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Study on Dust Collector

Peddi Aditya[1], Raj Kumar Singh[2], Satish P[3], Sunil K G[4]
[1, 2, 3, 4]*Students, Department of Mechanical Engineering , Ballari Institute Of Technology & Management , Bellary. Visvesvaraya Technology University, Belagavi, Karnataka.*

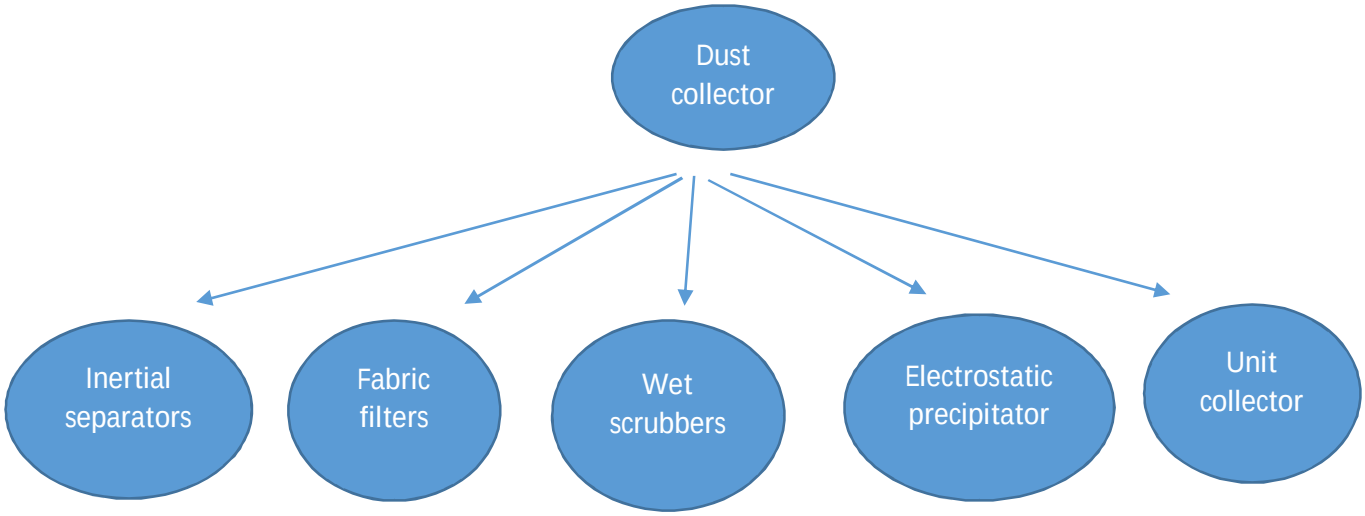
Abstract: ***Dust collector is an equipment that is being used in any industrial or commercial sectors to improve the quality of air released from its zone, by undergoing various stages of filtration. This equipment has two portions the upper half and the lower half, the lower half is generally conical in shape and collects the large size dust particles and the upper half is cylindrical portion containing filter bags collects finer particles. A common discharge port is provided to communicate the upper half, a collected dust recovery box is fixed at the lower space of the cyclone body and discharge blower is connected to a discharge port of the cyclone body.***

Keywords: Cyclone dust collector, bag house filter.

I. INTRODUCTION

Air that is being released from industries, automobiles and from house hold fuel burning cause a lot of pollution, this is an alarming situation that needs to be bought under control. This pollution or pollutant is in the form of PM (Particulate Matter),it is of utmost importance to enhance or filter this PM before releasing into atmosphere, and this is done by installing various kinds air pollution controlling equipment like ESP (Electrostatic Precipitators), Bag houses filters, Wet scrubbers and cyclone type dust collector. Cyclone type dust collector is considered to be cheaper having low maintenance cost. Cyclone separators are widely used as air pollution abatement devices. From the sources collected it is absorbed that higher dust collection efficiencies could be obtained from cyclones using different inlet velocities than those specified as the “ideal” velocity. The larger PM will be filtered in cyclone separator and the finer PM gets filtered in bag house. The bag house also known as bag house filter, bag filter is a dust collector that removes smaller PM effectively. This review paper gives a detail info of dust collecting methodologies opted in respective areas of profession and the outcomes.

