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A REVIEW PAPER ON AIR POLLUTION CONTROL

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ABSTRACT

Considering on simplicity or complication of air pollution issue, the single or complex technological devices and even combination of various process equipment may be utilized for the goal of reducing/eliminating output of emissions into the atmosphere. The market (i.e. investment, operating and maintenance costs), government oversight, space constraints and allocation of pressure gauges in the market are some of the possible limitations, which define choice, and installation of the adequate technical equipment (BREF) (BREF). An effective response to the issues of air pollution includes a deep understanding of the causes of pollution, as well as knowledge of current and future trends in air quality, as well as the effects on people and ecosystems. This chapter examines the complexity of air pollution and provides an overview of various technological procedures and equipment for air pollution management, as well as the fundamental principles that govern their operation. The problems of air protection as well as safeguards of other ecosystems can be solved only by the concerted endeavours of various scientific and subject areas, such as chemistry, physics, biology, medicine, chemical engineering and social sciences. The majority of the engineering contribution is focused on the creation, design, and operation of equipment for reducing hazardous emissions into the environment.

KEYWORDS: *Air, Chemical, Environment, Pollutant, Pollution.*

1. INTRODUCTION

1.1 Controlling Air Pollution:

1.1.1 Choosing an air pollution control strategy and method:

From an engineering standpoint, excellent air quality may be accomplished via a variety of methods. The following are some of the potential methods to air pollution control:

- The main or preventive strategy, all control actions used to prevent pollutants from forming immediately on the probable emission source.
- The secondary method, which involves the use of technological equipment to remove contaminants from the gas stream before it is released into the environment.
- The integral approach (or process-integrated techniques) – a combination of different engineering approaches and methods of control, as well as the identification and application

of specific measures for simultaneous removal of various air pollutants across various process plants, in order to meet environmental targets at the lowest possible cost.

Depending on the complexity of the air pollution issue, single or multiple technological devices, as well as a combination of various process equipment, may be utilized to reduce or eliminate pollutant emissions into the atmosphere. Some of the potential restrictions that determine the choice and installation of suitable technical equipment include the economics (i.e. investment, operating, and maintenance expenses), regulation, space constraints, and the availability of control equipment on the market (BREF). The European Commission's Joint Research Centre prepared the best available techniques (BAT) reference document (BREF) for Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector (BREF) as part of the implementation of the Industrial Emissions Directive (2010/75/EU) and because of information exchange between EU Member States **[1].** This paper offers basic information about wastewater and waste gases, as well as methods for preventing or reducing their negative effect on the environment **[2]**. An overview of the control methods available for typical waste gas treatment in the chemical industry. Figure 1 shows a strategy to air pollution management that is primarily preventive

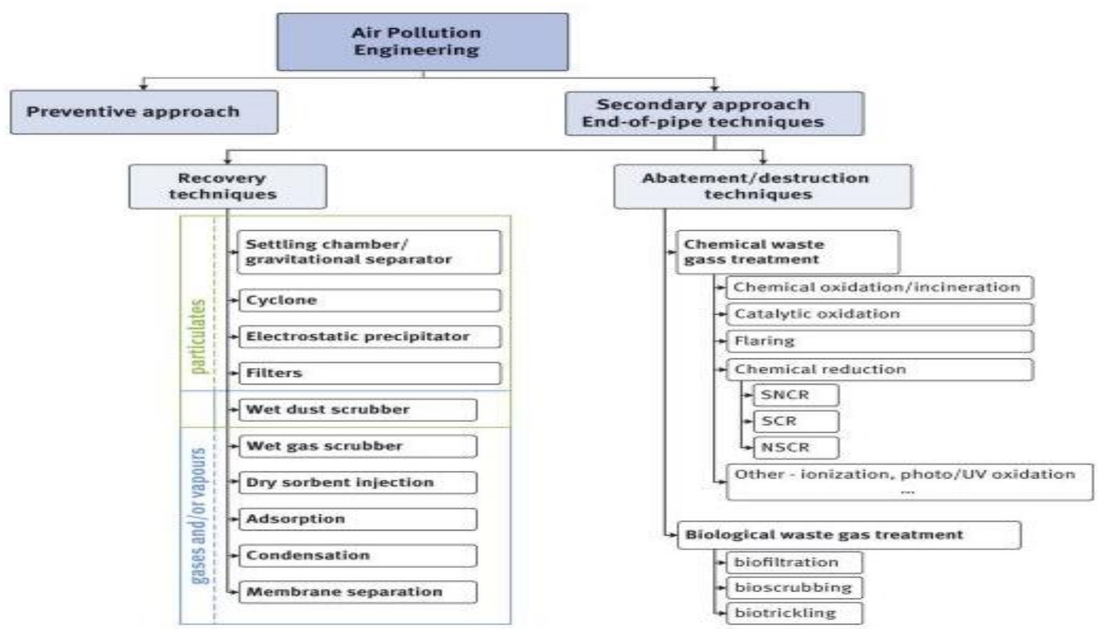

Figure 1: The above figure shows the Air pollution control techniques for removing harmful gases.

