AIR POLLUTION CONTROLLER BY USING SMOG TOWER

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Abstract: Air pollution is basically the foreign material in the air can be manmade or naturally occurring. Pollution is injurious to health and its prevention is economic burden on the citizen. High population density is huge contribution factor of air pollution in cities and urbanised areas. Air pollution has been at the peak in recent year posing serious threat to environment and social wellbeing government, authorities and industry have been at the forefront to tackle air pollution with the help of policy reformation and technological innovation. The aim is to understand the innovation activity in the technology domain and different ways to observe it. Smog tower is a modular technology which breath the polluted atmospheric air in and supply filtered air back to atmosphere.

I.INDRODUCTION

Air pollution occurs when harmful or excessive quantities of substances including gases, particulates, and biological molecules are introduced into Earth's atmosphere. It may cause diseases, allergies and even death to humans; it may also cause harm to other living organisms such as animals and food crops, and may damage the natural or built environment. Both human activity and natural processes can generate air pollution.

Smog is a type of air pollutant. The word "smog was coined in the early 20th century as a portmanteau of the words smoke and fog to refer to smoky fog, its opacity, and odour. Smog is a yellowish or blackish fog formed mainly by a mixture of pollutants in the atmosphere, which contains fine particles and ground level ozone. Smog, which occurs mainly because of air pollution, can also be defined as a mixture of various gases with dust and water vapor. Smog also refers to hazy air that makes breathing difficult. The atmospheric pollutants or gases that form smog are released in the air when fuels are burnt. When sunlight and its heat react with these gases and fine particles in the atmosphere, smog is formed. It is purely caused by air pollution. The main sources of these precursors are pollutants released directly into the air by gasoline and diesel-run vehicles, industrial plants and activities, and heating due to human activities. Smog is harmful and it is evident from the components that form it and effects that can happen from it. It is harmful to humans, animals, plants and the nature as a whole. Many people deaths were recorded, notably those relating to bronchial diseases. The tiny toxic particles known as PM 2.5 can be inhaled into the lungs. Research from Berkeley Earth, a non- profit that conducts scientific investigations on climate change, shows that 1.6 million people die each year of air pollution in China a harsh reality of modernization.

AIM & OBJECTIVE

Aim

Clean air is vital for the wellbeing of people and other living organisms. Air pollution control policies aim to maintain high air quality to preserve healthy and pleasant residential environments and viable natural ecosystems.

Objective:

To bring all around improvement in the quality of the environment by effectively implementation of the smog tower. Control pollution at source to the maximum extent possible with due regard to technological achievement and economical viability. Minimization of adverse effect of pollution by selecting suitable locations for the establishment of new projects. Designing Smog Tower by taking into consideration the various design parameters. At first the model will simulated to check the validity of the design. The model then fabricated using according to the design and the prototype testing will done and the following conditions will check: [1]Air breath during the suction. [2]Amount of PM in the suction air.[3] Each stage purification details. [4]Amount of PM in the exit air.

LITERATURE SURVEY

[1]Prof. Vijaya D. Gayki :- He says that Smog free tower project is a series of urban innovations led by Mr. Dann Roosegaarde to reduce pollution and provide an inspirational experience of clean future. Smog free tower provide a local solution of clean air in public places. Here along with government students and clean tech industry people can work together to make a whole city smog free. We humans have created machines to develop ourselves, we invented the wheel and cars to liberate ourselves and travel. But now these machines are striking back. In areas affected by severe air pollution, the smog free tower will harvest enough smog. Each smog free cube literally contains the smog out of 1000 cubic meters of air.

[2]Hesham M. El-Batsh :- He says cyclone performance is determined by pressure drop and collection efficiency. This study aims to optimize the dimensions of the exit pipe to improve cyclone performance. A numerical technique was used which is based on an Eulerian–Lagrangian approach for to investigate the effect of cyclone exit pipe dimensions on the flow and particle separation of tangential inlet cyclones.

[3]P.A. Funk:- He says Emission abatement cyclone performance is improved by increasing collection effectiveness or decreasing energy consumption. Cyclone exhaustwas passed through filters. Laser diffraction particle size distribution analysis was used to estimate PM2.5 emissions. Response surface models showed a strong correlation between cyclone pressure loss (Euler number) and inlet velocity and predicted a 46% reduction in pressure loss for a 25% reduction in inlet velocity (Stokes number).

[4]Akshey Bhargava:- He says wet scrubbers are compatible and effective air pollution control devices to arrest particulate matters and polluting gases coming out of industrial processes as air polluting emissions.

