restricted layout area due to robust construction.
The raw materials (Limestone, Hematite and Bauxite) cannot be controlled easily to required proportions.
Manpower is being engaged all the time.

Considering all the above problems a suggestion has been given to replace the "Table Feeder" with a "Weigh Belt Feeder".

3.3 Installation of "Weigh Belt Feeder"

3.3.1 Introduction

Weigh belt feeders are used for continuos gravimetric measuring of granular materials. Their task is to supply in a unit of time, a constant mass of material, with drawn from a silo or similar container. A weigh belt feeder consists of essentially a short belt conveyor, a weighing and a central system. Here, the constant conveying force or conveying effect (Q) of the material stream is formed from the product of constant belt load (P) and variable belt speed (v):

$$P_{constant} \times V_{variable} = Q_{constant}$$

3.3.2 Construction and Operating Principle

Measuring of the belt load is performed by the load cell (1). Referring fig. 2, this is fed from a constant voltage source (12). The out put from the load cell passes to an amplifier (2), where the voltage is amplified to a standard signal which prevails in the entire measuring and control system. The belt speed is measured by a tachometer generator (5), which is attached to the DC-Motor (6). The product of the belt load (out put voltage of the load cell), belt speed (i.e., the voltage of the tacho generator) is calculated in an electronic multiplier (3), in which, both measuring voltages are electrically multiplied. The analog signal which is proportional to the conveying load is compared in a controller to the conveying load is compared in a controller (4) with the setpoint adjuster (8). Variations in density of the material, due to changes in material bulk density (smaller or larger particle sizes), are instantly compensated for by changing the belt speed, this is accomplished by the thyristor controlled rectifier (6) changing the belt speed to keep the product of belt load and belt speed close to the set point. The output signal from the multiplier (3) shows the belt load (11). The same signal passes a voltage to frequency converter (9), and activates the counter to show the conveyed quantity (10). The hand operated gate (13) serves generally for the initial adjustment of the material height on the belt, which is weighed by the weigh belt feeder.

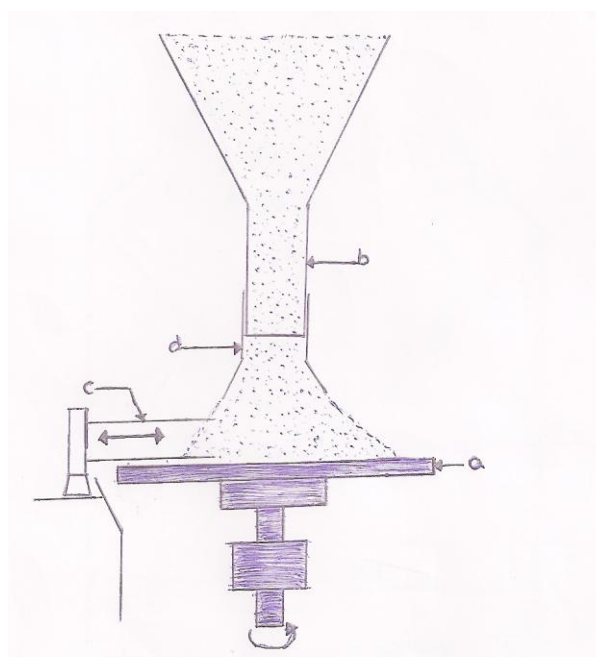

Fig 1: Schematic Of A Table Feeder

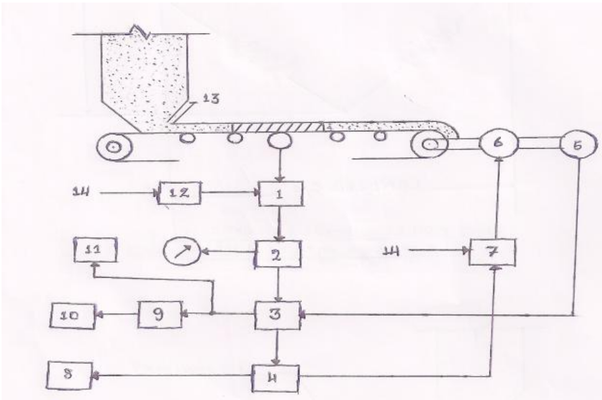

Fig 2: simplified electro mechanical block diagram of a weight belt feeder

1. Load Cell, 2. Amplifier, 3. Multiplier, 4. Controller, 5. Tachometer generator, 6. DC-Motor, 7. Thyristor controlled rectifier, 8. Set point Adjuster, 9. Voltage to frequency converter, 10. Conveying quantity counter, 11. Conveying mass indicator, 12. Constant voltage supply circuit,
13. Hand operated gate And 14. Power.

