



An Assessment of the Environmental Risk, Health Risks, And Using an Engineering Control Approach for Cement Dust Pollution Among Ambuja Cement Workers

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ABSTRACT: The cement industry in India is a major economic sector, contributing to local pollution and socioeconomic development. However, modern companies have implemented controls to mitigate air pollution. These industries contribute to atmospheric degradation through resource depletion, energy use, and waste creation, resulting in greenhouse and acidifying gas emissions. Cement is a crucial material in civil engineering and construction.

The cement production process, which uses non-renewable resources, produces dust, smoke, gases, organic compounds, and toxic heavy metals, contributing to global warming and climate change. Cement dust pollution poses health hazards like hypersensitivity, skin irritation, respiratory issues, asthma, anaemia, headaches, stomach-aches, lung cancer, and increased risk of lung diseases, cardiovascular diseases, and inflammatory harm. The exposure can enter the bloodstream, impact organs like the lungs, heart, kidney, liver, spleen, and pancreas, leading to major occupational diseases. Uncontrolled exposure among cement handlers may exacerbate health-related complications. Cement industries require safety measures like PPE, training, and dust control methods. Regular maintenance, inspections, hazard communication, and emergency preparedness plans are crucial. Noise control, chemical handling, and a clean work environment are also essential. Regular audits help identify hazards and ensure compliance, promoting a safer workplace.

1. Introduction

Cement plays a crucial role in housing construction and infrastructure expansion, but its importance is questioned due to socio-environmental conflicts and climate change. The cement industry provides direct work and business opportunities, but it also poses risks to local biodiversity and health [1]. Cement dust contains heavy metals, including

calcium, potassium, silica, and sodium, which can harm abiotic and biotic elements of the environment. Cement particles, ranging from 0.05-5.0 μm , can accumulate in the lung and enter the bloodstream, posing a health risk [2]. Cement dust contains various chemicals, including aluminium oxide, silicon oxide, and calcium oxide, with trace amounts of iron oxide, chromium, potassium,

sodium sulphate, and magnesium oxide. These substances have been linked to various diseases, including acute silicosis, chronic obstructive pulmonary diseases, interstitial fibrosis, malignancy, glomerulonephritis, pulmonary tuberculosis, vascular disorders, and immunological disorders. Aluminium exposure can cause anaemia, renal failure, and neurotoxicity, while chromium is a potent oxidizing agent with severe harm to organs like the lung, kidney, and liver [3]. Factory workers' liver and hematologic systems are adversely affected by cement dust exposure, with some target organs, such as the renal system, liver, and lungs, potentially triggering inflammatory reactions from occupational exposures. The most significant environmental problems associated with the production of cement are energy and raw resource use, as well as air



emissions. A few factors, such as inputs (the fuels and raw materials utilized) and the range of procedures employed, determine the kind and quantity of air pollution [4]. Regarding the major environmental problems associated with cement manufacturing, the clinker burning system is the central component of the strategy. Since Indian cement plants are often built around their raw material source limestone mine, they are mostly location specific. The limestone is transported to adjacent cement factories, where it is further crushed and heated with gypsum to create clinker [5]. Clinker is then used to make cement. To manage dust and prevent occupational health issues, regular cleaning and watering are essential. Regular maintenance of dust control systems is crucial. Worker exposures can be measured using air monitoring and protective gloves are used to prevent diseases like dermatitis [6]. Post-warning notices and employee training on safety controls are also important. Notifying OHS centres and government authorities of occupational health illnesses can help reduce the risk of cement dust-related illnesses. Noise levels should be reduced using enclosures, absorbers, and barriers [7]. Personal protective equipment (PPE) such as goggles and earplugs can protect ears and eyes from harmful substances. Risks must be detected in every process and operational activity, and appropriate control measures must be taken to minimize them as low as reasonably practical [8]. The hierarchy of hazard control measures is used to manage risks, with rest control measures being the final consideration when danger is not reduced to a bearable level.

2. Objective

In view of a “risk indicator of dust exposure and occupational health and safety in cement factory workers” the objective of this study aims to explore and evaluate the essential awareness and behaviour regarding the health risk and disease risk factors due to cement dust exposure within cement workers.

1. To look at the relationship between health issues connected to cement handling and the incidence or occurrence of occupational risk factors.
2. To evaluate safety precautions and create intervention plans.

3. Raising worker health awareness through ongoing seminars, Pep talks at work, exhibitions, and media exposure among industrial workers; raising knowledge of health and safety problems, such as instruction about the usage of personal protective equipment (PPEs).