II. TYPES OF DUST COLLECTOR



III. EXPLANATION FOR THE TYPES

A. Inertial Separator

Inertial separators make use of some external force to separate the impurities from gas streams. These forces make the dust to move across the area where the forces exerted by the gas stream are lowest. Then the separated dust are directed towards the hopper for storage section. Inertial separators may also be further classified such as Settling chambers, Baffle chambers and Centrifugal collectors

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B. Fabric Filters

Fabric filters also known as Baghouse filters are the dust collectors which are used to separate dust particles or PM(Particulate Matter) from dusty air. These are known to be one of the most efficient and cost-effective dust collectors. The dust that has been collected in it must be removed, and in order to achieve this there are various techniques such as Shaking, Reverse air, Pulse jet, Sonic, Cartridge collectors.

C. Wet Scrubbers

In wet scrubber system, there is a scrubbing liquid used to collect or attract the dust towards it, the scrubbing liquid comes in contact with a gas containing dust particles and collects the dust along with it. Greater the contact between the gas and liquid, greater will be its dust removal efficiency. The gases then pass through a eliminator to remove water droplets from the gas. The dirty water from the scrubber system is either cleaned or discharged. Dust on the scrubber is removed in a clarification unit or a drag chain tank. A drag chain tank or system removes the sludge and deposits it into a dumpster or stockpile.

D. Electrostatic Precipitators

In electrostatic precipitators the dust particles get separated from exhaust gas via the external force such as electrostatic force. The gases then flow through the passage where discharged electrodes are present. The particles in air receives a negative charge as they are directed to pass through the ionized field. After that these charged particles are then attracted to a positively charged electrode.

E. Unit Collector

Unit collector are usually small and consist of a fan along with few other equipment. These are generally suitable for various operations such as for isolated and portable or frequent. These are less expensive and less efficient. These can be further differentiated in two categories: Fabric collectors and Cyclone collectors.

IV. DISSCUSSION

Many citizens use subway trains on a daily basis, lots of studies are conducted on the air quality of the subway environment. The particle concentration has been measured to be over that within the urban atmosphere. The fine dust within the subway environment is thought to consist mainly of iron compounds. The iron- containing dust is principally generated or scattered by subway trains operating within the tunnel and may seep to the platform or subway carriage to be breathed in by passengers or subway workers. This dust is understood to be more harmful to the human beings than the fine dust generally occurred on roads. Thus, steps must be taken to eliminate fine dust within the subway environment.

The subway trains operate by repeatedly stopping, accelerating, cruising, and decelerating, it needs a dust collector with a high collection efficiency at various operating speeds. during this study, a hybrid dust collector was developed that is a combination of an electrostatic precipitator with high collection efficiency at low flow velocities and an inertial dust separator with high collection efficiency at high flow velocities nonparallel. The hybrid dust collector was designed to use the driving wind generated by a running railroad train for its operation. Thus, if the flow resistance is large, the train wind cannot flow into the dust collector, a louver dust collector with a comparatively low flow resistance was selected as inertial dust separator.

The louver dust collector primary function is to remove large dust like sand in gas turbines, and it can economically handle large flow rates due to its low flow resistance. The electrostatic precipitator is installed to the rear of the louver dust collector collects finer sized particles.