WORKING METHODOLOGY

The working principle of this project is quite simple. With the help of suction motor air is suck from atmosphere at high pressure and this air flow throw cyclonic separator. It is this motor which takes the electrical power from the power source and converts it into mechanical power in the form of suction with air flow. When pressurised air enter in cyclonic separator then cyclonic separation is use removing particulates from an air, gas or liquid stream, without the use of filters. When removing particulate matter from liquid, a hydrocycloneis used; while from gas, a gas cyclone is used. Rotational effects and gravity are used to separate mixtures of solids and fluids and particulate matters get collected in the vacuum chamber. The air outlet of the cyclonic separator is given to the wet scrubber as a input. With the help of scrubbing liquid partials which cannot be separated by cyclone separator are separated by wet scrubber due to density difference.

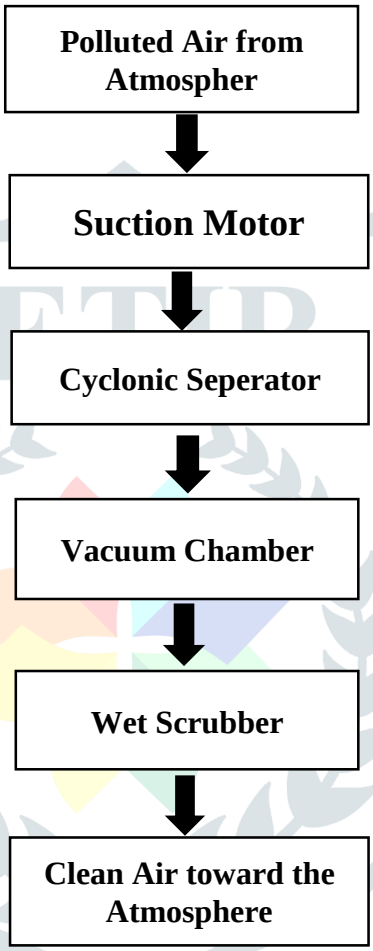

Figure No. 01 Flow of working process

WORKING OF SMOG TOWER

Suction Motor

The **suction motor** is one of the most important parts of a **vacuum** cleaner. It is this **motor** which takes the electrical power from the power source and converts it into mechanical power in the form of **suction** with air flow.

Cyclonic Separator

Cyclone separators provide a method of removing particulate matter from air or other gas streams at low cost and low maintenance. Cyclones are basically centrifugal separators, consists of an upper cylindrical part referred to as the barrel and a lower conical part referred to as cone. They simply transform the inertia force of gas particle flows to a centrifugal force by means of a vortex generated in the cyclone body. The particle laden air stream enters tangentially at the top of the barrel and travels downward into the cone forming an outer vortex. The increasing air velocity in the outer vortex results in a centrifugal force on the particles separating them from the air stream. When the air reaches the bottom of the cone, it begins to flow radially inwards and out the top as clean air/gas while the particulates fall into the dust collection chamber attached to the bottom of the cyclone.
Material used are: Material used for fabrication of cyclone separator is **iron, stainless steel & alloys.**

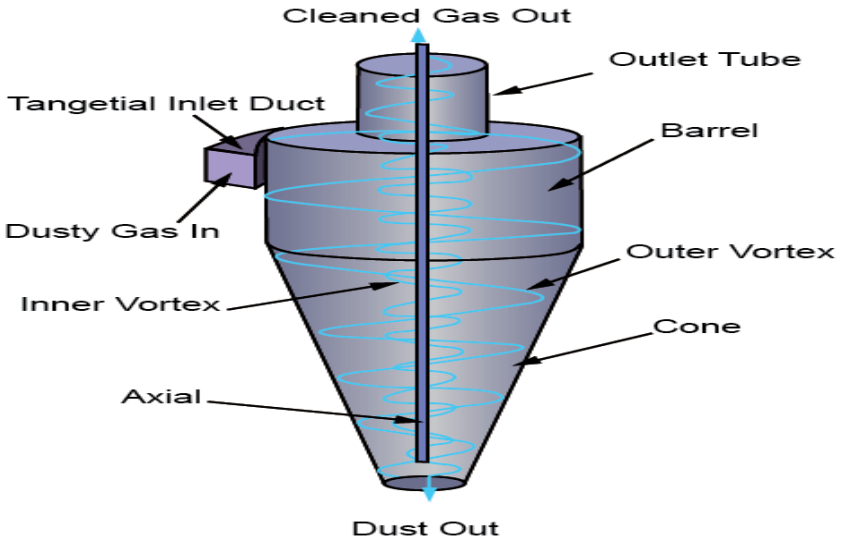

Figure No.02 Conical Separator

Vacuum Chamber

A **vacuum chamber** is a rigid enclosure from which air and other gases are removed by a vacuum pump. This results in a low-pressure environment within the chamber, commonly referred to as a vacuum. It is enclosed container which is used for collecting **particulate matter**. Material Use for vacuum chamber is **Glass, Stainless steel& Plastic.**

