ISSN:2348-2079

Volume-6 Issue-1

International Journal of Intellectual Advancements and Research in Engineering Computations

Eradication of Wastages Developed at the Dust Ejector Line in the Coal Mill

K.Anandhu[1], Aman kumar[2], S. Gowtham[2], V.Gowtham[2], T.Jeevanandan[2]

[1]Assistant Professor, [2]UG Students

Department of Mechanical Engineering, Nandha College of Technology,

Erode-52, Tamil Nadu, India

anandhu.mech@gmail.com[1], sskgowtham95@gmail.com[2]

Abstract - The project is about to completely eradicate the various wastages and the atmospheric emission of dust from the coal mill powder. The emission is controlled by the dedusting bag filter but the collected dusts are supplied again to the screw pump for further storage process at this point various issues such as surge, flush out of dusts. These are overcome by modification in their height elevation and the point of dust supply from the bag filter. They are supplied to the bin where the powdered coals are stored. These are stationery points where the supply of dust does not make any surge or flush out of dust. So, they are obtained to reduce the wastages and atmospheric pollution due to dust emission during their supply from the collector.

Keywords - PPC - Portland Pozzolanat cement, CFB - Circulating Fluidized Bed, Coal Mill, Dynamic separator

I. INTRODUCTION

Cement manufacturing consists of raw mill grinding, blending, pre heating, clinker burning and cement grinding. Limestone, Bauxite, Fly ash and Gypsum are crushed and milled into a raw mill. This is blended and preheated in a preheater cyclone. Preheating of raw feed increases the energy efficiency of the kiln as the material is 20-40% calcined at the point of entry into the kiln. At 700^oC water is removed from the raw feed and in the preheating section calcinations reaction, $CaCO3= CaO+CO2$ takes place. The initial combination of alumina, ferric oxide and silica with lime also occurs. This reaction is initiated between 700^oC to 900^oC depending on the composition of raw feed. The material is then fed into a rotary kiln for further heating. At 1500^oC elements fuse together to from predominantly calcium silicates and aluminates crystals, which are termed as clinker burning. The molten cement clinker is then cooled as readily as possible. The air used to cool the clinker is fed into the kiln as combustion air to ensure high utilization of the heat produced. The cement clinker is ground with about 5% gypsum. Other materials like slag, fly ash, ash of coal etc., may also be added in required proportion to get the final cement powder. The main fuel used for firing preheater cyclone and rotary kiln is coal. In The India Cements Ltd., Sankari West use Pet coke for such purposes. Therefore, Pet cock plays an important role in the manufacturing process of cement.

Based on the composition of raw feed a wide range of pet coke is used. In cement plant two systems of coal firing are used namely,

a) Direct firing and
b) Indirect firing.

II. LITERATURE SURVEY

Researched and written by Lorne Stockman with contributions from David Turnbull and Stephen Kretzmann Pet coke is like coal, but dirtier. Pet coke looks and acts like coal, but it have even higher carbon emissions than already carbon-intensive coal.

• On a per-unit of energy basis pet coke emits 5 to 10 percent more carbon dioxide than coal.

• A ton of pet coke yields on average 53.6 percent more CO_2 than a ton of coal.

• The proven tar sands reserves of Canada will yield roughly 5 billion tons of pet coke – enough to fully fuel 111 U.S. coal plants to 2050.

Petroleum Coke: Industry and Environmental Issues Anthony Andrews Specialist in Energy Policy, Richard K. Lattanzio Analyst in Environmental Policy Pet coke is a co-product of several distillation processes used in refining heavy crude oil. Nearly half of U.S. petroleum refineries (56 or more) use a coking process to convert heavy crude oils into refined petroleum products, and more refineries may follow suit to take advantage of the supply of heavy crude oils from Canada's oil sands projects. Although it is a refining co-product, pet coke has economic value as both a heating fuel and raw material in manufacturing. In 2012, the U.S. Energy Information Administration reported that U.S. refineries produced in excess of 56 million metric tons of pet coke, of which 80% was exported.

Pet coke may be combusted as fuel in industrial and power generating plants. Cement plants and power plants are currently the two greatest consumers of pet coke. There is some limited use as space heating and in commercial brick kilns in Europe, and a small but emerging market as a metallurgical coal blending component for the steel industry. In the United States, the high sulphur content may limit the pet coke in a coal/pet coke blend in a plant designed for coal. However, more recently designed Circulating Fluidized Bed (CFB) boilers can accommodate 100% high sulphur coke.

