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"Improving Air Quality: Dust Control Measures for Ports"

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Abstract: **-**Ports are vital centers of international trade, enabling the transportation of commodities and raw materials around the globe. However, port operations frequently produce large amounts of dust emissions, which can hurt the local community, worker health, and air quality. This essay examines several dust management strategies that can be used to enhance port air quality. We look at more contemporary technical solutions like dust extraction devices and real-time air quality monitoring, as well as more conventional techniques like chemical suppressants and water sprays. We also go over how strategic planning can help reduce dust emissions by using buffer zones and rethinking cargo handling protocols. This article offers extensive guidance for port authorities and those involved in dust pollution reduction by examining case studies from ports that have effectively and stakeholders to develop effective dust control strategies. The implementation of these measures not only enhances air quality but also promotes sustainable port operations and compliance with environmental regulations.

Keywords: *port, air quality, environment, berth and yard.*

1. Introduction

Ports are essential to international trade since they are the main hubs for the import and export of products. However, the heavy dust produced by the busy activities at ports can hurt the quality of the air. This dust is harmful to the environment, surrounding communities, and workers' health since it comes from handling bulk commodities, operating vehicles and machinery, and other port operations. As a result, putting in place efficient dust control methods is essential to lessening these effects and guaranteeing a safer and healthier port environment.

This article examines several technology and management approaches that can be used to control and lower dust emissions at ports. We'll look at the best practices for preserving air quality, from conventional techniques like water spraying and windbreaks to cutting-edge technologies like dust suppressants and automated monitoring systems. We will also talk about the significance of adhering to regulations and the part that constant improvement plays in attempts to control dust. Through the implementation of a comprehensive dust management strategy, ports can achieve notable improvements in air quality, public health protection, and sustainable operations.

2. Objectives

To improve air quality at ports, the primary objective is to identify and minimize dust emission sources. This involves conducting comprehensive assessments to pinpoint key areas where dust is generated, such as cargo

handling operations, vehicle movements, and storage facilities. Implementing measures like using covered conveyors, installing dust suppression systems, and employing water sprays can significantly reduce the amount of dust released into the atmosphere. By focusing on these emission sources, ports can create a cleaner and healthier environment for workers and nearby communities.

For dust control to be effective, precise dust level monitoring and measurement are essential. To consistently monitor air quality and spot patterns or increases in dust concentration, ports need to make investments in cutting-edge dust monitoring equipment. By erecting real-time monitoring stations throughout the port area, officials will be able to react to increased dust levels quickly. Furthermore, consistent upkeep and inspections of monitoring apparatus guarantee accurate data gathering. Ports can maintain air quality regulations by making early interventions and making educated decisions by improving their dust monitoring capabilities.

For effective dust control, modern technologies and best practices must be implemented. To protect their operations, ports ought to investigate and put into practice a mix of chemical, mechanical, and procedural controls. To significantly reduce dust generation, for example, wind barriers can be installed, material handling operations can be optimized, and dust suppressants can be used on unpaved roadways. Moreover, the efficiency of these methods can be improved by using cutting-edge technology like eco-friendly dust management agents and automated dust suppression systems. Ports can enhance their dust management tactics over time by keeping abreast of the most recent advancements.

For long-term improvements in air quality, dust management programs must be evaluated and improved continuously. To pinpoint opportunities for improvement, ports should set up a framework for the routine evaluation and assessment of their current dust management procedures. This entails evaluating the efficacy of present procedures, considering stakeholder input, and keeping up with changes in legislation and industry norms. Ports may remain resilient to changing circumstances and guarantee the durability and efficacy of their dust control methods by taking a proactive stance when evaluating policies.

3. Methods

CAAQM

The term "continuous ambient air quality management" describes a methodical, continuing procedure for tracking, evaluating, and controlling the air quality in the surrounding area. Through a network of monitoring stations positioned strategically in urban, industrial, and residential areas, data on a variety of air pollutants, including particulate matter, nitrogen dioxide, sulfur dioxide, ozone, carbon monoxide, and others, are continuously collected. Continuous ambient air quality management requires real-time data collection and analysis for authorities to evaluate pollution levels and possible public health threats.
The air quality acceptable index is shown in Table 1

TABLE 1 Air Quality Index

S.No	Category / Range	Description
1	Good (0-50)	The air is fresh and free from toxins. People are not exposed to any health
2	Moderate (51-100)	Acceptable air quality for healthy adults but a mild threat to sensitive individuals.
3	Sensitive groups (101-150)	Inhaling such air can cause some discomfort and difficulty in breathing.
4	Unhealthy (151-200)	This could be typically problematic for children, pregnant, women and the elderly.
5	Very Unhealthy (201-300)	Exposure to air can cause chronic morbidities or even organ impairment.
6	Hazardous (301-500)	Beware! Your Life is in danger. Prolonged exposure can lead to

Source: NationalAir Quality Index, Central Pollution Control Board.

