"OPTIMIZATION OF BAGHOUSE FILTER"

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Abstract: A Baghouse is a dust collector device used in large industries in order to purify exhaust gases that are released in the atmosphere. Baghouses, generally are bigger in size. Various modifications were put forth in progressing years to counter air pollution and lower the emissions of particulate matter. Although, satisfactory results were not obtained these filters are still effectively used worldwide. Different types of cleaning cycles such as mechanical shakers, reverse jet and pulse jet cycles are being used currently. In this particular project, pulse jet type baghouse has been prototyped. Our main focus is optimizing the bag filter i.e. to increase bag life, to use a fabric which is relatively cheaper and to increase filtration rate. Filter fabric used is doubled seam PTFE coated polyester felt which will be discussed.

Keywords – *Baghouse Filter, Air-to-Cloth Ratio, Filtration Rate, PTFE Membrane, Polyester, Pollution control*.

I. INTRODUCTION

A device which removes particulate matter from air or gas released from commercial processes. Power Plants, Steel Mills, Food manufacturers, Pharmaceutical producers, Chemical producers and other industrial companies often use baghouses to control emission of air pollutants. Baghouses came into widespread use in the late 1970s after the invention of high-temperature fabrics capable of withstanding temperatures over 350^0F. Unlike electrostatic precipitators, where performance may vary significantly depending on process and electrical conditions, functioning baghouses typically have a particulate collection efficiency of more than 99%, even when particle size is small.

What are the types of Baghouse Filters?

1 Mechanical shakers: The bags are fastened onto the cell plate at the bottom of the baghouse and suspended from horizontal beams at the top. The cleaning is obtained by shaking the top horizontal bar from which bags are suspended.
2 Reverse air: The bags are fastened onto the cell plate at the bottom of the baghouse and suspended from an adjustable hanger frame at the top. The cleaning action is obtained by injecting clean air into the dust collector in a reverse direction.
3 Pulse jet: The bags are supported by a metal cage which is fastened onto the cell `compressed air through a common manifold over a row of bags. The bags may be cleaned individually.

Filter Bag Material:

As fabric of filter bag varies from impurity to be trapped, there are various materials that can be used depending upon their availability, cost and durability. For our research we have selected polyester filter bag coated with Polytetrafluoroethylene (PTFE) sheet or membrane on both sides of the filter as complete PTFE bag would lead to increase in cost.

Why PTFE?

PTFE also known as Teflon is popular for its non-stick properties, it can withstand high temperatures which are caused in industries and exhibits durability under high stresses.