3.3.3 Observations

By the installation of "Weigh Belt Feeder" it is observed that each composition of the raw mill is weighed and under control. There is a constant TPH flow into the raw mill.
The quality of the raw mix drastically increased as shown in annexure.

3.4 Annexure 1

3.4.1 Quality Analysis in Raw Mill

BEFFORE							
TIME	SiO2(%)	Al2O3 (%)	Fe2O3 (%)	CaO (%)	LSF	SM	AM
MIN.	9.74	1.39	1.01	40.81	77.20	1.65	0.42
MAX.	16.58	3.59	5.01	47.19	154.51	3.99	2.02
AVG.	11.82	2.08	2.74	45.23	122.31	2.51	0.81
Std.Dev.	1.11	0.34	0.70	1.16	13.51	0.41	0.26
AFTER							
TIME	SiO2(%)	Al2O3 (%)	Fe2O3 (%)	CaO (%)	LSF	SM	AM
MIN.	9.37	1.29	0.81	40.97	87.18	1.64	0.53
MAX.	15.52	3.83	4.78	47.54	158.02	5.00	2.73
AVG.	12.01	2.45	2.45	45.06	118.08	2.45	1.00
Std.Dev.	0.89	0.41	0.64	1.09	10.57	0.48	0.40

LSF= Lime Saturation Factor, SM= Silica Modulus, AM= Alumina Modulus.

3.5 Raw Mill-2 Weigh Feeder Capacity

Advantages

- It supplies the production machinery with weighed amounts of material so that its efficiency can be constantly checked.
- It is useful to maintain the continuos gravimetric preparation of cement raw mix from different components, according to predetermined proportions.
- It provides controlled raw composition flow and hence improved quality of raw mill.
- Process variations can be controlled easily.
- Low maintenance cost.
- Less or no manpower is required at the site.

S.NO.	Equipment	Range in TPH	Load Cell Capacity in Kgs	Year of Installation
1	R.M.2 LSH	100	50	2007
2	R.M.2 CLAY	15	20	2007
3	R.M.2 HAMETITE	10	20	2007

4. RESULTS

By replacing the "Table Feeder" with "Weigh Belt Feeder" the required raw mix composition can be maintained very well. The required quality of cement can be obtained by maintaining proper percentage of individual components in the raw mix. Resulting in higher accuracy and by system automation there is complete elimination of human error. Operators at the site for transferring raw material from feeder to the chute are eliminated. Hence there is savings in labour cost.

4.1 Savings

1. Labour cost saving:
Earlier labour cost:
Labour cost for a shift = Rs 95.
Number of shifts per day = 3 shifts.
Number of labours required = 3 persons.
Labour cost per year = Rs 95 x 3 x 3 x 320 days.
Rs 2,73,600/year.

Now, for one person
Labour cost per year = Rs 95 x 3 x 1 x 320 days.
Rs 91,200/year.

Total savings = Rs 2,73,600 – Rs 91,200
Rs 1,82,400/year.

2. Power Consumption

Therefore, Power saving = 11kw – 7.9kw
= 3.1kw.
= 3.1kw x 24hrs x 320days x Rs 4.5
= Rs 1,07,136/year.

Total savings = Rs 1,82,400/year + Rs 1,07,136/year.
= Rs2,89,536/year.

Raw Material Transfer	Power Required	
	Table Feeder	Weigh Belt Feeder
High Grade Limestone	5Kw	3.5Kw
Low Grade Limestone	4Kw	3Kw
Hematite	2Kw	1.4Kw
Total	11Kw	7.9Kw

5. CONCLUSIONS

The analysis carried out in the Raw Mill-2" has resulted in increase in overall production of cement and also resulted in saving of the power, money and time. Replacing the table feeder by weigh belt feeder has resulted in labor cost saving by Rs 1,82,400/year and also the power saving by 3.1kw which results in annual saving of Rs 1,07,136/year.

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