

EXPOSURE OF INHALABLE DUST AND  
RESPIRATORY SYMPTOMS AMONG  
WORKERS IN CONSTRUCTION INDUSTRY

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Bachelor of Occupational Safety and Health with  
Honors

UNIVERSITI MALAYSIA PAHANG

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## **SUPERVISOR'S DECLARATION**

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of degree of Bachelor of Occupational Safety and Health with Honors.

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## **STUDENT'S DECLARATION**

I hereby declare that the work in this thesis is my own except for quotations and citation which have been duly acknowledged. The thesis has not been accepted for any degree and is not currently submitted for award of other degree.

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Dedicated to my beloved parents and siblings  
Respectful lecturers,  
My friends that inspired me through my degree journey

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## ABSTRACT

The air pollution in construction site had become great concern to the workers as it can significantly affect their respiratory health. The aim of this study was to investigate the inhalable dust exposure and its effect toward respiratory system among workers in construction industry. There were 13 workers randomly selected for indoor activities which include concrete breaking, hacking of wall and drilling. Meanwhile, another 13 workers participated as respondents for outdoor construction activities such as operation of backhoe and dump truck, housekeeping activity and construction of drain. Personal air monitoring was conducted using air sampling pump with flow rate of 1 L/min. All the workers were interviewed by using St George Respiratory Questionnaire (SGRQ). Results show that the average concentration for outdoor activities was higher (mean= 4.98mg/m<sup>3</sup>; SD= 2.72mg/m<sup>3</sup>) than indoor activities (mean= 4.19mg/m<sup>3</sup>) (SD= 2.22mg/m<sup>3</sup>). Most of inhalable dust concentration in the construction site were below the OSHA (15 mg/m<sup>3</sup>) and ACGIH (10 mg/m<sup>3</sup>) standard limits except for operation of heavy vehicles activity (backhoe =10.56 mg/m<sup>3</sup>). The prevalence of respiratory symptoms was in the range of 30.8% to 92.3% among indoor workers, while outdoor workers ranged of 23.1% to 76.9%. There was a significant correlation between personal concentration of inhalable dust and respiratory symptoms. Even though the concentration of inhalable dust below the exposure limit, however, workers still experience some of the respiratory symptoms such as coughing, phlegm secretion and shortness of breath. Therefore, the employer must provide appropriate respiratory protective equipment (RPE) with assign protection factor (APF) of 20 for the construction workers. Rescheduling and limit the working time for workers with respiratory symptoms can also be practiced in order to reduce the risk.

## ABSTRAK

Pencemaran udara di tapak pembinaan menjadi masalah besar kepada pekerja kerana dapat memberi kesan buruk kepada kesihatan pernafasan mereka. Tujuan kajian ini adalah untuk menyiasat pendedahan udara dan kesan terhadap sistem pernafasan kepada pekerja dalam industri pembinaan. Terdapat 13 pekerja yang dipilih secara rawak untuk aktiviti kawasan tertutup termasuklah aktiviti pecah konkrit, penggubahsuaian permukaan dinding dan penggerudian. Sementara itu, 13 pekerja lain mengambil bahagian sebagai responden untuk aktiviti pembinaan kawasan luar seperti operasi trak pengorek, lori sampah, aktiviti pengemasan dan juga pembinaan longkang. Pemantauan peribadi untuk tahap udara dilakukan menggunakan pam pensampelan udara dengan kadar aliran 1 L/min. Semua pekerja juga ditemubual dengan menggunakan Soal Selidik Respiratory St George. Keputusan menunjukkan bahawa kepekatan purata untuk aktiviti kawasan luar adalah lebih tinggi (mean= 4.98mg/m<sup>3</sup>) (SD= 2.72mg/m<sup>3</sup>) daripada aktiviti kawasan tertutup (mean=4.19mg/m<sup>3</sup>) (SD=2.22mg/m<sup>3</sup>). Kebanyakan kepekatan debu di tapak pembinaan berada di bawah tahap piawaian OSHA (15 mg/m<sup>3</sup>) dan ACGIH (10 mg/m<sup>3</sup>) kecuali aktiviti operasi kenderaan berat (trak pengorek= 10.56mg/m<sup>3</sup>). Kelaziman simptom pernafasan adalah dalam lingkungan 30.8% hingga 92.3% untuk aktiviti kawasan tertutup manakala pembinaan kawasan luar dalam lingkungan 23.1% hingga 76.9%. Terdapat perkaitan yang tinggi antara kepekatan debu dan gejala pernafasan. Walaupun kepekatan debu di bawah tahap piawaian, bagaimanapun, pekerja masih mengalami beberapa gejala pernafasan seperti batuk, rembesan kahak dan sesak nafas. Oleh yang demikian, majikan mestilah menyediakan peralatan perlindungan pernafasan dengan menetapkan faktor perlindungan sebanyak 20 untuk pekerja buruh binaan. Penjadualan semula dan pengurangan waktu kerja bagi pekerja yang mengalami gejala pernafasan boleh dipraktikkan untuk mengurangkan risiko tersebut.