Considering the different cargos & different operational methods may result in higher side emission of Particulate Matter in Ambient Air Quality at & around 500 Mts. at the Berths location requires Improvement at the source itself so that the impact on other activities will not affect the Ambient Air Quality values are

1. The values of Particulate Matter (PM-10) at Berth operational areas and the berth backup locations may be recorded on a higher side than the statutory standard of 100 µg/m^3.
2. Commodity-wise impact was also observed on higher side emission of Particulate Matter recording.
3. Suitable mitigation measures to be adopted to reduce the values to the maximum extent possible and to get good results within the radius of 500 mts from berths so that there will be more impact and to achieve good reduction to meet the statutory standards by the time the emissions cross Port boundary.

The air monitoring systems at different locations are shown in Table 2

TABLE 2 CAAQM Values Recorded for June 2023

S.No.	Date	Monitoring Stations Location (Parameter - PM_{10} (ug/m^3))				
		LOCATION 1	LOCATION 2	LOCATION 3	LOCATION 4	LOCATION 5
1	21.06.2023	183.40	104.40	73.35	69.68	70.49
2	22.06.2023	179.20	127.00	72.44	63.92	74.57
3	23.06.2023	184.00	118.80	69.88	62.87	70.05
4	24.06.2023	184.10	109.10	64.74	60.42	62.58
5	25.06.2023	231.10	101.10	64.02	59.75	61.88
6	26.06.2023	241.30	131.00	64.13	59.85	61.99
7	27.06.2023	260.80	116.70	64.34	60.05	62.19
8	28.06.2023	171.10	127.20	64.67	60.36	62.51
9	29.06.2023	189.20	118.20	64.14	59.86	62.00
10	30.06.2023	174.00	117.30	70.67	66.66	67.29
Average		199.82	117.08	67.24	62.34	65.56

Recommendations

To control the emissions & to control the higher values of Particulate Matter PM 10, the following mitigation measures were adopted & implemented.

- Continuous deployment of Road Sweeping Machines at Berths & all operational areas from time to time to ensure the roads are cleaned to the possible extent.
- Increasing the frequency of deploying the Mobile DSS tankers on haul roads based on the cargo handled at Berths.
- Ensuring control of the speed limit of vehicular movement to 30 KM/Hour
- Ensuring proper cleaning of Bulk Alumina trailers
- Ensuring the operating team follows proper SOP
- Creating awareness of overloading

- Mechanical & Manual cleaning of the spillages.
- Initiated development of greenbelt at CT Area
- The DSS tankers are provided with canons of two sprinkle the water instead of poring there so the water consumption will be redacted effectively.
- The capacity of DSS Tankers is 12 kl & the Cannon Nozzle size is 12mm.
- It will take an average time of 6 minutes to sprinkle 1.0 kl of water and for 12 kl 60 hrs to 75 mins to complete one trip.
- The cannons sprinkle the water with a height of about 12 to 15 meters and cover about 15 mts of distance.
- The road tanker is provided with a horizontal pipe of 4 meters with 20 to 25 holes of 6mm in 4 rows to form a mist of water sprinkling.
- It will take an average time of 45 to 60 Minutes to complete one trip.
- Deployment of the DSS is ensured after proper cleaning of the spillages both mechanically & manually to avoid the station of water & slurry /slippery road conditions.
    - Precautionary measures to be taken for dust control are cannons, Dust suppressing systems (DSS), and tree plantation. The number of cannon units available for suppressing the dust while operations in the yard and berth are 177 units, the Dust Suppression Systems for equipment are 98, and road sweepers available are 4 units, and every quarterly on average 1 lakh plantation done in and around the site for controlling the fine dust.
    - The number of dust suppression systems increased with cleaning the surroundings with dozer count also
      increased.

Figure 1 Dust Suppression Systems

Apart from the systems used, the new system is recommended for dust control, water Curtain System will further decrease in the air pollution levels.

