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ELIMINATION OF PRODUCT LOSS IN MICRONIZER EQUIPMENT USED IN PIGMENT PRODUCTION PLANTS

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ABSTRACT

The main problem associated with the pigment production plants is the final processing of the pigment in the micronizer equipment, in order to reduce the particle size to .5 micron. This paper deals with the product loss and thereby focus is made to improve the product yield of the titanium dioxide pigment. The root cause for product loss is found to be the micronizer equipment commonly used in the pigment production plants. It is found that about 8 to 10% of product loss is reported daily in several plants. Thus a detailed study and appropriate suggestions are made to improve the product yield. The product loss is mainly due to the exhaust system of the micronizer. Thus it is found that about 98% of product yield can be achieved by the suggestions made in this paper.

KEYWORDS: Pigment Production Plant, Micronizer, Exhaust System, Product Yield, Root Cause

INTRODUCTION

In the TiO2 plants, powder from spin flash dryer in the plant is conveyed to the micronizer feed bin by a series of mechanical equipments like screw conveyors. Due to the exhaust system used in the micronizer there are losses of the very fine powder of titanium dioxide. Micronizer is a device which makes use of superheated steam which is made to pass through nozzle on to powdering chamber. Here this high velocity of steam is used to achieve the fine material nature of titanium dioxide pigment. The steam after this purpose is made to pass through an exhaust, while the steam escapes through the exhaust it carries away some amount of the fine powder pigment. It is found that there will be a daily product loss of about 8 to 10% in the plant. Though some amount of powder is regained with the help of some secondary cyclone recovery process, this process is time consuming and is of high cost implication. Thus this product loss and associated other troubles are found to be one of the serious problems faced by the company. Here fully refined TiO2powder is wasted whereby the company suffers huge losses both directly and indirectly. It is also observed that the micronizer system is one of the main reasons of this reduction in product yield. Hence the maintenance associated with this system is also taken into account while suggesting a solution for this problem.

PROBLEM DESCRIPTION

The main problem found in the pigment production plants were the product loss at the final stage of the product micronizing section. Here the main aim is to reduce the size of the particles up to .05 micron size, so that fine material nature of the product can be achieved. Due to this fine nature of the pigment produced they are carried along with the exhaust steam which is used for this purpose. The below set of statistics shows the current production status of the plant.

Production per month =3030 MT

Expected production rate per day=110 MT

Loss of final product reported per month = 5-10%

Table 1: Product Loss for the Years 2012-2013

Months	Reported Product Loss(MT)
April 2012	166.65
May 2012	181.8
June 2012	151.5
July 2012	157.56
August 2012	184.83
September 2012	212.1
October 2012	160.59
November 2012	163.62
December 2012	190.89
January 2013	155.29
February 2013	190.89
March 2013	160.59

Average loss per month = 173.05 MT

Average loss per day = 5.77 MT

Total processing cost of 1 MT of titanium dioxide pigment = Rs 5975.60

Processing cost of 5.77 MT per day = 5975.60*5.77= Rs 34479.21

Total processing cost for one year considering 300 working days = Rs 10343763.6

Direct loss per year = Rs 10343763.6

Root Cause Analysis

From the fish bone diagram its evident that the main reason for the final product loss is due to the micronizer equipment. Among the micronizer equipment there are various factors which may the reason for the product loss. The various factors of micronizer which may be the reason for our problem are feed system, exhaust system, inner liner and product collector system.

Pareto chart for the same is developed which also reveals that the machine contributes the major part for the product loss in the plant. From these four different problems of the equipment, we have to find the major cause for the product loss. Here a questionnaire is prepared and was distributed among the employees of the PPP section and maintenance section.

Thirty questionnaires was made out of which majority of the employees was of the opinion that the main reason for the product loss is the micronizer exhaust system (18). Three employees were of the opinion that feed system is the reason for loss, four employees were of the opinion that inner liner is the reason and 5 employees were of the opinion that

product collector is the reason. The results obtained by this questionnaire method are represented by making use of a graph as below.