Wet Scrubber

A venturi scrubber accelerates the waste gas stream to atomize the scrubbing liquid and to improve gas-liquid contact. In a venturi scrubber, a "throat" section is built into the duct that forces the gas stream to accelerate as the duct narrows and then expands. As the gas enters the venturi throat, both gas velocity and turbulence increase. Depending upon the scrubber design, the scrubbing liquid is sprayed into the gas stream before the gas encounters the venturi throat, or in the throat, or upwards against the gas flow in the throat. The scrubbing liquid is then atomized into small droplets by the turbulence in the throat and droplet-particle interaction is increased. Some designs use supplemental hydraulically or pneumatically atomized sprays to augment droplet creation. The disadvantage of these designs is that clean liquid feed is required to avoid clogging. After the throat section, the mixture decelerates, and further impacts occur causing the droplets to agglomerate. Once the particles have been captured by the liquid, the wetted PM and excess liquid droplets are separated from the gas stream by an entrainment section which usually consists of a cyclonic separator and/or a mist eliminator. Current designs for venturi scrubbers generally use the vertical downflow of gas through the venturi throat and incorporate three features: [1] A"wet-approach" or "flooded-wall" entry section to avoid a dust build-up at a wet dry junction [2] An adjustable throat for the venturi throat to provide for adjustment of the gas velocity and the pressure drop and [3] A"flooded" elbow located below the venturi and ahead of the entrainment separator, to reduce wear by abrasive particles. The venturi throat is sometimes fitted with a refractory lining to resist abrasion by dust particles It is use to collect dust particle below 2.5 **particulate matter**. Material use for wet scrubber is **Cast Iron, Galvanized steel & materials with alloying elements like Nickel & Chrome.**

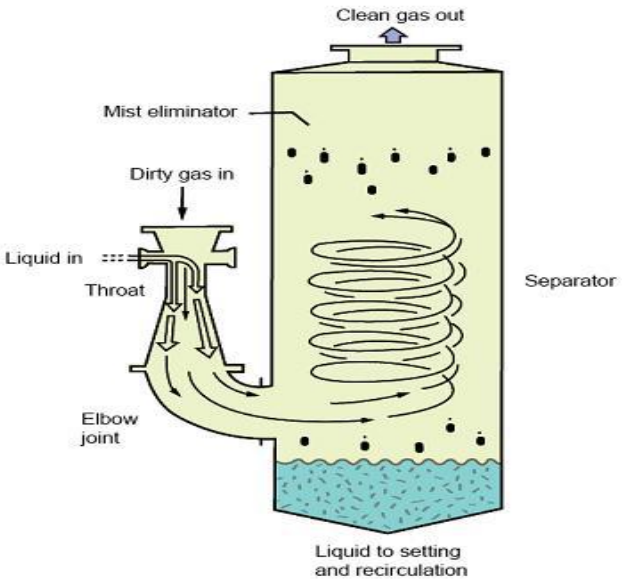

Figure No. 03 Wet Scrubber

DESIGN

DESIGN OF CYCLONE

All dimensions are related to the body diameter of the cyclone so that the results can be applied generally .

H = height of inlet duct
W = width of inlet duct
Lb = length of cyclone body
Lc = length (vertical) of cyclone cone De=Diameter of Gas Exit
Dd = Diameter of Dust outlet
S = Length of vortex Finder
Lb+Lc= Total length of cyclone

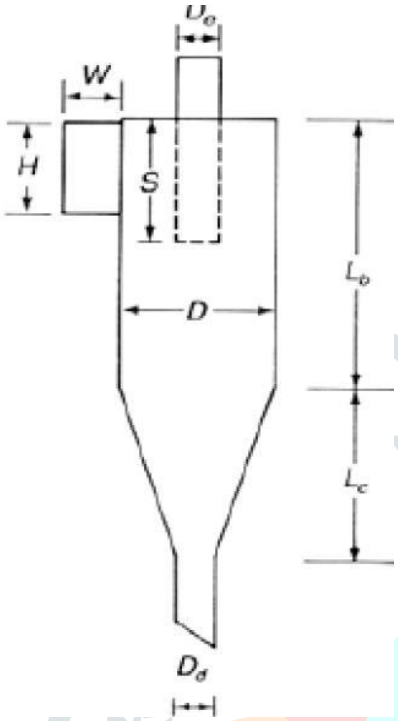

Figure No. 04 Design of Cyclone

The Number of Effective Turns (Ne)

