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BORANG PENGESAHAN STATUS TESIS*

JUDUL: STUDY OF SAFETY IMPROVEMENT FOR WOOD DUST HAZARD IN
FURNITURE PRODUCTION LINE

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Study of Safety Improvement for Wood Dust Hazard in Furniture Production Line

Thesis submitted in accordance with the requirements of the Universiti Teknikal
Malaysia Melaka for the Degree of Bachelor of Manufacturing Engineering
(Manufacturing Design) (Honours)

By


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April 2007

DECLARATION

I hereby, declare this thesis entitled “Study of Safety Improvement for Wood Dust Hazard in Furniture Production Line” is the results of my own research except as cited in the reference.

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APPROVAL

This thesis submitted to the Faculty of Manufacturing Engineering of UTeM and has been accepted as partial fulfillment of the requirement for the degree of Bachelor of Manufacturing Engineering (Honours) (Manufacturing Design).

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ABSTRACT

This thesis aims to analyze the wood dust in the Malaysia furniture's factory and to implement the safety improvement through the used of improved ventilation system. Safety improvement in this thesis is defined as the method of following the appropriate work practice and work station procedures in order to control the risks of danger to health at work. In this analyzing paper, both examination and analysis are allowed to study about the wood dust and what operation that causes this from happening. The primary goal was to prevent and reduce the hazard from occurring. Based to it, more analyzing researches should be made to give solutions on every safety improvement needs. Besides, it also can help to minimize hazard being faced in the factory to the workers. Based on this case study, the safety procedure can be implemented to prevent the wood dust hazard in order for the worker to work in an environmental friendly.

ABSTRAK

Penulisan tesis ini bertujuan untuk menjalankan analisis berkaitan dengan masalah berkenaan habuk-habuk kayu di kilang perabot di Malaysia dan pembaikan melalui penggunaan sistem penapisan habuk. Pengelokan dari segi keselamatan kilang dalam tesis ini didefinisikan sebagai cara atau kaedah yang dipraktikkan dalam menjalani kerja-kerja seharian di kilang berdasarkan kaedah kerja dan peraturan yang betul bagi mengatasi risiko yang berkaitan dengan kesihatan di tempat kerja. Dalam kertas kerja analisis ini, kedua-dua kaedah eksperimen dan analisis digunakan untuk mengkaji tentang habuk kayu dan mengenalpasti operasi-operasi yang mendatangkan habuk ini. Matlamat utama analisis ini dijalankan adalah untuk mengatasi dan mengurangkan habuk-habuk debu daripada berlaku. Oleh yang demikian, lebih banyak analisis perlu dilakukan untuk memberi jalan penyelesaian yang terbaik untuk setiap kaedah yang diperlukan selaras dengan penggunaan sistem penapisan habuk di kilang. Secara kesimpulannya, kaedah keselamatan dapat mengatasi habuk debu di tempat kerja dan menjadikannya suatu tempat yang bersih daripada habuk-habuk debu kepada pekerja-pekerja di kilang.

TABLE OF CONTENTS

Declaration	i
Approval	ii
Acknowledgement	iii
Abstract	iv
Abstrak	v
Table of Content	vi
List of Figures	x
List of Tables	xii
List of Symbols	xiii
List of Equations	xiv
1.0 INTRODUCTION	
1.1 Background Introduction	1
1.2 Problem Statement	3
1.3 Objectives	4
1.4 Scope of the Research	4
2.0 LITERATURE REVIEW	
2.1 Introduction	5
2.2 Relationship between safety and health	5
2.3 Risk assessment, hazard and risk definition	6
2.4 Dust	7
2.5 Wood Dust Hazard	9
2.6 Exposure to Wood Dust	10
2.7 Occupational Health	14
2.8 Health Effects	15
2.9 Exposure Limits	17

