ASSESSMENT OF CHEMICAL HEALTH RISK AND CHEMICAL SAFETY AWARENESS OF LABORATORY OPERATOR IN UMK, JELI CAMPUS

by

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A report submitted in fulfilment of the requirements for the degree of Bachelor of Applied Science (Sustainable Science)

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DECLARATION

I declare that this thesis entitled "Assessment of Chemical Health Risk and Chemical Safety Awareness of Laboratory Operator in UMK Jeli Campus" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :_____

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Date :_____

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LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
CHRA	Chemical Health Risk Assessment
CSDS	Chemical Safety Data Sheet
DOSH	Department Of Safety and Health
DV	Dependent variable
FSB	Faculty of Earth Science
HR	Hazard Rating
IV	Independent variable
JPKKP	Jawatankuasa Persekitaran, Keselamatan, Kesihatan Pekerja
MSDS	Material Safety Data Sheet
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Act
OSHA	Occupational Safety and Health Act 1994
PPE	Personal Protection Equipment
RR	Risk Rating
SPSS	Statistical Package for the Social Science
UMK	Universiti Malaysia Kelantan
USECHH	Use and Standard of Exposure of Chemicals Hazardous to Health

LIST OF SYMBOLS

%	Percentage

Assessment of Chemical Health Risk and Chemical Safety Awareness of Laboratory Operator In UMK, Jeli Campus

ABSTRACT

The objective of this study were to assess the chemical health risk in UMK teaching laboratory and to suggest risk control or action to be taken for the UMK teaching laboratory based on the assessment conducted. Besides that, this study also to determine the level of chemical safety awareness of laboratory operator in UMK. Chemical Health Risk Assessment (CHRA) conducted with the purpose of enabling decisions to be made on appropriate control measures, induction and training of employees, monitoring and health surveillance activities as may be required to protect the health of employees who may be exposed to chemicals hazardous to health at work. In addition, it also to evaluate the sufficiency of the current control measures practiced by the laboratory operator. Survey is conducted in order to identify the level of awareness among students (first year and third year), lecturer, lab assistance and science officer. Result showed that teaching laboratory in UMK Jeli campus can be conclude as C3, which risk significant now; and not adequately controlled. The use of chemical in both work unit (Chemistry subject and Waste Management and Pollution Prevention subject) can adversely affect the health of the laboratory operator. At the same time, not adequately control to prevent the laboratory operator from the exposure of hazardous chemical to health. Meanwhile, the level of awareness in UMK Jeli Campus is good. As a conclusion, the laboratory operator have a good awareness about the chemical safety, but there are no practices or implementation during laboratory activities.

Penaksiran Risiko Kepada Kesihatan dan Kesedaran Keselamatan Kimia Oleh Operator Makmal Dalam UMK Kampus Jeli

ABSTRAK

Objektif kajian ini adalah untuk menilai risiko bahan kimia terhadap kesihatan di makmal pengajaran UMK dan mencadangkan kawalan risiko atau tindakan yang perlu diambil berdasarkan penilaian yang dijalankan. Selain itu juga, untuk mengenal pasti tahap kesedaran keselamatan kimia terhadap pengendali makmal di UMK. Penaksiran Risiko Kepada Kesihatan (CHRA) dijalankan dengan tujuan untuk membolehkan keputusan dibuat mengenai langkah-langkah kawalan yang sesuai, induksi dan latihan pekerja, pemantauan dan pengawasan kesihatan sebagaimana yang diperlukan untuk melindungi kesihatan pekerja yang mungkin terdedah kepada bahan kimia berbahaya kepada kesihatan di tempat kerja. Di samping itu, ia juga untuk menilai kecukupan langkah-langkah kawalan sedia ada yang diamalkan oleh pengendali makmal. Kajian ini juga dijalankan untuk mengenal pasti tahap kesedaran di kalangan pelajar (tahun pertama dan tahun ketiga), pensyarah, pembantu makmal dan pegawai sains. Keputusan menunjukkan bahawa makmal pengajaran di UMK kampus Jeli boleh di simpulkan sebagai C3, iaitu sekarang berisiko besar; dan tidak dikawal sepenuhnya. Penggunaan bahan kimia untuk kedua-dua unit kerja (subjek Kimia dan subjek Pengurusan Sisa dan Pencegahan Pencemaran) boleh memberi kesan yang teruk kepada kesihatan pengendali makmal. Pada masa yang sama, tiada kawalan yang cukup untuk mencegah pendedahan terhadap kimia berbahaya kepada kesihatan. Sementara itu tahap kesedaran mengenai kesihatan terhadap bahan kimia di UMK kampus Jeli adalah baik. Sebagai kesimpulannya, pengendali makmal mempunyai kesedaran yang baik terhadap keselamatan bahan kimia, tetapi tidak mempraktik dan melaksanakannya semasa aktiviti makmal dijalankan.

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Chemicals are widely used nowadays either in laboratories for research or in industries (Draman *et al.*, 2010). At the same time, chemicals also have improved the quality of life through health care, food security and etc. (Man & Gold, 2005). But, certain chemical substance can cause injury, disease or death (Mat & Gold, 1993). It because, some of the chemical can be classify as a hazard substance. This is because, each chemical have different characteristic which it may be corrosive, explosive, flammable, radioactive, reactive or toxic (Draman *et al.*, 2010).

Chemical hazard can be defined as those where the potentially hazardous energy is released through disruption of the molecular bonding as a result of chemical reaction (Pisaniello & Tepe, 2012). The chemical hazard can cause harm and injury if not properly handled. This is because chemicals can present more than one hazard or combinations of several hazard. For example, corrosive chemical product can caused skin irritation, eye injury or blindness (Energy, 2012). That is why chemical safety is an important thing need to be concern especially in the university laboratories.

Chemistry and research with chemicals in university laboratories have been going on for centuries. Discoveries from chemical research carried out in university laboratories have led to revolutionary developments and advances in all aspects of the human condition. However, each university need to face the challenges for attempts to develop an institutional safety culture (Research; *et al.*, 2014). The major factors for laboratory accidents stem from human attitude and the accumulation of information

and experience, which cause individuals to act in a certain manner when confronted with a particular stimulus (Ismail *et al.*, 2015).

Chemical safety can be achieved by managing chemical in safe and sustainable ways to ensure the health and safety of employees and environment from the harmful effects of hazardous chemicals. The person who are in charge about chemical safety at workplace need to ensure that they controlling all kind of risk that may exist (Horgan, 2011). To control all kind of risk, an assessment of all chemicals used must be carried out in order to identify, evaluate and control any health risk associated with laboratories activities involving the use of the chemicals. According to the Occupational Safety and Health (Use and Standard of Exposure of Chemicals Hazardous to Health) Regulation 2000, the duty to perform an assessment of health risk arising from the use of chemicals hazardous to health at the workplace is mandatory. Whereby employers are not permitted to use any chemicals hazardous to health unless an assessment has been conducted (DOSH, 2000).

1.2 Problem Statement

Laboratory has been given a central and distinctive role in science education (Lunetta, 2003). During Laboratory session, students can apply the theory that they learn in the class by conducting experiment. Doing experiments in the laboratory will increase the understanding of students about the theory they had learn in class and will also increase their laboratory skills. In other words, laboratory session is a place for the students to develop their understanding of scientific concepts, science inquiry skills, and perception of science (Lunetta, 2003)

Laboratory is not a safe place to the students, lecturer and also lab assistance because laboratory is synonym with the hazardous chemical substance. The laboratory operator will probably expose with many kinds of hazardous chemicals. The most dangerous things are, it can cause accident and fatality. This hazardous chemical can enter their body by ingestion, inhalation, and absorption also can give acute or chronic effect to them. The accidents in the laboratory may probably easy to occur when the operators of the laboratory are not aware and understand the importance of the chemical safety. Lack of awareness among them can cause loss to the equipment or life.

To overcome this problem, it may require the continuous studies of chemical safety awareness in order to improve the chemical safety in laboratory. The Chemical Health Risk Assessment (CHRA) was conducted to know the level of risk in the laboratory to the operator health's. The result from this assessment can be a guideline to mitigate the hazardous environment in the laboratory.

1.3 Objectives

The objectives of this study were as follows:

1) To assess the chemical health risk in UMK Jeli Campus teaching laboratory
2) To suggest risk control or action to be taken for the UMK Jeli Campus teaching laboratory based on the assessment conducted
3) To determine the level of chemical safety awareness of laboratory operator in UMK Jeli Campus

CHAPTER 2

LITERATURE REVIEW

2.1 Chemistry

Chemistry can be defined as the study and practice of making basic materials and determining their character. It also include the preparation of mixtures by simple mixing of components (Nelson, 2003). The ability of basic material to change into other components makes this chemistry more interesting and useful. At the same time, chemistry also known as the science of atom and molecules, because it deals with the composition, structure and properties matter (Narlikar .J.V *et al.*, 2006).

Chemistry is the branch of science that studies the composition, properties and interaction of matter. Chemists are interested in knowing how chemical transformations occur. Chemistry plays a central role in science and is often intertwined with other branches of science like physics, biology, geology etc. Chemistry also plays an important role in meeting human needs for food, health care products and other materials aimed at improving the quality of life. (Narlikar .J.V *et al.*, 2006)

In chemistry, periodic table (shown in figure 2.1) is the most important chemistry reference as a chemical classification. It arranges all the known elements in an informative array. Elements are arranged left to right and top to bottom in order of increasing atomic number. Order generally coincides with increasing atomic mass. The period (different row of elements) number of an elements signifies the highest energy level an electron in that element occupies. Elements that lie in the same column on the periodic table (called a group) have identical valance electron configurations and consequently behave in similar fashion chemically (Alamos, 1943).

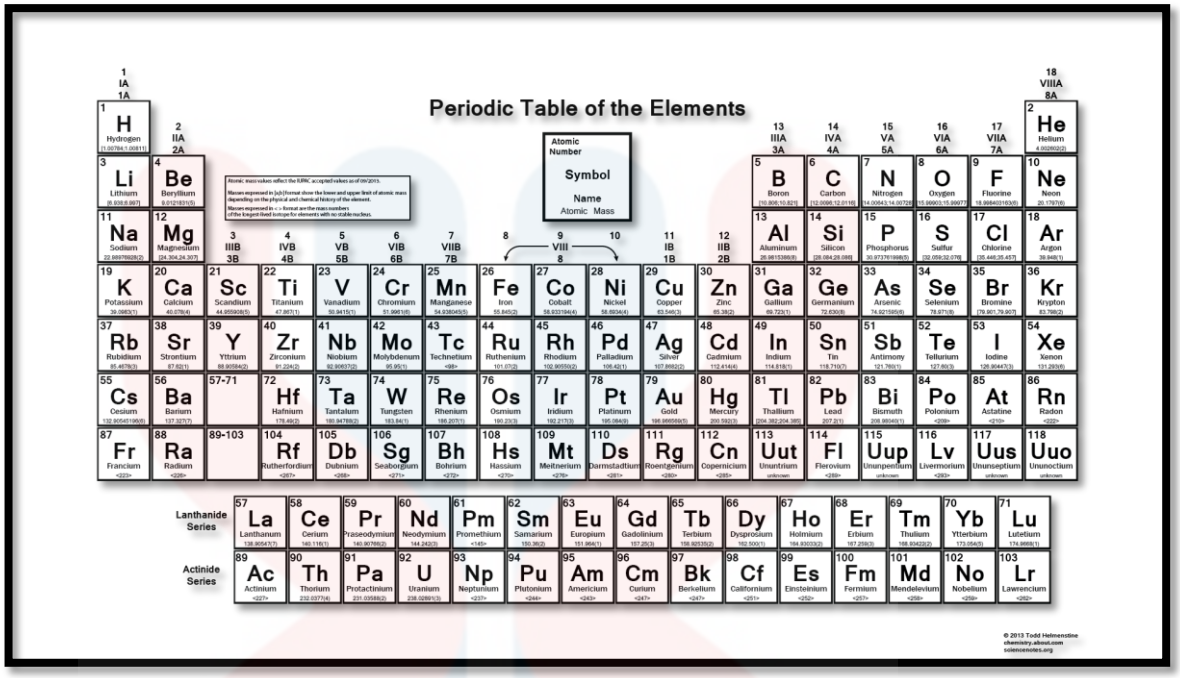


Figure 2.1: Periodic table (Todd, 2015)

2.2 Hazardous Chemicals and their Effects

Hazardous chemicals can be classified as a substance that capable to produce adverse effect to the human or environment (Wisconsin, 2004). A chemical that is categorized as hazardous can be either a physical or health hazard or both of it (Narayanasamy, 2014). Physical hazards can be define as a hazards that arise at work due to the influence of various form of energy. For example noise, temperature, lighting and radiation (DOSH, 2011). There is scientific evidence to classified physical hazards of chemical substance, which is flammable, combustible or explosive material, compressed gas, organic peroxide or an oxidizer. This physical hazard could cause damage to the physical surroundings through fire or explosion (Narayanasamy, 2014).

Health hazards synonyms with the occupational disease (Organization., 2001). It can arise from chemicals through acute exposure or chronic exposure (Narayanasamy, 2014). Acute exposure is exposure to a large, single dose of radiation, or a series of doses, for a short period of time (Poyarkov *et al.*, 2008). Symptoms resulting from acute exposures usually occur during or shortly after exposure (Kleiner *et al.*, 1985). For example, extremely high levels of acute radiation exposure can result in death within a few hours, days or weeks. It is because radiation affects different people in different ways, it is not possible to indicate what dose is needed to be fatal. The concentration required to produce such effects varies widely from chemical to chemical (Kleiner *et al.*, 1985).

The term chronic exposure generally refers to continuous or intermittent exposure to low levels of radiation over a long period of time in other words it develop slowly. It also considered to produce only effects that can be observed some time following initial exposure (Poyarkov *et al.*, 2008). The "low" concentrations required to produce symptoms of chronic exposure depend upon the chemical, the duration of each exposure, and the number of exposures (Kleiner *et al.*, 1985). For example, if workers breathe small amounts of asbestos fibers, they won't even notice them. This is because there are no acute effects, but if they inhale asbestos month after month, year after year, they greatly increase the chances of getting asbestos disease, such as lung cancer (Council, 2009).

2.3 Chemical Safety

Accidents that involved during handling the chemical substance arise mostly from human error (Narayanasamy, 2014). It occur in many ways but the basic factors of it is ignorance or carelessness (Project, 2012). Most of the workers ignore about the safety instruction at the workplace and also taking easy of it. Some of them also didn't give full attention to their work and careless during handling the hazardous substance.