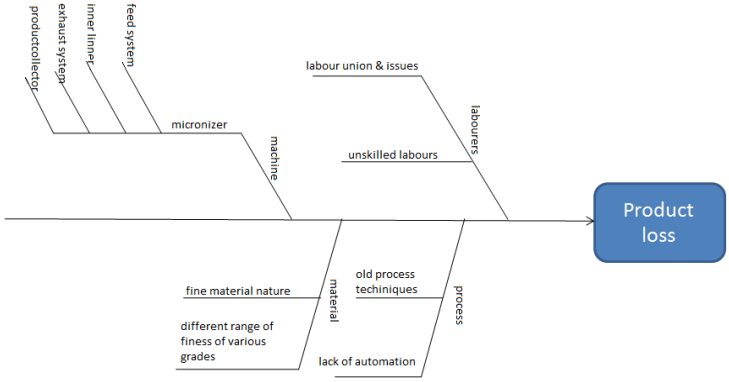

Figure 1: Fish Bone Diagram for Root Cause Analysis

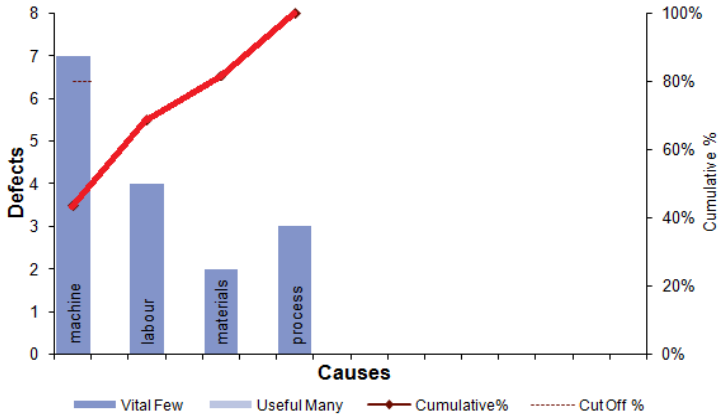

Figure 2: Pareto Chart Showing the Causes for Product Loss

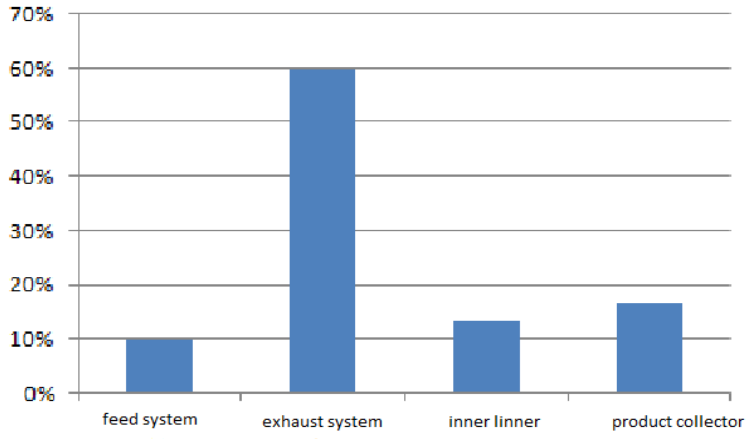

Figure 3: Chart Showing the Root Cause among the Various Machine Defects

Suggestion for Problem Rectification

Now from the root cause analysis it is evident that the main reason for the decrease in product yield is the micronizer exhaust system. So in order to reduce the product loss through the exhaust system a small modification is made in the micronizer exhaust system. Here there are two exits in the micronizer machine, one is the exhaust exit and the other one is the product collector exit.

So the suggestion is to make a single exit for the system that is both the exhaust and product collector are made into one single outlet unit. Thus the product after micronization is carried along with the steam through the exhaust outlet.

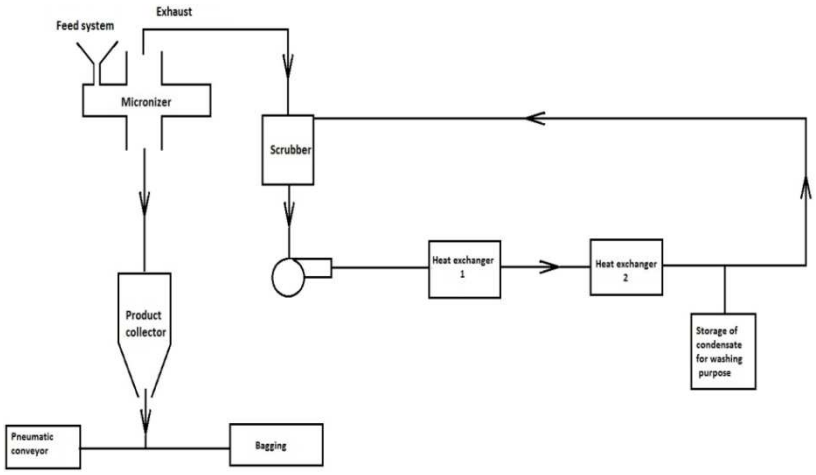

Figure 4: Current Micronizer System

The main challenges that is taken into account for the implementation of proposed system are

- The temperature of product collector should not fall below 250◦c.
- There are chances for condensation.
- High quality insulation required.
- There must be a control system between the product collector and micronizer feed system, so as ensure proper feed with varying temperature.

