INTER-RATER RELIABILITY OF THE ASSESSOR HAZARD RATING ASSESSMENT FOR CHEMICAL HAZARDOUS TO HEALTH IN MALAYSIA (KLANG VALLEY)

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A thesis submitted in
fulfilment of the requirement for the award of the
Degree of Master of Mechanical Engineering

Faculty of Mechanical and Manufacturing Engineering
Universiti Tun Hussein Onn Malaysia

DECEMBER 2022

For my beloved mother and father

ACKNOWLEDGEMENT

Alhamdullilah & Bless to The Almighty. I would like to give a thank you note to those who are involve and made this thesis possible.

I would like to dedicate my sincere appreciation to Dr. Nor Azali bin Azmir for his support and supervision during this term of research accomplishment. His provision and technicality were valuable to this manuscript.

I am very grateful to my colleagues from the Industrial Hygiene Division of Consultation, Research & Development Department of National Institute of Occupational Safety & Health (NIOSH), Malaysia for their strong support in encouraging me to conduct this study.

Not to forget technical experts, Dr. Vivien How of University Putra Malaysia and Department of Occupational Safety and Health (DOSH) for their guidance and expert view on this project paper. Much appreciation goes to my lovely wife Ruslina, my family and friends for their belief. I am fortunate to have such a wonderful family. Thank you, Allah.

ABSTRACT

Competent assessors are trained and developed to cater to the need of industries. This is part of Occupational Safety and Health requirements (Use and Standards of Exposure of Chemicals Hazardous to Health) of Regulation 2000 Part IV assessment of risk to health, Regulation 9. For many types of chemicals used inside any industries, employers are required to commit to a written assessment of the risk due to chemical hazardous to health. The general objective is to determine the inter-rater reliability of chemical health risk assessment hazard rating among competent assessors. Hazard rating determination by competent assessors varies, and this could be due to educational background and experience in the field of chemical assessment and using genuine document of safety data sheet. In this study, a survey using knowledge, attitude and practice concept was conducted on competent assessors registered with Department of Occupational Safety & Health in Selangor and Kuala Lumpur (Klang Valley), and the results found that hazard determination on five different chemicals was not the same. 51% of competent assessors was unsuccessful in getting the accurate hazard rating due to lack of information given on safety data sheet and less effort by assessors to compare to the updated safety data sheet information. Experience-based personnel is an important factor for hazard rating determination. Hazard rating is very important to distinguish which part of the hierarchy control to choose. The result of this study found that the inter-rater professional judgement output is moderately reliable (interclass correlation coefficient value of 0.722) among the assessors since the hazard rating values determined varies. Therefore, academic qualification-based assessor is crucial in providing correct hazard rating value during preparing chemical health risk assessment for occupational safety & health regulatory compliance program.