To prevent the accidents in the laboratory, each person need to have knowledge about the safety precautions (Narayanasamy, 2014). It must involve the understanding of the characteristic of particular chemical substance that will be used in the experiments. It also need to covers the information about what to do and what to avoid when handling chemicals. The most important source of chemical safety is characteristic described in the Material Safety Data Sheet (MSDS) (Narayanasamy, 2014).

Hazard relating to chemical in the workplace can come into contact with the worker or the environment, or that can produce a fire or an explosion. It can be control with reduce or eliminate it to the lowest possible level. The best method of preventing diseases and injuries caused by chemicals would be provide a working environment that is free from hazardous chemicals (Man & Gold, 2005). However, this is not always feasible. Therefore, it is necessary to isolate the danger, increase ventilation or used personal protective equipment (Man & Gold, 2005).

Personal protective equipment (PPE), is designed to protect the user from the health or safety risk at work (Executive, 2013). This equipment is the best approach to sustain a safe work environment and eliminate potential hazards (OSHC, 2001). The example of the equipment are such as safety helmets and hard hats, gloves, eye protection, high-visibility clothing, safety footwear and safety harnesses. But, the appropriate equipment need to choose wisely according to the situation at the workplace (OSHC, 2001). Every situation have a different risk exposure.

2.4 Occupational Safety and Health (OSH)

Occupational safety and health is an extensive multidisciplinary field, invariably touching on issues related to scientific areas such as medicine (including physiology and toxicology), ergonomics, physics and chemistry, as well as technology, economics, law and other areas specific to various industries and activities (Alli, 2008). The occupational accidents, injuries and diseases and major industrial disasters have long been cause for concern at all levels from the individual workplace to the national and international (Alli, 2008).

In Malaysia the study was directed to examine the awareness regarding health and safety among the staff members. The main objective from Ibrahim *et al.* (2012), to study the connection between the organizational policies regarding safety at the workplace, it include environment of the office, attitudes of staff-members, and commitments by the management. The findings from the study showed that there was a very significant correlation among the analysed and studied variables, which suggested that it is necessary for the management of the organization to set up and promote some safety codes in the organization (Ibrahim *et al.*, 2012).

Another study conducted by Khan *et al.* (2014) investigated the influence of the practices for risk prevention and the organizational factors which comprised of the safety measures, intensity of risk, risk prevention, quality management tools implementation, the enhancing the empowerment of the workers, and the usage of flexible technologies for production (Khan *et al.*, 2014). The results showed that the emphasis upon the prevention activities, empowerment of workers, and the wise use of quality management tools are the factors which contribute to lessen the number of injuries. In contrast to all this higher accident rates were observed as a result of implementing flexible manufacturing processes (Khan *et al.*, 2014).

Protecting employees from the adverse effects of chemicals is one of the primary duties of an employer under the Occupational Safety and Health Act 1994. To perform this duty, an assessment of all chemicals used in the workplace must be carried out in order to identify, evaluate and control any health risk associated with work activities involving the use of the chemicals (DOSH, 2000).

2.5 Occupational Safety and Health Act (OSHA)

Occupational Safety and Health Act 1994 (OSHA 1994) is an act that provides the legislative framework to secure the safety, health and welfare among all Malaysian workforces and to protect others against risks to safety or health in relation with the activities of persons at work stated under OSHA 1994 Part 1 (section 1). This Act was gazetted on 24th February 1994 and cited as the Occupational Safety and Health Act 1994. This Act is a practical tool cover on existing safety and health legislation (Chubb, 2013).

The department of Safety and Health (DOSH) which report to Ministry of Human Resources is responsible in enacting and implementing legislation of Occupational Safety and Health (OSH). Seven safety and health regulations under OSHA 1994 Act have been enforced by DOSH was tabulated in Table 2.1 (Narayanan, 2013).

Table 2.1: List of Regulations (Narayanan, 2013).

Number	Name of Regulation	Years
1	Employers' Safety and Health General Policy Statements (Exception) Regulations	1995
2	Control of Industrial Major Accident Hazards Regulations	1996
3	Classification, Labelling and Safety Data Sheet of Hazardous Chemicals	2013
4	Safety and Health Committee Regulations	1996
5	Safety and Health Officer Regulations	1997
6	Use and Standards of Exposure of Chemicals Hazardous to Health Regulations	2000
7	Notification of Accident, Dangerous Occurrence, Occupational Poisoning and Occupational Disease Regulations	2004

According to the Federal Subsidiary Legislation (2000), Chemical Health Risk Assessment (CHRA) is compliance with the Use and Standard of Exposure of Chemicals Hazardous to Health (USECHH) Regulation 2000 (Envoosha, 2006). The clause of CHRA in USECHH is on the PART II-Identification of Chemicals Hazardous to Health, which include the regulation 5 (refer appendix A). In the regulation 5 (Register of Chemical Hazardous to Health), state that employee need to identify and record all chemical hazardous to health in the workplace. At the same time the information always be updated from time to time (Federal Subsidiary Legislation, 2000).

Under the Occupational Safety and Health (Use and Standard of Exposure of Chemicals Hazardous to Health) Regulation 2000, the duty to perform an assessment of health risk arising from the use of chemicals hazardous to health at the workplace is mandatory. Whereby employers are not permitted to use any chemicals hazardous to health unless an assessment has been conducted (DOSH, 2000). So the academic laboratory need to conduct this assessment if not, the activities involved used of hazardous chemicals cannot been conducted.

2.6 Safety Practice in Academic Laboratory

Laboratory or practical work is considered a crucial component for science students (Ismail *et al.*, 2015). Students practice theories they have learned in the classroom by conducting experiments in the laboratories. This is one of the important ways to develop the scientific skill of the students in science. Laboratories are the arena for student to learn skills or verify scientific theories (Ali *et al.*, 2015).

In order to develop scientific skill, student need to be in protected condition from the hazardous exposure. Exposure of students to hazardous chemicals is depends on handling of chemicals in laboratory. The user of chemical requires understanding of what makes these chemicals dangerous, as well as appreciative of acute and chronic hazards. At the same time, the correct attitude for handling and using chemicals begin with understanding the nature of the chemical and its potential hazard. Misunderstanding or lack of appropriate knowledge to interpret the chemical labelling may lead to an accidents (Draman *et al.*, 2010). The exposure to hazardous chemical should be kept to minimal level to avoid hazards (Mohamed, 2008).

Students should know and understand all the information about the exposure and biological effect each of the hazardous chemicals before used. That information can get from the Material Safety Data Sheet (MSDS) for each chemical. According to previous study conducted by Artdej (2012), the students misunderstood their meaning of safety sign on sodium hydroxide and sodium chloride. The most students incorrectly considered that sodium hydroxide was not corrosive. In fact, solid or solution of sodium hydroxide can cause severe burns if students contact without safety equipment such as goggles and gloves (Artdej, 2012).

2.7 Chemical Health Risk Assessment (CHRA)

Protecting employees from the adverse effects of chemicals is one of the primary duties of an employer under the Occupational Safety and Health Act 1994. To perform this duty, an assessment of all chemicals used in the workplace must be carried out in order to identify, evaluate and control any health risk associated with work activities involving the use of chemicals (Mioshnet, 2013). CHRA is conducted with the purpose of enabling decisions to be made on appropriate control measures, induction and training of employees, monitoring and health surveillance activities as may be required to protect the health of employees who may be exposed to chemicals hazardous to health at work (DOSH, 2000). CHRA manual can be used as a guideline to conduct an assessment of the health risks arising from the threat, handling, and storage or transporting of hazardous chemicals.

This guideline refers to Use and Standard of Exposure of Chemical Hazardous to Health (USECHH) regulation 2000 (Dahan *et al.*, 2009). CHRA is compulsory to conduct in every sector which expose to hazardous chemical. This assessment will help the management to aware about the risk occurs from hazardous chemicals. At the same time, to verify the status of the current practice and the necessity for improvement (Ghafar, 2013). From this report of assessment, it can be used as a reference to the management and employee. So they will be aware on current condition involved in exposure to the hazardous condition. At the same time, the management can make decision either they need to do some improvement or not to the workplace (Ghafar, 2013).

2.8 Statistical Package for the Social Science (SPSS)

SPSS statistical package is one of the most popular statistical packages which can perform highly complex data manipulation and analysis with simple instructions (Li, 2008). This can prevents from making mistakes or even forgetting something (Griffith, 2010). SPSS is specifically made for analysing statistical data and thus it offers a great range of methods, graphs and charts. General programs may offer other procedures like invoicing and accounting forms, but specialized programs are better suited for this function. SPSS also comes with more techniques of screening or cleaning the information in preparation for further analysis (Daniel, 2012). SPSS is capable of handling large amounts of data and can perform all of the analyses covered in the text and much more (Howel, 2010).

CHAPTER 3

MATERIALS AND METHODS

3.1 Study Location

This study was conducted in teaching laboratory of University Malaysia Kelantan (UMK) Jeli campus (coordinates: latitude 5 ° 44' 44.946" N and longitude 101 ° 51' 52.226 E). The main reason in selecting laboratory in UMK Jeli for this study because in this campus is offering applied science courses, where most of the subjects have the lab component. As applied science community, handling and expose to the chemicals is part of their routine especially for the laboratory operator.

Figure 3.1: Location of study area: UMK Jeli campus (Google, 2015).

3.2 Target Population

Respondent of this study were from laboratory operator of the Universiti Malaysia Kelantan Jeli Campus. For the CHRA, it involved first year students (Chemistry subject) and third year students (Waste Management and Pollution Prevention subject) as two work unit for the assessment. It considered as two work unit because each subject have different task or different potential exposure.

Meanwhile, for the survey, it involved lecturer, lab assistant and students. The target population size involved 8 lectures of Sustainable Science, 8 lab assistance under Faculty Earth Science and 88 students involved in this survey, which involved 44 students for each first year and third year students. The target respondent for this study had different age, level of education, occupation and gender

3.3 Materials

Material for this research was divide into two part which for CHRA and questionnaire. To do CHRA, the most important material is manual of Chemical Health Risk Assessment (2nd edition) and act as a guideline under Department of Occupational Safety and Health. To support this assessment, Material Safety Data Sheet (MSDS) is needed, to get some information about each of the chemical used.

In second part of this study, a set of questionnaire were needed to do some survey about the level of chemical safety awareness of laboratory operator in UMK. An application of statistic, Statistical Package for the Social Science (SPSS), need to analysis the data of this survey.

3.4 Chemical Health Risk Assessment (CHRA)

3.4.1 Gather information

Information gathering and initial review were carried out in the preliminary inspection prior to the assessment in order to obtain as much information as possible on the chemicals and related tasks. Basic information includes the information on chemicals in the work place, layout plan, process flowchart, employees at risk, engineering control equipment, accidents and incidents, monitoring programme, health surveillance, training programme, and personal protective equipment programme.

3.4.2 Divide into work unit

Work unit can be defined as essentially a group of workers doing similar task (or having similar potential for exposure) whether in one work area covering several works areas and exposed to the same chemicals hazardous to health (Department of Occupational Safety and Health, 2000). First of all to identify the work unit, an inspection was conducted by walk through the work areas and obtained list of job tittle groups that involved of each area. For each job group the hazardous chemicals were exposed to, tasks performed and location of work were identified. To know the actual practice in the work area, an interview had been conducted. Lastly, all the information about the work unit will be fill in the form B (refer appendix A and appendix B).

3.4.3 Determine degree of hazard

Determination of the degree of hazards posed by the chemicals in the workplace is to obtain a hazard rating (hr) for that particular chemical. Hr is used to priorities hazards based upon the potential health effects of the chemical. The chemical that can be used for each work unit will be listed and the hazard rating for each chemical can be assigned by using Material Safety Data Sheet (MSDS) provided by supplier, ChemWatch Database & Management System, CLASS Regulations 2013 and Guidelines on the Classification of Hazardous Chemicals and International Chemical Safety Cards.

HR from the source of information is rated on a 1 to 5 scale where 1 implies "not hazardous" and 5 as "most hazardous to health". All the information and list of chemicals for each work unit will be fill in form A (refer appendix B and appendix C).

3.4.4 Evaluate exposure

The purpose of determining exposure rating is to assess the potential of the chemical hazardous to health entering the body through the various routes of entry. It will caused systemic effects or potential for contact with the eyes, skin or the respiratory tract causing localised effects. This information obtained from this evaluation will tabulated in form C and D (refer appendix B and C). Table 3.1 shown some important consideration in the assessment of an exposure.

Table 3.1: Important considerations in the assessment of an exposure in the workplace (DOSH, 2000).

Degree of exposure:	• Who is exposed • How and in what circumstances is the exposure • Frequency of exposure • Duration of exposure • Intensity or magnitude of exposure
Other factors:	• Training and information of employees • Monitoring of exposure • Health surveillance

The degree of exposure is to be estimated for the various probable route(s) of exposure. When a chemical exerts a direct effect to the skin or eyes, a "sk" notation will be made to indicate that skin and eye exposure needs control regardless of absorbed dose (DOSH, 2000). There are three parameters for the estimation of the degree of exposure primarily based on frequency of exposure, duration of exposure and intensity or magnitude of exposure.

First, frequency of exposure are for assessing the likelihood of acute effects which has a significant effects on the degree of exposure. The frequency of potential exposure will be estimated from observation of the work activities and feedback from the workers and management. Frequency rating is used and is determined from Table 3.2.

Table 3.2: Frequency rating (DOSH, 2000)

Rating	Description	Definition
5	Frequent	Potential exposure one or more times per shift or per day
4	Probable	Exposure greater than one per time week
3	Occasional	Exposure greater than one per time month
2	Remote	Exposure greater than one per time year
1	Improbable	Exposure less than one time per year

Second, duration of exposure was used to assess chronic or routine exposures and has a significant effect on the exposure. For assessing chronic exposure, the total exposure duration will be use rather than the frequency of exposure. The total exposure duration is the product of the number of exposures and the average duration of each exposure, shown in Table 3.3.

