Journal of Energy Research and Environmental Technology (JERET)
p-ISSN: 2394-1561; e-ISSN: 2394-157X; Volume 6, Issue 3; July-September, 2019; pp. 187-189

http://www.krishisanskriti.org/Publication.html

Air Pollution and Control Methods

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Abstract—*Air pollution refers to the presence of pollutants in the atmosphere which have detrimental effects on survival of living organisms. The main cause of air pollution is of man-made reasons like Emission of harmful gases from industries, automobiles, power plants, etcetera. And this emission of harmful gases creates an immense impact on human health which in turn affects the health of the environment. As a result of weakening condition of the environment, it is high time to control air pollution in order to prevent further destruction. The most effective means of dealing with air pollution is to either prevent the formation of pollutants or minimize the production of pollutants from the source. Some control measures or technologies must be developed for keeping a check on emission of gases which are harmful for the environment. The technologies introduced is proven to reduce the impact on environment by a larger scale.*

1. INTRODUCTION

Air pollution can be referred to as the presence in or introduction into the air of a substance which has harmful or poisonous effects on living organisms. The main cause of air pollution is the presence of toxic gases coming from automobiles, Industrialestates, powerplants, etc. Some of the major air pollutants are Ozone (O3), Nitrogen dioxide (NO2), Carbon monoxide (CO), Sulphur dioxide (SO2) and ChloroFluro Carbon (CFC). These harmful gases create a drastic impact on living organisms and mother nature.

2. AIR POLLUTION AND ITS IMPACT ON ENVIRONMENT

Air pollution caused by various sources of harmful gases create a dreading impact on living organisms and its natural environment. The impact created on the health of human beings is so drastic that causes long-term effects like irritation in eyes, nose, throat and upper respiratory infections and short-term effects on human health like chronic respiratory diseases, lung cancer, heart diseases, and damage to brain, nerves, liver or kidneys. Data released by the US Environmental Protection Agency (EPA); all Americans are under an increasing risk of cancer owing to continuous inhalation of toxic chemicals. Air pollution does not have any exception for mother nature. Inplants, air pollution affects stomata movements, photosynthesis and growth. Some of the adverse effects of air pollution in plants are declining mount of chlorophyll in plants which is one of the most essential constituents in the process of photosynthesis due to the high concentration of SO_2 in air. Low concentration of CO has no adverse effects on plants however high concentration of CO causes premature falling of leaves, smaller leaf size, curling of leaves, etc. The presence of pollutants in atmosphere may impact the climate of an area. Increase in air pollution may result in changes in climatic conditions and weather patterns. Increase in concentration of CO_2 causes accumulation of heat in atmosphere leading to the Global Warming which refers to increase in average temperature of Earth. Gases such as SO_2 and NO reacts with atmospheric moisture forming Sulphuric and Nitric Acids. These acids mix with rainwater and reaches the earth's surface as Acid Rain. Air pollution also causes depletion of ozone layer in the atmosphere leading to exposure of sun's UV rays which is harmful for living organisms.

3.POLLUTION CONTROL DEVICES

Air pollution control devices are a series of devices that work to prevent a variety of different pollutants, both gaseous and solid, from entering the atmosphere primarily out of industrial smokestacks. These control devices can be separated into two broad categories - devices that control the amount of particulate matter escaping into the environment and devices that control acidic gas emissions. Although complex, these devices have shown to be effective in the past with the overall levels of emissions for many pollutants dropping with the implementation of these control devices.

3.1 PARTICULATE CONTROL

3.1.1 CYCLONE SEPARATOR

A cyclonic separation is a method of removing particulates from an air, gas or liquid stream, without the use of filters, through vortex separation and the device which does this job is called a Cyclone Separator. A high-speed rotating (air) flow is established within a cylindrical or conical container called a cyclone. Air flows in a helical pattern, beginning at the top (wide end) of the cyclone and ending at the bottom (narrow) end before exiting the cyclone in a straight stream through the centre of the cyclone and out the top. Larger (denser) particles in the rotating stream have too much inertia to follow the tight curve of the stream, and thus strike the outside wall, then fall to the bottom of the cyclone where they can be removed. In a conical system, as the rotating flow moves towards the narrow end of the cyclone, the rotational radius of the stream is reduced, thus separating smaller and smaller particles. Thecyclone geometry, together with volumetric flow rate,

defines the cut point of the cyclone. This is the size of particle that will be removed from the stream with a 50% efficiency. Particles larger than the cut point will be removed with a greater efficiency, and smaller particles with a lower efficiency as they separate with more difficulty or can be subject to re-entrainment when the air vortex reverses direction to move in direction of the outlet. Large scale cyclones are used in sawmills to remove

