An Interview Survey: Knowledge on Chemical Hazards Among Chemistry Laboratory Staff at Secondary Schools in Kubang Kerian, Kelantan

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CERTIFICATE

This is to certify that the dissertation entitled

"An Interview Survey: Knowledge on Chemical Hazards Among Chemistry Laboratory Staff at Secondary Schools in Kubang Kerian, Kelantan"

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CONTENTS

ABSTRACT

The project aimed to evaluate the level of knowledge chemical and practice of chemical safety and also promote knowledge pertaining to hazardous chemical to staff working in the chemistry laboratory. Indirectly, the awareness of staff on the importance of chemical safety was also evaluated. The study was at chemistry laboratory of secondary schools in Kubang Kerian. There 5 schools in the Kubang Kerian district that have chemistry laboratory. A standard questionnaire was developed and utilized to obtain feedback from the laboratory staff. All the respondent willingly completed the questionnaire through verbal interview. These questionnaire includes question pertaining to classification of hazardous chemicals, ability to identify chemical hazards based on CPL (Classification, Packaging and Labeling) Regulation 1997, storing of bulk chemicals, recognizing chemicals warning symbol, handling control measures, training, and to access MSDS (Material Safety Data Sheets) and understanding of CPL (Classification, Packaging and Labeling) Regulation 1997. The result indicated that all the respondents are unaware of MSDS and the need to obey CPL Regulation 1997. Specific training about handling and managing hazardous chemicals was less provided. While some general chemical control measure were not practiced, lack of personal protective equipment and administrative controls which means safety are not emphasized in the laboratory. This information can be used in increasing awareness about hazardous chemicals, and extent to the planning and prioritizing of educative and other preventive strategies, to minimize risks to health and safety arising from work with hazardous chemicals substances.

ABSTRAK

Projek ini adalah bertujuan untuk menilai tahap pengetahuan tentang bahaya dan juga keselamatan bahan kimia dan meningkatkan pengetahuan tentang bahaya kimia dikalangan pembantu makmal. Di samping itu, kesedaran tentang keselamatan bahan kimia perlu ditingkatkan dikalangan pembantu makmal. Kajian dijalankan pada sekolah menengah di dalam daerah Kubang Kerian. Terdapat 5 buah sekolah kesemuanya. Satu soalan kajian soal selidik dihasilkan dan digunakan untuk menilai maklum balas daripada pembantu makmal. Semua responden berjaya menjawabnya melalui temubual . Soalan-soalan ini terdiri daripada bahagian-bahagian bahaya bahan kimia dan juga bagaimana hendak mengenali bahaya bahan kimia berdasarkan CPL (Classification, Packaging and Labeling) Regulation 1997, cara penyimpanan bahan kimia pukal, kemampuan responden mengenali symbol yang terdapat pada botol bahan kimia, penggunaa alat kawalan keselamatan bahan kimia, dan juga penggunaan MSDS (Material Safety Data Sheets). Keputusan kajian menunjukkan semua para responden tidak tahu dan tidak menyedari MSDS (Material Safety Data Sheets) dan juga tidak mematuhi CPL (Classification, Packaging and Labeling) Regulation 1997. Latihan kursus mengenai pengendalian dan pengurusan bahan kimia berbahaya kurang dijalankan.

Disamping itu, bahan kimia berlebihan tidak dilupuskan mengikut jadual pelulupusan DOE (Department of Environment). Selain itu, alat kawalan keselamatan tidak digunakan sepenuhnya, kurangnya penggunaan alat kawalan kesematan tersebut menunjukkan bahawa keselamatan didalam makmal tidak dititikberatkan. Segala maklumat ini boleh digunakan untuk meningkatkan kesederan tentang bahan kimia berbahaya, disamping merancang dan mengutamakan pendidikan dan juga langkah-langkah pencegahan yang sesuai untuk mengurangkan risiko terhadap kesihatan dan meningkatkan keselamatan di tempat kerja apabila berurusan dengan bahan kimia berbahaya ini.