2.10 Types of Tasks Exposed Workers to Wood Dust	19
2.10.1 Sanding Process	23
2.10.2 Sawing Process	26
2.10.3 Routers Process	27
2.10.4 Shaping Process	29
2.11 Actions to Control Exposures	30
2.11.3 Exhaust Ventilation System	35
2.11.3.1 Hood for Exhaust Ventilation System	37
3.0 METHODOLOGY	
3.1 Introduction	44
3.2 Analyzing the wood dust	46
3.2.1 Observation Method Flow	46
3.2.1.1 Job Safety Analysis (JSA)	46
3.2.1.2 Fundamental steps compliance with COSHH	48
4.0 RESULTS	
4.1 Checklists	54
4.1.1 Checklist 1	54
4.1.2 Checklist 2	54
4.1.3 Risk Assessment Table	55
4.2 Contributor for Wood Dust Hazard	60
4.3 Faulty Ventilation Condition and Causes	60
5.0 DISCUSSION	
5.1 Introduction	63
5.2 Determinants of Exposure through Woodworking Process	63
5.3 Steps to Mitigate Problems	66
5.4 Ventilation System	67

5.5 Design of Modified Exhaust Hood for Shaper Machine	70
5.6 Result after Installing the Modified Hood for Shaper Machine	73
6.0 CONCLUSION AND RECOMMENDATIONS	
6.1 Conclusion	75
6.2 Recommendation	76
7.0 REFERENCES	77

LIST OF FIGURE

- Figure 2.1: Definition of Risk
- Figure 2.2: A Two-Way Relationship
- Figure 2.3: Respiratory System of Human Body
- Figure 2.4: Bandsaw Machine
- Figure 2.5: Molder Machine
- Figure 2.6: Drilling Machine
- Figure 2.7: Router Machine
- Figure 2.8: Drilling Process
- Figure 2.9: Drum Sander
- Figure 2.10: Belt and Disc Sander
- Figure 2.11: Radial Saw
- Figure 2.12: Router Machine
- Figure 2.13: Router Machine
- Figure 2.14: Shaping Machine
- Figure 2.15: Shaping Machine
- Figure 2.16: Example of Local Exhaust Ventilation for Table Saw
- Figure 2.17: Worker Using the Respiratory in the Work Station
- Figure 2.18: Exhaust Ventilation System for Different Types of Machines
- Figure 2.19: The use of Static Pressure Taps to Measure Hood Static Pressures (SPH)
- Figure 2.20: Relationship of Capture Velocity (V_c) to Duct Velocity (V_d)
- Figure 2.21: Rule of Thumb Can Be Used With Simple Capture Hoods
- Figure 2.22: A Guide for Determining an Effective Flange Width
-
- Figure 3.1: General Methodology Flow
- Figure 3.2: Worksheet for Job Safety Analysis (JSA)
- Figure 3.3: Steps fundamental to compliance with COSHH

Figure 5.1: Design of Modified Hood

Figure 5.2: Design of Modified Hood (Front View)

Figure 5.3: Design of Modified Hood (Top View)

Figure 5.4: Design of Modified Hood (Bottom View)

LIST OF TABLE

Table 2.1: Concentrations of total dust, inhalable dust and ratio between respirable and total or inhalable dust during furniture making (including joineries) (personal measurements)

Table 2.2: Grit Guide for Wood Sanding

Table 4.1: Risk Assessment (Severity)

Table 4.2: Risk Assessment (Likelihood)

Table 4.3: Likelihood

Table 4.4: Risk Assessment Form

Table 4.5: Faulty Ventilation Conditions and Causes

Table 5.1: Worksheet for Job Safety Analysis (JSA)

LIST OF SYMBOLS

- SMI : Small Manufacturing Industry
ACGIH : The American Conference of Governmental Industrial Hygiene
OSHA : Occupational Safety and Health Association
OES : Occupational Exposure Standard
MEL : Maximum Exposure Limit
PEL : Personal Exposure Limit
TLV : Threshold Limit Value
STEL : Short-term Exposure Limit
PPE : Personal Protective Equipment
MC : Medical Certificate
COSHH : Control of Substances hazardous to Health Regulations 1994
HSE : Health and Safety Management
ACOP: Approved Codes of Practice
HSC: Health and Safety Committee
IARC: International Agency for Research on Cancer
NIOSH: National Institute for Occupational Health and Safety
TWA: Time-Weighted Average
LEV: Local Exhaust Ventilation
ANSI: American National Standards Institute
SCBA: Self-Contained Breathing Apparatus
SPH: Hood Static Pressures