ABSTRAK

Pengapit yang kompeten dilahirkan menerusi latihan dan ditugaskan menaksir penggunaan dan pendedahan bahan kimia bagi memenuhi keperluan industri. mengikut Peraturan Keselamatan dan Kesihatan Pekerjaan (Penggunaan dan Standard Pendedahan Bahan Kimia Berbahaya kepada Kesihatan) 2000 Bahagian IV penilaian risiko terhadap kesihatan, peraturan 9. Majikan sesuatu industri tidak boleh menjalankan apa-apa kerja yang boleh mendedahkan atau mungkin mendedahkan mana-mana pekerja kepada bahan kimia berbahaya kepada kesihatan melainkan jika dia telah membuat penaksiran bertulis mengenai risiko yang terhasil daripada bahan kimia itu kepada kesihatan pekerja. Majikan hendaklah memastikan bahawa bahan kimia digunakan dalam mana-mana industri, ditaksir dan dinilai secara kualitatif bertulis mengenai risiko kerana bahan kimia berbahaya kepada kesihatan. Objektif umum adalah untuk menentukan kebolehpercayaan antara pengapit yang berdaftar dalam menentukan penilaian hazad sesuatu bahan kimia. Penentuan penilaian hazad oleh pengapit yang kompeten mungkin berbeza-beza, disebabkan oleh latar belakang pendidikan, berpengalaman dalam bidang penilaian kimia, serta penggunaan dokumen risalah data keselamatan yang asli. Dalam kajian ini, tinjauan menggunakan konsep pengetahuan, sikap dan amalan dilakukan terhadap pengapit yang kompeten dan berdaftar dengan Jabatan Keselamatan & Kesihatan Pekerjaan serta lesennya masih aktif khusus di kawasan Selangor dan Kuala Lumpur (Lembah Klang). Hasilnya mendapati bahawa penilaian hazad pada lima bahan kimia yang berbeza adalah tidak sama. 51% pengapit tidak berjaya mendapatkan penilaian hazad yang tepat disebabkan oleh kekurangan maklumat yang diberikan mengenai risalah data keselamatan dan usaha yang sedikit oleh pengapit dalam membandingkan maklumat risalah data keselamatan yang terkini. Pengapit yang berpengalaman merupakan faktor penting untuk menentukan penilaian hazad. Penilaian hazad sangat penting dalam mengambil kira dan menentukan hierarki kawalan yang mana sesuai mengikut penggunaan dan pendedahan bahan kimia. Hasil kajian mendapati bahawa kebolehpercayaan penentuan penilaian hazad bahan kimia oleh pengapit profesional adalah sederhana

(nilai '*interclass correlation coefficient'* 0.722) kerana keputusan penilaian hazad yang berbeza. Oleh itu, penilai berasaskan kelayakan akademik adalah penting dalam menyediakan penilaian hazad yang tepat semasa menyediakan penilaian risiko kesihatan kimia untuk program pematuhan kawal selia keselamatan & kesihatan pekerjaan.

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LIST OF SYMBOLS AND ABBREVIATIONS

S	-	Sample size
X^2	-	Table value of chi-square for one degree of freedom
N	-	Population size
P	-	Population proportion
D	-	Degree of accuracy expressed as a proportion
B	-	LC_{50} for 1 hours
D	-	LC_{50} for 4 hours
Ci	-	Concentration of ingredient i
n	-	Ingredient and I is running from 1 to n
ATEi	-	Acute toxicity estimation of ingredient i
r	-	Pearson's correlation value
$\sum xy$	-	Sum of the products of paired scores
$\sum x$	-	Sum of x scores
$\sum y$	-	Sum of y scores
$\sum x^2$	-	Sum of squared x scores
$\sum y^2$	-	Sum of squared y scores
UTHM	-	Universiti Tun Hussein Onn Malaysia
UPM	-	Universiti Putra Malaysia
IIUM	-	International Islamic University of Malaysia
AIHA	-	American Industrial Hygiene Association
ACGIH	-	American Conference of Governmental Industrial Hygienists
CHTH	-	Chemical hazardous to health
CHRA	-	Chemical health risk assessment
CLASS	-	Classification, labelling and safety data sheet of hazardous chemical
CIMS	-	Chemical management information system
DOSH	-	Department of Occupational, Safety & Health
EPA	-	Environmental Protection Agency

HR	-	Hazard Rating
IARC	-	International Agency of Research & Cancer
MITI	-	Ministry of International Trade and Industry
OSH	-	Occupational, Safety & Health
SOCSO	-	Social Security Organization
SDS	-	Safety Data Sheet
USECHH	-	Use and Standard of Exposure Chemical Hazardous to Health