III. GENERAL CEMENT PROCESS

Cement is a binding agent that hardens in air and water and becomes water resistant when hard. It consists mainly of compounds of calcium oxide, silica, alumina the main components of cement are lime, silica, alumina and iron oxide. Seldom are these components found in the need of proportion in only one raw material. Therefore it is usually necessary to select a measured mixture of a high lime component along with a component which is lower in lime, containing however more silica, alumina and iron oxide. These two main components are generally limestone and clay. The components cement manufacturing process can be divided into following process steps.

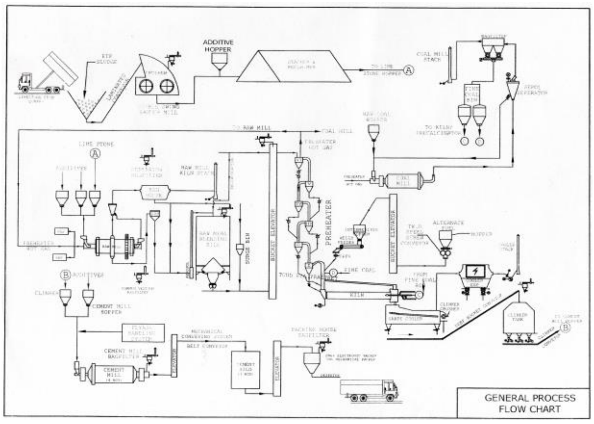

Fig.1 General Process flow chart

1.Raw Material Preparation

Normally there are various sources of limestone, each with different qualities, which are added with various additives to get the required composition of raw mix. As there are various sources of raw materials, it becomes necessary to blend and homogenize these different materials efficiently to counteract fluctuation in the chemical composition of the raw meal. In order to blend and homogenize the raw materials properly, continuous blending silos are used. The raw meal is then fed at a controlled rate to preheat. The quarried limestone is normally in the form of big boulders, ranging from a few inches to meters in size. These varying sizes of limestone need to be crushed to be crushed to size in order to be prepared for finish grinding. These are mainly two types of crushers available for this purpose-compression type or impact type crushers.

2. Clinker Manufacturing

The raw meal is preheated and calcined in the cyclone preheated and calciner. The preheating of the raw material is of paramount importance for the economical production of cement clinker, preheated systems offer heat transfer from the kiln gases produced during burning process in the kiln. During the calcinations process, at 600 deg C the limestone breaks down into calcium oxide and carbon dioxide. The reaction ends at 900 deg C. the cooling, cold air is blown to effect heat exchange between hot clinker and cold air. The clinker cooler has to perform the tasks of cooling the clinker discharged from over 1,300^{O} C to 100-125^{O} C.

The hot clinker discharged from the kiln rolls down on the reciprocating grates of the clinker cooler. The cold air is blow from below the grates plates, which cools clinker. Most of the heat given off during clinker cooling is recovered for the use in the production process. Clinker further crushed into size by hammer crusher at the end of cooler or by intermediate/and roll crushers. The crushed clinker is further conveyed to clinker storage y deep pan/deep bucket conveyors.

3. Cement Manufacturing

Clinker, along with additives, is ground in a cement mill. The output of a cement mill is the final product viz. Cement. In a cement mill, there is a cylindrical shell lying horizontal which contains metallic balls and as it rotates, the crushing action of the balls helps in grinding the clinker to fine powder. The term bag house is applied to large filters containing a number of tubular bags mounted in a usually rectangular casing. The dust laden air is drawn through them by suction. The bag house is used to remove dusty particles from discharge of different equipment such as cement mill, coal mill and kiln.

4. Central Control Room

It is the nerve centre of the cement plant since all equipment is controlled from this place. It is the place from where all the process parameters are controlled.

IV. STUDY ON COAL MILL DUST

Norms on Dust Emission

< 50 mg/nm^3

Revised Norms

< 30 mg/nm^3

Normal Dust Emission

100 mg/nm^3

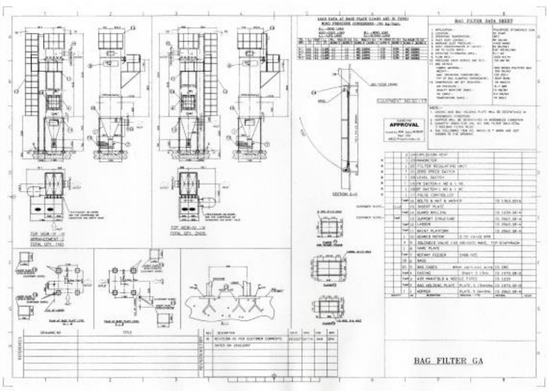

Fig.2 Bag Filter parameter and dimension

Problems Specified:

- Dust flush out at the screw pump
- Reduction in dust collection rate
- Surge occurs at dust feed
- Consistence wastages of collected dust
- Additional dust pollution

V. STUDY ON BAG FILTER

A Bag filter (BF), baghouse (BH, B/H), or fabric filter (FF) is an air pollution control device that removes particulates out of air or gas released from commercial processes or combustion for electricity generation. Power plants, steel mills, pharmaceutical producers, food manufacturers, chemical producers, cement industries and other industrial companies often use bag filter to control emission of air pollutants. Bag filter came into widespread use in the late 1970s after the invention of high-temperature fabrics (for use in the filter media) capable of withstanding temperatures over 350 °F. Unlike electrostatic precipitators, where performance may vary significantly depending on process and electrical conditions, functioning baghouses typically have a particulate collection efficiency of 99% or better, even when particle size is very small.

Baghouse types - Cleaning method

- Mechanical Shaker Baghouse
- Reverse Air Baghouse
- Reverse Jet Baghouse

Baghouses are classified by the cleaning method used. The three most common types of baghouses are,

- Mechanical shakers
- Reverse gas and
- Pulsejet

Fabric filter bags (sometimes referred to as envelopes) are oval or round tubes, typically 15–30 feet and 5 to 12 inches in diameter, made of woven or felted material. Depending on chemical and/or moisture content of the gas stream, its temperature, and other conditions, bags may be constructed out of cotton, nylon, polyester, fiberglass or other materials. Reverse air bags have anti-collapse rings sewn into them to prevent pancaking when cleaning energy is applied. Pulse jet filter bags are supported by a metal cage, which keeps the fabric taut. To lengthen the life of filter bags, a thin layer of PTFE (teflon) membrane may be adhered to the filtering side of the fabric, keeping dust particles from becoming embedded in the filter media fibres.

VI. SPECIFICATION OF BAG FILTER AND PARAMETRS

Location: Coal Mill
Application: Pulverised Bituminous Coal

Table 1 Bag filter parameters

Capacity	30000 m^3/hour
Dust Load at Inlet	280 gm/m^3
Temperature	90 – 100 ^oC
Particle Size	2%R on 90micron (Pet) 15% R on 90 micron (Coal)
Dusting Equipment	Bucket Elevators + Fluidor
Dust Flow Type	Pulse Jet
Dust Load at Outlet	50 mg/nm^3
Motor Speed	58 – 348 rpm

Equipment: FK Pump

Table 2 FK pump parameters

Operating Temperature	80^0 C
Inlet Dust Loading	50 g/m^3
Working Dust Pressure	± 400 mm wg
Dust Concentration at Outlet	40 mg/Nm^3
Air to Cloth Ratio	0.97 m^3/m^2/min
Effective Filtration Area	51.7 m^2
Pressure Drop Across the Bag Filter	150 mm wg

Equipment: Bag Filter Bag

Table 3 Bag Filter bag parameters

Fabric Material	Non Oven Polyester Bag
Weight	550 g/m^2
Maximum Operating Temperature	150^0 C
Types of Bag Claiming Arrangement	Snap Band
Compressed Air Quality Required	20 Nm^3/hr

Equipment: Compressor

Table 4 Bag filter compressor parameters

Air Pressure	6-7 bar
Quality Moisture (max)	10 g/m^3
Oil (max)	0.2 g/m^3
Temperature (max)	70^0 C

Height Elevation
No. of Bag Filter: 3

Table 5 Height elevation

	Before	After
Height (Bag Filter 1&2)	+16.38 m	+25.2 m
Height (Bag Filter 3)	+16.38 m	+29.95 m
Angle	$< 40^0$	57^0

VII. ELEVATION DESIGN

This design represents the position of dedusting bag filter before their relocation, initially the point of dust deposits at the screw pump from the bag filter where much of surge and flush out of dust occurs frequently. It is the major problem that encountered in the coal mill bag filter elevation. In order of reducing such problems the point of dedusting and their height elevation are varied to avoid them completely.