A wind tunnel and simulation test were conducted to check the performance of the hybrid dust collector. A louver dust collector was used as an inertial dust separator, and an electrostatic precipitator employing a tungsten wire and aluminum plate was chosen. The differential pressure was measured within the construction test, and also the flow resistance ratio of the louver dust collector was 10 times beyond that of the electrostatic precipitator within the hybrid dust collector. Thus, the rate of flow of the hybrid dust collector is greatly influenced by the flow resistance of the louver dust collector. the gathering efficiency of the electrostatic precipitator was highest at 1 m/s and later decreased as the flow velocity increased up to 8 m/s. On the opposite hand, the gathering efficiency of the louver dust collector significantly increased as the flow velocity rise from 1 to 8 m/s. Therefore, the hybrid dust collector demonstrates how each collection method may well be used at various flow velocities. As a more quantitative comparison, this study predicted the quantity of subway tunnel PM10 and PM2.5 collected by each dust collector, supported the mass concentration distribution of particles within the actual subway tunnel. When the rate of air entering the dust collector was above 2 m/s, the PM10 and PM2.5 collected by the hybrid dust collector was predicted to range from 88 to 123lg/s, and from 30 to 35lg/s, respectively. If

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multiple such hybrid dust collectors are attached to several subway trains, their driving wind can be often used to reduce the fine dust concentration in subway tunnels with low power consumption.

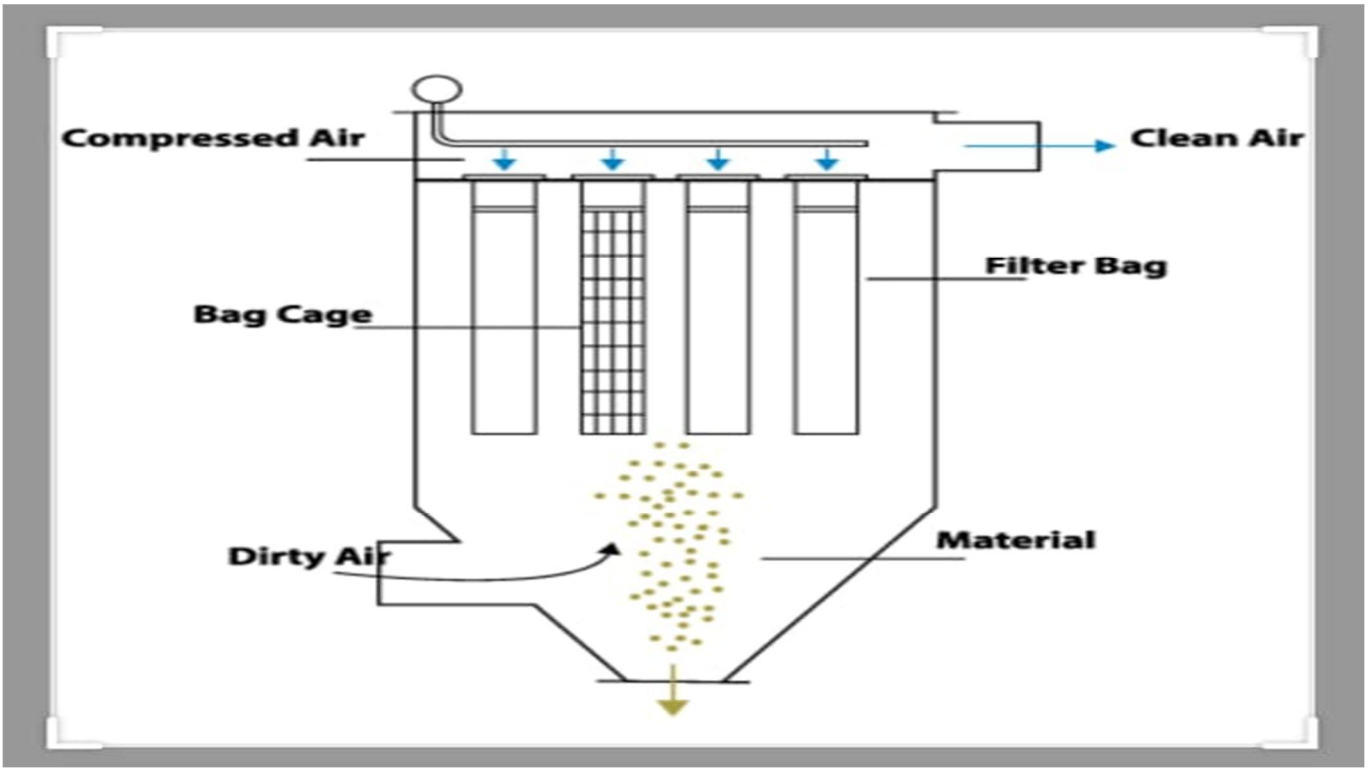
Cyclone separator is one amongst such, there are various parameters that will affect the performance of cyclone separator, this include factors like design parameters, particle density, and operating temperature. Apart from these there are few other operating parameters like the inlet velocity, physical properties of fluid namely the density and viscosity and also the outlet conditions affects the gathering efficiency of the cyclone. Thus while designing the apparatus, the above discussed factors must be taken into consideration.