CHAPTER 1

INTRODUCTION

In 2000, one Guidelines are released which is to elaborate on and explain the requirements of Regulation 14 to Regulation 19 of the Occupational Safety and Health (Use and Standard of Exposure of Chemicals Hazardous to Health) Regulations 2000, which stipulates the duty of employer to take action to control chemicals hazardous to health, through progressive application of control measures in the order of elimination, substitution, isolation, process modification, engineering control, safe work procedure and personal protective equipment which can reduce the exposure level of employees to the lowest practicable level. The Guidelines also recommend, some method of control that have been used widely by the industries world wide.

The principal objective of this regulation is to minimize risks to health arising from occupational exposure to hazardous substances, thereby achieving a reduction in the incidence of occupational disease and mortality associated with these substances. Such information from the Guidelines is needed in order to inform, plan and prioritize prevention programs to ensure that the occupational health problem arising from hazardous substances is indeed minimized, and to provide baseline information against which preventive interventions, including regulatory reforms, can be evaluated (OSHA, 2000).

The research reported here to evaluate the knowledge chemical hazards and practice of chemical safety among laboratory assistant at Secondary

Schools in Kubang Kerian, Kelantan. These study invoke recognized elements of effective management of substances including information provision (labels, material safety data sheets (MSDS), CPL (classification, packaging and labeling) regulation 1997 and register), risk control, with reference to control measures (OSHA, 2000).

The research drew on the practical knowledge and experience of laboratory assistants, in order to gain a workplace perception of the use and management of chemical substances. After analyzed the result, the information would be contributed to Ministry of Education as a platform to access training need for laboratory assistants.

CHAPTER 2

LITERATURE REVIEW

Science Laboratory safety in schools are one of the important aspect that we have to give more attention by school management especially school laboratory which is observed student running experiments. Injury is highly risk in the laboratory if we deal with chemical hazardous. So, the knowledge about type of chemical hazardous is very important (Jahangir, personal communication).

Hazardous chemical substance is a chemical substance which can entail a risk of ill-health or accident because of toxicological properties, temperature, radioactivity, displacement of atmospheric oxygen or the risk of fire, explosion (Annika Hellberg,2002). The existence of a chemical can be conveniently divided into at least five phases which are production, storage, transport, use, and disposal (ILBS, 2003). Hazardous chemicals present physical or health threats to consumers in clinical, industrial, and academic laboratories. They include carcinogens, toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins as well as agents that act on the hematopoietic systems or damage the lungs, skin, eyes, or mucous membranes. OSHA currently has rules that limit exposures to approximately 400 substances (OSHA,2002).

Chemical hazard can be divided into 2 types, health and physicochemical properties.

2.1 Classification based on health effect:

(a) Very toxic, that means substances and preparations which if inhaled or ingested or penetrated into the skin may involve extremely serious, acute or chronic health risks or even death, also can defined as substances and preparations for which the LD-50 absorbed orally in rat is less than 25 mg/kg or LD-50 percutaneous absorption in rat or rabbit is less than 25 mg/kg or the LC-50 absorbed by inhalation in rat is less than 0.5 mg/litre (administered for a minimum period of four hours).

(b) Toxic, that means substances and preparations which if inhaled or ingested or penetrated into the skin may involve serious, acute or chronic health risks or even death, also can defined as substances and preparations for which the LD-50 absorbed orally in rat is between 25 to 200 mg/kg or LD-50 percutaneous absorption in rat or rabbit is between 50 to 400 mg/kg or the LC-50 absorbed by inhalation in rat is between 0.5 to 2 mg/litre (administered for a minimum period of four hours); or substances and preparations which are defined as carcinogenic, teratogenic or mutagenic.

(c) Harmful, that means substances and preparations which if inhaled or ingested or penetrated into the skin may involve limited health risks, also can defined as substances and preparations for which the LD-50 absorbed orally in rat is between 200 to 500 mg/kg or LD-50 percutaneous absorption in rat or rabbit is between 400 to 2000 mg/kg or the LC-50 absorbed by inhalation in rat is between 2 to 20 mg/litre (administered for a minimum period of four hours).

(d) Corrosive, that means substances and preparations which may, on contact with living tissues, destroy them.

(e) Irritant that means non-corrosive substances and preparations which, through immediate, prolonged or repeated contact with the skin or mucous membrane, can cause inflammation (ILBS, 2003).