Table 3.3: Duration rating (DOSH, 2000)

Rating	**Total duration of exposure**	
	% Work Hour	Duration per 8 hour shift or 40 hour week
5	>87.5	>7 hour/shift or >35 hour/week
4	50.0 – 87.5	4 to 7 hours/shift or 20 to 35 hours/week
3	25.0 – 50.0	2 to 4 hours/shift or 10 to 20 hours/week
2	12.5 – 25.0	1 to 2 hours/shifts or 5 to 10 hours/week
1	<12.5	<1 hour/shift or <5 hours/week

Third, intensity or magnitude of exposure for estimating exposure intensity or magnitude. There are two possible ways, either quantitatively or qualitatively. In the presence of quantitative inhalation exposure data, this will form the basis of the estimate. In the absence of quantitative data, a qualitative estimate of exposure will be used. Quantitative evaluation carried out for inhalation exposure (if air sampling data for exposed employees are available) while qualitative is made for the two main routes of entry (refer appendix D).

3.4.5 Control measures

Control measures are steps taken to prevent or minimize risks. The hierarchy of control measures is shown in the Figure 3.3 accordance with USECHH Regulations, 2000. To determine the adequacy of the control measure will include three factors which is suitability, use and effectiveness, and maintenance. Some supporting control measure will be adopted as part of the chemical health risk management, involved personal hygiene; control equipment maintenance; providing information, instruction and training to workers; personal exposure and area monitoring (to check on effectiveness of control measures); workers health surveillance; and emergency and first aid procedure.

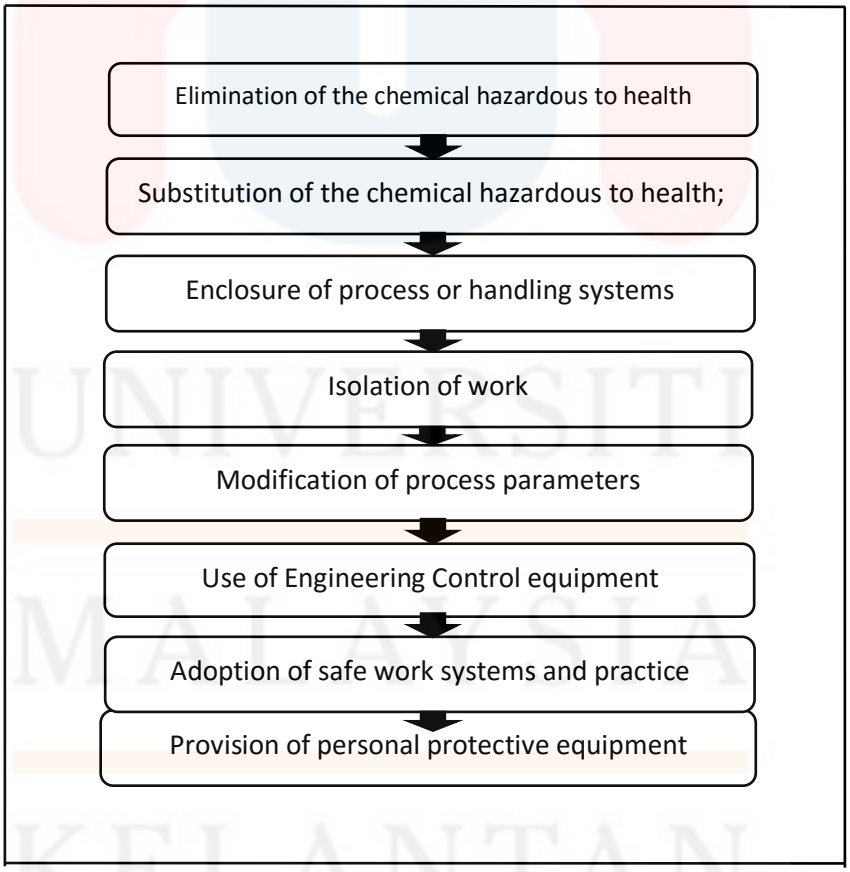


Figure 3.2: Hierarchy of control measure (DOSH, 2000)

3.4.6 Determination of risk – assigning risk rating

The Risk Rating (RR) is obtained from the hazard determination process and the exposure evaluation is described in Section 3.4.3 and 3.4.4 respectively. Risk will be evaluated as either "significant" or "not significant". Table 3.3 will be used to identify and prioritise control strategies. Priority in implementing control measures will depend on the degree of risk, the number of person at risk and the practicability of the control measures.

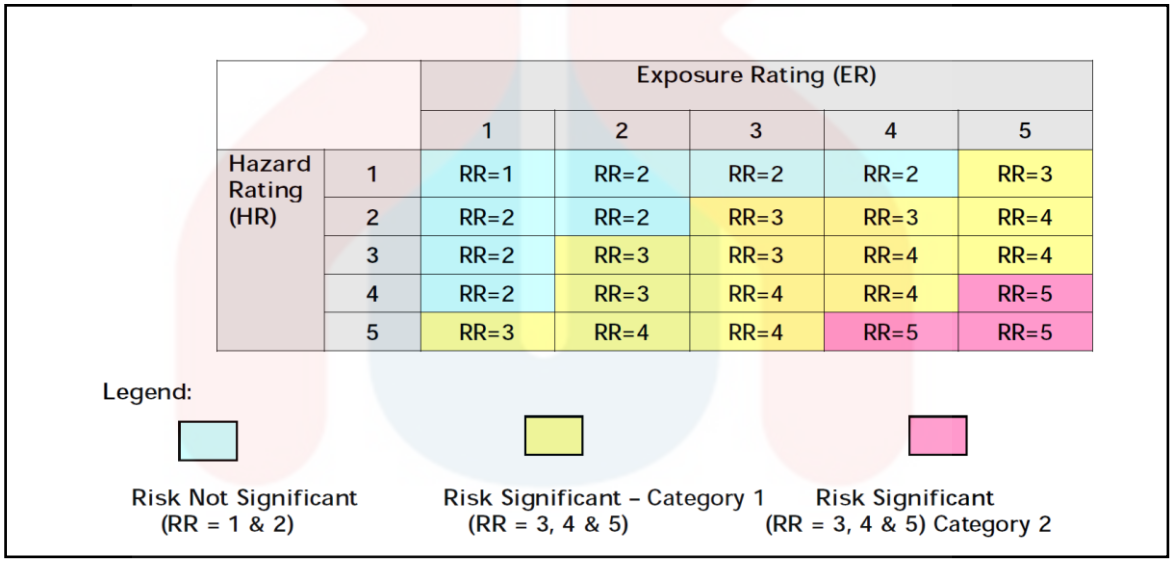


Figure 3.4: Risk Matrix (DOSH, 2000)

For the purpose of prioritising action to control risks, two categories can be assigned under significant risk. First, **Category 1** is assigned where the risks must be controlled to as low as reasonably practicable (ALARP). Under the Occupational Safety and Health Act, 1994, practicable means taking into consideration involve severity of risk; existing knowledge about the risk; availability and suitability of mitigation or elimination measure; and cost of mitigation and elimination measures.

Category 2 is considered intolerable risk, where the chemical hazardous to health should be eliminated. If this is not possible then substitution of the hazardous chemical with a less hazardous chemical ; total enclosure of the process and handling system; or isolation of the work to control emission of chemicals hazardous to health is to be adopted so that employees exposure are kept well below the permissible exposure limits.

3.4.7 Risk conclusion

The conclusion of the assessment is taking into account the risk rating (RR) as described in Section 3.4.6 and the adequacy of control measures described in Section 3.4.5. There are five conclusions that may be obtained as shown in Table 3.5 and Table 3.6 below.

Table 3.4: Conclusion of assessment (DOSH, 2000)

Risk Decision	Adequacy of Control Measure	Conclusion
Risk Not Significant	-	C1
Risk Significant	Adequate	C2
	Not Adequate	C3
Insufficient Information	-	C4
Uncertain about Exposure	-	C5

Table 3.5: Conclusion of assessment description (DOSH, 2000)

Conclusion	Description
C1	Risks Not significant now and not likely to increase in future
C2	Risks significant but already adequately controlled could increase in future
C3	Risk significant now; and not adequately controlled
C4	Uncertain about Risk; Insufficient information
C5	Uncertain about risk; uncertain about degree and extent of exposure

3.4.8 Action to be taken assessment

At the end of the assessment action will be taken on the risk decision obtained. The action will be required as a summarized in Table 3.7.

Table 3.6: General Actions Required (DOSH, 2000).

Conclusion	Actions Required
C1	• End assessment and • Review in 5 years or when there were changes
C2	• Determine precautions to maintain control and minimize chance of higher exposure occurring; • Determine additional control measure for unexpected/unwanted events; • Determine monitoring or health surveillance requirements; and • Review assessment in 5 year or when there were changes.
C3	• Determine immediate measures for preventing or controlling exposures; • Establish need to stop process; • Review longer term control measures; • Determine monitoring or health surveillance requirements; and • Re-evaluate exposure when improve control measure in place.
C4	• Obtain additional information-obtain specialist advice if necessary; • Determine immediate measures for preventing or controlling exposures; • Establish need to stop process; • Review longer term control measures; • Determine monitoring or health surveillance requirements; and • Re-evaluate exposure when improve control measure in place.
C5	• Conduct a more detail assessment-obtain specialist advice if necessary; • Determine immediate measures for preventing or controlling exposures; • Establish need to stop process; • Review longer term control measures; • Implement good work practice to minimize exposures; • Determine monitoring or health surveillance requirements; and • Re-evaluate exposure when improve control measure in place.

3.5 Questionnaire

3.5.1 Design questionnaire

A set of the questionnaire (refer appendix 5) was design to evaluate the chemical safety awareness and practices of the respondent. The questionnaire was adopted from previous study by Siti Zulhanini Binti Zulkefli with a few amendment. The design of this questionnaire contain four part, which start from Section 1 (demographic), Section 2 (awareness), Section 3 (practice for chemical safety), and Section 4 (recommendation).

Demography is the study of human populations including their size, composition and distribution across place and the process through which populations change (Sociology, 2016). In section 1, it consist five questions which is age, gender, race, occupation and level of education. This section described the characteristic of the respondent.

In section 2, it consist of three parts which is knowledge, skills and attitude. The three part in this section give a meaning of awareness. Part A (knowledge), to determine the level of knowledge of respondent towards chemical safety. Part B (skills), to determine the skill that related with the chemical safety and part C (attitude), to determine the concern behaviour of respondent at laboratory related to chemical safety. This part consist 10 question for each part.

Practice for chemical safety in laboratory UMK Jeli campus was determined in section 3. This section consists of 10 question. It touches about how the university manage about the chemical safety including the policy applied, instruction, manual and others.

3.5.2 Pilot study

Pilot study is a small study for helping to design a further confirmatory study (Arain *et al.*, 2010). It also can be the pretesting or 'trying out' of a particular research instrument. One of the advantages of conducting a pilot study is that it might give advance warning about where the main research project could fail, where research protocols may not be followed, or whether proposed method9s or instruments are inappropriate or too complicated (Teijlingen & Hundley, 2001). According to the Connelly (2008), pilot study sample should be 10% of the sample projected (Connelly LM, 2008). The questionnaire were analysed using SPSS software to test the Cronbach's Alpha. Cronbach's Alpha is the most commonly used measure of reliability statistic or internal consistency (Allen, 2004). The reliability and considered acceptable of the questionnaire when the coefficient 0.70 or higher by using Cronbach's Alpha (Garth, 2008).

3.5.3 Distribution of questionnaire

This questionnaire distributed to the target population which is involve in handling laboratory in UMK Jeli campus. The target population have been decided based on stratified sampling, which involved sustainable science students (year 1 and year 3), lecturer and lab assistance. Stratified sampling is the process of dividing a population of elements into distinct sub-populations. The target population size involved 8 lectures of Sustainable Science, 8 lab assistance under Faculty Earth Science and 88 students involved in this survey, which involved 44 students for each first year and third year students.

Table 3.7: Number of respondent

Occupational	Number of people
Lecturer	8
Lab Assistance	8
Students	88
Total of sample	104

3.5.4 Data collection

In surveying, data collection obtained from sample of respondents in order to generalize to their parent population. There are two ways to conduct this surveying which obtained from the self- administered or interview administered (Synodinos, 2003). In this study, self-administered will be conduct which respondent will complete the questionnaire by their self. This method will conduct in large number of respondent at once and involve less administrative time. Also, it categorized as a quantitative method which the information from this method can generate the percentage (Foundation, 2010).

3.5.5 Data interpretation

At the end of this analysis, the result summarised by show the comparison about the knowledge, skill, attitude and practice in UMK Jeli campus between first year and third year students. At the same time, the comparison also made between lecturer and lab assistant or science officer. The analysis of data are made by using independent t-test. T-test was used to analyse statistically significant difference between the means in two unrelated groups.

CHAPTER 4

RESULT AND DISCUSION

4.1 Finding of the Assessment

In this study, 37 types of chemical were recorded. For chemistry subject, the consumption of the chemical involved 34 types of chemical meanwhile, waste management and pollution prevention only consumed 3 types of chemical.

4.1.1 Hazard Rating (HR)

All 37 types of chemicals found in UMK laboratory were ranked for hazard rating (HR). Table 4.1 indicates the HRs for the registered chemical found in the labs. Hazard rating are divided into two categories based on systemic effects and local effects.

Table 4.1: Summary of Hazard rating

Hazard Rating	List of Chemical
1	Potassium Bicarbonate, Hydrochloric acid 0.1M, Potassium Chloride 0.2M, Zinc Sulfate 0.1M, Magnesium Sulfate 1.0M, Glacial Acetic Acid
2	Acetic Acid 0.1M, Potassium Iodide 0.2M, Sodium Sulfate 0.1M, Iron (II) Sulfate 1.0M, Iron (III) sulfate 1.0M, Silver Nitrate 0.1M
3	Potassium Persulfate, Ethanol, Isopropanol, Salylic Acid Crystal, Acetone, Ammonia Salicylate reagent pillows
4	Hydrochloric acid 6M, Hydrochloric acid 3M, Sulfuric acid, Ammonium Nitrate crystal, Sodium Thiosulfate, Copper (II) Nitrate 1.0M, Methanol, 10% Sodium Hydroxide, Dilute sulfuric acid, Potassium Permanganate, Concentrated Sulfuric Acid, Isoamyl Alcohol, Ammonium Hydroxide, Nitric Acid, Sodium Hydroxide 1.25M, Ammonia Cyanurate reagent pillows, Digestion Solution for COD
5	Phenolphthalein solution, 10% Formaldehyde,

Systemic effects can caused hazardous chemicals that can absorbed in to the body and causing damage to organs or system of the body. The chemicals groups in this category based on the greatest degree of hazard from Group 1 hazard categories shown with risk phrases classified very toxic, toxic and harmful. Table 4.2 indicates the chemical into categorised based on systematic effect.

