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Optimization of Bag Filter in a Cement Factory in Order to Increase of Dust Collection Efficiency

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Abstract: The bag filters are important equipments in cement factory. In these filters current flow that includes gas and dust cross through the pores are located in the stuff filter and filtrate by that remaining on the bag. Afterward, by dust increase on the bag, the filter is shaken until dust collecting leads to exit hopper. This system in this project is called mechanical method. In order to obtain a better operation after introducing to the operation mechanism, the same steps like create good situation for maintain for maintenance and repairs by consideration on important fragment and appoint minority of stock in the stores, carry out the planning of the maintenance and repairs, improvement of stock mandatory. Then, the pressures were measured in various part of filter system and controlled the pressure drop. By inspection of various kinds of bags used in the filter, 550 g m^{-2} polyester bags showed a better performance and parameter effective in tearing and wearing of bags which were recognized. Also by installing timer on the shaking system, the shaking periods of bags were increased. In order to increase dust cake layer and better performance of deducting and bags life time. Assessment of operation on a sample bag filters show that the ready operation time of filter was increased about 200% and out put of dust amount decreased to the below of the standard limits.

Key words: Bag filter, cement, air pollution, dust, optimization, dust collection

INTRODUCTION

In a cement production plant, due to corrosion, grinding, discharge, replacement, baking materials in furnace and its movement inside furnace and so on dust is produced. In this regard, origin of dust in a cement production process in different sections such as; preparation of raw materials; raw materials grinding; readiness of raw materials combination; clinker cooler; clinker storage; final milling; packing and loading shall be worth of consideration (Debell, 2000; Holberg Bank, 2000). One of the important dust control device in cement industry is application of fabric filters with diameter of 300 mm or less and with height of 15 m. These fabric filters generally made from woven and needle felt of natural or artificial fibers. Fabric filters absorb soft micron particles with considerable operation and in approximate level of 99.95% with regard to type of filter. These filters also apply for gas with thermal temperature up to 285°C. Dust together with gas will pass from one side of filter and sediment in pre readiness holes (Duda, 1982; Philip, 2001). After filling holes, particles will locate in surface of fabric filters which the most part of filtration will place in this part and in a few minutes, its operation decrease. When dust layer being thick in surface of filter causes to increase of pressure fault. In this time, surface and lines of filter should be cleaned.

In selection and design of fabric filters, one of the important factor is rate of filtration which shown velocity of guided polluted air to filters inside fabric in such a way that five parameters; type of dust, its application, temperature, size of dust and dust density are important factors in this regard (Chehregani, 2005).

Some factors including composition and nature of pollutants from view point of density, acidity and available gases in environment, temperature of environment, particles type and size of particles are the most important factors for selection of filter (BHA Group, 2001; Schobestberger, 1998). Suitability of textile filters for the subjective aims are depend on main materials (type of

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fabric, its fineness and fabric length), production method (woven and non woven), weight on surface unit, density (air penetration, holes inside filter) and related specifications to level of affiliated filter (Adloch, 1993; Leibacher and Ragazzini, 1999).

Some prior reports indicate that non-woven cloths as bag filter are more effective than woven cloths (Reitemeyer, 2005; Cengotibaben, 2003). In comparison with structure of woven fabric in form of one or two systematic forms, in non woven structure is form in 3D with accidental forms which causes pressure division for passing higher phases. Due to this process, a disperses phase of aero-cell will produce and such a continuous distribution and its analysis to separation and smaller currents may increase rate of combination of forming elements of filter and provide the better situation for absorbing dust. In contrast woven fabrics are some advantages. They are low cost, abundant and suitable for cleaning and long time application (Reitemeyer, 2005; Cengotibaben, 2003). The aim of this research is to elucidate comparison of different bag filters regarding as optimum time work, efficiency and time of work before cleaning at different condition and also we had been tried to solve operational problem of bag filters in Tehran cement factory.

