Sustainability, Agri, Food and Environmental Research, (ISSN: 0719-3726), 10(X), 2022:
http://dx.doi.org/

Impact of dust on health of on-site construction workers – a case study.

Impacto del polvo en la salud de los trabajadores de la construcción en el sitio: un estudio de caso.

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ABSTRACT

The rate of air pollution is becoming a cause for worldwide concern because of its substantial increase. Different sources like combustion of fuels, release of smoke from industries etc are responsible for the pollution of air. The construction industry is a major contributor to air pollution in the form of dust. Most of the activities involved in the completion of a construction project contribute to the generation of dust in one way or another. There are many sources of dust in a construction site like the use of construction equipment, transportation activities etc. the dust thus generated can ill effects as well. But, the problem of dust pollution is not addressed properly mainly because of the lack of awareness in this area. Proper identification of sources of dust in sites, its health impacts etc can help generate awareness and also help in implementing control measures. This can help reduce dust pollution on site. Here, a residential building site is taken for the case study. A questionnaire survey is conducted for the workers to identify the negative impacts construction dust has and also to determine the most common dust control measures employed in site.

Keywords—air pollution, construction activities, construction equipment, questionnaire survey, dust control.

RESUMEN

La tasa de contaminación del aire se está convirtiendo en un motivo de preocupación mundial debido a su aumento sustancial. Diferentes fuentes como la combustión de combustibles, la liberación de humo de las industrias, etc. son responsables de la contaminación del aire. La industria de la construcción es uno de los principales contribuyentes a la contaminación del aire en forma de polvo. La mayoría de las

actividades involucradas en la finalización de un proyecto de construcción contribuyen a la generación de polvo de una forma u otra. Hay muchas fuentes de polvo en un sitio de construcción, como el uso de equipos de construcción, actividades de transporte, etc., el polvo así generado también puede tener efectos nocivos. Sin embargo, el problema de la contaminación por polvo no se aborda adecuadamente debido principalmente a la falta de conciencia en esta área. La identificación adecuada de las fuentes de polvo en los sitios, sus impactos en la salud, etc. puede ayudar a generar conciencia y también ayudar a implementar medidas de control. Esto puede ayudar a reducir la contaminación por polvo en el sitio. Aquí, se toma un sitio de construcción residencial para el estudio de caso. Se realiza un cuestionario a los trabajadores para identificar los impactos negativos que tiene el polvo de construcción y también para determinar las medidas de control de polvo más comunes empleadas en el sitio.
Palabras clave: contaminación del aire, actividades de construcción, equipo de construcción, encuesta por cuestionario, control del polvo.

INTRODUCTION

There has been an alarming increase in the rate of air pollution in both developing as well as in developed countries. Sources of air pollution include vehicular emissions, combustion of fossil fuels, emissions from factories, dust emissions etc. Construction industry is one of the primary contributors to dust pollution. Most of the activities involved in the completion of a project can result in the generation of dust. Transportation activities to and from the construction site for the movement of raw materials, surplus materials or waste products, operating construction equipment etc may be factors generating dust. These activities result in the generation of dust that are emitted into the environment and can significantly affect the air quality of the surroundings. These emissions affect the health of site workers as well. They cause significant environmental impact as well. Proper identification of factors causing dust pollution on site can help in implementing control measures which can help reduce dust pollution on site. Therefore, identification of factors affecting dust pollution on site is one of the main steps in dust control.

LITERATURE STUDY

Choi et al (2020) did a review of research on particulate matter pollution in the construction industry. A total of 48 journals were reviewed. Journals related to particulate matter concentration, dust control, health impacts etc were used. The 48 journals could be classified into five categories. PM emission from construction equipment, PM emission from construction activities, PM control measures, health impacts and PM monitoring. It was seen that there was an increase in journals in this area from 2014 which showed increased concern regarding PM pollution. The review showed that research related to fine dust from

construction equipment were studied, but that of construction activities were still in an early stage.