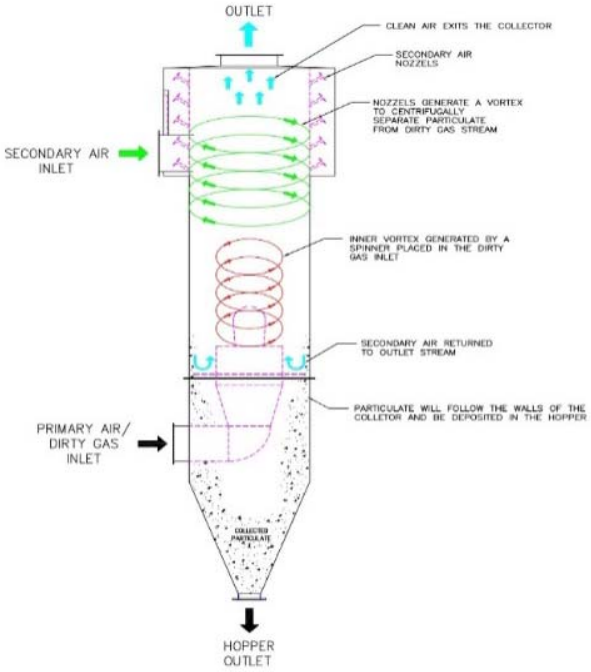

Figure 1: Cyclone Generator

sawdust from extracted air. Cyclones are also used in oil refineries to separate oils and gases, and in the cement industry as components of kiln preheaters. Cyclones are also used in industrial and professional kitchen ventilation for separating the grease from the exhaust air in extraction hoods.

3.1.2 ELECTROSTATIC PRECIPITATORS

An electrostatic precipitator (ESP) is a filtration device that removes fine particles, like dust and smoke, from a flowing gas using the force of an induced electrostatic charge minimally impeding the flow of gases through the unit. Electrostatic smoke precipitators work by forcing dirty gas past two electrodes (electrical terminals), which take the form of metal wires, bars, or plates inside a pipe or smokestack. The first electrode is charged to a very high negative voltage. As the dirt particles move past it, they pick up a negative charge. Higher up the pipe (or further along, if it's a horizontal pipe), there's a second electrode consisting of metal plates charged to a high positive voltage (50, 000–00, 000 volts are typical voltage mostly used). Since unlike charges attract, the negatively charged soot particles are attracted to the positively charged plates and stick there. From time to time, the collecting plates must be shaken to empty away the soot; that can be done either manually (by someone brushing them clean) or automatically (by automated shaking or brushing mechanism in a process called rapping).

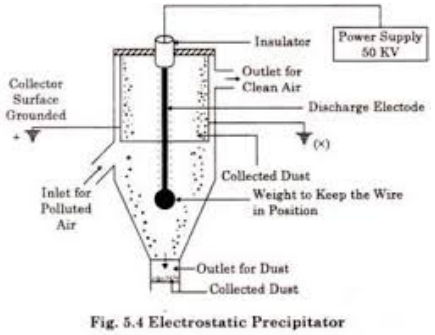

Fig. 5.4 Electrostatic Precipitator

Figure 2: Electrostatic precipitator

3.1.3 FABRIC FILTERS

Fabric filter also known as baghouse filter is an air pollution control device and dust collector that removes particulates or gas released from commercial processes out of the air. Power plants, steel mills and other industrial establishments use the fabric filters to control the emission of air pollutants. Most baghouses use long, cylindrical bags (or tubes) made of woven or felted fabric as a filter medium. Dust-laden gas or air enters the baghouse through hoppers and is directed into the baghouse compartment. The gas is drawn through the bags, either on the inside or the outside depending on cleaning method, and a layer of dust accumulates on the filter media surface until air can no longer move through it. When an enough pressure drop occurs, the cleaning process begins. Cleaning can take place while the baghouse is online (filtering) or is offline (in isolation). When the compartment is clean, normal filtering resumes. Baghouses are very efficient particulate collectors because of the dust cake formed on the surface of the bags. The fabric provides a surface on which dust collects and can be cleaned easily.

