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A Study on Innovative Aspects of New Technologies in Air Pollution Control

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ABSTRACT

In recent years, there has been an increase in air pollution. There are several harmful environmental repercussions of air pollution. In order to minimise the harmful impacts of air pollutants on the environment and human health, a variety of air pollution control technologies may be used to decrease air pollution. Numerous technology applications are used for this. The study showcases several cutting-edge air pollution reduction systems.

Keywords: Air pollution, Control technologies, Prevention of air pollutants

Introduction

For reducing air pollution emissions from coal-fired power stations, a variety of solutions are available. Depending on the size, age, fuel qualities, and design of the boiler, as well as the kind and size of the electric generating unit, the best mix of control systems will differ from plant to plant. Existing air pollution management technologies have a good deal of success in capturing many of the air pollutants that the proposed Transport Rule and the Air Toxics Rule target. Technologies used to control one pollutant often regulate others as well. It may or may not be possible to comply with the Transport Rule or the Air Toxics Rule using these "co-benefits." As a consequence, it could sometimes be essential to include additional pollution control systems. Among other things, the ongoing development of environmental quality is closely tied to the enhancement of living quality. Utilizing suitable intelligent monitoring, analysis, forecasting, decision, and control systems that are built on intelligent tools and approaches can help accomplish this. Pollutant concentrations in the atmosphere will decrease if the quantity of pollutants released into the atmosphere is reduced (Srivastava, 2000).

Effective Solutions using Smart Technologies

Although we can control stopping the burning of fossil fuels, crops in certain locations, and vehicle mobility to a significant degree, a sustainable solution has to be looked into to manage this issue over the long run. Utilizing smart technology solutions to reduce pollution at its source and in larger impacted areas is the sole factor that might be a thrust area for attention. One of the most discussed social, economic, sociological, and environmental issues is how to reduce air pollution and environmental hazards while also developing natural resources sustainably and recycling natural resources. Minimization and mitigation remain effective methods for reducing pollution, and data computing and technology advancements have had a significant impact on these strategies as well. This development has resulted in the gathering, processing, and forecasting of environmental data that is eventually helpful for environmental and health monitoring (EPA, 2005).

Titanium Dioxide Technology

By facilitating the reduction of pollutants released during combustion, ACTIVE Technology. The method works well in power generation facilities. As a DeNOx catalyst, ultrafine titanium dioxide (TiO2) is used to remove up to 90% of the NOx released during the combustion of coal, gas, or any other material or fossil fuel used to generate power. Titanium Oxide serves as a catalyst in the process, turning dangerous gases and other emissions into harmless nitrogen and water vapour. Since it has been in use for over 35 years, this technology has established itself as one of the best and most productive ways to reduce air pollution (EPA, 2010).

Artificial Intelligence and Other Disruptive Technologies

Artificial intelligence can anticipate the location, level, and quantity of pollution in any place before it occurs, making it a crucial tool for addressing this issue. Since the issue's source is well known and recurrent every year, corrective actions are often conducted after the problem arises (Li and Hassan, 2009). Artificial intelligence (AI) techniques that can be coupled in an ideal and hybrid way may be used to construct such a system. Rule-based expert systems, machine learning methods like artificial neural networks (ANN), and inductive learning are examples of AI strategies that may be used. Technology is centred on the creation of wind-driven environmental sensors. Here, the usual pollutants including carbon and nitrogen oxides, ozone, and

particle matter may be measured using small-scale air quality monitors. The system, which is based on machine learning and big data technologies, leverages the Adaptive Cloud Calibration Engine to improve the quality and dependability of the data (Karatzas, 2010).

Techniques for Reducing SO2 Emissions

Highly reactive gas SO2 has been associated with a variety of negative effects on the human respiratory system. Power plants were responsible for 66 percent of the nation's SO2 emissions inventory in 2008, with coal-fired power plants contributing more than 98 percent of this total. In order to reduce SO2 emissions from coal-fired power stations, which are created when sulphur in the fuel is oxidised, there are two main options: (1) switching to lower sulphur fuels; and (2) SO2 capture, including Flue Gas Desulfurization (FGD), sometimes known as "scrubbing."(EPA, 2010)

Coal with less Sulphur

The Acid Rain Program's most popular method of compliance was switching to reduced sulphur coal (Title IV of the 1990 Clean Air Act Amendments). Sub-bituminous coal, for example, has a naturally low sulphur content.
Without significant boiler or fuel handling system upgrades, certain facilities cannot burn 100 percent PRB coal. To cut emissions, these plants may mix bituminous coal with PRB or another lower sulphur coal. Flue gas treatment may be necessary for plants that can't burn lower sulphur coals or for facilities that need to reduce SO2 emissions more drastically.