Chen et al (2019) quantitatively assessed the dust pollutants emitted from construction equipment were assessed quantitatively. A computational framework for quantifying concentration variations of pollutants near construction sites using project- and location-specific information was proposed. Equipment emissions estimated with the EPA's Motor Vehicle Emission Simulator (MOVES) and the meteorological data from AERMET were entered into MS/EPA Regulatory Model (AERMOD) from which pollution concentration levels were obtained which were checked against set limits. The framework was applied to an earth work project in Texas and the concentration of CO released from equipment were determined and checked against standards. CO was chosen because AERMOD can estimate CO's both 1-hour and 8- hour concentration values not only daily averages. The highest 1-hour concentration values of CO were 0.842µg/m3, which was below the EPA's standard of 40mg/m3 and the highest 8-hour concentration value was 0.105µg/m3, which was also below the EPA's standard of 10mg/m3 and was concluded that the existing construction plan doesn't need to be adjusted. Peak values of CO were confined to limited areas and hence more attention should be paid to construction worker's health than the health of residents

Gupta et al (2017) assessed the particulate matter concentrations at a site in Bangalore. Concentrations were found using an air quality monitor. The concentrations were checked for different distances (50m, 200m, 500m) from the site. The mean concentrations at a distance of 200 meters from the construction site were almost half or even less of what was recorded at a distance of 50 meters. The values of PM2.5 here too were way above the permissible limits but PM10 concentrations were within the prescribed limits. At a distance of 500 meters, the values of PM10 further reduced. But, the concentration of fine particulate matter was excessive. The concentrations of PM10 were generally within the permissible limits prescribed by CPCB, but the concentrations of fine PM2.5 were alarming. The air (especially PM2.5) that a resident inhaled was 4-5 times more polluted than the threshold prescribed by the Central pollution control board and nearly 10 times the limits given by the World Health Organization. The life time of PM2.5 varied from several days to many months due to negligible sedimentation rate leading to their excessive concentrations. On the contrary, PM10 particles being heavy settled quickly and were unable to travel long distances.

Zuo et al (2017) studied the awareness of managers regarding the consequences and self-responsibility of dust pollution and control on site using Norm Activation Model (NAM). NAM evaluates the intensity of awareness of consequence of action (or non-action), and

acceptance of responsibility leading to the activation of personal norms which in turn determine the behaviour. For this, 24 interviewees were chosen and interviewed. The questions were meant to study the interviewees' view on the awareness of consequences of dust pollution and ascription of responsibility which influences their personal norms according to NAM. Considering dust pollution as trivial and less important compared to other problems had a negative moderating effect while the manager's expertise, size of company, commitment to reduce dust etc had positive effects. It was found that regular monitoring, use of new techniques for dust control, inclusion of dust control in environmental and project management plan can improve the manager's attitude towards dust control.

Wu et al (2015)studied the dust control measures available in China. Fromanalysis of existing regulations, 11 current regulations like 'Environmental Protection Law of the People's Republic of China', 'Guideline for Green Construction', etc. were found and they were reviewed. From interviews and site visits, the different sources of construction dust were identified which included excavation, transportation of soil, storage of construction materials etc. In order to make a quantitativeanalysis on the impacts of these identified sources, a questionnaire survey was conductedand a five-point Likert scale was used to evaluate each source's contribution. For ranking their contribution, a relative contribution index (RCI) was introduced. It was found that the activities related to soil were the chief contributors to construction dust. The control measures suggested included the development of targeted regulations, implementation of charging schemes, creation of different monitoring systems to monitor the dust generated from different sites, providing sufficient training etc.

CASE STUDY

The site taken for the case study is located at Trivandrum, Kerala.The site was of a high-rise residential apartment with 12 storeys other than the basement and ground floor and the construction was at its finishing stage at the time of the study. When the work was in full swing, approximately 70 workers were employed at the site. During the finishing stage, a total of 15 workers were working atthe site.

METHODOLOGY

The site engineer was also interviewed in order to understand the major sources of dust experienced in the site, control measures employed in site to reduce it and to know their opinion regarding the impacts of dust.