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CHAPTER 1

INTRODUCTION

1.1 Background of study

Protecting employees from the adverse of chemicals is one of the primary duties of an employer under the Occupational Safety and Health Act 1994 as per stated under Use and Standards of Exposure of Chemical Hazardous to Health (Malaysia, 2000). Thus, all chemicals used in the workplace have to be assessed in order to anticipate, recognize, evaluate, and control hazard towards employees during work activities which could cause occupational diseases such as carcinogenic. The number of cases reported to the Department of Occupational Safety and Health (DOSH) was 365, and number of confirmed cases were 234, related to occupational diseases and poisoning specific to lung and skin disorders as of September 2018 (DOSH, 2018). Health effects related to these cases are respiratory asthma, respiratory bronchitis, respiratory pneumonia, skin dermatitis, and occupational cancer (SOCSO, 2018). Chemicals may contribute to hazardous health effects such as acute toxicity; oral, dermal, and inhalation, skin corrosion or irritation, serious eye damage or eye irritation, respiratory sensitization, skin sensitization, germ cell mutagenicity, carcinogenicity, reproductive toxicity, specific target organ toxicity – single exposure, specific target organ toxicity – repeated exposure, and aspiration effect.

The Chemical Health Risk Assessment (CHRA) is an assessment that has to be conducted by the employer arising from the use, handling, storage or transportation of chemicals hazardous to health in their workplace as required by the Occupational Safety and Health, USECHH Regulation 2000, as specified under regulation 11 that the employer shall ensure that any assessment carried out pursuant to this part is conducted by an assessor. There are five duties to be carried out by an assessor; (1)

carry out assessment of health risks arising from the use of chemicals hazardous to health (CHTH) at the workplace (Malaysia, 1994; Malaysia, 2000); (2) furnish a report of the assessment to the employer; (3) make recommendations on the necessity of programme to control exposure of employees to CHTH; (4) present findings and recommendations to the employer upon completion of the assessment report and (5) submit within 30 calendar days a summary to the Director of the nearest DOSH office and forward a copy to the Director General.

The employer is allowed to appoint an assessor registered with DOSH Malaysia to conduct the chemical health risk assessment in their workplace. All assessors should conduct the CHRA Manual (Assessment of the Health Risks Arising from the Use of Hazardous Chemical in the Workplace (2nd Edition), 2000) that was published by DOSH. The manual provides guidance for competent assessors to conduct an assessment of health risks arising from the use, handling, storage, or transportation of chemicals hazardous to health at the workplace as required by the Occupational Safety and Health (USECHH) Regulation 2000.

CHRA is a cornerstone on which compliance with the USECHH Regulations 2000 is achieved. It requires employers to make a comprehensive assessment of the risk of employee exposure to chemical hazardous to health in the workplace for the purpose of enabling decision to be made on appropriate control measure, further training of employee, monitoring and health surveillance activities as may be required to protect the health of employees who may be exposed to chemical hazardous to health at work. CHRA's first objectives are to identify the hazards posed by each chemical substance used, stored, handled, or transported within the workplace. Second, to evaluate the degree of exposure of employees to the chemical hazardous to health, either through inhalation, skin absorption, or ingestion. Third, to evaluate the adequacy of existing control measures. Fourth, to conclude on the significance of health risk posed by the chemicals hazardous to health, and fifth, to recommend further appropriate control measure to prevent or reduce risks. This is based on the Assessment of the Health Risks Arising from the Use of Hazardous Chemical in the Workplace (DOSH, 2000).

In carrying an assessment involving large number of chemical substances, chemical mixture or preparations or complex chemical processes, a team comprising of assessors or an assessor and specialists or competent person is compulsory. It is

recommended that an assessment team be set up to ensure that the assessment can run smoothly. The assessor should have the abilities to:

a) Interpret the information in the Safety Data Sheets (SDS) and labels;
b) Understand the hazard classifications as prescribed by Classification, Labelling and Safety Data Sheets of Hazardous Chemicals (CLASS) Regulations 2013;
c) Observe the conditions of work and foresee potential problems induced to occupational disease or injury;
d) Communicate effectively with employees, contract workers, managers, specialists, and others by presentation and documented report;
e) Draw all the information together in a systematic way to form a valid conclusion about exposures and risks generated from chemical exposure;
f) Report the findings accurately to all parties concerned such as employers and authority.