3. Review of Literature

There have always been an infinite number of health problems that environmental pollution might cause. In this context, the cement industry is significant and expanding rapidly in India as well as worldwide. The growing market is seeing a spike in demand due to the continuous growth of cement building [9–10]. The cement industry is one source of environmental contamination. Dust and other airborne particles are released during the various phases of cement manufacturing, which include raw material grinding, clinker cooling, storage and packaging facilities, and rotating kilns [11]. Cement dust contains a variety of carcinogens, such as crystalline silica and hexavalent chromium. These variables may adversely affect several physiological organs [12].

Environment pollution from cement industry

The cement industry is currently one of the primary contributors to environmental damage. The pollutants that are generated by the cement industry have an adverse effect on the air, water, and land. According to the Central Pollution Control Board (CPCB) [13], cement factories rank among the top seventeen industries in India in terms of pollution. As a result of their expansion to meet the growing demand for cement-based building materials, these facilities' dust emissions have alarmingly increased over the past few decades. The area's limestone and sandstone quarries, as well as quicklime production facilities, have expanded, contributing to an increase in dust pollution. The primary source of dust pollution on construction sites is dusty facilities. The addition of harmful chemicals, biological elements, or small particle matters.

The effects of the cement industry on environmental quality

Environmental effects from the manufacturing of cement are felt throughout the whole process. These include the



release of gases and dust into the atmosphere, noise and vibration from machinery use and quarry blasting, and the permanent deformation of the surrounding natural environment caused by limestone quarries, which are visible for miles around. A decrease in the number of non-renewable resources, such as limestone, is brought about by the increased extraction of raw materials for growing cement production [14]. The actions associated with taking resources from the natural environment harm the green space that serves as a habitat for wildlife and plants, putting an ecosystem at danger of imbalance. The ongoing use of these priceless resources puts them at danger of future depletion. In addition, the factory's raw material processing stages emit noise, dust, and greenhouse gases, particularly carbon dioxide, which worsen climate change and damage the environment [15].

Health effects: General clinical manifestations

Workers in the cement sector may have clinical symptoms and an inflammatory response from high concentrations, extended inhalation, or both, of cement dust, which might lead to structural and functional problems. The most frequently reported clinical characteristics in workers in cement factories include a persistent cough and production of phlegm, both restrictive and obstructive lung conditions, fatigue, headaches, stomachaches, inflammation of the skin, conjunctivitis, lung function impairment, tightness in the chest, and lung, stomach, and colon cancers [16-17].

Different respiratory health issues in the cement industry due to dust exposure

In cement manufacturers, chronic respiratory symptoms include persistent coughing and phlegm production, tightness in the chest, and wheezing are the most often reported respiratory health issues. Lung function impairment, such as that caused by some obstructive lung diseases, is also often documented. There have also been reports of lung and laryngeal cancers [20].

4. Methodology

Study groups: In this method, 60 people took part in this investigation. 40 of them were categorized as cement handlers or workers exposed to cement dust based on their employment history spanning the previous eight years and 20 are designated as non-cement handlers

(control groups) in Ambuja Cement Limited in Unit - Roper, Punjab-140113. For the study to be completed, research methods will be crucial. This study's approach was created with the purpose of finding and assessing risk assessment in the cement sector. To identify various threats, a questionnaire was created in order to gather data. This approach provides enough information to answer all research questions and study objectives. It also covers pertinent data gathering areas and allows for the interviewing of various industry management personnel to obtain correct information about potential dangers. In order to gather relevant data that would yield solutions to the issue raised by the study, the researcher also made an observation. The investigator scrutinized the tangible surroundings and actions of the personnel in the cement production.

Data collection technique and tool: The workers were interviewed by researcher on the same days the workers and others (instead of being asked to complete a questionnaire as their reading skills were not known) as well as helped to complete a questionnaire format prepared by researcher that included questions on anthropometric measurements, period of livelihood at work-place and in that area, health impact by cement dust, usage of PPEs. Study consisted of various questions evaluating knowledge about health hazards and diseases caused by cement dust, types of PPE and its benefits, taken appropriate actions. The questionnaire was filled under close supervision to avoid conflicts by the selected subjects. In each section sampling was performed in accordance with the order of names in the alphabetical list from the factory. The health questionnaire was prepared in local language Bhojpuri. Prior to the field work, the questionnaire was translated from local language to English and then compared according to standard procedures.