Table 4.2: Summary of systemic Effect

Classification of hazard	List Of Chemical
Very Toxic	-
Toxic	Hydrochloric acid 6M, Sodium Thiosulfate, Copper (II) Nitrate 1.0M, Methanol, Isoamyl Alcohol, Digestion Solution for COD
Harmful	Potassium Persulfate, Ethanol, Potassium Permanganate, Salylic Acid Crystal, Acetone, Ammonia Salicylate reagent pillows

Frequency of exposure also has an important influence on the nature and extent of toxicity (Carroll *et al.*, 2011). The frequency of exposure to the hazardous chemical for all the chemical involved was less than one per year. This is because each of the chemical only used once in a time for this semester. The probability of the students to have systemic effect is low. The total amount of a chemical required to produce a toxic effect is generally less for a single exposure than for intermittent or repeated exposures because many chemicals are eliminated from the body over time, because injuries are often repaired, and because tissues may adapt in response to repeated low-dose exposures. (Carroll *et al.*, 2011)

Among the chemical that categorized as systemic effect, the degree chemical release of Methanol and Ethanol is moderate. Both of the chemical involved in combustion, which it produce the water vapour and gases (carbon dioxide). The product of the combustion for both alcohol can enter in to the body by inhalation because of no PPE was used during the experiment. Once inhaled the vapour and gases

of the chemical, it can deposited in the respiratory tract. The damage can occur through direct contact with tissue or the chemical may diffuse into the blood through the lung-blood interface and may cause health effect ranging from simple irritation to severe tissue destruction. (Safety, 2012)

While local effects means that those hazardous chemicals may cause effect at the site of contacts either on the skin or eyes. The chemicals groups in this category are those chemicals in Group 2 hazardous categories based on chemical shown with hazard categories classified as corrosive and irritants to skin or eyes. This hazardous chemicals will assign as "sk" notation. Refer Table 4.3 for summarized of chemical categorized as local effect.

Table 4.3: Summary of local effect

Classification of hazard	List of Chemicals
Corrosive	Hydrochloric acid 3M, Sulfuric acid, Ammonium Nitrate crystal, 10% Sodium Hydroxide, Dilute sulfuric acid, Concentrated Sulfuric Acid, Ammonium Hydroxide, Nitric Acid, Sodium Hydroxide 1.25M, Ammonia Cyanurate reagent pillows
Irritation	Acetic Acid 0.1M, Potassium Iodide 0.2M, Sodium Sulfate 0.1M, Iron (Holden ThorpH. (Chair) *et al.*) Sulfate 1.0M, Iron (Holden ThorpH. (Chair) *et al.*) sulfate 1.0M, Isopropanol, Silver Nitrate 0.1M

The degree chemical release of Isopropanol was moderate compare to others chemical in this categorised. It is because this chemical involved in combustion of alcohol same as Ethanol and Methanol. The product of this chemical can cause serious eye irritation. Based on this assessment, no adequately control for this chemical, which the students should wear a google to protect their eyes from the vapour or gases from that combustion. The eyes are particularly sensitive to chemicals. Even a short exposure can cause severe effects to the eyes or the substance can be absorbed through

the eyes and be transported to other parts of the body causing harmful effects. (Safety, 2012)

Hazard rating of 5 known as a most hazardous chemical to health and can causing damage to organs or systems of the body or can cause fatality. The hazardous chemicals may cause acute effect at the site of contact either systemic effect or local effects and those that may cause effect at the site of contact either on skin, respiratory track and the oral route (DOSH, 2000). Based on Table 4.4, there are two of chemicals in Chemistry subject that has been classified as the most hazardous to health (HR 5). All two of the chemicals are Phenolphthalein solution and 10% of Formaldehyde. Both of the chemical is carcinogenic and may cause a cancer (HACH, 2016; Scientific, 2015).

Table 4.4: The list of chemical of Hazard Rating 5

Work unit	LIST OF CHEMICAL
Chemistry subject	10% of Formaldehyde, Phenolphthalein solution
Waste Management and Pollution Prevention subject	-

4.1.2 Risk Rating (RR)

Risk is evaluated as either “significant” or “not significant”. Risk is regarded as not significant if it is unlikely that the work exposure will adversely affect the health of workers. This situation arises when either there is no likelihood of exposure or the chemical is least hazardous or the exposure is very low. Hence, there risk situations where either Risk Rating (RR) is either 1 or 2 are considered as not significant. RR 3 and 4 are considered as significant Category 1 and RR 5 are considered as significant Category 2.

In this assessment, the majority of the chemicals for both work unit are in Category 1. There are 37 of chemicals in this category tabulated at Table 4.5. In this category, three of it is from Waste Management and Pollution Prevention subject while the remaining are from the Chemistry subject. There are no chemical classified as RR 5 in this assessment. The use of chemicals under risk Category 1 or Category 2 must be controlled to below the permissible exposure limits or to as low as reasonably practicable (ALARP) where no limits are specified. Refer Form D and E in appendix 2 and appendix 3 for the name of chemical.

Table 4.5: Hazard rating of both Work unit.

		Risk Rating	Work unit	
			Chemistry	Waste Management and Pollution Prevention
Not Significant		RR 1	-	-
		RR 2	11	-
Significant	Category 1	RR 3	21	3
		RR 4	2	-
	Category 2	RR 5	-	-

Although the work unit exposure to certain chemicals are moderate but due to the high health effects posed some of chemicals used onsite, the risk of adverse health effects from the use of these chemicals are high compared to the less hazardous chemicals. The variation of risk rating rising from the use of similar chemicals is due to the different levels of exposure of each work unit. Determination of exposure and risk based on appendix 2 for chemistry and appendix 3 for waste management and pollution prevention.

4.1.3 Action to be taken

Laboratory operator must develop safety and health training as related to handling of chemical hazardous to health. Under Section 22 of the USECHH Regulations, 2000, Chemical handling training must be conducted at least once in two years to all Lab Assistance and students. Training must be conducted when there is a change in the hazard information, safe work practices, control measures and when employees are assigned to new work areas where they are exposed to chemicals hazardous to health. Reliance on on-job-training may be sufficient but these will need to be evaluated regularly and when new chemicals are introduced. The training should provide information such as the risk to health created by such exposure and precautions, which should be taken when handling chemicals hazardous to health. All training programs should be documented and must be made available for inspection by DOSH officer when required.

UMK management need to establish, maintain and update Chemical Register in accordance to the USECHH Regulations, 2000. The Register must include the list of all chemicals hazardous to health; updated CSDS/MSDS; number of workers exposed; Average quantity used or stored per month/year; Compliance with the Classification, Packaging and Labelling of Hazardous Chemicals Regulations, 1997 and Name and address of the supplier.

Material Safety Data Sheet (MSDS) must be in both language Bahasa Malaysia and English. This is to ensure all laboratory operator and students are understand about the content of MSDS. Besides that, MSDS must available at the facility where the chemicals are used or stored. So, the each person who doing the activities involved

with chemical can refer MSDS before use it. This help to increase the chemical safety in the teaching laboratory.

Maintenance for Fume hood should be do yearly by Hygiene Tech. to ensure the air velocity or pressure in the system are functioning well. It relates to the Occupational Safety and Health (Use and Standards of Exposure of Chemicals Hazardous to Health) (USECHH) Regulations, 2000. Specifically, under Section 17 of the USECHH Regulations, 2000 require any engineering equipment provided shall be inspected at an appropriate intervals by the employer, each interval being no longer than one month; and examined and tested for its effectiveness by a registered hygiene technician at appropriate intervals, each interval being no longer than 12 months.

Personal Protective Equipment (PPE) need to use during experiments or usage of highly hazardous chemicals or very toxic or toxic chemicals, cartridge type respirators Organic Vapour should be used rather than used normal surgical mask. Also eye protective equipment and Nitrile glove should be provide and using during handle chemical. At the same time, management need to improve the pressure of water at safety eye-wash (refer Figure 4.1). Lastly, CHRA should review for next five years or when there is a change in procedure or as directed by DOSH.

Figure 4.1: Safety eye-wash at environmental laboratory

4.1.4 Risk conclusion

Based on the risk decision and the assessment of existing control measures there are four conclusions that could be reached from the assessment. The conclusion statements are denoted by C1, C2, C3, C4 or C5 and determined as table 4.6.

Table 4.6: Conclusion of assessment description (DOSH, 2000)

Conclusion	Description
C1	Risks Not significant now and not likely to increase in future
C2	Risks significant but already adequately controlled could increase in future
C3	Risk significant now; and not adequately controlled
C4	Uncertain about Risk; Insufficient information
C5	Uncertain about risk; uncertain about degree and extent of exposure

The chemical health risk assessment results indicate that all chemicals assessed were found to have C1 until C3 risks for Chemistry subject, while Waste Management and Pollution Prevention indicate to have C3 only. For risk conclusion C1 indicate that risks is not significant now and not likely to increase in the future. Based on Table 4.7, there were six of chemical that classified as C1 for the chemistry subject. Most of it was classified as low hazard rating (HR 1).

Table 4.7: Conclusion for work unit of Chemistry subject

Conclusion	Chemical Hazardous to Health
C1	Potassium Bicarbonate, Hydrochloric acid 0.1M, Potassium Chloride 0.2M, Zinc Sulfate 0.1M, Magnesium Sulfate 1.0M, Glacial Acetic acid
C2	Hydrochloric acid 6M, Ammonium Nitrate crystal, Isoamyl Alcohol,
C3	Hydrochloric acid 3M, Acetic acid 0.1M, Sulfuric acid, Phenolphthalein solution, Potassium Iodide 0.2M, Potassium Persulfate, Sodium Sulfate 0.1M, Sodium Thiosulfate, Copper (ll) Nitrate 1.0M, Iron (ll) Sulfate 1.0M, Iron (lll) Sulfate 1.0M, Methanol, Ethanol, Isopropanol, Sodium Hydroxide 10%, Diluted Sulfuric acid, Potassium Permanganate, Concentrated Sulfuric acid, Salylic Acid Crystal, Silver Nitrate 0.1M, Ammonium Hydroxide, Formaldehyde 10%, Acetone, Nitric acid, Sodium Hydroxide 1.25M

Besides that, only three of the chemical hazardous to health have adequately control and classified as C2. Conclusion for C2 indicate that the conditions for the chemical where adverse health effect could increase in future due to undetected deterioration in the efficiency of control measure. In addition, risk could increase in future due to plan and equipment failure. Which is, plan no functional well and the laboratory operator (lecturer, lab assistant and students) were not wear the PPE during running lab activities. Besides that, it can be the system failure during do the lab experiments due to laboratory operator are not followed the safe operating plan (SOP) and warning signage in the laboratory, in other word, control measures are not used properly.

Human error also can be a reason risk could increase in the future. For instance, lack of awareness about the chemical safety because of inadequate training or monitoring failure. Another condition can cause increasing of adverse health effect in the future is changes in laboratory methods or changes in rate of work. Changes in laboratory methods means laboratory operator used different method from the past. For example, changes the method of measure smallest volume the chemical from using the measuring cylinder to micropipette. Lastly, due to a significant increase in the quantity of chemical hazardous to health used in laboratory.

Table 4.8: Conclusion for work unit of Waste Management and Pollution Prevention

Conclusion	Chemical Hazardous to Health
C3	Ammonia Cyanurate reagent pillows, Ammonia Salicylate reagent pillows, Digestion Solution for COD (20-1500 mg/l Range)

Chemical hazardous to health that not adequately control has classified as C3. Table 4.7 and Table 4.8 show the list of chemical indicate as C3. For risk conclusion C3 the actions required are, first determine immediate measures for preventing or controlling exposures. Laboratory management need to identify and implement immediate measures and procedures for preventing or controlling exposure of the chemical hazardous to health that exposed to the laboratory operator. Such as to produced safe operating procedures.

Second, laboratory management need to stop process, if the process is very danger to health. For this reason the activities should be stop to prevent the health effect to the laboratory operator. Third, Review longer term control measures. After produced the SOP, the lab management should review the SOP of the lab procedures yearly to ensure that the SOP are still relevant to prevent the risk and the health effects.

Fourth, determine monitoring or health surveillance requirements. The lab management need to send the laboratory operator to do the health and biology monitoring by the Occupational Health Doctor (OHD). Occupational Health Doctor are the doctor that are qualified and already passed the exam conducted by NIOSH (National Institute of Occupational Safety and Health) and registered to the DOSH. Meanwhile biological monitoring is the measurement and assessment of agents or their metabolites either in tissues, secreta (substance secrete by a cell, tissue or organ), excreta or any combination of these to evaluate exposure and health risk compared to an appropriate reference. Health surveillance means any examination and investigation which may be necessary to detect exposure level; and early biological effects monitoring, medical surveillance, enquires about symptoms of occupational poisoning or occupational disease and review of records and occupational history.

4.2 Chemical Safety Awareness

Pilot study has been carried out before start distribute the questionnaire. The pilot study tested 68 questions using SPSS to analyse the validity. The result shows Cronbach's Alpha value is 0.928 where indicate this study is reliable and acceptable since it greater than 0.07.

4.2.1 Demographic analysis

The background of the respondent is required in order to begin the questionnaire studies. This section involved age, gender, race, occupation and highest achieve academic qualification of respondent. Figure 4.2 shows the percentage of age that answered the questionnaire. Based on figure 4.1 it revealed that 85% as whole respondent was the age between 18 - 24 years which is it present the number of students. Meanwhile, there are no respondent from the age of 45 years old and above.