MATERIALS AND METHODS

This study was taken from July 2004 to September 2005. Tehran cement factory that is one of the most important cement factories in Iran was chosen for this study. In the subjective plant, two remedies will made which follow on in two main process: 1) Increasing time of process for readiness of filter for dust removing, 2) Increasing output or filtration operation. One of the most important parameters for correction of filter position is application of suitable component with related optimal operation. In all mechanical system, due to depreciation of parts, after long or short term of use such a part should be replaced. If there is no access to spare parts or parts without good quality, device operation will decrease. With regard to the said mentioned facts and importance of quantity and type of spare parts (from quality and quantity view point), attention to inventory of storage is an important factor for consideration. Items such as rate of use and rate of purchase for each part, last inventory data from view point of part and its application, feasibility of part repair and remedy, number of subjective part in production line, rate of use, feasibility of part purchase inside or outside country, type of part form view point of generality or specialty (in other words, is there any possibility to purchase in general market or not?) order point and minimum inventory, important matters to management of maintenance and supplying spare parts of filters that all went under consideration in this research. Some parts can also be changed until those parts that due to continuous use needs to replacement can assemble in main part without change in other part of device.

Among important parameters to increase filter output is determination of pressure fault of different filter parts (Sohobesberger, 2003). The goal for doing this is access to our subjective data about current position inside pipes and operation usage of fabric filters in different parts of plant. It means, after determination of pressure loss and its comparison with permissible limit and in case of non-conformity, its reasons may be under investigation process. These reasons include pipe closing, fault in vibrating system, non-adjustment of damping fans, air penetration to filter and suitable operation of clean and dust tackle orifices, fabric filters tearing. The process is in such a way that, first of all suitable holes should be placed with dimension of 5 mm in head side of polluted air collected fans and in route of un healthy air to filter and in front side of fan. Then with a pitot pipe that contain grading 80 cm. water, number of static pressure will create in different point and then pressure fault being under review and control. Another effective action for ancient installed filters is installation of electrical timers on vibrator engine. To do this and with regarding type of dust and utilization parameters, vibrating time may be adjusted. With regard to different polluted points in cement plan and difference of type of dust from view point of material, grading and heat. Use of suitable fabric filter for increase dust absorption is an important factor. For determination of fabric for filter fabric, we can use tables that point out to specifications of different fabrics as woven or needle felt. Usually, point out to two types of utilization temperature (ordinary utilization in long term and short term utilization). In addition to general remedies on filters, due to provided situation, some remedies also perform for each filters that to be considered in which in time replacement of fabric is one of these cases (Raly, 2003; Leibeinger, 2004). Fabric (bags) in two situations should be replaced: 1-Long term use, 2-Tearing

One of the reasons for fault of absorbing air in filters is due to non-suitable discharge of dust from filter bag. Since filter bag after utilization due to its filling of hole cause for fault in filter output till for problem solving, 4 solution with the following description applied in this plant: 1) Correct adjustment of pulse system (replacement of maintenance leg), 2) Bags shaking in time of fan(s) stop, 3) Use of heaters, 4) Welding and pre readiness use of indoor walls of filter.

RESULTS

Many shakers had not timer for cleaning of dust particles and they were operate automated every each minutes, before this study in Tehran Cement Faculty. We installed timer for shakers and compared amounts of accumulated dust particles before and after timer installing in 6 bag filters. Present experiments showed that when timers regulate to work each 8-10 min, their efficiency were increased considerably. Rate of collected and discharge dust also take under consideration process for five times before and after timer installation, each time one hour. Results were presented in Fig. 1. Data showed that timer installing cause to increase about 10-20% dust accumulation on all subjected bag filters.

We compared different kind of bag filters regarding time of operation and efficiency of dust filtration (Table 1). Present results showed that non-woven polyester cloths are better than woven cotton ones regarding as efficiency of dust filtration. Exited dust particles were 88 mg m^{-3} in cotton fabrics that is two times more than Polyester 550 g m^{-2} with exited dust about 45 mg m^{-3}. Determination of time of operation showed that woven cotton bag filters is more than non-woven polyester fabrics 400 g m^{-2}, 302 days instead of 298 days, but less than 550 g m^{-2}ones. Operation time of Polyester 550 g m^{-2} was 328 days. Data showed that non-woven Polyester filters 550 g m^2 are more effective regarding as dust filtration and also longer time operation.