Exclusion criteria: Workers who have previously worked in any other industry that produces fumes or dust were also excluded from this study. Workers in the cement industry who have a history of known blood transfusion, consumers of alcohol, smokers, anemia, asthma, or a family history of the diabetes disease were also excluded.

Ethical clearance: Prior approval was taken by management authority of Ambuja Cement limited. All participants received an explanation of the study's



purpose. Each of them freely participated in the study and completed a written informed permission form. Participants were given the assurance by researcher that their personal information would be kept private, and coding ID was completed.

Knowledge: This section of the survey had 19 questions that assessed participants' knowledge of illnesses and health risks associated with cement dust, different forms of personal protective equipment (PPE) and their advantages, and appropriate measures performed.

5. Result and Discussion

After gathering information on the health of cement handlers' workers and non-cement handler's workers, we discovered that the risk of harm is dependent on the time, quantity of exposure, individual age, and sensitivity, as previously stated. During the investigation, personnel were discovered to have a variety of ailments, including skin irritation, respiratory irritation, eye irritation, chest and stomach discomfort, heart illness, high blood pressure, as well as irritation of the throat and nose. It has been estimated that the cement sector affects most of the population in Cement factory area. Rashes and dry skin, as well as red eyes, stiff nails, and a dry cough, seemed to be widespread among employees with several years of

experience. A substantial number of persons have complained dry cough, respiratory issues, nasal congestion, asthma, skin rash, and irritability. Cement handlers and Non cement handlers who have worked for a long time have been proven to be impacted by a variety of occupational illnesses (double, triple, or multiple) based on their age and sensitivity. Occupational illnesses such chronic bronchitis, dry cough, eye difficulties, and skin and skin allergies are often connected to the pollution caused by the cement factory and other comparable resources, but

Table-1: Demographic Profile of the Respondents

none of them developed lung cancer. Air pollution has been demonstrated to affect asthmatics' lungs, as well as raise blood pressure, induce blood clots and raise the danger of stroke and heart disease. Common eye problems including tears, redness, irritation, and myopia were found during these research questioners.

The Measurements of Socio-demographic characteristics (Weight, Height, and BMI), Mean Age of Non-Cement Handlers (NCH) Designated as Control Groups and Cement Dust Exposed Cement Handlers (CH) Designated as Test Groups Were As Seen In Table No. 1.

Variables	Description
Age (years)	36.54 ± 1.15
BMI (m/Kg ²)	22.40 ± 2.38
Exposure to cement dust (Months)	94.15 ± 3.85
Daily Working Hours (Hrs.)	8 Hours shifts
<u>Educational level</u>	
Primary	50 (83.33 %)
Secondary	10 (16.66 %)
<u>Employment type</u>	
Cement handler's workers	40 (66.66 %)
Non-Cement handler's workers	20 (33.33 %)

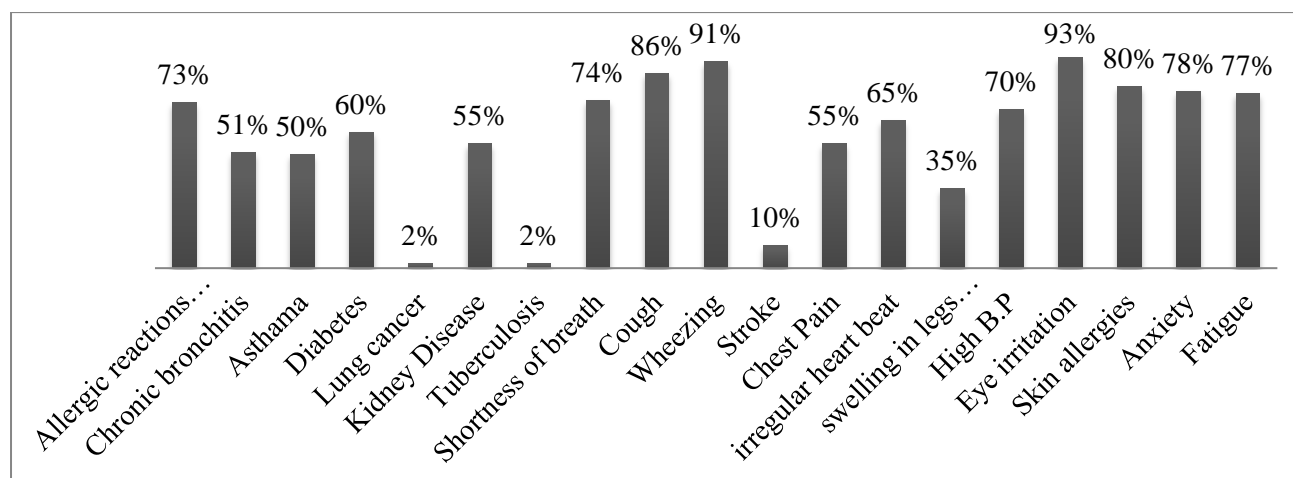
Cement handler workers often face challenges related to their education and knowledge base, which can significantly impact their safety and job performance. Many workers in this field have limited formal