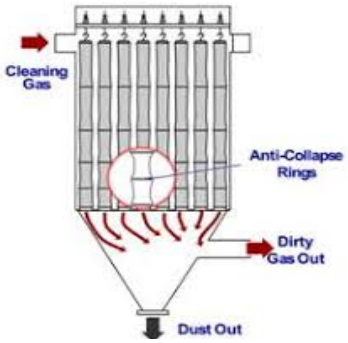

Figure 3: Fabric Filter

3.2 GAS CONTROL

3.2.1 SCRUBBERS

Scrubber systems (e.g. chemical scrubbers, gas scrubbers) are a diverse group of air pollution control devices that can be used to remove some particulates and/or gases from industrial

exhaust streams. The first air scrubber was designed to remove carbon dioxide from the air of an early submarine, in simple words, a scrubber is a system that inject a dry reagent or slurry into a dirty exhaust stream to "wash out" acid gases. Scrubbers are one of the primary devices that control gaseous emissions, especially acid gases. There are several methods to remove toxic or corrosive compounds from exhaust gas and neutralize it namely Wet Scrubbing and Dry Scrubbing. A wet scrubber is used for cleaning air, fuel gas or other gases of various pollutants and dust particles. Wet scrubbing works via the contact of target compounds or particulate matter with the scrubbing solution. Solutions may simply be water (for dust) or solutions of reagents that specifically target certain compounds. A dry or semi-dry scrubbing system, unlike the wet scrubber, does not saturate the flue gas stream that is being treated with moisture. Dry scrubbing systems are used to remove acid gases (such as SO2 and HCl) primarily from combustion sources.

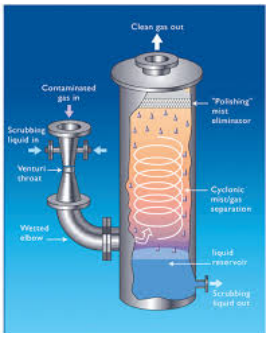

Figure 4: wet and dry scrubbers

3.2.2 INCINERATORS

Incineration is used to convert VOC emissions into carbon dioxide and water through combustion. The incineration generally takes place in a specialized piece of equipment known as an afterburner, which is built to create the conditions necessary for complete combustion and the device which helps to control air pollutant emission is called an Incinerator.

3.2.3 CARBON CAPTURE

Carbon capture and storage, sometimes referred to as CCS, is a process that can take up to 90% of the carbon dioxide emissions produced from the use of fossil fuels in electricity generation and put them underground or under the ocean. This prevents the carbon dioxide from entering the atmosphere, reducing the impact these emissions have on global warming and the enhanced greenhouse effect. There are two types of carbon capture namely Pre-Combustion Capture and Post-Combustion Capture. A pre-combustion method of removing CO2 involves converting the fuel into a mixture of hydrogen and CO2 through gasification, a process also used to make town gas This heated mixture of hydrogen and carbon dioxide is then treated in a catalytic converter, which produces more hydrogen. Finally, this mixture is fed into a flask and the gases begin to rise. An amine is added which binds with carbon dioxide, causing it to fall in the flask while other gases rise. This is how the carbon dioxide is collected.The hydrogen that is produced through this gasification process can be used as a fuel for electricity generation and the carbon dioxide is captured. Carbon dioxide is captured from the flue gases from combustion by using a solvent to absorb it. These flue gases include water vapour, sulphur oxides, and nitrogen oxides. The carbon dioxide is freed from the solvent by heating it after capture, leaving a concentrated stream of CO2.[3]. It is then compressed for transportation. This process is beneficial as older plants can be retrofitted with the machinery needed to trap the carbon dioxide as it moves out the smokestack. CO2 can also be separated from exhaust gases through highpressure membrane filtration or cryogenic separation.

4. CONCLUSION

Even though there are many technologies coming up to control emission of air pollutants, there are a few things which as human beings can do that easily. One can plant trees as much as they can which has the natural property of absorbing the $CO_{2\ present}$ in air and facilitates healthy rainfall and sort out the uneven weather patterns.

REFERENCES

[1] Environmental studies simplified (3rd Edition) by Benny Joseph.
[2] Environmental Pollution Control Engineering (2nd Edition) by C.S. Rao.
[3] Textbook of Environmental Studies (2nd Edition) by Deeksha Dave & S.S. Katewa.
[4] https://energyeducation.ca/encyclopedia/Air_pollution_control_devices.