LIST OF EQUATION

Equation 4.1: Hood Entry Loss (H_e)

Equation 4.2: Hood's Ability

CHAPTER 1

INTRODUCTION

1.1 Background Introduction

According to Occupational Safety and Health Act 1994 (Feb 1994), an Act is for securing that safety, health and welfare of persons at work, for protecting others against risks to safety or health connections with the activities of persons at work, to establish the National Council for Occupational Safety and Health, and for matters connected therewith.

Safety is defined as the prevention of accidents particularly those resulting in physical injury. In general, safety involves controlling the risks from moving machinery, electricity and flammable materials. It also involves preventing injury from natural sources (such as lightning, earthquake and storms), toxic sources (e.g. poisonous gases) and deprivation (e.g. lack of oxygen, water).

According to Donald and Young (1996), the use of safety attitudes are as the basis for an intervention to improve safety performance. A major study carried out during the mid-1980's by the Safety Research Unit (SRU) for British Steel demonstrated a clear correlation between attitudes and safety performance (Canter and Donald, 1990). At the same time, Cox and Cox (1991) also carried out a study about safety attitudes identifying some of the major factors which it comprises. As part of the project carried out for British Steel by the Safety Research Unit (Canter and Donald, 1990) safety

attitudes were used as the basis for introducing safety initiatives which resulted in improvements in the safety performance of the company. Such improvements included the achievement of zero lost time accidents (LTA) in a number of hazardous plants. The use of goal setting as a way of increasing safety performance has also been reported (Cooper et al., 1994). Further, the relationship between safety and total quality management (TQM) has also been discussed (Cooper and Philips, 1995).

Dust is fine, small particles of dry matter. Dusts can be generated by handling, crushing, grinding, rapid impact, detonation, and breakdown of certain organic or inorganic materials, such as rocks, ore, metal, coal, wood and grains. Wood dust on the other hand may have a slight aromatic odor. Color and odor depend on the wood species and time since dust was generated. The wood component may consist of alder, aspen, beech, birch, cottonwood, fir, gum, hemlock, hickory, maple, oak, pecan, pine, poplar, spruce, walnut, and Western red cedar. Wood dust depending on the species may cause allergic contact dermatitis and respiratory sensitization with prolonged, repetitive contact or exposure to elevated dust levels.

According to Mikkelsen, Schunssen and Schaumburg, (June 2002), processing of wood results in the formation of wood chips and dust. The dust is partly suspended in the air and may then inhaled by the workers. Results from epidemiological studies indicate that workers exposed to wood dust stand an increased risk of suffering from asthma symptoms (Shamssain, 1992; Ahman *et al.*, 1995; Herbert *et al.*, 1995), chronic bronchitis (Ahman *et al.*, 1995), nasal inflammation (Holness *et al.*, 1985; Holmstorm and Wilhelmsson, 1988; Pisaniello *et al.*, 1991; Norrish *et al.*, 1992; Shamssain, 1992; Ahman *et al.*, 1995) and impairment of lung function (Al-Zuhair *et al.*, 1981; Whitehead *et al.*, 1981; Holness *et al.*, 1985). Exposure to dust from certain types of wood, such as western red cedar, oak, abachi dan iroko, may cause asthma (Hausen, 1981; Chan-Yeung, 1993).

