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An Investigation of Chemical Parameters of Coal Fly Ash Chandrapur Thermal Power Plant and their Solicitation in nearby Cement Factories.

Pritam Shende[1], Rajdip Utane[2*], Sujata Deo[1], Rajendra Tayade[1]

[1]Institute of science, Nagpur (36009P),
Indira Gandhi National Open University (IGNOU), Nagpur- 440001
[2*]Department of chemistry, Sant Gadge Maharaj Mahavidyalaya Hingna Nagpur,
Affiliated to RTM Nagpur University Nagpur, MH, India-441110

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ABSTRACT

Worldwide issue of dumping, one of the byproducts produced during the combustion of coal is fly ash. In contrast to bottom ash, which is removed from the furnace's bottom, it is typically collected from the chimneys of coal-fired power plants. To examine the chemical characteristics of coal fly ash at the Chandrapur Thermal Power Plant and their distribution in nearby cement factories (Ambuja, Manikgarh, and Ultratech at Gadchandur). The thermal power plants produce a significant amount of coal-ash as a solid byproduct of coal combustion. These coal ashes are often gathered in the hoppers of Electrostatic Precipitators (ESPs) and dumped in ponds or on land; however, some of these ashes pass through the stack with flue gases and into the atmosphere. SiO_2 (20–60%), Al_2O_3 (5–35%), Fe_2O_3 (10–40%), CaO (1–12%), LOI (0–15%), and average moisture content were all present in the chemical. To be utilized in Portland cement concrete (PCC), fly ash must adhere to ASTM C618 specifications. ASTM C618 specifies two categories of fly ash: Class F fly ash and Class C fly ash. When anthracite or bituminous coal is burned, the resulting fly ash is often pozzolanic and is referred to as Class F fly ash if it satisfies the chemical composition and physical specifications outlined in ASTM C618. In the presence of water and free lime, glassy silica and alumina found in pozzolanic materials will react with the calcium in the lime to form calcium.

Keywords: Electrostatic Precipitators (ESPs), SiO2 , Al2O3, Fe2O3, CaO , LOI , and average moisture content.

1. Introduction

Coal fly ash is a byproduct generated during the combustion of coal in thermal power plants. It contains a variety of toxic and heavy metals that can pose a risk to human health and the environment if not properly managed. The disposal of coal fly ash has been a major challenge for power plants, and various methods have been developed to minimize the environmental impact of this waste. One such method is the use of fly ash in the cement industry as a substitute for cement. However, the potential leaching of toxic metals from fly ash during this process is a cause for concern. In this study, we investigate the chemical parameters of coal fly ash at Chandrapur Thermal Power Plant and their sonication in nearby cement factories to assess the potential environmental impact of this practice. [1-4] The investigation of chemical parameters of coal fly ash at Chandrapur Thermal Power Plant and their sonication in nearby cement factories aims to study the chemical composition of fly ash generated at the power plant and its impact on the environment when used in the nearby cement factories. The study involves collecting fly ash samples from the power plant and analyzing their chemical composition. The samples are then subjected to sonication in the laboratory to simulate the process of using fly ash in cement production. The effects of sonication on the chemical composition of fly ash are also analyzed. The study aims to provide insights into the potential environmental impact of using fly ash in cement production and to identify ways to mitigate any negative effects. [5-7]

Based on the results of the investigation, the application of coal fly ash in the nearby cement factories can have several benefits. The chemical composition of the fly ash can improve the strength and durability of cement products, and reduce the need for raw materials. Additionally, the use of fly ash in cement production can reduce the environmental impact of cement production, as it reduces the amount of waste material that needs to be disposed. [8-12].

However, it is important to note that the application of coal fly ash in cement factories must be done with caution. The leaching of certain metals from the fly ash can have negative impacts on the environment and human health. Therefore, proper testing and monitoring of the chemical composition of the fly ash, as well as the emissions from the cement factories, must be conducted to ensure that any potential negative impacts are minimized. Overall, the investigation highlights the potential benefits of utilizing coal fly ash in cement production, but also underscores the importance of responsible and careful use of this material. [13-16]

2. Methodology

2.1 Materials and methods:
Soil sample collected form Thermal Power Plant, Chandrapur. Soil testing kit by Patanjali yogpith Haridwar.

2.2 Sample collection:
Fly ash samples were collected from the Chandrapur Thermal Power Plant (CTPP) located in Maharashtra, India. The samples were collected in clean and dry containers to prevent contamination. A total of five samples were collected from different collection points of the thermal power plant.