A questionnaire survey was conducted for the 15 workers who were employed at the site when the construction was at its finishing stages. Out of the 15 workers, 3 skilled and 2 unskilled workers were employed for masonry works. The rest of the workers were unskilled

labourers who were mainly employed as helpers in the site. Most of the workers employed at the site had 5-10 years of work experience.

DISCUSSION

The site engineer as well as the on-site workers agreed that dust was one of the major problems experienced in the site.Loading and unloading of construction materials, transportation of materials toand from site, masonry works, storing of cement and tile cutting were listed as the major activities that were responsible for the generation of dust in the site. Sprinkling of water is used as the main dust control measure to reduce the dust being generated and was said to be effective.

From the responses obtained from the workers, it can be inferred that dust is one of the major problems experienced by workers at the site. The dust generated mainly affects the general labours as they deal with mostly material shifting and dismantling. Major activities creating dust, according to the workers, are cleaning and waste removal, material shifting such as cement or M-sand, dismantling built-up walls, chipping of plasteretc as depicted in Figure 1.

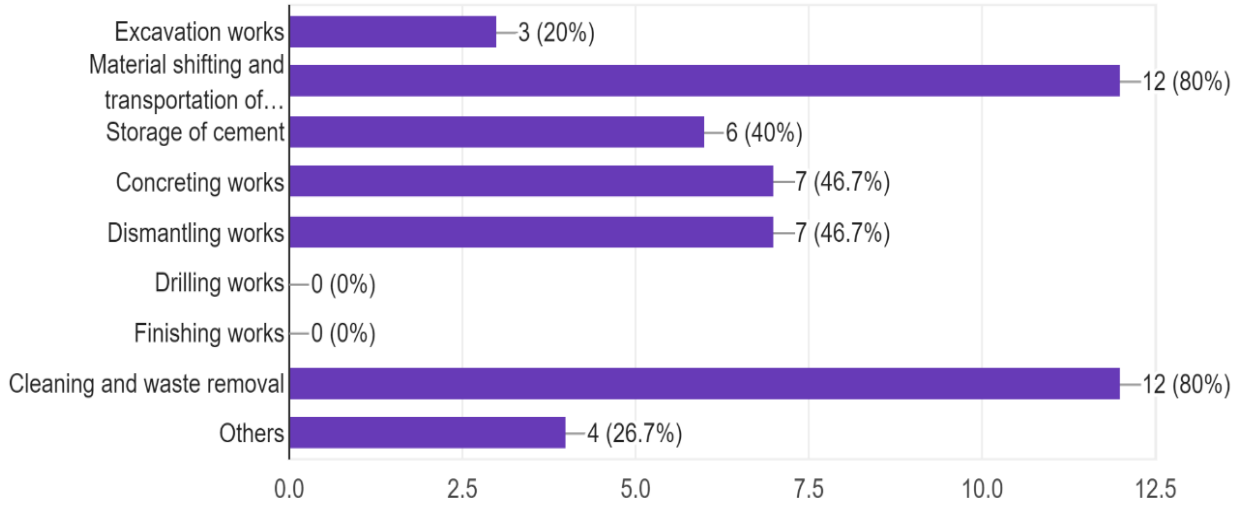

Figure 1: Activities that generated dust at the site according to the workers

Allergies, respiratory problems etc were among the difficulties mentioned by the workers as shown in Figure 2. Among the general labourers, some workers were comparatively old and were 50 and above. Among them, two had serious dust allergy issues. The issues of dust become more problematic with age. Among masonry workers, dust generated from cement had the most impact on their health. This dust is generated during the transportation and storage of cement, mixing of concrete etc.