Therefore, the inter-rater reliability study from different assessors' points of view would be beneficial as it is vital to study how the hazard rating is performed and decided by each assessor based on their knowledge and experiences in assessing chemical hazard at the workplace.

1.2 Problem statement

Chemicals are used widely throughout the world, including Malaysia, as it could improve our daily lives and provide human with a lot of benefits. From the economic point of view, the chemical industry in Malaysia experiences a growth in export of 23.8% in 2016 compared to 2015, giving a total export amount of RM 40.82 billion (MITI, 2016). This amount contributes to 6.4% of Malaysia's total export in 2020. Meanwhile, imports on chemicals into the country are also significant in which it contributes 8.6% to the country's total import amount of RM 45.3 billion.

Although chemical use offers improvements to our daily lives, some chemicals pose certain threats to the safety and health of humans as well as the environment. Data obtained from the Social Security Organisation (SOCSO) Malaysia indicate an increase from 2630 to 4270 cases of occupational diseases that are associated with exposure to chemicals hazardous to health (SOCSO, 2016). An increase of 62% of the

cases related to occupational diseases and expectation are likely to intensify in coming years.

Some examples of chemicals that are claimed to be hazardous to health through research are asbestos, benzene, and formaldehyde. The U.S. Department of Health and Human Services, Environmental Protection Agency (EPA), and the International Agency for Research on Cancer (IARC) have classified asbestos as a known cancer-causing chemical to humans (Cogliano *et al.*, 2011). Asbestos is widely used in Malaysia as construction/roofing material, exposing and risking a substantial number of industrial workers to diseases such as lung cancer and asbestosis. Benzene, used to produce polymers and plastics, is also another chemical that is classified as carcinogenic by the aforementioned agencies. Another chemical recently classified as carcinogen by IARC is formaldehyde (Hauptmann *et al.*, 2009). Formaldehyde is widely used as adhesive in Malaysia. The number of workers involved in the manufacturing and handling of these types of chemicals is substantial and therefore their welfare needs to be taken care of.

In accordance with the Use and Standard of Exposure of Chemicals Hazardous to Health (USECHH) Regulation 2000, Regulation 9 assessment of risk to health, an employer shall not carry out any work which may expose or is likely to expose any employee to any chemical hazardous to health unless has made a written assessment of the risks created by the chemical to the health of the employee, which contain as follows:

a) The potential risks to an employee as a result of exposure to chemicals hazardous to health;
b) The methods and procedures adopted in the use of the chemicals hazardous to health;
c) The nature of the hazard to health;
d) The degree of exposure to such chemicals hazardous to health;
e) The risk to health created by the use and the release of chemicals from work processes;
f) Measures and procedures required to control the exposure of an employee to chemicals hazardous to health;
g) The measures, procedures, and equipment necessary to control any accidental emission of a chemical hazardous to health as a result of leakage, spillage, or process or equipment failure;

h) The necessity for employee exposure monitoring programme;
i) The necessity for health surveillance programme; and
j) The requirement for the training and retraining of employees as required under regulation 22.

Based on Occupational Safety and Health, USECHH Regulations 2000 require chemical health risk assessment (CHRA) to be conducted to assess the health risks arising from the exposure of using chemicals at the workplace. Each chemical has its own documented Safety Data Sheet (SDS), and according to CLASS Regulation 2013, all 16 elements are required. Elements regarding hazard classification, health effects, hazard statement (health code), and toxicological information are vital for determining hazard rating. Industries in Malaysia have to commit and review their Chemical Health Risk Assessment (CHRA) report every five years to ensure the chemicals stored and used are safe for workers. Review assessment should be done every five years or when there is a change in or as directed by the Director General of DOSH. Thus, every five years, a competent assessor will be hired to conduct CHRA at industries.