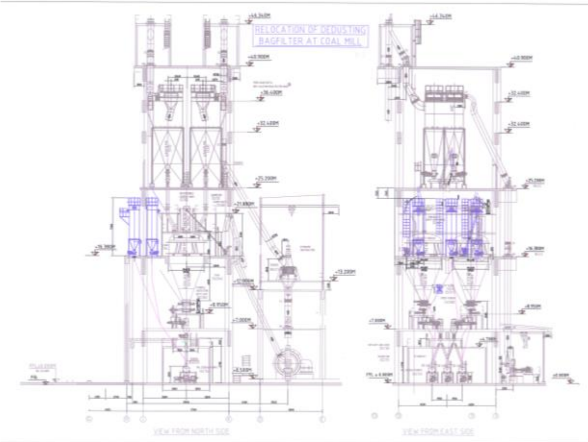

Fig.3 Bag filter position design before relocation

In this design the point of dust deposit and their height elevation variation are specified. In this the dusts are directly deposited at the bin where there is no movement systems so, such problems will not occur, they are completely eradicated from flush out and surge problems. The relocation of complete bag filter setup could change their dust collection point and their dust delivery point, reduces much dust emission problem in the atmosphere.

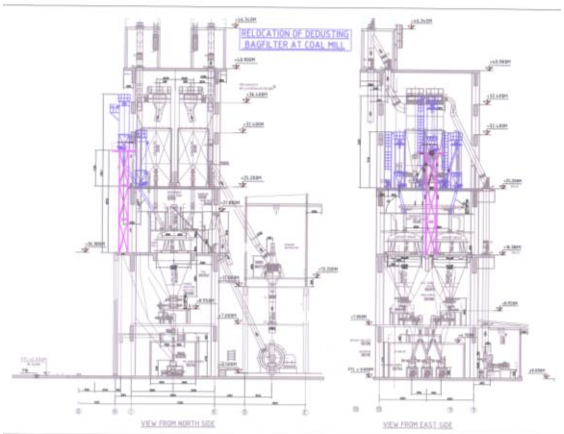

Fig.4 Bag filter position design after relocation

It represents the structural support arrangement and their elevation dimensions of dedusting bag filter in the coal mill. It also shows the positioning of bag filter within the support arrangement at that height of support. This support is given only for the one bag filter where the other two bag filters are made to fit in the concrete floor. Due to insufficient floor space extra support is erected to carry them at that height.

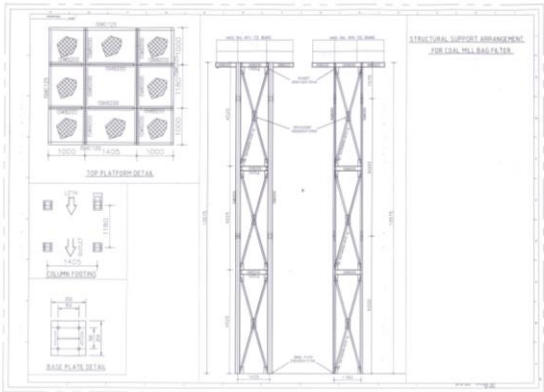

Fig.5 Structural support arrangement for bag filter

VIII. COSTANALYSIS

1.Dismantling from 16.5 ML Erection at 25.2 ML	= 1.5 L
2.Additional support structure	= 0.75 L
3.Pipe line erection work	= 0.2 L
4.Painting	= 0.05 L
Total	= 2.5 L

IX. CONCLUSION

The main objective of this project is to eradicate the major dust emission that occurs in the atmosphere due to transfer of coal products at the screw pumps, which also produces additional dust emission at their transfer points. It is eradicated by means of various methods such as making alteration to the position of bag filter and their height elevation, It is achieved completely by such alterations. In the previous arrangements the flush out, surges occur at the dust ejection place, so, they are modified to eradicate them completely without any wastage at any of their point of dust collection. Initially the point of dust deposit occur at screw pump but on modification it is lifted to the bin where it is dumped without any flush out or surge, it does not affect any other process or atmosphere due to dust emission they are controlled by the dedusting bag filter they are librated in the atmosphere under the values of government norms and conditions.

REFERENCE

[1] "Baghouse filter installation manifold – US Patent 5636422 Description", Patentstorm.us. Archived from the original on 13 October 2012. Retrieved 6 August 2013.

[2] "Baghouse / Fabric Filters KnowledgeBase". Neundorfer.com. Retrieved 6 August 2013.

[3] Coal Pulverising Mill Types, by Glenn Schumacher, 2010.

[4] High dimensional structural reliability with dimension reduction Zhongming Jiang | Jie Li, 2011

[5] Jump up^ Beachler, David S.; Joseph, Jerry; Pompelia, Mick (1995). "Lesson 2: Fabric Filter Bag Cleaning". North Carolina State University. Archived from the original on 9 November 2013. Retrieved 6 August 2012.