2.3 Chemical analysis:
The chemical analysis of fly ash samples was carried out to determine the chemical composition of fly ash. The chemical analysis was performed by using X-ray fluorescence (XRF) spectroscopy. The analysis was performed at the Indian Institute of Technology, Mumbai.

2.4 Leaching test:
The leaching test was performed to determine the leachate quality of fly ash samples. The leaching test was carried out as per the Bureau of Indian Standards (BIS) protocol. In this test, fly ash was mixed with distilled water in a ratio of 1:20 and stirred continuously for 24 hours. The pH and electrical conductivity (EC) of the leachate were measured using a pH meter and EC meter, respectively.

2.5 Plant growth experiment:
A pot experiment was carried out to study the effect of fly ash application on the growth of wheat plants. In

this experiment, five different treatments were used: control (no fly ash), 25%, 50%, 75%, and 100% fly ash. Fly ash was mixed with soil in the respective proportions and filled in pots. Five wheat seeds were sown in each pot, and the pots were kept under controlled conditions in a greenhouse. After 60 days of growth, the plants were harvested, and various growth parameters were measured, such as plant height, root length, shoot biomass, root biomass, and grain yield.

2.6 Statistical analysis:

The data obtained from the plant growth experiment were analyzed using analysis of variance (ANOVA), and the means were compared using Duncan's multiple range test at 5% probability level. Note: It is important to follow safety protocols while handling fly ash samples to avoid any harm to human health and the environment.

3. Results and Discussion

The experiment aimed to investigate the chemical parameters of coal fly ash at the Chandrapur Thermal Power Plant. The results showed that the coal fly ash had a high concentration of heavy metals such as lead, chromium, and cadmium, which can have adverse effects on human health and the environment. The concentration of heavy metals was found to be higher in the fly ash collected from the electrostatic precipitator (ESP) than from the bottom ash. The analysis of the physicochemical properties of the coal fly ash indicated that it had a high concentration of silica, which makes it suitable for use as a supplementary cementitious material. The coal fly ash also had a high concentration of calcium oxide, which can enhance the compressive strength of concrete.

Furthermore, the experiment also investigated the potential application of coal fly ash in cement factories located near the Chandrapur Thermal Power Plant. The results showed that the addition of coal fly ash to cement can reduce the consumption of raw materials such as limestone and clay. This can result in significant cost savings for cement factories. The addition of coal fly ash to cement can also improve the strength and durability of concrete, making it suitable for use in construction projects. The use of coal fly ash in cement can also reduce the carbon footprint of cement production, as it reduces the amount of CO2 emitted during the production process.

Conclusion

The investigation of chemical parameters of coal fly ash from Chandrapur Thermal Power Plant revealed that the fly ash samples had high levels of major and trace elements, including Si, Al, Fe, Ca, Mg, Na, K, As, and Cd. These elements have the potential to cause environmental pollution if not properly managed. The results also showed that the sonication process increased the concentration of some elements in the fly ash, indicating that the process may not be suitable for treating fly ash.

Table 1. Physicochemical analysis of sample

Sample No.	Sp. Gravity (Astm D 854)	True Density	Moisture Content (%.)	Specific Surface Area (Square Meter Per Gram)	Particle Size Analysis (μm)
1	2.275	2.29	0.175	0.42	7.080
2	2.4235	2.67	0.195	0.41	7.489
3	1.967	1.99	0.172	0.39	8.120
4	2.075	1.79	0.177	0.38	7.961
5	2.245	3.19	0.165	0.41	8.325
6	2.322	1.87	0.175	0.43	8.412
7	2.645	1.91	0.099	0.42	8.384
8	2.274	1.90	0.145	0.39	8.289
9	2.269	2.01	0.176	0.40	8.476
10	2.201	2.73	0.168	0.43	7.972

The high concentration of silica in the fly ash suggests that it may be suitable for use as a pozzolanic material in the production of cement. However, further testing and analysis are necessary to confirm this potential application. Overall, the findings of this study can provide useful information for the management and utilization of coal fly ash from thermal power plants.

Overall, the investigation of chemical parameters of coal fly ash at Chandrapur Thermal Power Plant showed that fly ash is a valuable byproduct of coal combustion that can be utilized in the cement industry. The use of fly ash in cement production will not only reduce the environmental impact of coal combustion but also conserve natural resources and reduce the cost of cement production. In conclusion, the results of the experiment suggest that coal fly ash from the Chandrapur Thermal Power Plant has potential applications in the cement industry. However, the high concentration of heavy metals in the coal fly ash should be carefully considered, and appropriate measures should be taken to ensure that its use does not have adverse effects on human health and the environment.

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