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Research Paper

An investigation on cement industry's air pollution management methods

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Abstract: Cement preparation includes mining; crushing and grinding of raw materials, resulting in cooling of the clinker, mixing clinker with gypsum, milling, storage, and receiving finished cement. This process generates a variety of wastes including dust, which is captured and recycled into process. The gases emitted from the clinker cooler are used as secondary combustion air. The dry process using pre heaters and pre liners is economically and environmentally preferable to wet process, as energy consumption is about 200 (J/kg)-wet process. Some solid waste products from other industry, such as power stations, slag, roasted pyrite residues, and PFA from foundry sands can be used as additives in cement production.

Due to technological advancements, cement making companies have been able to produce higher volumes than in the past. However, high production levels have also been identified as a major cause of pollution. This paper examines options in practice to reduce pollution by companies work for development of cement and link, and this will help to ensure legislative compliance. This study can play a role for cement manufacturing industry as by adopting appropriate technology like computer modeling and reducing pollution by cement companies.

Keywords: Cement, Pollution, Technology,

Introduction:

In the previous several decades, India has experienced a rapid rise in industrialization, resulting in India's economic and social growth as a developing country, as well as a high rate of urban migration to the large cities. As a result, cement manufacturing has overtaken steel and power generation as India's most significant sector, owing to increased demand for cement in the building industry. As a result, India's economic and social development is hampered by poor air quality. (Mehraj et. al., 2014) Methane, Fume, Dust, Nitrogen oxide, Sulphur oxide, Carbon oxide, and Carbon dioxide are the primary air pollutants produced by cement manufacturing, and they are responsible for global warming potential, as well as being

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hazardous to human and plant health through respiration.

The dust from the cement making process is carried by the wind and deposited in a region adjacent to the manufacturing facilities or far away to distant locations. Villages, towns, green spaces, recreational areas, natural vegetation, and agricultural land are all included. The depositions disrupt the normal metabolic system of agricultural production, affecting the quality and amount of food produced. The cement business is one of India's 17 most polluting industries, according to the Indian Central Pollution Control Board. Because of the expansion of an existing cement factory and the construction of a new plant to satisfy the annual demand for building materials and other construction demands. As a result, immediate air pollution control is required. Reduce the concentration of GHGs in the atmosphere to counteract deteriorating human health and reduce climate change (Chaurasia et. al., 2013). Due to their comparably high efficiency, this study will suggest an environmentally friendly technology for air quality management in the cement sector, such as wet cement manufacturing, replacing electronic filters with bag house filters and precipitators.

Cement Industries in India

After China, India is the world's second-largest cement producer. It contributes significantly to India's economy by directly or indirectly employing over 1 million people. There are 209 major cement factories with a total installed capacity of 378.3 million tonnes per year. Because India is densely populated and has a great potential for infrastructure development, both international and domestic investors are flocking to the country. The availability of limestone and coal is also a factor in India's cement industry's growth. The demand for cement is much higher in India, thanks to the government's initiation of big infrastructure projects.

Economic considerations

In India, the cement industry is critical to the country's economic prosperity. When the economy was in a slump in 2008-09, many industries actually increased their output. The demand for cement is rising as India develops its infrastructure. The cement business is vital to India's economy since it is intertwined with other industries such as building, transportation, coal, and electricity. India's cement industry exports the most to Nepal. It makes up roughly 49% of the total. Other nations to export to include Sri Lanka, Bangladesh, Iraq, Egypt, and the Maldives. Pakistan is also a source of cement for India. The cement industry has received $1.5 billion in foreign direct investment (FDI). Between 2000 and 2013, 2.12 billion people were born. The Indian cement industry is the country's oldest industry, and it is fueled by infrastructure development, building, and transportation.

Social considerations

The cement industry in India directly or indirectly employs 1 million people. It has shown to be a valuable asset in the development of society's infrastructure. The big and small-scale cement industries that are accessible have contributed to enhance people's economies. Cement businesses in India are socially responsible, providing free drinking water, medical, electrical, and educational services to the community in addition to teaching employees in the fields

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of health, environment, water supply, and industrial control.