2.2 Classification based on physicochemical properties.

The classification is as follows:

(a) Explosive that means chemicals and preparations which may explode under the effect or flame or which are more sensitive to shocks or friction than dinitrobenzene.

(b) Oxidizing, that means chemicals and preparations which give rise to highly exothermic reaction when in contact with other chemicals, particularly flammable chemicals.

(c) Extremely flammable, that means liquid chemicals and preparations having a flash point lower than 0 degree Celsius and a boiling point lower than or equal to 35 degrees Celsius.

(d) Highly flammable, that means chemicals and preparations which may become hot and finally catch fire when in contact with air at ambient temperature without any application of energy; solid substances and preparations which may readily catch fire after brief contact with a source of ignition and which continue to burn or be consumed after removal of the source of ignition; liquid substances and preparations having a flash point below 21 degrees Celsius; gaseous substances and preparations which are flammable in air at normal pressure; or substances and preparations which, when in contact with water or damp air, evolve highly flammable gases in dangerous quantities(ILBS, 2003).

2.3 Risk Phrase

The risk phrases which shall be included, where applicable, in labelling of a chemical product at the workplace to supplement the name and the danger symbol with indication of danger. As regards other risk phrases on the supplier's label, the indication of danger beneath the symbol informs on the risk. For examples:

- R340(A certain risk of cancer can not be excluded after frequent exposure)
- R40 (Limited evidence of a carcinogenic effect)
- R10 (Flammable)
- R35 (Causes severe burns)
- R42 (May cause sensitization by inhalation)
- R43 (May cause sensitization by skin contact)
- R45 (May cause cancer)

- R46 (May cause heritable genetic damage)
- R49 (May cause cancer by inhalation)

(ILBS, 2003)

2.4 Safety Guidelines

It is vital to take necessary precaution in the organic chemistry laboratory. The laboratory instructor will advise of specific rules for the laboratory work. The following list of safety guidelines should be observed in all organic chemistry laboratories (Donald, 2002).

2.4.1 Eye Safety

Always Wear Approved Safety Glasses or Goggles. It is essential to wear eye protection whenever work in the laboratory. Even if not carrying out an experiment, a person nearer might have an accident that could endanger others eyes. Even dish washing may be hazardous. We know of cases in which a person has been cleaning glassware only to have an undetected piece of reactive material explode, throwing fragment into the person's eyes. To avoid such accidents, wearing safety glasses or goggles at the all times.

Learn the Location of Eyewash Facilities. If there are eyewash fountains in the laboratory, determine which one is nearest before start to work. If any chemical enters the eyes, go immediately to the eyewash fountain and flush eyes and faces with large amounts amount of water. If an eyewash fountain is not available, the laboratory will usually have at least one sink fitted with a piece of flexible hose. When the water is turned on, this hose can be aimed upward and the water can be directed into the face, working much like an eyewash fountain. To avoid damaging the eyes, the water flow rate should not be set too high, and the water temperature should be slightly warm (Donald, 2002).

2.4.2 Fires

Use Care with Open Flames in the Laboratory. Because an organic chemistry laboratory course deals with flammable organic solvents, the danger of fire is frequently present. Because of this danger, DO NOT SMOKE IN THE LABORATORY. Furthermore, use extreme caution when lighting matches or use any open flame. Always check to see whether the neighbors on the either side, across the bench, and behind when using flammable solvents. If so, either wait or move to a safe location, such as a source of dense vapors that can travel for some distance down a beach. These vapors present a fire danger, and should be careful, because the source of those vapors may be far away. Do not use the bench sinks to dispose of flammable solvents. If bench has a trough running along it, pour only water into it. The troughs and sinks are designed to carry water- not flammable materials- from the condenser hoses and aspirators.

Learn the Location of Fire Extinguishers, Fire Showers, and Fire Blankets. For own protection in case of a fire, it should be immediately determine the location of the nearest fire extinguisher, fire shower, and fire blanket. It is a must to learn how to operate these safety devices, particularly the fire extinguisher.