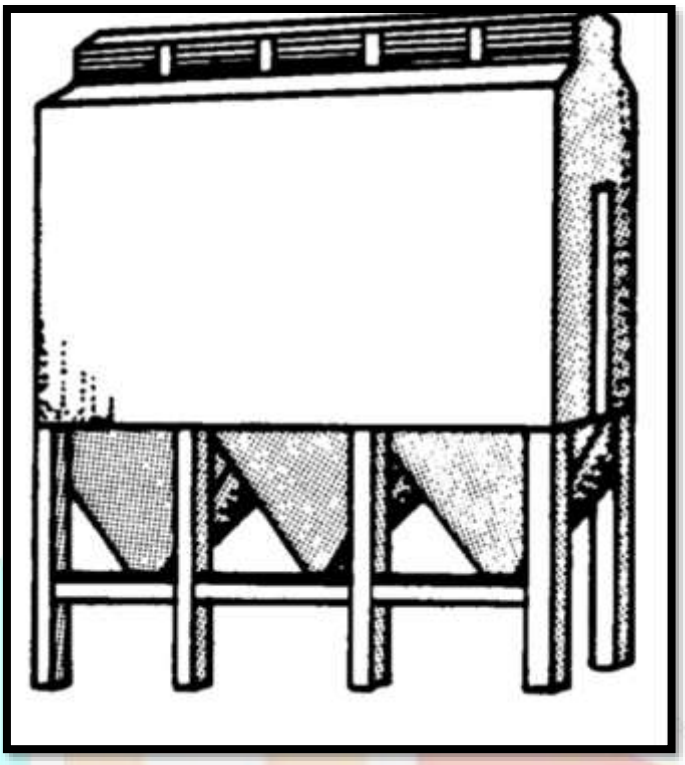


Figure No. 01: A Typical Baghouse

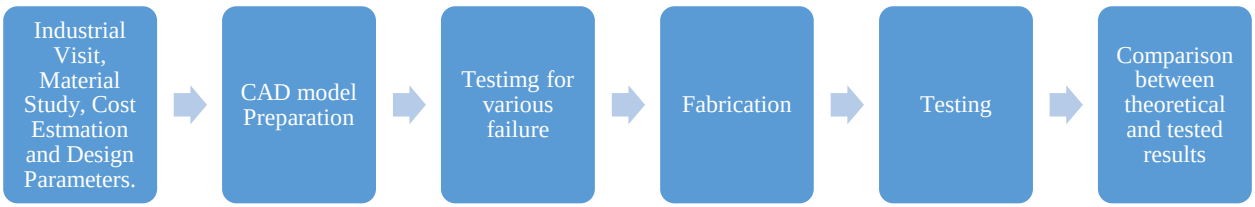
II. OBJECTIVE

The goal of our research and design is optimizing various factors which affect the performance of a bag in a baghouse filter which in turn will reduce the excessive power consumption. It will lead to a low investment cost and a low maintenance cost and it can be used by any type of industry to follow the governments' norms for the air-pollution control. The objectives are:

1) To optimize various parameters like pressure drop, filtration rate, bag life, air-to-cloth ratio, fan speed, power consumption, air flow of the Bag House and to increase efficiency in current methods.
2) To render it cost-effective and to make it affordable even for the smaller scale industries which face the problem of being shut down by the government as they fail to meet the standards set for the air-pollution control.
3) To use alternate materials which are cheaper and readily available and to increase filtration rate per filter, if more than one filter is present and to keep filtration rate equal in filter bags in case of multiple bags.

III. METHODOLOGY

The methodology is as follows:



IV. FABRICATION

Figure No. 02: Complete Unit

Filter Bags: Production of Filter bags was done in the following steps:

1. Polyester threads were interwoven into cylindrical bags.
2. These bags were then doubly coated with thin PTFE membrane.
3. Finally, these bags are seamed twice on the ends with polyester felt.

Unit: The unit was manufactured with mild steel sheets which were forged and bent in order to obtain the hopper shape. Tube sheet was produced by laser cutting the sheet metal. Bolt holes were drilled wherever necessary. Ash cap was manufactured by using abrasive cutting machine. Tube sheet and pipes were welded at the desired locations and ultimately the unit was bolted and made air tight.

4.1. Following are the operations carried out on the components to be manufactured:

1) Abrasive Cutting Machine: For Sheet Metal Parts
2) Drilling: For Bolt Holes
3) Welding: For Stand, Tube sheet, Pipe
4) Forging: For bending sheet metal parts
5) Galvanized Laser Cutting: For bag holes in tube sheet.

4.2. Following are the components used:

Table No.1: List of components used

Sr. No	Name of Parts	Qty. Nos.	Material
1.	The Main Unit	1	MS
2.	Bags	1	PTFE over Polyester
3.	Hopper	1	MS
4.	Stand	1	CI

5.	Pipe	2	PVC.
6.	Fan Blade	1	CI
7.	Blower	1	MS
8.	Motor	1	MS
9.	Chimney	1	CI
10.	Bolts	30	MS
11.	Nuts	30	MS

Table No.01: List of Components

V. WORKING PROCESS.

Figure No. 3: Working

Working

- A 1 HP, 3 phase motor is connected to a 3-phase supply.
- The motor is turned on and with the help of centrifugal blower vacuum is created inside the chamber.
- This creates suction at the inlet where impure air is drawn in.
- Once the particle laden air is drawn in, the particles adhere to the bag filter and purified air penetrates through the pores of the filter.
- This air moves to the uppercasing of the unit.
- It then moves to the exit pipe and is finally thrown out of the exit of centrifugal blower.
- Once the blower is turned off, the dust falls into the hopper and is collected using ash cap.
- Separate compressed air cycles is not required for this unit due to PTFE's non-stick properties.

VI. RESULTS & DISCUSSIONS

Preliminary Results: -

- Our preliminary result is the optimization of bag filters.
- We have used a thin membrane of PTFE (polytetrafluoroethylene) or simply Teflon over polyester bags.
- It has resulted into low frictional drag, which in turn will reduce the fan power and the maintenance cost.
- Thus, it would become economical design and small-scale industries can employ it easily.
- However, this result is based on research and industrial consultations and will be verified when the secondary results are obtained.

Secondary Results: -

The unit was tested in a controlled environment and the following results were obtained:

Parameters	Observed	Standard
Air-Cloth Ratio (For Coal and Sawdust)	2.5 (ft/min)	2-5(ft/min)
Operating Temperature	Approx. 115°C	Up to 150°C

Table No. 02: Comparison of Results

VII. CONCLUSION

After researching and performing tests on the unit, the conclusions drawn are as follows:

1. Thin layer of PTFE (polytetrafluoroethylene) membrane on polyester or any other filter fabric material can be used instead of only PTFE filter which saves the cost without compromising the efficiency.
2. This unit can be installed in small scale industries.
3. Cleaning cycles are drastically reduced which saves the cost of compressed air which is used in cleaning.
4. Optimum filtration rates with increased bag life is obtained.

VIII. ACKNOWLEDGEMENT

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