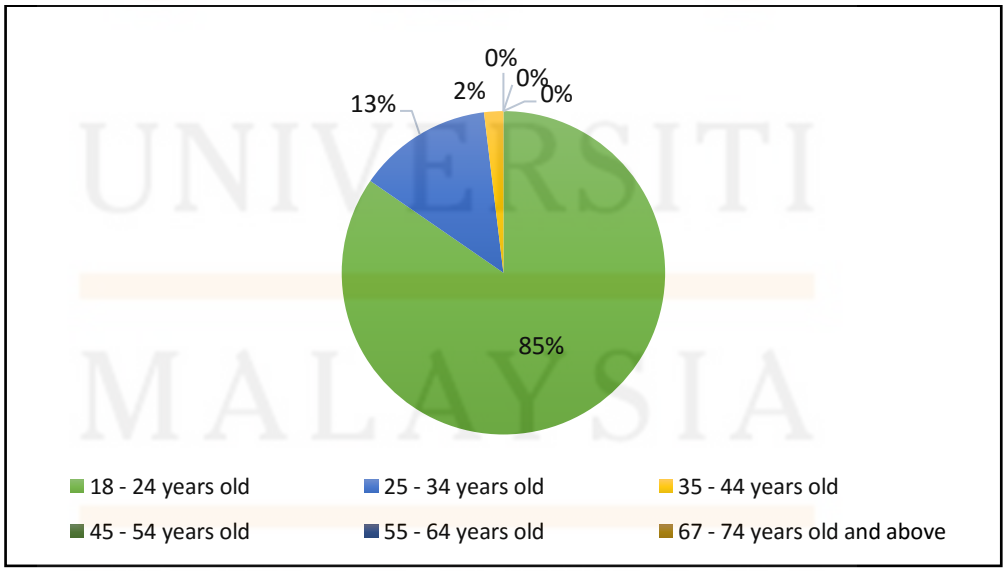


Figure 4.2: Percentage of respondent by age

Figure 4.3 shown the percentage of respondent according to their gender. Based on the figure, the male respondent was nominated compared to the female respondent. The gender of female holding 87% of respondent. Meanwhile male respondent holding only 13%, the minority of the respondent.

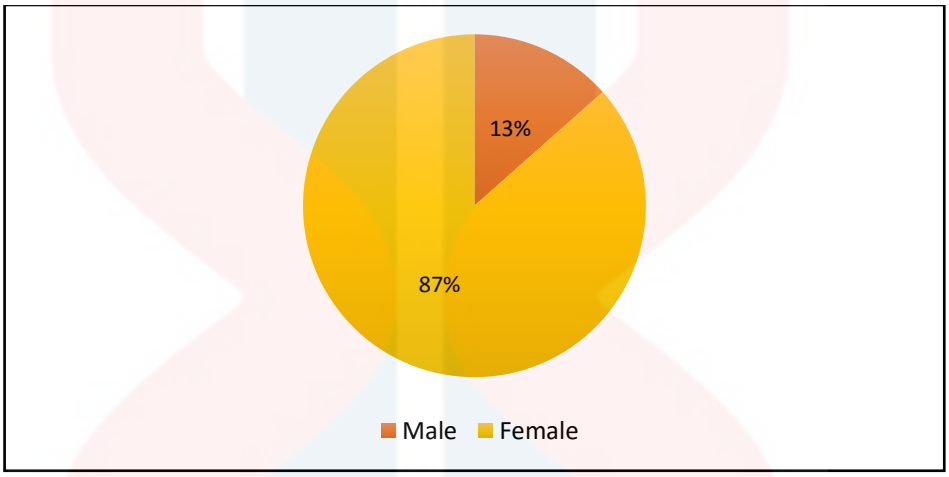


Figure 4.3: Percentage of respondent by gender

The number of respondent according to races is shown in Figure 4.4 where it demonstrated that 86% as whole respondent was Malay, it followed by Chinese (12%), Indian (1%) and other race (1%), which is bumiputra. All of the Chinese respondents are third year students while the Indian was from the first year student.

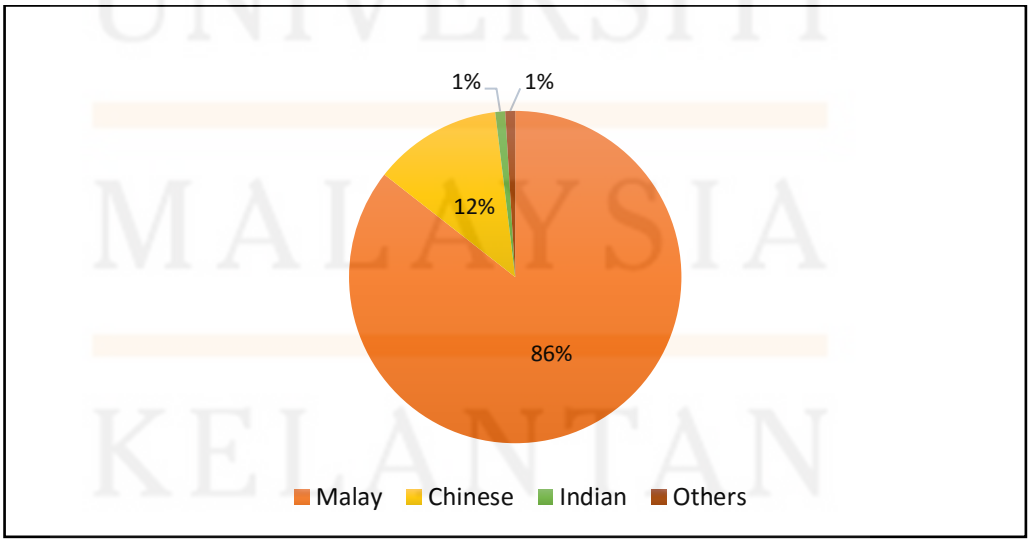


Figure 4.4: Percentage of respondent by race

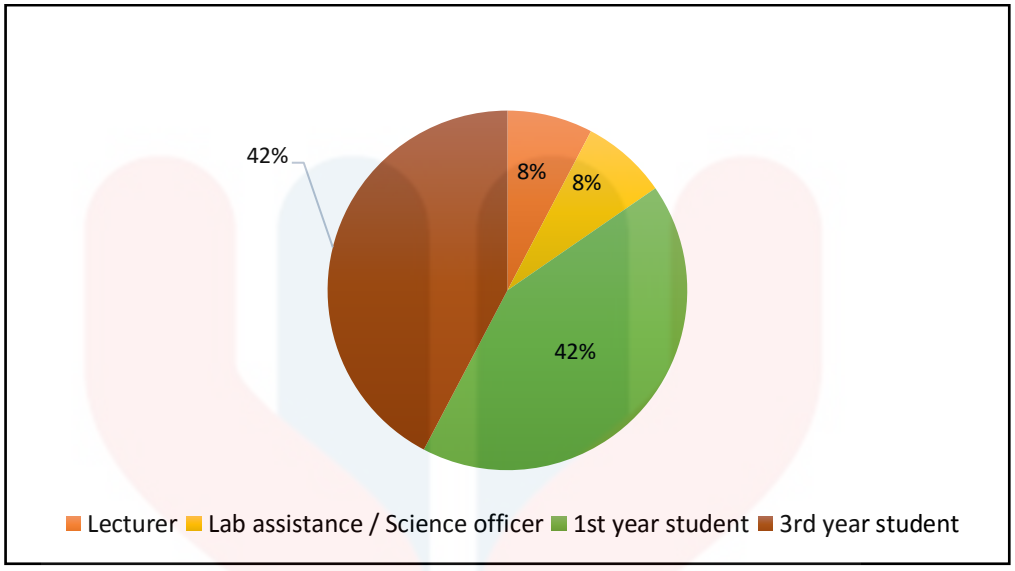


Figure 4.5: Percentage of respondent by occupation

Based on Figure 4.5 the occupation dominated by first year student and third year student which hold 42% respectively. The overall level of education for students (first year and third year) about 70% are from matriculation or foundation demonstrate at Figure 4.6. About 14% respondent from STPM level, include student and lab assistant. Meanwhile, the others lab assistance have SPM (2%) and Degree (4%) level. Additionally, the level of education for lecturer were either master or PhD where 2% and 8% respectively.

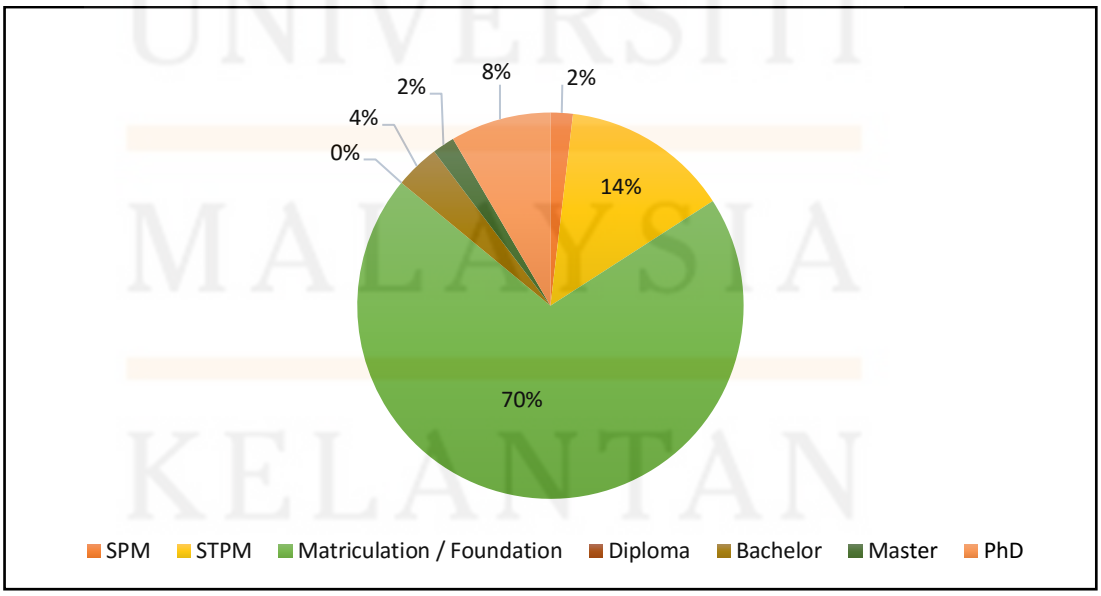


Figure 4.6: Percentage of respondent by highest achieve academic qualification

4.2.2 Awareness

For questionnaire from Part A until Part C were analysed by independent T-Test method to compare the chemical safety awareness between lecturer and lab assistant or science officer. Besides that it also to compare between first year and third year student of Sustainable Science. The data shown significant different between the group. If the value of significant different less than 0.05, it's mean that there have the different among the groups of each category. The choices of opinion are rating from 1 (strongly disagree) to 10 (strongly agree). The average index reflected overall respondent opinion on the statement as mention in the question.

4.2.2.1 Knowledge

In this study, knowledge of respondent related to chemical safety was investigated by the response of 10 questions. The overall data regarded to the respondent's knowledge on chemical safety can be observed on Appendix F. The overall data has been analysed according to their occupation.

Among the lecturer and lab assistance or science officer (N=8), there was no statistically significant difference between lecturer (M =9.14) lab assistant or science officer (M=8.74). Specifically, there was no different in knowledge about the chemical safety between the lecturer and lab assistance.

Among the statements about the knowledge of chemical safety and health, the statement about "chemical waste disposal procedure in UMK is comply with regulations" was a statistically significant difference between first year and third year students (N=44). First year student (M =8.1, SD =1.8) and third year student (M =6.7,

SD =2.2), under t-test, t (86) =3.30, p =0.01. These result show that, the knowledge of first year student about that statement was better than third year student. As the reason, first year student already exposed about the regulation that related with the chemical waste disposal procedure.

Based on my interview, on the first laboratory session, first year student, was briefed about the safety in laboratory by lab assistant. Third year students also received the same briefing about that during their first year. Unfortunately during their second year, third year student don't involve any laboratory activities. So they leave behind all the rules and regulation in laboratory. So, laboratory assistant should consistently give awareness to the students so they always comply with all rules and regulation in the laboratory, at least once in a year.

4.2.2.2 Skills

In this study, skills of respondent related to chemical was investigated by the response of 10 question. This part to identify either respondent had receive training or course related to the chemical safety. The overall data regarded to the respondent's skill on chemical safety can be observed from Appendix G. The overall data has been analysed according to their occupation.

Among the lecturers (N=8) and lab assistants or science officer (N=8), there was no statistically significant difference between lecturer (M =8.14) and lab assistant or science officer (M=7.79). Specifically, there was no different in skill about the chemical safety between the lecturer and lab assistance. Meanwhile, among the first year (N = 44) and third year students (N = 44), there was no statistically significant difference between first year students (M = 7.40) and third year students (M=6.33).

Specifically, there was no different in skill about the chemical safety between the first year and third year students. The mean score of lecturers and lab assistants or science officer is highest than both of the students.

This is because, lecturers and lab assistants already exposed with the training or course related with chemical safety. For example, on last August 2016, the lecturers, lab assistants and science officer attend the workshop about the "Introduction to Occupational Health and Safety (OSH) and chemical handling. The objective of that workshop was to expose each JPKKP (Ahli Jawatankuasa Persekitaran, Keselamatan dan Kesihatan Pekerjaan) roles and duties. Besides that, it also to provide practical training on how to properly control chemicals in accordance with the legal requirements in the regulation of occupational safety and health (Use and Standards of Exposure of Chemicals Hazardous to Health) to individuals who are involved with the handling of chemicals in the workplace.

Laboratory management should provide students in terms of training or course related with chemical safety. Students also need to have skill in chemical safety to ensure they follow all the rules and regulation in laboratory. This is because the majority of the laboratory operator was students. In the lack of awareness in terms of a skill, they will contribute to increase the accident or incident in the laboratory.

4.2.2.3 Attitude

In this study, attitude of respondent in the laboratory was investigated by the response of 10 question. This part to identify either respondent aware about situation in the laboratory. The overall data regarded to the respondent's attitude on

chemical safety can be observed from Appendix H. The overall data has been analysed according to their occupation.

Among the first year (N=44) and third year (N=44) students, there was no statistically significant difference between first year (M =8.13) lab assistant or science officer (M=7.97). Specifically, there was no different in attitude about the chemical safety between the first year and third year students. Most of the students agree that they doing all the 10 statement in the questionnaire.

Among the statements about the attitude of chemical safety and health, the statement about "clean up and reorganize the apparatus after use" was a statistically significant difference between lecturer (N=8) and lab assistance or science officer (N=8). Lecturer (M =10, SD =0.0) and lab assistance or science officer (M =9.0, SD =0.9) t-test; t (14) =3.06, p =0.009. These result show that, the attitude of lecturer about that statement was better than lab assistance or science officer. Specifically, lecturer have a good attitude in ensuring the cleanliness of the laboratory always in a good condition.

Besides that, the attitude in ensuring neatness is important when working in the laboratory was a statistically significant difference between lecturer (N=8) and lab assistance or science officer (N=8). Lecturer (M =9.9, SD =0.4) and lab assistance or science officer (M =9.0, SD =1.1) based on t-test; t (14) =2.198, p =0.045. These result show that, the attitude of lecturer about that neatness of laboratory was better than lab assistance or science officer. Specifically, lecturer have a good attitude in ensuring the neatness of the laboratory in order to avoid the occurrence of an accident.