A complete set of SDS document is comprehensive to lead with decisive judgment by competent assessors and determination of hazard rating (HR). The hazard rating is used to prioritize hazard based on the potential health effects of the chemical depending on the substances and composition. It is rated on a scale of 1 to 5 with the rating of 1 implying not hazardous and rating of 5 implying most hazardous to health effects. This hazard rating is harmonized with the classification of hazardous chemical under the CLASS Regulation 2013. Any given chemical together with its SDS would result in the same output. As these chemicals contain the same ingredients, assessor of hazard determination should conclude in the same hazard rating value. However, in certain CHRA report, it was found that hazard rating concluded for the same chemical names and brands differs when determined by competent assessors.

On the other hand, an incomplete source of SDS would rather give indecisive determination. Thus, the need is to study the inter-reliability of hazard rating determination on the same set of chemicals hazardous to health as to identify the common problems of inconsistency. Hazard rating determination differences of the same type of chemicals would lead to the reliability of the whole recommendation of the Chemical Health Risk Assessment (CHRA) report. This written report is essential

and would assists industries in preventing chemical related incident as well as providing accurate information.

1.3 Objectives

Inter-rater reliability of the hazard rating assessment assessor for chemical hazardous to health in Klang Valley has objectives as follows:

a) To identify the usability of safety data sheet resources for hazard rating during chemical health risk assessment.

b) To evaluate the significant factors influencing the hazard rating for chemical health risk assessment.

c) To investigate the inter-rater reliability of professional judgement for hazard rating among competent assessors.

1.5 Scope of study

The boundary of this study focuses on:

a) The data collection will be collected among approximately 50 competent assessors registered with DOSH in Klang Valley.

b) Developing a questionnaire based on the concept of knowledge, attitude, and practice for practitioners (competent assessors).

c) Using questionnaire consisting of personal data information, background study qualification, assessor experiences, and amount of CHRA conducted annually as inclusive variables.

d) Five different types of chemicals to be studied are Saphira MRC UK, KMC – TEG, Hydrogen Sulphide, Fovac lubricant chemseal, and Saphira blanket cleaner chemicals – to compare hazard rating determination among assessors.

e) Using recommended practice manual on assessment of health risks arising from the use of chemicals hazardous to health at the workplace (2^{nd} and 3^{rd} Editions) to determine hazard rating (HR).

f) Inter-rater reliability technique to be used for data analysis using SPSS software.

g) Justify the resource element to be studied in the SDS.

1.6 Significance of study

From the findings of the study, assessor's hazard rating determination would distinguish the outcome of the recommendation of CHTH. Therefore, this study will define the suitable knowledge, experience, and skill that would enhance an assessor's job satisfaction, improve quality, and intensify productivity in referring to the deviation judgment during CHRA. In Malaysia, there have been no researches done in evaluating and investigating assessors' judgment of chemicals from the same source.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Diseases resulting from exposure to chemicals and physical agents have existed since people know those are needed, and how it is important to handle hazardous materials. As the Earth grows old, human race faces various potential hazardous chemicals at work and at home. The sources of these chemicals are as near as house deodorizers and solvents from industry. The descriptions of occupational diseases recorded hundreds of years ago were accurate even though the disease has not always been recognized and associated with their effects. Hippocrates, in the fourth century Before Common Era (BCE), are among the earliest person who has recorded work-related diseases and observations of lead poisoning among miners. Chemicals enter through inhalation, dermal of eyes and skin, and through ingestion, thus work-related diseases can occur due to handling chemicals. In China today, oil-based drill cuttings lead to heavy metal wastes, such as chromium, copper, cadmium, manganese, nickel, lead, and zinc (Tengtun *et al.*, 2019). Other emerging issues include heavy metals in cosmetic production which would lead to eye problem to workers (Barroso *et al.*, 2017).

2.2 Industrial hygiene as a recognized profession

The profession of a hygienist is general unknown and unrecognized by the general public, with only few industries employed industrial hygienists in 1900s (Nims, 1999). Although there have been misconceptions about industrial hygienists, the situation changes over time. From the perspective of a physician, an industrial hygienist is often

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