If there is fire, the best advice is to get away from it and let the instructor or laboratory assistant take care of it. Don't panic! Time spent in thought before action is never wasted. If it is a small fire in a container, it can usually be extinguished quickly by placing a wire gauze screen with a ceramic fiber center or, possibly, a watch glass over the mouth of the container. It is good practice to have a wire screen or watch glass handy whenever using a flame. If this method does not extinguish the fire and if help from an experienced person is not readily available, then extinguish the fire ourselves with a fire extinguisher.

Should your clothing catch on fire, Do not run. Walk purposefully toward the fire shower station or the nearest fire blanket. Running will fan the flames and intensify them (Donald, 2002).

2.4.3 Organic Solvents: Their Hazards.

Avoid Contact with Organic Solvents. It is essential to remember that most organic solvents are flammable and will burn if they are exposed to an open flame or a match. Remember also that on repeated or excessive exposure, some organic solvents may be toxic, carcinogenic or both. For example, many chlorocarbon solvents, when accumulated in the body, result in liver deterioration similar to cirrhosis caused by excessive use of ethanol. The body does not easily rid itself of chlorocarbons nor does it detoxify them; they build up over time and may cause future illness. Some chlorocarbons are also suspected of being carcinogens. Minimize the exposure. Long-term exposure to benzene may cause a form of leukemia. Do not sniff benzene, and avoid spilling it on ourselves. Many other solvents, such as chloroform and ether, are good anesthetics and will put person to sleep if breathing too much of them. They subsequently cause nausea. Many of these solvents have a synergistic effect with ethanol, meaning that they enhance its effect. Pyridine causes temporary impotence. In other words, organic solvent are just as dangerous as corrosive chemicals, such as sulfuric acid, but manifest their hazardous nature in other, more subtle ways.

If pregnant, it may want to consider taking this course at a later time. Some exposure to organic fumes is inevitable, and any possible risk to an unborn baby should be avoided.

Minimize any direct exposure to solvents, and treat them with respect. The laboratory room should be well ventilated. Normal caution handling of solvents should not result in any health problem. If trying to evaporate a solution in an open container, it is a must to do evaporation in the hood. Excess solvent should be discarded in a container specifically intended for waste solvents, rather than down the drain at the laboratory bench.

A sensible precaution is to wear gloves when working with solvents. Gloves made from polyethylene are inexpensive and provide good protection.

The disadvantage of polyethylene gloves is that they are slippery.

Disposable surgical gloves provide a better grip on glassware and other equipment, but they do not offer as much protection as polyethylene gloves. Nitrile gloves offer better protection

Do not breathe solvent vapors. In checking the odor of substance, be careful not to inhale very much of the material. The technique for smelling flowers is not advisable here. Rather, a technique for smelling minute amounts of a substance is used. Pass a stopper or spatula moistened with the substance (if it is a liquid) under your nose. Or hold the substance away and waft the vapors towards the in charged person with hand. But never hold the nose over the container and inhale deeply! If using proper safety precaution, the exposure to harmful organic vapors will be minimized and should present no health risk (Donald, 2002).

2.4.4 Waste Disposal

Do not Place Any Liquid or Solid Waste in Sinks ; Use Appropriate Waste Containers. Many substances are toxic, flammable, and difficult to degrade; it is neither legal nor advisable to dispose of organic solvents or other liquid or solid reagents by pouring them down the sink.

The correct disposal method for wastes is to put them in appropriately labeled waste containers. These containers should be placed in the hood in the laboratory. The waste containers will be disposed of safely by qualified persons using approved protocols.

Specific guidelines for disposing of waste will be determined by the people in charge of your particular laboratory and by local regulations (Donald, 2002).

2.4.5 First Aid: Cuts, Minor Burns, and Acid or Base Burns

If any chemical enters the eyes, immediately irrigate the eyes with copious quantities of water. Tempered water, if available, is preferable. Be sure that the eyelids are kept open. Continue flushing the eyes in this way for 15 minutes.

In case of a cut, wash the wound well with water, unless there are specifically instructions to do otherwise. If necessary, apply pressure to the wound to stop the flow of blood.