In addition, the attitude of wearing the appropriate clothing when working in the laboratory was a statistically significant difference between lecturer (N=8) and lab assistance or science officer (N=8). Lecturer (M =10.0, SD =0.0) and lab assistance or science officer (M =9.3, SD =0.7) based on t-test, t (14) =3.00, p =0.01. These result show that, the attitude of lecturer about wearing the appropriate clothing when working in the laboratory was better than lab assistance or science officer. Specifically, lecturer have a good attitude in wearing the appropriate clothing when working in the laboratory.

The different attitude of the lecturer and lab assistant or science officer can related with their education. Most of the lecturer either have master of PhD for their level of education while the lab assistant either have bachelor, STPM and SPM. Based on their education, person who have high level of education tend to follow all the rules and regulations in laboratory, which it give effect to the attitude in chemical safety.

4.2.3. Practice for Chemical Safety in UMK Jeli campus

Section 3 of the questionnaire, also was analysed by independent T-test method to compare between lecturer and lab assistant or science officer about the practice for chemical safety in UMK Jeli campus. Besides that it also to compare between first year and third year student of Sustainable Science. The data show significant different between the group of respondent. If the value of significant different less than 0.05, it's mean that there have the different among the groups of each category. The choices of opinion are rating from 1 (strongly disagree) to 10 (strongly agree). The average index reflected overall respondent opinion on the statement as mention in the question. The overall overview of this analysis was present in Appendix I.

Among the lecturer and lab assistance (N=8) or science officer (N=8), there was no statistically significant difference between lecturer (M =7.82) and lab assistant or science officer (M=8.18). Specifically, there was no different in practice about the chemical safety between the lecturer and lab assistance. The practice of lab assistant was better than lecturer. This is because, all of lab assistant was attend any activities that conduct by JPKKP of UMK.

The statement of "UMK provide a manual for chemical safety to each student before start of an experiments" was a statistically significant difference between first year students (N=44) and third year student (N=44). First year students (M =7.8, SD =1.5) and third year student (M =6.9, SD =2.6) based on t-test; t (86) =2.03, p =0.046. These result shows that, most of the first year student agree that UMK provide a manual for chemical safety to each student before start of an experiment compare to third year student. This is because, on lab manual of first years students (chemistry subject) have a rules and regulations to students follow during in laboratory.

In addition, the statement about "UMK record all the incidents or accident occurred in laboratory" was a statistically significant difference between first year students (N=44) and third year student (N=43). First year students (M =7.6, SD =1.5) and third year student (M=6.8, SD =2.2) based on t-test, t (83) =2.5, p =0.015. These result show that, most of the first year student agree that UMK record all the incidents or accidents occurred in laboratory compare to third year student.

There was statistically significant difference between first year students (N=44) and third year student (N=43) of statement "UMK investigate incident or accident involving chemical" was a First year students (M =7.6, SD =1.5) and third year student (M =6.8, SD =2.2) under t-test; t (83) = 2.1, p = 0.039. These result show

that, most of the first year student agree that UMK investigate all the incidents or accidents occurred in laboratory compare to third year student.

Besides that, the statement of "UMK provide training on chemical safety to student, staff and lecturer" was a statistically significant difference between first year students (N=43) and third year student (N=44). First year students (M =7.6, SD =1.6) and third year student (M =6.5, SD =2.4) conditions; t (85) =2.5, p =0.013. These result show that, most of the first year student agree that UMK provide training on chemical safety to student, staff and lecturer compare to third year student.

The statement "UMK take serious action towards staff or student who not follow the rules and regulations in laboratory" was a statistically significant difference between first year students (N=44) and third year student (N=44). First year students (M =7.6, SD =1.6) and third year student (M =6.8, SD =2.1) conditions; t (86) =2.1, p =0.037. These result show that, most of the first year student agree that UMK take serious action towards staff or student who not follow the rules and regulations in laboratory compare to third year student.

The reason most of first year students mean score of this section is highest that third year students it can be because of, on the first lab session of this semester, first year student had received briefing about the rules in laboratory by lab assistance. So they get the early knowledge about the safety in laboratory. If compared with the third year students, the last briefing that they have was during their first year. So most of the third year students almost forget about the rules and regulation in laboratory.

4.2.4 Opinion of Respondent

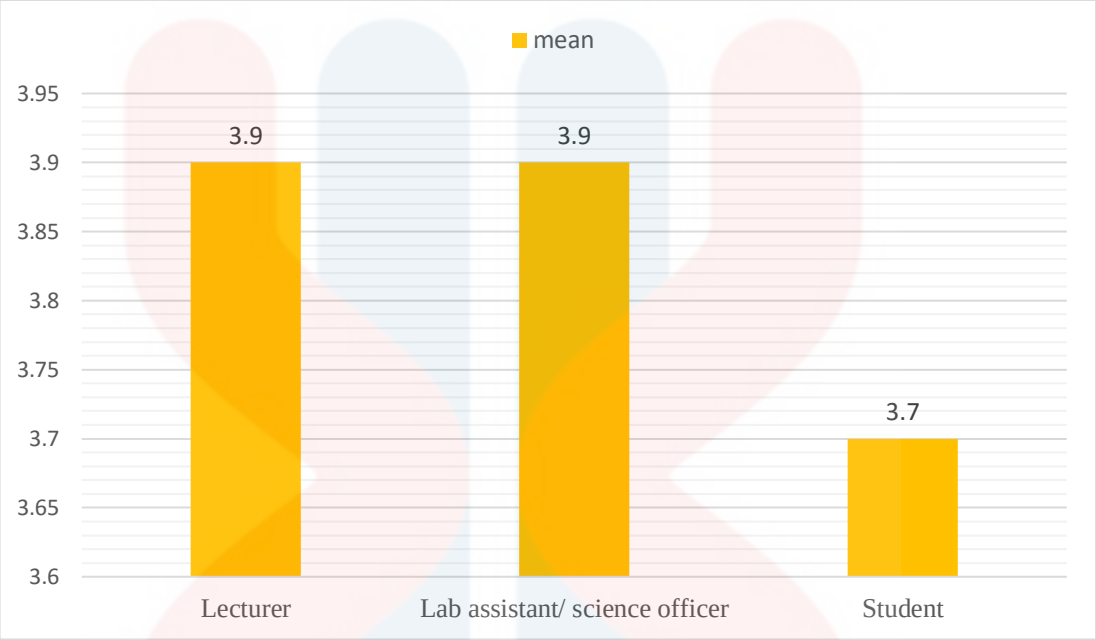
The last section of the survey, there were two question which the opinion of respondents about level of awareness chemical safety and opinion on the efficient way to improve chemical safety in UMK Jeli Campus. The first question of the opinion was divided into five scales (very good, good, satisfy, unsatisfactory and very unsatisfactory), while the second question is in the form of multiple question.

4.2.4.1 Level of Awareness on Chemical Safety and Health

The level of awareness on chemical safety and health in UMK Jeli campus were investigated based on occupation which lecturer, lab assistance or science officer and students. Figure 4.6 shows the overall mean score based on occupation regarded to the level of awareness on chemical safety and health in UMK Jeli campus. Based on the mean score, lab assistant or science officer had share the same mean score with the lecturer, which the level of awareness for both of them is very good (3.9). Meanwhile, level of awareness of student is good (3.7). So the level of awareness in UMK Jeli campus was good (3.8).

The level of awareness on chemical safety of lecturer and lab assistant or science officer was better than students. Where the range good of the lecturer is 62.5% and very good 12.5% while the lab assistant or science officer 50% (good) and 25% (very good). The frequency of scale of unsatisfactory of students is highest than lab assistant or science officer. This data show that level of awareness in UMK Jeli campus need to improve especially to the students.

Figure 4.6: Mean of level awareness of lecturer, lab assistant and students on chemical Safety and Health in UMK Jeli Campus



4.2.4.2 Effective Way to Improve Chemical Safety

This part was adopted from previous study by Siti Zulhanini Binti Zulkefli (2016) with a few amendment. This recommendation is important to increase the awareness and practice towards the chemical safety. This recommendation can be recommend to the administrative of UMK Jeli campus in order to increase the chemical safety in laboratory of UMK Jeli campus.

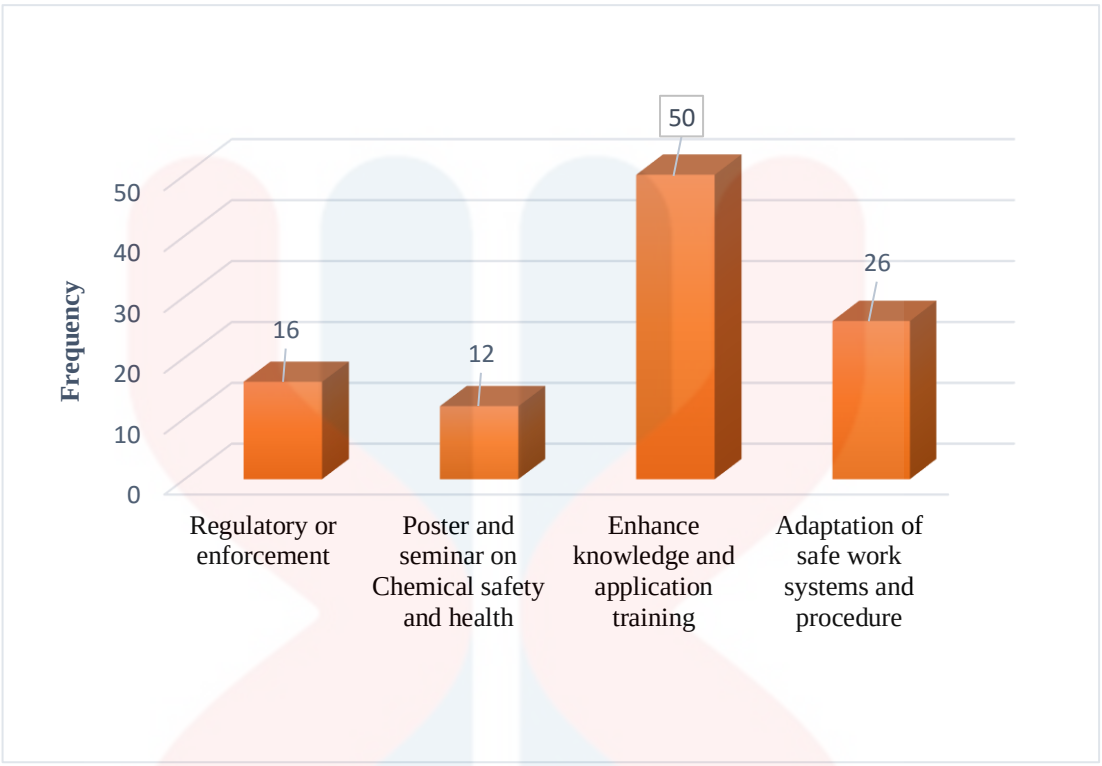


Figure 4.7: The most effective ways to improves chemical safety in UMK Jeli campus

The Figure 4.7 shows that most of the respondents believe that knowledge enhancement and application training was the best method in order to improve the chemical safety in this campus, followed by adaptation of safe working system and procedure which 26 of the respondents voted for it. Besides that, less than 20 respondents voted for the regulatory or enforcement also have poster and seminar on Chemical safety and health as the most effective ways to improves chemical safety in this campus.

CHAPTER 5

CONCLUSION

5.1 Conclusion

This study focused on assess the chemical health risk in UMK teaching laboratory. The findings from the assess reveals that, the laboratory have been conclude as a risk significant now; and not adequately controlled (C3). Furthermore, the risk control or action to be taken for the UMK teaching laboratory have been suggest in order to improve the safety in that laboratory.

Besides that, this study also focused on determine the level of chemical safety awareness of laboratory operator in UMK Jeli campus. The findings of this survey shown the knowledge, attitude, skill and practice of the respondent are different according to their occupation. The level of awareness in UMK Jeli campus was good. But the improvement still needed especially to the students.

The limitation of the study is during the data collection where some target respondent did not give a feedback about the questionnaire. Besides that, another limitation is in order to get the MSDS of the chemicals, which, different source of the MSDS, different information about the certain chemical. The laboratory in UMK Jeli campus not prepared any specific MSDS for each chemical.

5.2 Recommendation

In further study, it is suggested that to increase the sample size. This is because larger sample size will have less sampling process error compared to the study with smaller sample size. As the sample size increases, it approaches the size of the entire population, therefore, it also approaches all the characteristics of the population, thus, decreasing sampling process error (Cornish, 2006).

Besides that, equalize the number of sample size, so analysis of variance (ANOVA) can be used. In this study T-test analysis has been used because the number of lecturer and lab assistant or science officer have a big different with the number of students (1^{st} year and 3^{rd} year). The comparison only involved lecturer with lab assistant or science officer and 1^{st} year and 3^{rd} year students. The comparison of knowledge, attitude, skill and practice of safety awareness cannot be done between three sample sizes.

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7.0 APPENDICES

APPENDIX A

PART II - IDENTIFICATION OF CHEMICALS HAZARDOUS TO HEALTH

Regulation 5. Register of chemicals hazardous to health.

(1) An employer shall identify and record in a register all chemicals hazardous to health used in the place of work.

(2) The register shall be maintained in good order and condition and be updated from time to time and shall contain the following information:

(a) a list of all chemicals hazardous to health used;

(b) the current Chemical Safety Data Sheet for each of the chemicals hazardous to health except for pesticides which shall have information as specified in Schedule III;

(c) the average quantity used, produced or stored per month or per year whichever is applicable for each of the chemicals hazardous to health;

(d) the process and work area where the chemicals hazardous to health are used; and

(e) the name and address of the supplier of each of the chemicals hazardous to health.

(3) The register shall be accessible to all employees at the place of work who may be exposed or are likely to be exposed to chemicals hazardous to health.

(4) The requirements in subregulations (1) and (2) shall not apply if the employer has complied with the requirements of regulation 9 and subregulation 11(1) of the Environmental Quality (Scheduled Wastes) Regulations 1989 [*P. U. (A) 139/89*].