Proposed System

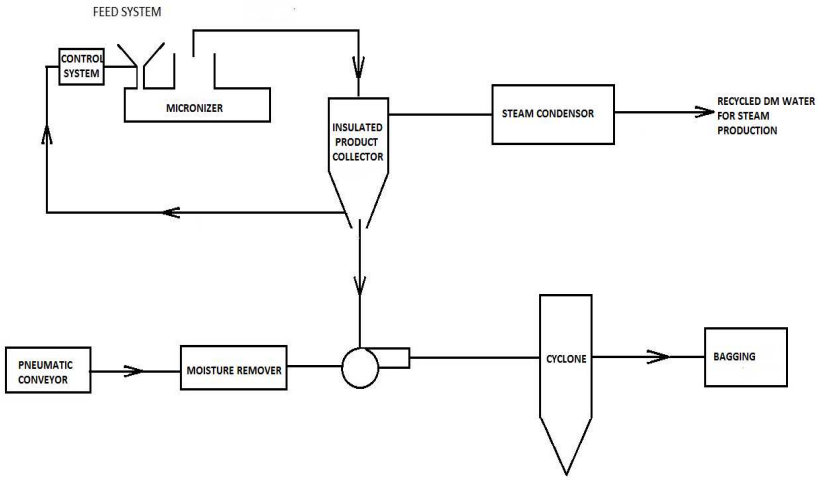

Figure 5: Proposed Dry Micronizer System

Major modifications over the current system

- Micronizer with single outlet is proposed instead of conventional dual exit system.
- An insulated product collector with temperature sensor.

- Control system is installed to ensure proper feed with varying temperature.
- Steam condenser mechanism.
- Cyclone system.
- Moisture remover system.

Table 2: Capital Cost Estimation for Proposed System

No	Components & Specification	Capital Cost(Rs)
1	Blower (2.5 to 280 kw)	648000
2	Product collector insulated	700000
3	Steam condenser(220v,50Hz/43kw)	60000
4	Cyclone equipment	250000
5	Control system(sensor, controller unit, relay unit)	28000
6	Moisture remover	120000
7	Micronizer modification cost	200000

Capital cost = product price + installation cost

= Rs20, 60, 000

Table 3: Energy Consumption

No.	Equipment	Energy in kwh (Fully Loaded)	Unit Price of Energy	Total Cost of Running(Rs)
1	Blower	280	4.5	1260
2	Steam condenser	43	4.5	193.5
3	Cyclone	210	4.5	945

Total cost of running per day = Rs 2398.5

Considering 300 working days, total running cost per annum = 2398.5*300=Rs 7, 19, 550

Expected maintenance and labor cost =Rs 30000

Total cost associated with the operation of the proposed system is found to be the total of the sum of capital cost and energy cost associated along with maintenance which sums to (considering300 days of operation)=Rs 28,09,550/-

FINANCIAL FEASIBILITY

Based on the analysis made on the product yield statistics it is found that considerable amount of product loss is incurred which results in a direct total loss of Rs 10343763.6. By installing the new system the estimated capital cost incurred along with running cost and labor cost was calculated to be around Rs28,09,550/-. Now by adopting this system the loss can be considered as the profit for the firm. Now the payback period can be calculated as below.

- Total cost associated with the operation of the proposed system=Rs 28,09,550/-
- Cash inflow after installing the system per annum= Rs 10343763
- Cash inflow per month = Rs 8,61,980
- Payback period =2809550/861980= 5 months (considering 25 working days per month)

CONCLUSIONS

The main problem faced by the pigment production plant was the product loss of about 5 to 10%. The proposed system enables the achievement of about 100% product yield. Thus the calculation shows that the firm will be in a situation to earn profit from the 5thmonthonwards. The only additional requirement is the installation of an insulated product collector along with a control unit. The micronizer exhaust and product collector exit are made into one single outlet. Thus a high pressure will be developed in the micronizer and the pressure in the product collector will be low which ensures the complete product flow towards the same. Here by making use of a steam condensate the steam can be condensed to water which may be recycled. Thus the new system makes use of mechatronic elements that controls the feed thus ensuring effective utilization of resources.

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