Figure 2 Water Curtains

The CAAQM system being incorporated shows the recorded values for the month of September 2023 are shown in Table 3

TABLE 3 CAAQM Values Recorded for SEP 2023

S.No.	Date	Monitoring Stations Location (Parameter - PM_{10} (ug/m^3))				
		LOCATION 1	LOCATION 2	LOCATION 3	LOCATION 4	LOCATION 5
1	11.09.2023	80.83	49.10	61.38	57.55	67.14
2	12.09.2023	78.98	59.72	61.29	57.46	67.04
3	13.09.2023	81.10	55.87	61.11	57.29	66.84
4	14.09.2023	81.14	51.31	49.68	46.55	54.06
5	15.09.2023	101.86	47.54	45.81	42.83	46.54
6	16.09.2023	106.35	61.60	45.94	42.87	44.40
7	17.09.2023	114.95	54.88	45.62	42.58	44.10
8	18.09.2023	75.41	59.82	45.71	42.62	44.19
9	19.09.2023	83.39	55.59	44.56	41.59	43.07
10	20.09.2023	76.69	55.16	46.53	43.42	44.98
Average		88.07	55.06	50.76	47.48	52.24

Outcomes

After incorporating the control measures and practical implementation the values recorded at 5 different locations reduced with percentage values are shown in Table 4

S.No.	Average	Monitoring Stations Location (Parameter - PM_{10} (ug/m^3))				
		LOCATION 1	LOCATION 2	LOCATION 3	LOCATION 4	LOCATION 5
1	June 2023	199.82	117.08	67.24	62.34	65.56
2	Sep 2023	88.07	55.06	50.76	47.48	52.24
% of Reduction in PM 10 Values		55.93%	52.97%	24.51%	23.84%	20.32%

TABLE 4 Percentage Reduction in CAAQM Values

Reduction in PM 10 values of Ambient Air Quality, results in good environmental conditions, thereby projection of implementation of sustainable environment conditions within the port and creating a better work environment.

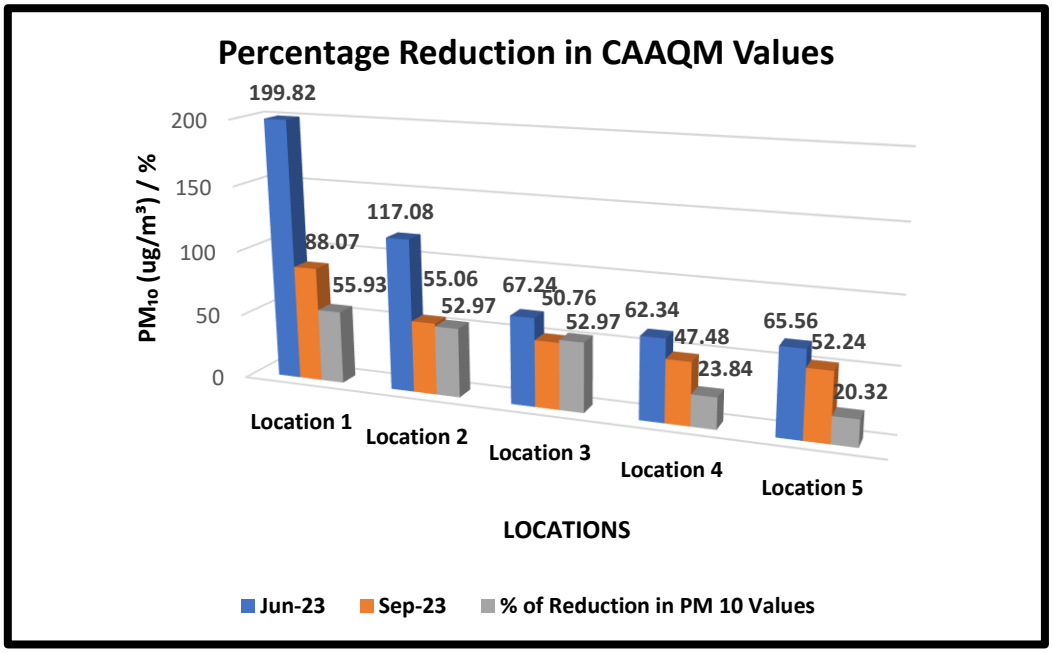

Figure 3 Percentage Reduction in CAAQM Values

The impact of good work environment conditions and surroundings will inspire the employee/ worker to give better output.

Due to the implementation of environmental sustainability, the impact of air/dust pollution on the surrounding habitation/environment will be reduced thereby the opinion of the habitants will be positive against the industry.

4. Results

Fine dust particles are inevitable in the material handling system while loading and unloading the cargo, which makes its system and surroundings dusty.

To mitigate these issues continuous ambient air quality systems were introduced and implemented after incorporating the control measures and practical implementation the values recorded at 5 different locations were reduced to88.07, 55.06, 50.76, 47.48, 52.24 compared to 199.82, 117.08, 67.24, 62.34, 65.56 respectively.

5. Discussion

To mitigate the environmental issues due to the material handling of various cargoes in the port premises and its surroundings and to observe the dust emissions, PPM, and the CAAQMS have been incorporated in different locations. The readings have been noted with necessary measures taken in point of view of dust suppression it yielded a lesser valve in CAAQMS respectively.

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