In general, cyclone consists of an upper cylindrical section and lower conical section. In this study a cyclone travel distance is determine by the cyclone dimensions and flow pattern. on this basis travel distance the effective number of turns was calculated. during this apparatus cylindrical section length capable the cylindrical section diameter and a cone length adequate to twofold the cylindrical section diameter. within the cyclone the most important pressure loss components are the frictional loss within the outer vortex and therefore the rotational energy loss. In this study test had been conducted on various cyclones sizes(4, 12 and 36 in) and from this theoretical analysis is has been proved that cyclone pressure drop is independent of cyclone diameter. To verify the theoretical analysis results obtained by the Classical Cyclone Design (CCD) method, this study and several other theoretical models within the literature, experiments were conducted.

From various theoretical studies it is found that the pressure drop varies with inlet velocity, and is independent of cyclone diameter. When we decrease cyclone body diameter, inlet width, operating temperature then cyclone efficiency increases. Similarly when we increase the inlet velocity and particle density, then the collection efficiency also increases. With increase in inlet velocity the pressure drop also raises, but the pressure drop decreases with the rise in temperature

This article tells us about the parameters that affect the performance of cyclone separator. several factors like design parameters, like dimensions of cyclone separator, operating temperature and particle density, and Operating parameters like the inlet velocity of the fluid and therefore the physical properties of fluid, namely the density and viscosity and also the outlet conditions affects the gathering efficiency of the cyclone. Thus while designing the apparatus the above mentioned factors must be taken into consideration.

V. WORKING PRINCIPAL



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In this equipment the air containing dust enters the inlet of the equipment, here the air is made to spin in a centrifugal manner with the help of blower, due to the centrifugal action of air, the large size dust particles gets collected at bottom and the fine dust will float upward, for handling fine dust the method of filtration that has become almost universally adopted I.e., bag type filter. These filters are commonly called bag houses.

Bag houses are very efficient particulate collector. They collect particles with sizes ranging from sub-micron to several hundred microns, it provides efficiency around up to 99 percent or better. The layer of dust that is being collected on the bag generally called as dust cake is primarily responsible for such high efficiency.

Most of the bag houses are long and cylindrical bags, and are usually made of woven or felted fabric as a filter medium. We are using cotton bags as a filter medium. Dust laden gas or air enters the bag house due to the suction or positive pressure generated by the blower. The gas enters the bags, either from inside or outside tubes, and the dust that has been accumulated on the filter medium increases the resistance to flow, therefore the filter must be cleaned periodically in order to avoid pressure drop across it. Thus by doing so the total dust load on the bag is reduced.

VI. CONCLUSION

Study says Bag houses are very efficient particulate collector. They collect particles with sizes ranging from sub-micron to several hundred microns, it provides efficiency around up to 99 percent or better. Study done on the dust collectors having cyclone separator and analysis from different papers any change in inlet velocity gives change to pressure drop, but it is independent of cyclone diameter. Factors like body diameter, cyclone separator width, cyclone inlet width and operational temperature will affect the efficiency of the dust collectors. With decreasing cyclone body diameter, cyclone width, cyclone inlet width, operating temperature cyclone efficiency increases. With rise in inlet velocity and particle density the collection efficiency increases. With rise in inlet velocity the pressure drop rise, but the pressure drop goes down notably with increase in temperature.