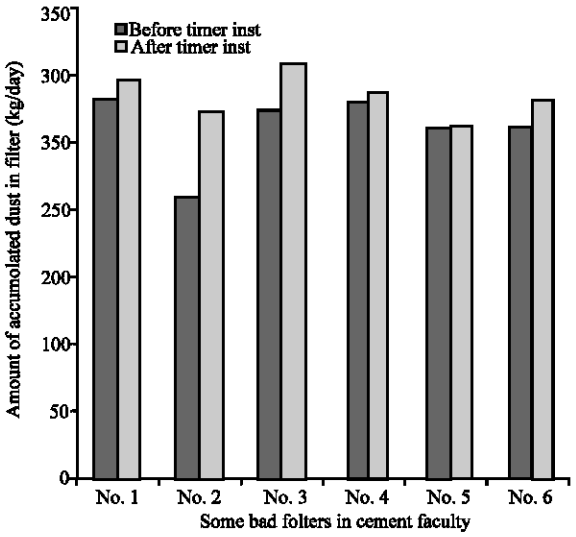

Fig. 1: Results of deducing tests insample bag filter with change of shaking time period

Table 1: Comparison between three types of bag filters regarding as time of operation and efficiency of dust filtration

Kind of bags cloth	Texture	Time of operation (Mean)	Exit dust from stack (mg m^{-3})
Polyester 550 g m^{-2}	non-woven	328 days	45
Polyester 400 g m^{-2}	non-woven	298 days	64
Cotton fabric	woven	302 days	88

As stated before, aim of use for bags dust removing is preventing of increase pressure loss in filter bag and its increase of life duration. With use of four methods as described in pre section, readiness time for use of these filter increase 20%. Also bags find better long life in similar rate. Related details results for each filter, also determine with use of static pressure measuring.

DISCUSSION

Fabric filters have a vide application in cement industry for preventing of dust scattering in such a way that in a unit with production capacity of 2000 tons per day, approximate 20 fabric filters were installed. Fabric bags, due to simple operation, high dust absorbing output, suitable flexibility, low sensitivity due to change in operational conditions, low investment cost, found its way to apply for pollutants control. Today, modern technology named bag house related for electro filters of dust absorber in furnace gas. All details as noted above, causes for better utilization and operation of fabric filters in our subjective plant.

The rate of output dust have a vide area and we anticipate it since with regard to changes on type of dust, rate of polluted air, dust density, life of bags, position of filter and its operation conditions, such a rate may be changeable. But, as our measuring shows related improvement is for decrease in output duet of filter that in some of them were decreased from more than 200 mg m^{-3} to 60 mg m^{-3} that are a proof for improvement of filter operation.

Without consideration of economic aspects, our results showed that non-woven bag filters are more effective than similar woven bag filters (Table 1). This finding is agreement with some prior reports (Phillip, 2001; Raly, 2003). Different type of bag filters was tested regarding as time of operation and efficiency of dust removing. Results showed that polyester non-woven fabrics are longer work time that is agreement with (Cheheragani, 2005; Leibacher, 1999) but not with some reports (Philip, 2001; Raly, 2003). Also their efficiency in dust removing is better than woven fabrics.

We showed that timer installing could increase dust removing by bag filters (Fig. 1). On the base of our results when bag filters are shaking in every 8-10 min, dust removing increase about 20% than prior condition.

As we experiments showed, good efficiency of bag filters in dust removing depend on different factors that

explained above. For continuous improvement of fabric filters of plant, the following recommendation is hereby presented:

- Executing continuous plan of repairs and preventive maintenance
- Supply spare parts with sufficient rate and suitable type
- Periodical measuring of static pressure in determines points and control of pressure fault in each limit.
- Periodical measuring of output dust from fabric filters
- Periodical review of fans position for providing suitable pressure for absorbing polluted air inside filter
- Replacement of mechanical system into air jet system.

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