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## LIST OF SYMBOLS

$\mu\text{m}$	Microns in diameter
$\text{PM}_{2.5}$	Particulate matters with size 2.5 microns in diameter
$\text{PM}_{10}$	Particulate matters with size less than 10 microns in diameter
ppm	Parts per millions
$\text{Mg}/\text{m}^3$	one milligram per cubic meter
%	Percent
$R^2$	The coefficient of determination

## LIST OF ABBREVIATIONS

PM	Particulate Matters
VOC	Volatile Organic Compound
COPD	Chronic Obstructive Pulmonary Disease
HSE	Health and Executive
FEV1	forced expiratory volume in one second
FVC	forced vital capacity
FEV1/ FVC	ratio of forced expiratory volume in one second & forced vital capacity
EEA	European Environment Agency
OSH	Occupational Safety and Health
EPA	Environment Protection Agency
USEPA	US Environmental Protection Agency
PEL	Permissible exposure limit
NAAQS	New Ambient Air Quality Standard
ACGIH	American Conference of Governmental Industrial Hygienists
DOE	Department of Environment Malaysia
UMP	Universiti Malaysia Pahang
TPS	total suspended particulate
SPSS	Statistical Package for Social Science
NIOSH	National Institute for Occupational Safety and Health
NMAM	NIOSH Manual Analytical Method
RPE	Respiratory protective equipment
SGRQ	St George Respiratory Questionnaire
OSHA	Occupational Safety and Health Administration
SPSS	Statistical Package for the Social Science



## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 INTRODUCTION**

This chapter served to introduce the study about the exposure of inhalable dust and lung function impairment among workers in construction industry. Some of the elements include in this chapter are background of study, research objectives, research hypothesis, and significance of study and scope of study. It is hope that from this chapter, readers can get a brief idea and can understand more about this study.

#### **1.2 BACKGROUND OF STUDY**

Inhalable dust can be generated from various human anthropogenic activities. The sources of exposure for particulate matter are associated with many industries such as restaurant, manufacturing industry, agriculture and also construction industry that can contribute to a high risk of emission for inhalable dust. Construction industry can contributes about 4% of particulate emissions that include pollution for air, water and soil (Gray, 2017). Air pollution usually attributed with construction site which can significantly affect worker's health.

The activities in construction site can release dust particles with size small in diameter and invisible to the naked eye which include inhalable dust [particles diameter <100µm], coarse particles [ aerodynamic diameter <10µm] and fine [aerodynamic diameter < 2.5µm] (Abdullahi et al., 2013). The exposure of inhalable dust can effect construction workers which working indoors and outdoors. Usually, the dust emission exposure to workers for indoor and outdoor construction can be different based on the

environment. This emission of particulate matter usually varying in degrees, different durations and frequencies. For outdoor construction, the exposure to dust can be high due to the sources from several type of activities such as operation of heavy vehicles such as tractor, loader and backhoe, mechanical activities like grinding or drilling and also transportation of building equipment and materials within the site. Meanwhile, the exposure for indoor construction activities can be high due poor air ventilation from dust emission of several construction activities. Those construction activities usually involved housing or building modifying work such as hacking of concrete, brick or stone crushing, tiles cutting or also installation of piping system (Government Quality, 2001) which can cause the release of pollutant emission to the air. All the construction activities of indoor and outdoor can cause the exposure of particulate matter such as fumes, aerosol, smokes and combustion particles which can pollute the surrounding air.

Some previous studies stated the sources and impact of dust from the activities in construction industry which are study from Boumann et al, (2017), Kromhout et al, (2009) and Robert et al, (2018) had explained about the relevant of exposure dust to construction workers. As construction workers usually working in a long duration at the construction site until the building project finished, the risk of exposure to particulate matter will become very high. The emission of total inhalable dust can affect the health of people living and working in the surrounding area of the site.

Moreover, it has been found that particulate matters have a great impact on human health (Xing et al, 2016). Construction workers can be infected by various respiratory diseases that are bronchitis and cancer but the most common respiratory illness is chronic obstructive pulmonary disease (COPD) and asthma. Workers at construction site can high risk of exposure to COPD disease and occupational asthma which cause from the emission fume, aerosol and dust from construction activities. There are many previous studies showed the relevance of dust exposure at construction site with these two respiratory illnesses. Construction workers can get severe health problem of asthma when they breathe in or having skin contact with dust, gases, fumes, and vapours (Walton, 2017). According to Health and Executive (HSE), (2017), occupational asthma is an allergic reaction which workers will experience when exposed to certain substances in the workplace such as construction dust. Moreover, a study from Bergdahl et al., (2004) found that the mortality among construction workers

can increase due to occupational exposure to chronic obstructive pulmonary disease (COPD), even though the workers were never smokers. Construction workers experience a wide spectrum of exposures and are at increased risk for COPD and COPD-related mortality (Dement et al., 2015). Construction workers are also exposed to non-specific construction dust and therefore potentially exposed to inhalable dust above the occupational exposure limit and may have an increased risk of developing COPD (Borup, 2017).

Workers in the construction industry could be exposed to particulate matter which comes from various activities associated with environmental air which is polluted from the emission of construction heavy vehicles and other equipment. Actually, this emission of particles can be harmful to the workers as when they breathe in too frequently, they will get lung function impairment. This is because construction workers usually will be at the construction site for a very long duration until the building project is finished. Therefore, in this study, the levels of exposure to inhalable dust along with the lung function status were investigated. From the research, the control and management options for inhalable dust will be investigated so that the exposure can later be reduced.

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