Minor burns caused by flames or contact with hot objects may be soothed by immediately immersing the burned area in cold water or cracked ice until no longer feel a burning sensation. Applying salves to burns is discouraged. Severe burns must be examined and treated by a physician. For chemical acid or base burns, rinse the burned area with copious quantities of water for at least 15 minutes.

If accidentally a chemical ingested, call the local poison control center for instruction. Do not drink anything until have been told to do so. It is important that examining physician be informed of the exact nature of the substance ingested (Donald, 2002).

2.5 Case Histories

Understanding reactive chemical hazards may seem like a very basic concept. However, there is no shortage of incidents resulting from inadequate understanding of reaction hazards, or from mishandling reactive chemicals. Reactive chemical incidents can occur at any scale, from the laboratory, through scale up and pilot plant operations, and in large scale production. For example include:

· A laboratory digester exploded when hydrogen peroxide was added to an organic sample. The digestion process called for adding sulfuric acid to the organic sample before adding the peroxide. An operational error or equipment malfunction caused the sulfuric acid addition to be skipped. During the incident investigation, a review of *Bretherick's Handbook of Reactive Chemical Hazards2* indicated the explosive decomposition reaction was known. The referenced literature emphasized the hazard of undercharging or not charging sulfuric acid. The laboratory equipment, although automated so it could be run unattended, had no safeguards to check for sulfuric acid addition before the hydrogen peroxide addition. Fortunately, damage was limited to the equipment and the hood (David W. Mosley et al, 2000)

CHAPTER 3

MATERIALS AND METHODS

There were five government secondary schools equipped with chemical laboratory in the area of Kubang Kerian, Kelantan. The schools were Sekolah Menengah Kebangsaan Kubang Kerian 1, Sekolah Menengah Kebangsaan Kubang Kerian 2, Sekolah Menengah Kebangsaan Long Gafar, Sekolah Menengah Kebangsaan Panji dan Sekolah Menengah Kebangsaan Raja Sakti..

Ministry of Education allocates science laboratories at government secondary schools that are designated for teaching of science stream. The science laboratories are generally consist of biology, physic and chemistry laboratories. The respective secondary schools assigned a chemistry teacher and a laboratory assistant to manage the chemical laboratory. For the purpose of the study, the laboratory assistant was selected.

3.1 Materials

A questionnaire was developed by Jahangir Kamaldin, a lecturer at School of Health Science, University Science Malaysia. The questionnaire was developed based on Malaysia regulatory requirements for standard classification, packaging and labeling of chemicals. The requirements are gazette in the

Malaysian Occupational Safety and Health Regulations (Classification, Packaging and Labeling of Hazardous Chemicals) 1997 (CPL, 1997)

The questionnaire was divided to two parts. The first part described research background, ethical consideration and respondent consent to participate. While the second part consist of three sections, namely (1) Respondent background, (2) Respondent Knowledge and (3) Respondent Practice. Prior to conduct research, a written permission was obtained from Ministry of Education Malaysia (Appendix 1) and Kelantan Department of Education (Appendix 2).

3.2 Methods

3.2.1 The population size.

The study only selected government schools in the area of Kubang Kerian. The list of schools was obtained from the *Jabatan Pelajaran Negeri Kelantan.* (Appendix 4).

3.2.2 Data collection

Before meeting the respondent, the head of the school was informed and appointment was made. Upon meeting the respondents, the background, purpose and the outcome of the research were well explained to the respondent.

As an evidence the information was indicated at the Part One of the questionnaire. After the respondent was satisfied with the explanation and agreed to participate, the person was requested to signature the consent form included in the questionnaire.

The feedbacks from the respondent was obtained through face to face interview and guided by the questionnaire. The aim was to evaluate the level of knowledge, practice and attitude of the respondent pertaining to chemical safety at chemical laboratory. The wording of questions were in simple comprehension either in *Bahasa Malaysia* or English Language as preformed by respondent. Each question was clarified by interviewee upon respondent request. Such approach was designed to facilitate respondents who may have a low level of literacy. The interview conducted objectively in order to seek factual information and avoid individual perceptions as suggested by Bluff.

3.3 Data Analysis

Answer given by the respondents were coded and transformed to numerical. Subsequently the results were analyzed using descriptive statistics.