The first step of CCD process is to calculate the number of effective turns. The number of effective turns in a cyclone is the number of revolutions the gas spins while passing through the cyclone outer vortex. A higher number of turns of the air stream result in a higher collection efficiency.

$$N = \frac{1}{H}\left(\mathbf{Lb} + \frac{\mathbf{Lc}}{2}\right)$$

N = 10.0762(0.3045 + 0.30452)

N = 6 (No of Effective Turns)

where
N = number of turns inside the device (no units)
H = height of inlet duct (m or ft)
Lb = length of cyclone body (m or ft)
Lc = length (vertical) of cyclone cone (m or ft).
N = 10.0762(0.3045 + 0.30452)
N = 6 (No of Effective Turns)

Cut point Diameter

The second step of the CCD process is the calculation of the cut-point diameter. The cut-point of a cyclone is the aerodynamic equivalent diameter (AED) of the particle collected with 50% efficiency. As the cut-point diameter increases, the collection efficiency decreases.

$$\mathbf{d_{pc}} = P\left(\frac{9\mu W}{2\Pi(\rho p - \rho g)}\right)^{1/2}$$

Where,
dp = diameter of the s_mallest particle that will be collected by the cyclone
μ = gas viscosity (kg/m. s)
W = width of inlet duct (m)
Ne=1/H[Lb+Lc/2]=number of turns
Vi = inlet gas velocity (m/s)
ρp=particle density (kgm3)

pa = Density of fluid

$$dpc = (9\times(1.81\times10-5)\times0.03812\pi\times6\times16.59\times(1.308-1.225))12$$

$$dcp = 0.3457\times10-3$$

Pressure Drop (ΔP)

Cyclone pressure drop is another major parameter to be considered in the process of designing a cyclone system. Two steps are involved in the Lapple approach to estimation of cyclone pressure drop. The first step in this approach is to calculate the pressure drop in the number of inlet velocity heads (Hv) by equation The second step in this approach is to convert the number of inlet velocity heads to a static pressure drop (ΔP) by equation.

$$H_v = K\frac{HW}{D_e^2}$$

Where

Hv = pressure drop, expressed in number of inlet velocity Heads

K = constant that depends on cyclone configurations and

Operating conditions (K = 12 to 18 for a standard tangential-entry cyclone)

$$Hv = 18\left(\frac{0.0762\times0.0381}{0.0762^2}\right)$$

$$Hv = 9$$

$$\Delta P = \frac{1}{2}\rho_g V_i^2 H_v$$

$$\Delta\mathbf{P} = \frac{1}{2}0.26\times16.59^2\times9$$

$$\Delta\mathbf{P} = 322\ \text{kg}/m^2\text{s}$$

Table No.01 Cyclone Separator Dimensions

	Dimensions	Ratio	Value
Diameter od cyclone Body (Barrel)	D	D	0.1524
Length of the Body	Lb	2D	0.3045
Length of the Cone	Lc	2D	0.3045
Height of the Inlet	H	D/2	0.0762
Width of the Inlet	W	D/4	0.0381
Diameter of inlet Pipe	d	$A=\pi r2$	0.059
Diameter of Gas Exit	De	D/2	0.0762
Diameter of Dust outlet	Dd	D/4	0.0381
Length of vortex Finder	S	0.625	0.0922
Length of Sc	Sc	D/8	0.019
Total length of cyclone	Lb+Lc	4D	0.1096

Project outcome:

Nowadays, one of the biggest problems we faces are related to the pollution. The air we breathe has great impact on our health. We have to reduce pollution in our cities. Pollutants in the atmosphere, which contains fine particles and ground level ozone. Pollution, which occurs mainly because of air pollution, can also be defined as a mixture of various gases with dust and water vapor. It is also refers to hazy air that makes breathing difficult. The atmospheric pollutants or gases that form air are released in the air when fuels are burnt. When sunlight and its heat react with these gases and fine particles in the atmosphere, pollution is formed. It is purely caused by air pollution. The main sources of these precursors are pollutants released directly into the air by gasoline and diesel-run vehicles, industrial plants and activities, and heating due to human activities. Smog is harmful and it is evident from the components that form it and effects that can happen from it. It is harmful to humans, animals, plants and the nature as a whole. Many people deaths were recorded, notably those relating to bronchial diseases. The tiny toxic particles known as PM 2.5 can be inhaled into the lungs.Research from Berkeley Earth, a non-profit that conducts scientific investigations on climate change, shows that 1.6 million people die each year of air pollution in world—a harsh reality of modernization.

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