Effects on the environment

CO_2 emissions are the most serious health and safety concern in the cement industry. It is one of the anthropogenic sources of pollution in the atmosphere. In India, the cement sector is regarded as the most polluting. Increased cement production in India has harmed the environment and harmed the health of individuals who are exposed to cement dust. It has a negative influence on the environment, including the air, water, and land. Pollutants released in India have resulted in a decrease in agricultural yield and growth. It also alters the chemical makeup of the soil. Pollutants carried by the wind accumulate in agricultural vegetation and society nearby. Cement industry are thought to be responsible for 5% of worldwide CO_2 emissions.

Health Consequences

Pollutants from the cement industry may be classified into two categories. They are particulate and gaseous contaminants. Nitrogen oxides, sulphur oxides, carbon dioxide, volatile organic compounds, and hydrogen sulphide are among the gaseous emissions. Particulate emissions come from the extraction of raw materials, fuel preparation, road cleaning, and stacks. Other sources of emissions include transportation, fuel utilised, operational processes, and production itself. The following are some of the most common air contaminants and their health risks: Sulfur dioxide (SO_2) (SOx)

Sulphur is found in almost all cement raw materials. Sulphur oxides are formed by the burning of Sulphur-containing fuels and the oxidation of Sulphur in raw materials. In the presence of sunshine, emitted sulphur oxides mix with water vapour and other molecules in the environment to create sulfuric acid. Acid rain occurs when the acid produced is rinsed away by rain and snow. It reduces agricultural production and accelerates plant mortality. It can also induce bronchitis, a respiratory disease. CO_2 and CO are two different types of carbon dioxide.

CO_2 emissions are mostly emitted by the cement industry. Cement industry CO_2 emissions are projected to account for 5% of overall CO_2 emissions. CO_2 is generated as a result of the burning of fossil fuels and the decarbonization of raw materials. Other sources of CO_2 emissions include the kind of fuel used, transportation, and energy consumed from start to finish. CO_2 is to blame for global climate change, as well as many respiratory illnesses including asthma in humans. CO has health consequences because it reduces oxygen supply to the human body and has an impact on the cardiovascular and neurological systems. Nitrogen oxide (NOx) is a gas that is (NOx)

Thermal oxidation, which occurs between 1200 and 1600 degrees Celsius, produces NOx. Nitrogen dioxide, nitric acid, nitric oxides, nitrates, and nitrous oxides are all members of the nitrogen oxide family. Nitrogen oxide is responsible for a wide range of human and environmental consequences due to its diverse family of chemicals. When NOx interacts with water, it produces a variety of acidic chemicals. These acidic chemicals acidify lakes and water streams, making it harder for aquatic creatures to survive. It is also to blame for the rise in global temperatures. When NOx pollution is inhaled, it causes respiratory illnesses. It causes breathing difficulties and persistent lung illnesses. It has the potential to lead to cancer. Organic substances that are volatile (VOCs).

VOCs are produced as a result of organic materials in the source material. VOCs are

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produced when the process is not completely burned. Ozone production and pollution of soil and water are caused by VOCs. It slows down the development of plants. It causes irritation of the respiratory tract, eyes, and skins in humans, as well as headaches, liver damage, nausea, and damage to the liver, kidneys, and central nervous system. Particulate matter is a kind of dust.

Particulate matter includes tiny particles such as dust, soot, and liquid droplets that can be suspended in the air. It lowers visibility and lowers air quality in the area. When these dust particles are carried away by rain, they contaminate the waterways. It slows down the plant's growth. Toxic metals and chemicals such as chromium, lead, barium, and nickel make up particulate matter. When these chemicals are breathed through the respiratory system, they have a variety of physiological consequences. It raises the chances of cardiovascular and respiratory problems. It also irritates the eyes, skin, and throat.

Technologies of Control

In many nations, cement manufacturing is a key contributor to economic prosperity. Many processes occur during cement manufacturing, all of which generate various types of pollutants. Suspended Particulate Matter, carbon dioxide, nitrogen oxides, sulphur dioxide, and grey dust are the major pollutants produced by cement manufacturing. The amount of carbon dioxide emitted is influenced by the manufacturing process, its efficiency, and the fuel utilised (Shivaram et. al., 2014, Zimwara et. al., 2012).