1.1.1.1 A strategy to air pollution management that is primarily preventive:

A thorough understanding of the air pollutants and the source of their emission is required for effective air pollution management. When at all feasible, it is preferable to avoid the production of pollutants. One of the main or preventive strategies for controlling emissions of air pollutants released by businesses is to change or eliminate process stages that are fundamental sources of pollution. Operational changes, minimizing the volumetric flow rate of the stream to be treated, substitution of raw materials or fuels, and use of efficient filtration systems are examples of such control measures to meet emission standards based on consideration of source reduction opportunities, careful planning, and process optimization to minimize pollutants and carrier fluid generation at the source. In contrast to the more known fossil fuel-fired facilities, which release a lot of pollutants (carbon oxides, nitrogen oxides, sulphur dioxide, hydrocarbons, and fly ash), contemporary nuclear power plants seem to be comparatively pollution-free alternatives. However, issues with waste and spent-fuel disposal may restrict the apparent benefits. The most significant improvement in air quality in most US and European Union cities was achieved by replacing coal with natural gas, switching vehicles from gasoline to unleaded gasoline, compressed natural gas, and other more environmentally friendly fuels, adding oxygenated compounds to motor fuels, and using low-sulphur fuels, among other things. Additional preventive measures to minimize air pollution include appropriate industrial design and placement, development of new technology and regulatory restrictions, and the use of administrative controls. Through government laws that compel businesses to minimize pollutant discharge and encourage new technological advances, the government plays a critical role in preventing all types of environmental pollution **[3]–[8]**.

1.1.1.2 The alternative strategy for reducing air pollution:

The recovery or abatement of pollutants from waste gas streams, as well as the use of end-of-pipe treatment equipment, are used in the secondary air pollution management strategy. This entails the placement of a control mechanism (or equipment) between the pollutant production source and the discharge of the pollutant into the atmosphere. In such scenario, pollution control may include removing or degrading the pollutant, converting it to a less harmful form, or recovering economically useful waste products. These solutions are mainly aimed at well-defined (or controlled) sources of emissions and are focused on particular air quality goals or emission limitations. Only ducted emissions may be treated using end-of-pipe treatment devices, which implies that collecting hoods and a ventilation system are needed upstream of the end-of-pipe abatement system. All technical and mechanical engineering equipment, techniques, and technologies that may assist reduce the amount of pollutants released into the atmosphere are referred to as abatement. Devices (or equipment) for decreasing particulates and devices (or equipment) for lowering emissions of gaseous and vaporous pollutants are separated into two categories, but certain devices may be used to remove both types of pollutants at the same time. In many instances, the gaseous effluent must be heated or cooled before entering the appropriate control device **[9].**

Environmental engineers must understand gas laws, thermodynamic characteristics, and all reactions in order to build a suitable control mechanism. The process conditions, the physical-chemical and other essential properties of pollutants and the benefit of the released compound are generally taken into account when designing air pollution control equipment. The total gas flow rate (or velocity) and volume of the waste gas to be treated, temperature limitations, allowable pressure drop, degree of variability depending on operating and process conditions (i.e. variation in pollutant concentration, gas flow rate, and temperature), power/energy requirements, removal efficiency requirements, and so on are all part of the process conditions.

Aside from the nature of the air pollutant and its concentration (including minimum and maximum values), typical properties of pollutants that are usually considered during the design of an air pollution control system are:

- solubility
- flammability
- toxicity
- reactivity (if pollutants are gaseous)
- size range and distribution
- particle shape
- agglomeration tendencies
- corrosively
- abrasively
- hygroscopic properties

The benefit of the emitted product is also significant, and it may influence the selection of appropriate air pollution control equipment or the decision between recovery methods (e.g., fabric filter, cyclone, adsorption, condensation) and abatement or destruction techniques (e.g. thermal or catalytic oxidation, chemical reduction, bio filtration). VOCs from solvent vapoursand vapours of low-boiling compounds, NH3 (to recycle in the production process), SO2 (converted into H2SO4, sulphur, or gypsum), dust containing higher amounts of solid raw products or products are examples of air pollutants for which recovery techniques are economically feasible. Some of the recovery methods described above may be utilized to reduce odour emissions, which are also highly volatile chemicals **[10].**

1.1.1.3 Integral thinking (or process-integrated techniques):

To meet all of the rigorous air quality standards, it is often essential to combine several engineering techniques and control systems, i.e. an integrated strategy and complete solution to environmental pollution caused by specific human activities. Some waste gas treatment methods (such as scrubbing, adsorption, and electrostatic precipitation) require additional treatment of the wastewater or solid waste generated during the air purification process. Unfortunately, waste disposal costs may account for a substantial portion of the overall cost of air pollution management. Engineers working in the field of air pollution control have a variety of duties, one of which is the design of air pollution equipment in order to meet emission limits and regulatory criteria.