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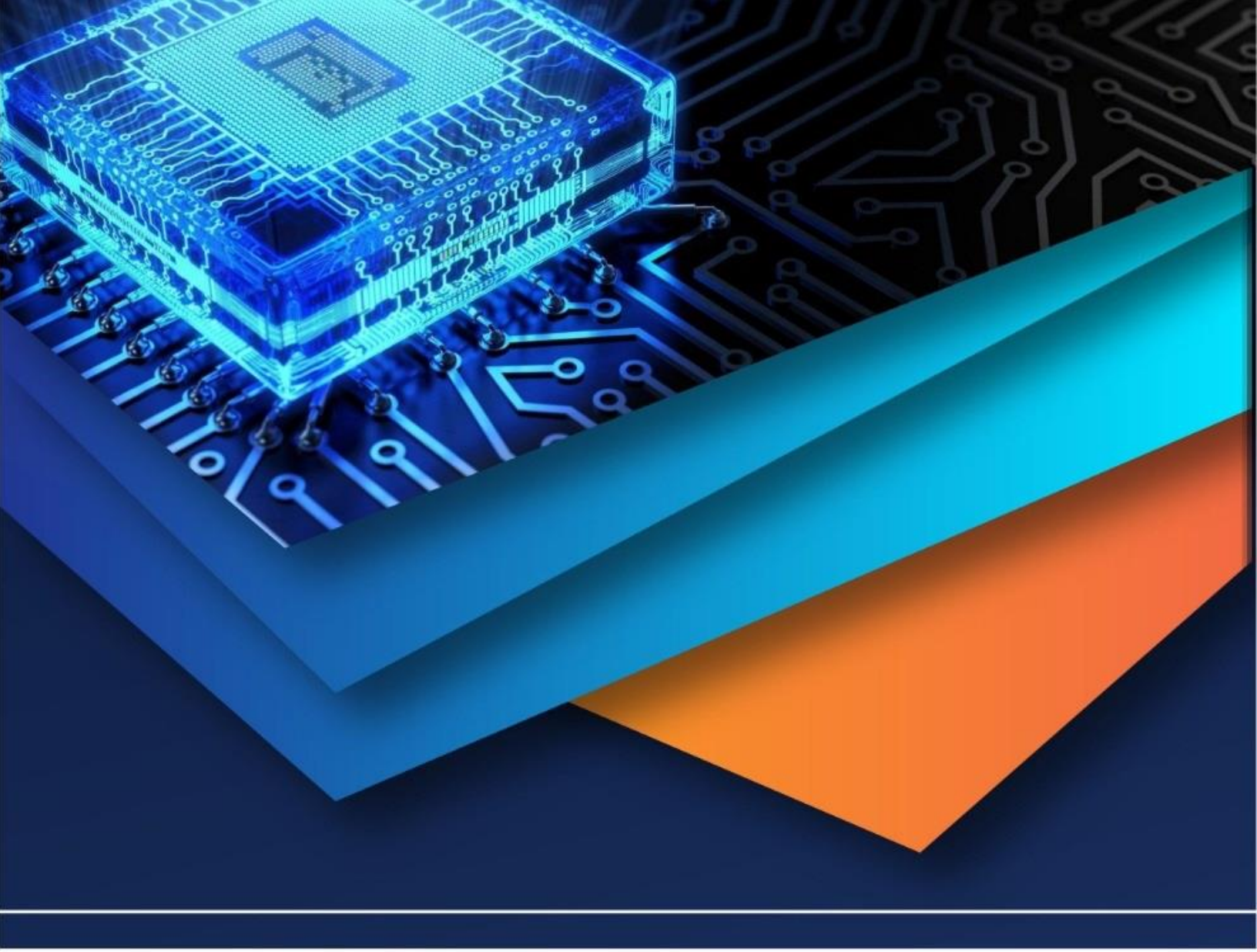

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