Scrubbing, also known as Flue Gas Desulfurization (FGD)

More coal-fired power facilities have FGD systems installed as EPA and states have increasingly restricted SO2 emissions. A plant operator may employ a larger range of coals while still maintaining low SO2 emissions thanks to FGD controls. FGD comes in two fundamental variations: wet and dry.
The more costly reagent is lime. Because of this, limestone-forced oxidation (LSFO) wet scrubber technology, which is more prevalent on coal-fired power stations than all other types of FGD combined, is the most extensively utilised kind of wet FGD. Modern LSFO systems are able to remove SO2 at rates of 98 percent or more, which is a very high level.

Dry Cleaners/Scrubbers

In order to react with the SO2 in the flue gas, dry scrubber technology (dry FGD) injects hydrated lime and water (either individually or combined as a slurry) into a large vessel. The word "dry" describes a situation in which water is introduced to the flue gas, but only in sufficient quantities to keep the gas above the saturation (dew point) temperature. The dry FGD method often results in the collection of reaction products and any unreacted lime in a downstream fabric filter (baghouse), which aids in the further SO2 capture. 90 percent or more of SO2 is generally captured by modern dry FGD systems.

Techniques for Limiting NOx Emissions

Nitrogen oxides (NOx) are a precursor to acid rain and a factor in the creation of ground-level ozone, a key element of smog. 18% of the total inventory of national NOx emissions in 2008 came from power plants. The majority of the NOx produced during combustion is the result of two oxidation processes: (1) thermal NOx, which is produced when nitrogen in the combustion air reacts with excess oxygen at high temperatures, and (2) fuel NOx, which is produced when nitrogen is chemically bonded in coal. Controlling NOx emissions may be done by post-combustion controls or by preventing NOx from forming in the first place through combustion controls (EPA, 2010).

Controls for Combustion

Because they are generally less expensive than post-combustion controls, combustion controls reduce the generation of NOx within the furnace and are frequently the initial option for NOx management. Since no chemicals or catalysts need to be purchased after installation, most combustion control methods have low continuing costs. The furnace's internal combustion controls, which use techniques like low NOx burners (LNB), over-fire air (OFA), and separated over-fire air, are what regulate how much fuel is burned (SOFA). Another method of controlling combustion is by reburning, although this method only chemically lowers NOx produced in the initial combustion zone. Natural gas may also be used in reburning technology.The majority of utilities have previously successfully used combustion controls, often in conjunction with post-combustion controls, to significantly reduce NOx emissions. Some buildings still stand to gain from combustion controls, although these are often the smaller ones where utilities have not yet made NOx control investments (EPA, 2010).

Carbon Injection with Activated (ACI)

Activated carbon injection, often known as ACI, is a common method for capturing mercury. The injected carbon is then caught by a downstream PM capture system (ESP or a baghouse). Storage equipment, a pneumatic conveyance system, and injecting hardware (sometimes known as "injection lances") make up an ACI system, which is quite straightforward and affordable.

Methods to Control Acid Gas

Because coal naturally contains halogens, these halogens are released during burning and turn into strong acids when the flue gas cools, such as hydrogen chloride (HCl) and hydrogen fluoride (HF). The concentration of halogens in coal varies greatly by coal type and even within coal kinds, similar to how mercury content does. Because chlorine is often found in larger amounts than other halogens in U.S. coals, it is of the most concern. The proposed Air Toxics Rule from the U.S. EPA for power plants puts a numerical emission limit for HCl. The HCl limit also serves as a stand-in restriction for other acid gases that are not subject to separate emission limitations under the proposed regulation (EPA, 2010).

Conclusions

This evaluation is being done to provide a general overview of how technology is evolving in this area and to assess how it may be used to boost energy security, reduce health concerns, and improve air quality. The three main topics covered in the report are: 1) novel methods for enhancing city air quality; 2) novel methods for reducing emissions from industrial activities; and 3) novel methods that can be combined with current technology. There have been important technical advancements in recent years. The essential aspects and distinguishing characteristics of the review of new air pollution control technology are covered. A novel technology for reducing air pollution combines many techniques and methods. It is used to lessen or completely eradicate air pollution. Utilizing less energy and resources to limit the emissions of dangerous gases into the environment is the primary objective of new technologies in air pollution management.

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