education, resulting in a lack of awareness regarding proper handling techniques, safety protocols, and

equipment operation. This gap in knowledge can lead to increased risks of accidents, injuries, and inefficiencies in their work.



Figure No.1: This graph illustrates the prevalence of nineteen different illness kinds among CH & NCH at Ambuja Cement Ltd, Unit - Roper.



Response to questionnaire: -

The study's conclusions state that the investigator discovered nineteen different types of illnesses as shown in (Figure No.1) were documented from the labor force employed in the Ambuja Cement Ltd in the Indian state of Punjab. They included: breathing-inhibiting allergic reactions, long-term bronchitis, asthma, kidney disease, lung cancer, diabetes mellitus, tuberculosis, dyspnea, coughing, wheezing, a heart attack, chest discomfort, an abnormal pulse, and edema in the feet and legs (not from walking), elevated blood pressure, diabetes mellitus,

renal dysfunction, eye irritation, skin allergies, anxiety, and exhaustion.

In the Ambuja Cement Ltd, 91% of the employees reported having wheezing issues, and 93% had skin allergies. The percentage of industrial workers with irregular heartbeats who also had coughs ranged from 65% to 86%. Around 55% of cement workers reported having chest problems. It was discovered that 50% of workers had asthma issues, and 93% reported having irritated eyes. Workers at cement factories were also shown to have a high frequency of many other ailments.

Table No. 2: The right responses to practice problems varied significantly between cement handlers and non-cement handlers, as demonstrated below: -

No	Practice on Daily basis	Correct answer	
		Frequency (n)	Percentage (%)
Q1	Appropriate knowledge about all type of PPE usage	100	83.33
Q2	Knowledge about benefit of PPE	70	58.33
Q3	Do you use any safety devices such as masks, gloves, boot, goggles and protective cloths	83	69.17
Q4	Frequency of wearing mask	20	16.67
Q5	The reason why workers wear mask	80	66.67



Q6	Hand washing after cement dust exposure work	73	60.83
Q7	Bathing after cement dust exposure work	78	65

Note: For categorical data, frequencies and percentages were utilized, whilst mean \pm SD was employed to represent continuous values.

Most employees/workers had respiratory conditions, including allergies, sore throats, and respiratory infections. These findings were also consistent with, who claimed that cement dust can induce a variety of acute and chronic respiratory disorders. Respiratory problems are more common in those who have come into contact with cement. Furthermore, the reported findings revealed a definite link within generated dust from the cement mill and the incidence of respiratory disorders. These findings were comparable with those previously obtained by. There were acute health effects on the workers' respiratory systems, which were probably brought on by significant exposure to irritable cement dust. Also, the findings show that the questionnaire is a valuable tool for monitoring the short-term impact on respiratory health.

6. Conclusion and Recommendation

The study conducted at Ambuja cement Ltd in Punjab, India, investigates the link between workplace exposure to cement dust and occupational health diseases among factory workers and cement handlers. The research found that prolonged, uncontrolled exposure to cement dust significantly increases occupational health risks in cement handlers compared to non-cement workers. The study also found a positive correlation between the duration of exposure and the age of cement handlers, suggesting a link between disease and organ impairment. The long-term effects of cement dust on cardiac indicators and cardiovascular disease risk factors suggest a potential predisposition to cardiovascular disorders among cement workers. The study found that cement handler manufacturing workers had a higher frequency of respiratory disorders than non-cement workers. The study highlights the importance of health and safety training and higher education levels in cement factory workers to prevent respiratory symptoms. It suggests collaboration between government, employees, and supervisors to implement technological safeguards, regular medical exams, proper protective clothing, and ongoing education on personal protective activities.

Cement industries face health risks from pollution, dust, fumes, gases, noise, mechanical, electrical, fall, and physical hazards.

Conflicts of Interest: The author declares no conflict of interest.

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