The following are the major obstacles to utilizing suitable technology for air pollution control:

- Pollutant amount and concentrations in air streams (including physical and chemical properties of the effluent from the emission source).
- The amount of space available and the placement of the equipment.
- Contribution of air pollution control systems to wastewater and land pollution, as well as waste recovery and disposal.
- Cost-effectiveness (investment and installation costs of process equipment, maintenance expenses).

- Security

1.1.2 Particulate air pollution control

Several preventative strategies, such as reducing or eliminating PM generation, are relevant particularly to PM emissions. This can be accomplished in a variety of ways, including switching to a process that does not require operations like crushing, grinding, milling, sharpening, pulverizing, or spraying, switching from solid to liquid or gaseous material, switching from dry to wet solid material, changing solid particle size, or switching to a process that does not require particulate material. There are two types of secondary particulate control devices: dry dust removal apparatus and wet dust collection equipment.

Gravity settling chambers (or gravity settlers), centrifugal settlers (cyclones), electrostatic precipitators (ESP), and bag houses (fabric filters) are examples of dry dust removal equipment, whereas wet dust removal equipment includes scrubbers (such as packed column scrubbers, vortex scrubbers, and Venturi scrubbers) and some configurations of so-called wet ESPs. The best device for controlling particulate air pollution is always linked to a specific particulate removal problem and is based on two groups of criteria: gas-stream specific criteria and a device-specific criterion (particle concentration, particle size distribution, gas temperature, and tendency.

It is crucial to note that various separation devices work with different particle sizes. These control devices can be classified further into processes where an external force is applied to the substance (mechanical collectors and ESP) and processes where the gas stream is forced to pass through a barrier that the dispersed particles cannot pass through, such as holes smaller than the particles or a droplet cloud (different kind of filters and scrubbers). Gravity and centrifugal forces may be extremely efficient in removing bigger particulates (greater than 10 m). It is beneficial to employ an electrostatic force in conjunction with particle charging (ESP) or Venturi scrubbers for small particles (less than 2 m). Even for the filtration of solids as small as a few micrometers, venturi scrubbers are extremely effective. Filters have extremely high efficiency across a broad range of sizes, making them highly versatile in contrast to other separation methods, but they do have certain drawbacks, as will be discussed later. In the design of materials, as well as the expenses of generated wastewater and waste solid treatment, cost and energy requirements are critical.

2. DISCUSSION

The author has discussed about the air pollution control, A thorough understanding of the sources of pollution, as well as present and future changes in air quality, as well as the impacts on people and ecosystems, is required for an effective response to air pollution problems. This chapter looks at the complexities of air pollution and gives an overview of the different technical processes and equipment used to control air pollution, as well as the basic principles that govern their functioning. Only a coordinated effort of different scientific and topic fields, including as chemistry, physics, biology, medicine, chemical engineering, and social sciences, can address the issues of air protection and other environmental protections. It is desirable to prevent the generation of pollutants wherever possible. Change or elimination of process steps that are primary causes of pollution is one of the major or preventative methods for reducing emissions of particulate matter produced by companies. Operational changes, such as reducing the flow rates of the stream to be treated, substituting raw materials or fuels, and employing efficient filtration systems, are examples of emission control measures based on source reduction employment options, careful planning, and optimizations to reduce pollutants and carrier fluid era at the source.

3. CONCLUSION

The author has concluded about the air pollution control, Cutting or degrading the polluting, transforming it to a less hazardous form, or recycling socially beneficial waste products are all examples of pollution control. These solutions are primarily aimed at well-defined (or controlled) sources of emissions, with specific air quality goals or emission limitations in mind. End-of-pipe treatment devices can only handle ducted emissions, which means collecting hoods and a ventilation system are required above of the end-of-pipe abatement system. Abatement refers to all technical and mechanical engineering machinery, processes, and technologies that can help minimize the amount of harmful gases released into the atmosphere. Devices (or equipment) for reducing particle emissions and devices (or materials) for reducing emissions of gaseous and viscous liquid emissions are divided into two categories, although some devices may remove both kinds of pollutants simultaneously.

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