APPENDIX B

FORM A: LIST OF CHEMICALS

Work unit: Laboratory

No.	Name of Chemical & indicator ingredient	Physical Form	Source of Information	Classification of Hazard	Risk Phrases	Skin Notation	Hazard Rating
1	Potassium Bicarbonate (298-14-6)	Solid	SDS Sigma Aldrich 2015	Not Classified as Hazardous to Health	Not Classified as Hazardous to Health	-	1
2	Hydrochloric acid 6M (7647-01-0)	Liquid	SDS Sigma Aldrich 2015	Toxic	R38 - Irritating to skin R36 - Irritating to eyes R23 - Toxic by inhalation	sk	4
3	Hydrochloric acid 0.1M (7647-01-0)	Liquid	SDS Sigma Aldrich 2015	Toxic	R38 - Irritating to skin R36 - Irritating to eyes R23 - Toxic by inhalation	sk	4
4	Hydrochloric acid 3M (7647-01-0)	Liquid	SDS Fisher	Corrosive	R35 - Cause severe skin burns and eye damage R37 - Irritating to respiratory system R36 - Irritating to eyes	sk	4
5	Acetic Acid 0.1M (64-19-7)	Liquid	SDS Carolina	Irritation	R36- Irritating to eyes R38 - Irritating to skin	sk	2
6	Sulfuric acid (7664-93-9)	Liquid	SDS Fisher	Corrosive	R35 - Cause severe skin burns and eye damage R37 - Irritating to respiratory system	sk	4
7	Ammonium Nitrate crystal (6484-52-2)	Solid	SDS Carolina	Corrosive	R36- Irritating to eyes R38 - Irritating to skin R25 - Toxic if swallowed	sk	4

8	Phenolphthalein solution (77-09-8)	Liquid	SDS Sigma Aldrich 2016	Carcinogen	R45(1) - Cause carcinogenicity R46(2) - Cause cell mutagenicity	-	5
9	Potassium Iodide 0.2M (7681-11-0)	Liquid	SDS Fisher	Irritation	R36- Irritating to eyes R38 - Irritating to skin	sk	2
10	Potassium Chloride 0.2M (7474-40-7)	Liquid	SDS Sigma Aldrich 2016	Not Classified as Hazardous to Health	Not Classified as Hazardous to Health	-	1
11	Potassium Persulfate (7727-21-1)	Liquid	SDS Fisher	Harmful	R22 - Harmful if swallowed R38 - Irritating to skin R41 - Causes severe irritating to eyes R43 - Cause an allergic skin reaction R37 - Cause respiratory irritation R42 -Cause sensitisation by inhalation	sk	3
12	Sodium Sulfate 0.1M (7787-82-6)	Liquid	MSDS Science Lab	Irritation	R36 - Irritating to eyes R38 - Irritating to skin	sk	2
13	Sodium Thiosulfate (7772-98-7)	Liquid	MSDS ClearTech	Toxic	R37 - Irritating to respiratory system R38 - Irritating to skin R36 - Irritating to eyes R25 - Toxic if swallowed	sk	4
14	Copper (II) Nitrate 1.0M	Liquid	MSDS Flinn Scientific	Toxic	R36 - Irritating to eyes R38 - Irritating to skin R25 - Toxic if swallowed	sk	4
15	Iron (II) Sulfate 1.0M (7720-78-7)	Liquid	SDS Sigma Aldrich 2016	Irritation	R36- Irritating to eyes R38 - Irritating to skin	sk	2

16	Zinc Sulfate 0.1M (7447-20-0)	Liquid	SDS Fisher	Not Classified as Hazardous to Health	Not Classified as Hazardous to Health	-	1
17	Magnesium Sulfate 1.0M (7487-88-9)	Liquid	SDS AmericanBio 2014	Not Classified as Hazardous to Health	Not Classified as Hazardous to Health	-	1
18	Iron (III) sulfate 1.0M (10028-22-5)	Liquid	MSDS Flinn Scientific	Irritation	R38 - Irritating to skin	sk	2
19	Methanol (67-56-1)	Liquid	SDS Fisher	Toxic	R23 - Toxic by inhalation R24 - Toxic in contact with skin R25 - Toxic if swallowed	-	4
20	Ethanol (64-17-5)	Liquid	SDS Blue Diamond	Harmful	R20 - Harmful by inhalation R22 - Harmful if swallowed R36 - Irritating to eyes R38 - Irritating to skin	sk	3
21	Isopropanol (67-63-0)	Liquid	SDS Monica	Irritation	R41 - Risk of serious eye irritation.	sk	3
22	10% Sodium Hydroxide (1310-73-2)	Liquid	SDS LabChem 2013	Corrosive	R35 - Cause severe skin burns and eye damage	sk	4
23	Dilute sulfuric acid (7664-93-9)	Liquid	SDS Sigma Aldrich 2016	Corrosive	R35 - Cause severe skin burns and eye damage	sk	4
24	Potassium Permanganate (7722-64-7)	Solid (Powder)	SDS Fisher	Harmful	R22 - Harmful if swallowed R37 - Irritating to respiratory system R35 - Cause severe skin burns and eye damage	sk	4
25	Glacial Acetic Acid (64-19-7)	Liquid	SDS Sigma Aldrich 2015	Not Classified as Hazardous to Health	Not Classified as Hazardous to Health	-	1
26	Concentrated Sulfuric Acid (7664-93-0)	Liquid	SDS Fisher 2016	Corrosive	R35 - Cause severe skin burns and eye damage R37 - Irritating to respiratory system	sk	4

27	Isoamyl Alcohol (123-51-3)	Liquid	SDS Carolina	Toxic	R25- Toxic if swallowed	-	4
28	Salylic Acid Crystal (69-72-7)	Solid (Powder)	SDS Fisher 2016	Harmful	R22 - Harmful if swallowed R35 - Cause serious eye damage	sk	3
29	Silver Nitrate 0.1M (7761-88-8)	Liquid	SDS sigma Aldrich 2015	Irritation	R36 - Irritating to eyes R38 - Irritating to skin	sk	2
30	Ammonium Hydroxide (1336-21-6)	Liquid	SDS Fisher 2016	Corrosive	R35 - Cause severe skin burns and eye damage R37 - Irritating to respiratory system	sk	4
31	10% Formaldehyde (50-00-0)	Liquid	SDS Azer Scientific	Carcinogen	R45 (1) - May cause cancer R36 - Irritating to eyes R38 - Irritating to skin R43 - Cause an allergic skin reaction	sk	5
32	Acetone (67-64-1)	Liquid	MSDS Acros Organics	Harmful	R22 - Harmful if swallowed R38 - Irritating to skin R20 - Harmful by inhalation R36 - Irritating to eyes	sk	3
33	Nitric Acid (7697-37-2)	Liquid	SDS Fisher	Corrosive	R35 - Cause severe skin burns and eye damage	sk	4
34	Sodium Hydroxide 1.25M (1310-73-2)	Liquid	SDS Sigma Aldrich	Corrosive	R35 - Cause severe skin burns and eye damage	sk	4

FORM B: WORK UNIT DESCRIPTION					
WORK UNIT: Chemistry subject					
1. WORK AREA	Lab B.A.P 1.2			**7. EMPLOYEE HEALTH FEEDBACKS (Any ill-effects experienced)**	
2. JOB TITLE	Lab Assistance & Students			No illness effects to the Lab Assistance & students	
3. NUMBER OF EMPLOYEES (attach list as appendix)				**8. REPORT OF HEALTH EFFECTS (summaries of effects reported)**	
Male:	3	Female	47	No Lab Assistance & students having health effects	
4. CATEGORY OF WORKERS IN WORK UNIT (tick)					
Lab Assistance	√			**9. WORKRS WITH SUSPECTIBLE CONDITION (describe condition)**	
Student	√			No workers with susceptible condition	
				10. POSIBILITIES OF ABNORMAL EXPOSURE (other than normal work)	
				No possibilities of abnormal exposure	
				11. POSIBILITIES OF MIXED EXPOSURE (other chemicals effecting same organ)	
				No other chemical affecting the same organ	
				12. POSIBILITIES OF INGESTION EXPOSURE (describe situation)	
5. WORKING HOUR				No possibilities. The workers are not taking meals and drinks in the plant area	
3 hour				**13. INFORMATION, INSTRUCTION & TRAINING GIVEN**	
Work Arrangements (tick): Normal [√] Shift work [ ]				Lab assistance have attended training on Safe Handling of Chemical, while the student haven't expose with safety awareness programme.	
6. BRIEF PROCESS DESCRIPTION				**14. OTHER COMMENTS**	
This work unit conducts experiment for the teaching purpose. The laboratory assistant prepare the solution for the experiment by students					

FORM C: WORKPLACE ASSESSMENT											
WORK UNIT :Chemistry subject				ASSESSMENT TEAM: Nurul Nazleatul Najiha Mohd Nazif				DATE: 2/10/2016			
WORK AREA: Lab B.A.P.1.2				PERSONNEL: En. Muhammad Che Isa Pn Nur Izzati bt. Salleh							
Chemical Hazardous to Health	**Task**	**Frequency/ Duration**	**Routes of Entry**	**Existing Controls**	**Suitable & Effective Yes/No**	**Main. Testing & Exam**	**Adequate?**	**Degree Chemical Release**	**Degree Contact/ Absorb**	**MR**	**ER**
Potassium Bicarbonate	2-3 g is dissolve in 5 mL of distilled water (Experiment 1)	FR =2 >1 x per year	Skin	Latex glove	Yes	Yes	Yes	Low	Low	1	2
			Inhalation	Surgical Mask	Yes	Yes	Yes				
	Preparation of Potassium Bicarbonate by lab assistant	FR=2 >1 x per year	Skin	Latex glove	Yes	Yes	Yes	Low	Low	1	2
			Inhalation	Surgical Mask	Yes	Yes	Yes				
Hydrochloric acid 6M	6 mL is used by mix with Potassium Bicarbonate solution and evaporate the mixture (Experiment 1)	FR =2 >1 x per year	Skin	Nitrile glove	Yes	Yes	Yes	Moderate	Low	2	2
			Eyes	Fume hood	Yes	Yes	Yes				
			Inhalation	Fume hood	Yes	Yes	Yes				
	Preparation 6M of Hydrochloric acid by lab assistant	FR =2 >1 x per year	Skin	Nitrile glove	Yes	Yes	Yes	Low	Low	1	2
			Eyes	Fume hood	Yes	Yes	Yes				
			Inhalation	Fume hood	Yes	Yes	Yes				

Hydrochloric acid 0.1M	60 cm^3 is used with different concentration to test the pH of acid solution (Experiment 2)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
	Preparation of 0.1M Hydrochloric acid by lab assistant	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
Hydrochloric acid 3M	100 mL is used by mix it with the Sodium Hydroxide and measure the temperature of it (Experiment 3)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
			Inhalation	No	No	No	No				
	Preparation of 3.0M hydrochloric acid by lab assistant	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
			Inhalation	No	No	No	No				
Acetic Acid 0.1M	60 cm^3 is used with different concentration to test the pH of acid solution (Experiment 2)	FR =2 >1 x per year	Eyes	No	No	No	No	Low	Low	1	2
			Skin	Latex glove	No	Yes	No				
	Preparation of 0.1M Acetic Acid by lab assistant	FR =2 >1 x per year	Eyes	No	No	No	No	Low	Low	1	2
			Skin	Latex glove	No	Yes	No				
Sulfuric acid	5mL of the chemical is used by mix it with 45mL of tap water to test the Hydration of chemical (Experiment 3)	FR =2 >1 x per year	Eyes	Fume hood	Yes	Yes	Yes	Low	Low	1	2
			Skin	Latex glove	No	Yes	No				
			Inhalation	Fume hood	Yes	Yes	Yes				
	Preparation of Sulfuric acid by lab assistant		Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	Fume hood	Yes	Yes	Yes				

		FR =2 >1 x per year	Inhalation	Fume hood	Yes	Yes	Yes				
Ammonium Nitrate crystal	3g of the chemical is mix with the 20mL of tap water in Heat of Reaction test (Experiment 3)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
			Ingestion	No	No	No	No				
	Preparation of Ammonium Nitrate crystal by lab assistant	FR =2 >1 x per year	Eyes	Latex glove	No	Yes	No	Low	Low	1	2
			Skin	No	No	No	No				
			Ingestion	No	No	No	No				
Phenolphthalein solution	A few drops are used in the test for estimation of acetic acid from vinegar (Experiment 4)	DR =2 >1 to 2 x per hours	Skin	Latex Glove	No	Yes	No	Low	Low	1	2
			Inhalation	Surgical Mask	No	No	No				
	Preparation of Phenolphthalein solution by lab assistant	DR =2 >1 to 2 x per hours	Skin	Latex Glove	No	Yes	No				
			Inhalation	Surgical Mask	No	No	No	Low	Low	1	2
Potassium Iodide 0.2M	Mix with the Potassium Chloride, Potassium Persulfate and starch in a test tube to test the Reaction Kinetics by record the time taken for the deep blue colour to appear and their temperature (Experiment 5)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
			Skin	Latex glove	No	Yes	No	Low	Low	1	2

	Preparation 0.2M of Potassium Iodide by lab assistant	FR =2 >1 x per year	Eyes	No	No	No	No				
Potassium Chloride 0.2M	Mix with the Potassium Iodide, Potassium Persulfate and starch in a test tube to test the Reaction Kinetics by record the time taken for the deep blue colour to appear and their temperature (Experiment 5)	FR =2 >1 x per year	Skin	Latex glove	Yes	Yes	Yes	Low	Low	1	2
	Used by students in the Reaction Kinetics test (Experiment 5)	FR =2 >1 x per year	Skin	Latex glove	Yes	Yes	Yes	Low	Low	1	2
Potassium Persulfate	Mix with the Potassium Iodide, Potassium Chloride and starch in a test tube to test the Reaction Kinetics by record the time taken for the deep blue colour to appear and their temperature (Experiment 5)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
			Inhalation	No	No	No	No				
			Ingestion	No	No	No	No				
	Preparing 0.1M solution by lab assistant	FR=2 >1 x per year	Eyes	No	No	No	No	Low	Low	1	2
			Skin	Latex glove	No	Yes	No				
			Inhalation	No	No	No	No				
			Ingestion	No	No	No	No				