According to reports, the business contributed for 5% of greenhouse gas emissions in 2007, negatively impacting air quality. Cement manufacturing is energy demanding, and the resulting environmental damage and health issues must be managed. One tonne of cement is predicted to create one tonne of carbon dioxide (Shivaram et. al., 2014).

To limit the release of dust and other pollutants into the environment, the cement industry employs a variety of Air Pollution Control Devices (APCDs). The sort of dust collector to be utilised is determined by particle size, dust loading, flow rate, moisture content, and gas temperature. Cyclones, multi-cyclones, fabric filters, bag filters, electronic precipitators, scrubbers, and gravel bed filters are used to control particle emissions (Shivaram et. al., 2014, Zimwara et. al., 2012).

Precipitators

Electrostatic precipitators are commonly used to remove dust because they are effective, simple to operate, and have a minimal pressure drop. The electrostatic force is the mechanism for dust removal. The gadget is made up of negatively charged wires and parallel metal plates. The raw gas flows slowly through the passages between the plates. The corona effect ionises the tiny particles near the wires, which then travel down the electromagnetic field to the earthed metal.

By rapping at precise intervals, the particles are removed from the collecting plates and released via the hopper below the device. The ESP is used for de-dusting because of its high efficiency and minimal pressure loss. Particles as small as 10m may be collected (Vehlow 2015).

Scrubbers

The contaminated gases are brought into contact with a cleaning liquid that is sprayed into the gas stream to remove the contaminants in this application. Particulate particles and gaseous pollutants are

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collected by the scrubbers. Dust particles are captured by liquid droplets, and gaseous pollutants are absorbed in liquid using wet scrubbers (Zimwara et. al., 2012).

Absorption is a two-phase process in which the efficiency is determined by the size of the liquid-gas contact region. In many cases, wet scrubbers are utilised as support precipitation devices. The venturi types are commonly employed for controlling acid gases and have a high capacity to separate particles using inertia (Vehlow et. al., 2015).

House – Bag

One of the earliest and most successful techniques of particulate matter management is bag-house filtration. The gadget is made up of cloth bags that guide the air flow. Particles are caught in the fabric bags' fibres, as well as in the filter cake that forms (Zimwara et. al., 2012). The air flow through the bag filters can go either direction, allowing the particles to collect in the bag. Manual and mechanical cleaning procedures are used to clean the bag filters.
Limestones, as the base material, remove acidic components such as sulphur dioxide, hydrogen chloride, and hydrogen fluoride from the system.

The tropical cyclones

The particles enter the cylindrical chamber at a high velocity in cyclones, and separation is achieved by increased impact inertia. The particle removal efficiency of cyclones is poor, therefore cyclones are tuned to enhance the efficiency. Cyclones are an uncommon technology for removing fly ash due to their poor effectiveness (Vehlow et. al., 2015). Selective non-catalytic reduction (SNCR) is used to eliminate nitrogen oxides that are produced as a result of the high temperature at which clinker combustion occurs (Shivaram 2014).

Discussion

Despite the fact that some manufacturers are replacing electronic filters with bag house filters, electronic precipitators are still recommended for pollution control due to their comparably high efficiencies. For pollution management, wet scrubbers are also advised. Because of the mechanical cleaning of the filters and good SO_2, HF, and HCl levels, bag houses are also recommended for use in pollution management. The team was able to study and comprehend several air pollutants in the cement manufacturing process while producing this report. Air Pollution Control Terminologies and How to Reduce Cement Production's Carbon Footprint Air quality improvement methods and their use in underdeveloped nations. Has a good understanding of pollutants and remediation options.

Conclusions:

Cement plants in India provide enormous economic and social advantages. It is likewise impossible to overlook the structural developmental contributions. However, the environmental consequences of deteriorating air quality, as well as the effects on human health and food production quality, necessitate prompt action. Pollutants connected with cement manufacturing require the use of air pollution control techniques, procedures, and regulations.
As noted in the study, several types of air pollution management methods are used in India today, ranging from government regulations to standardisation processes. Cement companies are also using various technologies to reduce GHG emissions by 2030, in accordance with government regulations to reduce emissions in the industry and worldwide conventions and treaties.

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