1.2 Problem Statement

For a small or a big factory, it is important for the workers to implement the safety in their daily work. Safety is important in order to prevent the danger or lack of safety from happen. For this case study, in analyzing the wood dust that occurs in the furniture factory line, there are few problem statements can be cited in link for the safety improvement and wood dust problems for the furniture factory being done. In the furniture factory line, there are few departments that differentiate the working operations in the factory. There are fine shape department, assembly department, finishing and packaging department. In different department, there are different types of operations being done in each of the department. Among the operations being done in the fine shape department are shaping, cutting, dowelling, grinding, drilling, sanding, mortising and so on types of job operation can be done in this fine shape department. In the assembly department, among job operations being done are gluing, nailing and screwing and finishing department operations are lacquering, painting and so on. It is difficult to identify which job operation that causes more wood dust in the factory since there are lots of operations in producing one furniture product. Besides, lack of ventilation may also cause to this problem to occur in the work station area. Levels of machine do also play a role in conjunction to this problem. As a result, in order to identify what problem cause wood dust in the factory, all the factors need to be analyzed and observed to get the best solutions for this problem.

1.3 Objectives

The objectives are:

- 1) To study wood dust hazard in the furniture factory line
- 2) To suggest improved ventilation system of the shaping machine

1.4 Scopes of the Research

The scopes of this project are such as:

- 1) Explore and analyze the wood dust hazard that occurs in a furniture factory
- 2) Suggest a design of ventilation system

In this project, observations and survey will be done to observe the working procedures and working equipments in the factory. Based on this, the Job Safety Analysis (JSA) and Fundamental steps compliance with COSHH was being used for the observations and survey method. Each machines and procedures will be evaluated to identify what types of variables that contribute wood dust to the workers especially. These observations will mainly focus on the fine shape department. This is because; this department is being identified as a potential department that contributes the most wood dust to the workers than other departments. Based on the result that will be collected, appropriate method will be implementing in order to minimize the problem that occurs.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature review discuss about safety improvement in furniture factory SMI. Improvement for safety was been done by narrow the study of safety to wood dust exposure at furniture factory and make a planning of problem solving in order to solve the problem of wood dust hazard in the factory especially in the work station of the wood processing for the furniture for example the shaping and sanders part of wood for the furniture.

2.2 Relationship between safety and health

Safety has generally been regarded as the prevention of accidents, particularly those resulting in physical injury.

Health on the other hand has been seen as the prevention of disease usually over a longer period of time. It involves reducing the risks from chemical, physical and biological agents that would cause disease.

Acute hazards are usually related with the safety problems while chronic hazards are usually relate with health hazard. Acute hazard are immediate in their effects and relatively simple to control. Chronic hazards are much more difficult to assess or identify as they may take a long time to have any effect.

2.3 Risk Assessment, Hazard and Risk

Risk assessment determines systematically what the hazards are, the probability of harm occurring, and the possible consequences of that harm and its severity.

Hazard can be defined as to expose to chance of injury or loss, venture on, and accept the chance of. Hazard is not deemed to be synonymous with risk although it can be an important determinant of risk. Although risk may be related to a chance event and expressed as a probability, there is much more to it than that. The relationship between hazard and risk must be treated very cautiously. If all other factors are equal especially the exposures and the people subject to them, then the risk is proportional to the hazard. However, all other factors are very rarely equal. Thus, a low exposure to something that is highly hazardous may result in a low risk. Conversely, a high exposure to something of incredibly low hazard may result in a moderate or even high risk therefore every reasonable attempt must be made to attempt quantify exposure (e.g. noise, to a specified dust or to radiation) in order to then proceed to attribute a measure at risk to it.

2.3.1 The law

Risk assessment is not a new concept. Case earlier this century established the fact that risks needed to be assessed. In 1992, legislation introduced the concept of risk assessment. This completed the so-called 'Six Pack', that is

1. Management of Health and Safety at Work Regulations

2. Workplace (Health, Safety and Welfare) Regulations
3. Provision and Use of Work Equipment Regulations
4. Personal Protective Equipment at Work Regulations
5. Manual Handling Operations Regulations
6. Health and Safety (Display Screen Equipment) Regulations

$\text{Risk} = \text{Hazard effect (severity)} \times \text{Likelihood of occurrence}$
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Figure 2.1: Definition of risk

There are three basic steps should be taken to ensure a safe and healthy workplace. They are based on the concept that the workplace should be modified to suit people, not vice versa. The three steps are:

- i. **Identifying the hazards** - involves recognizing things which may cause injury or harm to the health of a person
- ii. **Assessing the risk** – involves looking at the possibility of injury or harm occurring to a person if exposed to a hazard
- iii. **Controlling the risk** – by introducing measures which will eliminate or reduce the risk of a person being exposed to a hazard

2.4 Dust

According to Brian Kohler a dust is fine (small) particles of dry matter. Dusts can be generated by handling, crushing, grinding, rapid impact, detonation, and breakdown of certain organic or inorganic materials, such as rocks, ore, metal, coal, wood and grains. Dusts can form a cloud or suspension in air, but the material tends to settle to the ground evenly rather than diffuse (migrate) throughout an area like a vapor. Dusts do not tend to flocculate (clump together in fluffy masses). The term fumes are sometimes used to refer to airborne dusts. Dusts are different than vapors and mists. Dusts are comprised of solid

particles, each of which consists of large number of atoms or molecules of a material that is not normally volatile. Of course, dusts and vapors may sometimes be intermingled.

Dust is a general name for minute solid particles with diameter less than 500 micrometers and more generally for finely divided matter. On Earth, dust occurs in the atmosphere from various sources; soil dust lifted up by wind, volcanic eruptions and pollution are some examples. Airborne dust is considered an aerosol and can have a strong, local radioactive forcing on the atmosphere and significant effects on climate. In addition, if composed of a flammable substance (such as flour or coal dust), under some circumstances it can be an explosive hazard. Dust particles may be small enough that they are respirable, capable of being drawn deep into the lungs when take breath. Some dusts, such as being certain forms of asbestos and coal dust, remain lodged deep inside the lungs where they can eventually cause cancer or other chronic health effect such as emphysema, pneumoconiosis and bronchitis.

There are general ways to avoid being exposed to dusts are:

1. Control dust at its source using engineering controls. This can involve using a dust collection system on a grinder or saw or simply wetting the material with water. If you do not generate airborne dust in the first place, it can't pose an inhalation hazard.
2. Local exhaust ventilation provided by a ventilating blower or fume collector can remove any dust that gets into the air and help keep the concentration to more acceptable levels.
3. Appropriate personal protective equipment (PPE) such as dust masks or respirators when working with dusts of any nature but especially those that are hazardous.

2.5 Wood Dust Hazard

Wood is one of the world's most important renewable resources. At least 1700 million m³ are harvested for industrial use each year. Wood dust generated in the processing of wood for a wide range of uses, is a complex substance. Its composition varies considerably according to species of tree. Wood dust is composed mainly of cellulose, polyoses and lignin and a large and variable number of substances of lower relative molecular mass which may significantly affect the properties of the wood. These include non-polar organic extractives (fatty acids, resin acids, waxes, alcohols, terpenes, sterols esters and glycerols), polar organic extractives (tannins, flavonoids, quinines and lignans) and water-soluble extractives (carbohydrates, alkaloids, proteins and inorganic material). Trees are characterized botanically as gymnosperms (principally conifers, generally referred to as softwoods) and angiosperms (principally deciduous trees, generally referred to as hardwoods). Roughly, two-thirds of the wood used commercially worldwide belongs to the group of softwoods. Hardwoods tend to be somewhat denser and have a higher content of polar extractives than softwoods.

Wood dust can be categorized in the physical hazard type of group (Module III: Occupational Health book). It represents a source of energy and cause damage to the body by the force they exert.

Wood dust (Thomas L.Bean, Timothy W.Butcher and Timothy Lawrence, 1995) is created when machines are used to cut or shape wood materials. Industries that have a high risk of wood-dust exposure include sawmills, dimension mills, furniture industries, cabinet makers, and carpenters. According to their studies, The American Conference of Governmental Industrial Hygienists (ACGIH) had recognizes wood dust as a "confirmed human carcinogen and recommends a limit of 1 milligram per cubic meter (mg/m³) for hardwoods and 5mg/m³ for softwoods. At this time, OSHA regulates wood dust as a nuisance dust; however, OSHA strongly encourages employers to keep exposures to a