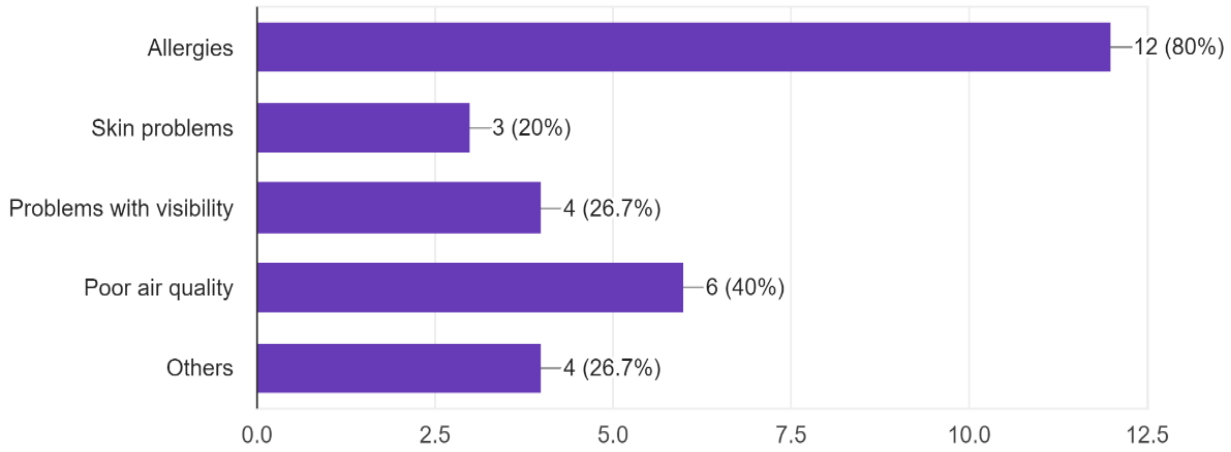

Figure 2: Problems experienced by workers

From Figure 3, it can be seen that most of the labourers (10 out of the 15 workers) wore mask or clothes to cover nose and mouth so as to avoid health issues due to dust. They were found to reduce the risk of direct exposure to dust to an extent.

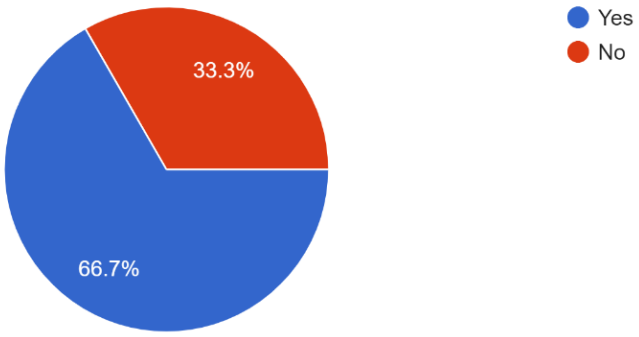

Figure 3: Percentage of workers who does and does not use masks

CONCLUSION

The construction industry has a negative effect on the environment and also impacts the health and wellbeing of workers because of the dust generated in the sites. From the case study, it can be seen thatconstruction activities like transportation of materials or material shifting and the process of cleaning and removal of construction wastes from site are the major factors causing dust. The dust thus generated causes many health problems for the workers on-site with respiratory problems and dust allergies being the chief problems. Age was also a governing factor while considering the impact of dust on workers. Sprinkling of water is the most commonly used dust control method. This method helps the dust to settle so as to prevent it from spreading to wider areas.Providing appropriate covers for construction materials like soil can help reduce the dust generated during its transportation. Employment of better dust control measures and creating awareness among the workers

regarding the ill-effects of dust are some methods by which we can effectively reduce the generation of dust on site and thereby reduce its impact on the health of workers.

LIMITATIONS

Only 15 workers were interviewed for this study resulting in a smaller number of responses. Only 1 site was considered for this study which was already at its finishing stage. The conditions in different sites will be different from one another.

ACKNOWLEDGMENT

We thank God Almighty for letting us complete and submit this paper without any difficulties. We thank the Department of Civil Engineering, Toc H Institute of Science and Technology for organizing this conference.

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Received: 30th January 2021; Accepted: 11th March 2021; First distribution: 01th April 2021