Sodium Sulfate 0.1M	Mix with the Sodium Thiousulfate in a test tube to test the Reaction Kinetics by record the time taken for the deep blue colour to appear and their temperature(Experiment 5)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
	Preparation of 0.1M Sodium Sulfate by lab assistant	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
Sodium Thiosulfate	Mix with the Sodium Sulfate in a test tube to test the Reaction Kinetics by record the time taken for the deep blue colour to appear and their temperature(Experiment 5)	FR =2 >1 x per year	Eyes	No	No	No	No	Low	Low	1	2
			Skin	Latex glove	No	Yes	No				
			Inhalation	No	No	No	No				
			Ingestion	No	No	No	No				
	Preparing 0.005M solution by lab assistant	FR=2 >1 x per year	Eyes	No	No	No	No	Low	Low	1	2
			Skin	Latex glove	No	Yes	No				
			Inhalation	No	No	No	No				
			Ingestion	No	No	No	No				
Copper (II) Nitrate 1.0M	30mL is used and the copper strip is place in this solution to test the Electrochemical (Experiment 6)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
			Ingestion	No	No	No	No				
	Preparing the solution by lab assistant		Skin	Latex glove	No	Yes	No	Low	Low	1	2
			eyes	No	No	No	No				

		FR =2 >1 x per year	Ingestion	No	No	No	No				
Iron (II) Sulfate 1.0M	Add this solution into porous pot and nail is place in this solution to test the Electrochemical (Experiment 6)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
	Preparation of 0.5M Iron(II) Sulfate by student (Experiment 6)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
	Preparation to 0.1M Iron(II) Sulfate by student (Experiment 6)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
	Preparation of 1.0M Iron (II) Sulfate by lab assistant	FR =2 >1 x per year	Eyes	No	No	No	No	Low	Low	1	2
			Skin	Latex glove	No	Yes	No				
Zinc Sulfate 0.1M	Add this solution into porous pot and nail is place in this solution to test the Electrochemical (Experiment 6)	FR =2 >1 x per year	Skin	Latex glove	Yes	Yes	Yes	Low	Low	1	2
	Preparation of 0.1M Zinc Sulfate by lab assistant	FR =2 >1 x per year	Skin	Latex glove	Yes	Yes	Yes	Low	Low	1	2

Magnesium Sulfate 1.0M	Used by students in the Electrochemical test (Experiment 6)	FR =2 >1 x per year	Skin	Latex glove	Yes	Yes	Yes	Low	Low	1	2
	Preparation 1.0M of Magnesium Sulfate by lab assistant	FR =2 >1 x per year	Skin	Latex glove	Yes	Yes	Yes	Low	Low	1	2
Iron(III) sulfate 1.0M	Used by students in the Electrochemical test (Experiment 6)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
	Preparation 1.0M of Iron (III)Sulfate by lab assistant	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
Methanol	1mL is place in evaporating dish and ignite the alcohol to test combustion of Alcohols (Experiment 7)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Moderate	Low	2	2
			Inhalation	Surgical Mask	No	No	No				
			Ingestion	No	No	No	No				
	3mL is mix with the 12mL water, 1 drop of 10% sodium hydroxide, 1 drop of dilute sulfuric acid and 1 drop potassium permanganate solution to test oxidation of Alcohol with Potassium Permanganate (Experiment 7)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Inhalation	Surgical Mask	No	No	No				
			Ingestion	No	No	No	No				

	2mL is used to form Methyl salicylate (Experiment7)	FR =2 >1 x per year	skin	latex glove	No	Yes	No	Low	Low	1	2
			Inhalation	Surgical Mask	No	No	No				
			Ingestion	No	No	No	No				
	Preparation of Methanol by lab assistant	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Inhalation	Surgical Mask	No	No	No				
			Ingestion	No	No	No	No				
Ethanol	1mL is place in evaporating dish and ignite the alcohol to test combustion of Alcohols (Experiment 7)	FR =2 >1 x per year	Eyes	No	No	No	No	Moderate	Low	2	2
			Skin	Latex glove	No	Yes	No				
			Inhalation	No	No	No	No				
	3mL is used to form Ethyl acetate (Experiment7)	FR =2 >1 x per year	Eyes	No	No	No	No	Low	Low	1	2
			Skin	Latex glove	No	Yes	No				
			Inhalation	No	No	No	No				
	Preparation of Ethanol by lab assistant	FR =2 >1 x per year	Eyes	No	No	No	No	Low	Low	1	2
			Skin	Latex glove	No	Yes	No				
			Inhalation	No	No	No	No				
Isopropanol	1mL is place in evaporating dish and ignite the alcohol to test combustion of Alcohols (Experiment 7)	FR =2 >1 x per year	Eyes	No	No	No	No	Moderate	Low	2	2

	3mL is mix with the 12mL water, 1 drop of 10% sodium hydroxide, 1 drop of dilute sulfuric acid and 1 drop potassium permanganate solution to test oxidation of Alcohol with Potassium Permanganate (Experiment 7)	FR =2 >1 x per year	Eyes	No	No	Yes	No	Low	Low	1	2
	Preparation of Isopropanol by lab assistant	FR =2 >1 x per year	Eyes	No	No	Yes	No	Low	Low	1	2
10% Sodium Hydroxide	1 drop is mix with the dilution of methanol (in first test tube) to test the oxidation of Alcohols with Potassium Permanganate (Experiment 7)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
	Mixing 1 drop of the chemical with the 8mL of 0.1M Silver Nitrate and several drop of dilute ammonium hydroxide to produce Tollens Reagent (Experiment7)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				

	Preparation of 10% Sodium Hydroxide by lab assistant	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
Dilute sulfuric acid	1 drop is mix with the dilution of methanol (in second test tube) to test the oxidation of Alcohols with Potassium Permanganate (Experiment 7)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
	Preparation of Dilute Sulfuric acid by lab assistant	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
Potassium Permanganate	1 drop is mix with the all (four test tube) dilution of methanol to test the oxidation of Alcohols (Experiment 7)	FR =2 >1 x per year	Ingestion	No	No	No	No	Low	Low	1	2
			Skin	Latex glove	No	Yes	No				
			Eye	No	No	No	No				
			Inhalation	No	No	No	No				
	Preparation of Potassium Permanganate by lab assistant	FR =2 >1 x per year	Ingestion	No	No	No	No	Low	Low	1	2
			Skin	Latex glove	No	Yes	No				
			Eye	No	No	No	No				
			Inhalation	No	No	No	No				

Glacial Acetic Acid	0.5mL is used to form Ethyl acetate & Isoamyl acetate (Experiment 7)	FR =2 >1 x per year	Skin	latex glove	Yes	Yes	Yes	Low	Low	1	2
	Preparation of Glacial Acetic Acid by lab assistant	FR =2 >1 x per year	Skin	latex glove	Yes	Yes	Yes	Low	Low	1	2
Concentrated Sulfuric Acid	5mL is mix with 45mL of tap water in a styrafom cup and record the maximum temperature to test Heat of reaction (Experiment3)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	Fume hood	Yes	Yes	Yes				
			Inhalation	Fume hood	Yes	Yes	Yes				
	10 drops is used to form Ethyl acetate Isoamyl acetate & Methyl salicylate (Experiment 7)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	Fume hood	Yes	Yes	Yes				
			Inhalation	Fume hood	Yes	Yes	Yes				
	Preparation of Concentrated Sulfuric Acid by lab assistant	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	Fume hood	Yes	Yes	Yes				
			Inhalation	Fume hood	Yes	Yes	Yes				
Isoamyl Alcohol	3mL is used to form Isoamyl acetate (Experiment7)	FR =2 >1 x per year	Ingestion	No	No	No	No	Low	Low	1	2

	Preparation of Isoamyl Alcohol by lab assistant	FR =2 >1 x per year	Ingestion	No	No	No	No	Low	Low	1	2
Salylic Acid Crystal	Used about 1cm deep in the test tube tu form Methyl salicylate (Experiment7)	FR =2 >1 x per year	Eye	No	No	No	No	Low	Low	1	2
			Ingestion	No	No	No	No				
	Preparation of Salylic Acid Crystal by lab assistant	FR =2 >1 x per year	Eye	No	No	No	No	Low	Low	1	2
			Ingestion	No	No	No	No				
Silver Nitrate 0.1M	Mixing 8mL of the chemical with the 1 drop of 10%NAOH and several drops of dilute ammonium hydroxide to produce Tollens Reagent (Experiment 7)	FR =2 >1 x per year	Eyes	No	No	No	No	Low	Low	1	2
			Skin	Latex glove	No	Yes	No				
	Preparation 0.1M of Silver Nitrate by lab assistant	FR =2 >1 x per year	Eyes	No	No	No	No	Low	Low	1	2
			Skin	Latex glove	No	Yes	No				
Ammonium Hydroxide	Mixing several drop of the chemical with the 8mL of		Skin	Latex glove	No	Yes	No	Low	Low	1	2

	0.1M Silver Nitrate and 1 drop of 10% Sodium Hydroxide to produce Tollens Reagent (Experiment7)	FR =2 >1 x per year	Eye	No	No	No	No				
			Inhalation	No	No	No	No				
	Preparation of Ammonium Hydroxide by lab assistant	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eye	No	No	No	No				
			Inhalation	No	No	No	No				
10% Formaldehyde	2 drops of the chemical is used to test with the Tollens Reagent (Experiment 7)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
			Inhalation	No	No	No	No				
	Preparation 0of 10% Formaldehyde by lab assistant	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
			Inhalation	No	No	No	No				
Acetone	2 drops of the chemical is used to test with the Tollens Reagent (Experiment 7)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
			Inhalation	No	No	No	No				
			Ingestion	Hygiene	Yes	Yes	Yes				
	Preparation of Acetone by lab assistant	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
			Inhalation	No	No	No	No				
			Ingestion	No	No	No	No				

Nitric Acid (7697-37-2)	30mL is used by mix it with the Sodium Hydroxide and measure the temperature of it (Experiment 3)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
	Preparation of Nitric Acid by lab assistant	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
Sodium Hydroxide 1.25M	140 mL is used by mix it with the Sodium Hydroxide and measure the temperature of it (Experiment 3)	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				
	Preparation 1.25M of Sodium Hydroxide by lab assistant	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eyes	No	No	No	No				

FORM D: WORKPLACE ASSESSMENT RESULT								
WORK UNIT : Chemistry subject				ASSESSMENT TEAM: Nurul Nazleatul Najiha Mohd Nazif			DATE: 2/10/2016	
WORK AREAS: Lab B.A.P.1.2				PERSONNEL : En. Muhammad Che Isa Pn Nur Izzati bt. Salleh				
Chemical Hazardous to Health	HR	ER	Task	Routes of Exposure	Risk Decision	Control Adequacy	Conclusion	Action to be Taken
Potassium Bicarbonate	1	2	2-3 g is dissolve in 5 mL of distilled water (Experiment 1)	Skin	RR2 Risk Not Significant	Yes	C1 Risk not significant now and not likely to increase in future	Recommendations for all chemicals: 1) Chemical handling training must be conducted at least once in two years to all Lab Assistance and students. 2). Chemical register should be updated in accordance to the USECHH Regulations 2000. 3). Safety Data Sheet (SDS) must be in both language Bahasa Malaysia and English and also must available at the facility where the chemicals are used or stored.
			Preparation of Potassium Bicarbonate by lab assistant	Inhalation		Yes		
Hydrochloric acid 6M	4	2	6 mL is used by mix with Potassium Bicarbonate solution and evaporate the mixture (Experiment 1)	Skin	RR3 Risk Significant Category 1	Yes	C2 Risk significant but already adequately controlled could increase in future	
				Eyes		Yes		
				Inhalation		Yes		
			Preparation 6M of Hydrochloric acid by lab assistant	Skin		Yes		
				Eyes		Yes		
				Inhalation		Yes		

Hydrochloric acid 0.1M	4	2	60 cm^3 is used with different concentration to test the pH of acid solution (Experiment 2)	Skin	RR3 Risk Significant Category 1	Yes	C2 Risk significant but already adequately controlled could increase in future	4). Maintenance for Fume hood should be do yearly by Hygiene Tech. to ensure the air velocity or pressure in the system are functioning well. 5). During experiments or usage of highly hazardous chemicals or very toxic or toxic chemicals, cartridge type respirators Organic Vapour should be used rather than used normal surgical mask. Also eye protective equipment and Nitrile glove should be provide and using during handle chemical. 6)Management need to improve the pressure of water at safety eye-wash 7) CHRA should review for next five years or when there is a change in or as directed by DOSH
			Preparation of 0.1M Hydrochloric acid by lab assistant	Skin		Yes		
Hydrochloric acid 3M	4	2	100 mL is used by mix it with the Sodium Hydroxide and measure the temperature of it (Experiment 3)	Skin	RR3 Risk Significant Category 1	No	C3 Risk significant now and not adequately controlled	
				Eyes		No		
				Inhalation		No		
			Preparation of 3.0M hydrochloric acid by lab assistant	Skin		No		
				Eyes		No		
				Inhalation		No		
Acetic Acid 0.1M	2	2	60 cm^3 is used with different concentration to test the pH of acid solution (Experiment 2)	Eyes	RR2 Risk Not Significant	No	C3 Risk significant now and not	

				Skin		No	adequately controlled	
			Preparation of 0.1M Acetic Acid by lab assistant	Eyes		No		
				Skin		No		
Sulfuric acid	4	2	5mL of the chemical is used by mix it with 45mL of tap water to test the Hydration of chemical (Experiment 3)	Eyes	RR3 Risk Significant Category 1	No	C3 Risk significant now and not adequately controlled	
				Skin		No		
				Inhalation		Yes		
			Preparation of Sulfuric acid by lab assistant	Skin		No		
				Eyes		Yes		
				Inhalation		No		
Ammonium Nitrate crystal	4	2	3g of the chemical is mix with the 20mL of tap water in Heat of Reaction test (Experiment 3)	Skin	RR3 Risk Significant Category 1	Yes	C2 Risk significant but already adequately controlled	
				Eyes		Yes		

				Ingestion		Yes	could increase in future	
			Preparation of Ammonium Nitrate crystal by lab assistant	Eyes		No	C3 Risk significant now and not adequately controlled	
				Skin		No		
				Ingestion		Yes		
Phenolphthalein solution	5	2	A few drops are used in the test for estimation of acetic acid from vinegar (Experiment 4)	Skin	RR4 Risk Significant Category 1	No	C3 Risk significant now and not adequately controlled	
			Preparation of Phenolphthalein solution by lab assistant	Inhalation		No		
Potassium Iodide 0.2M	2	2	Mix with the Potassium Chloride, Potassium Persulfate and starch in a test tube to test the Reaction Kinetics by record the time taken for the deep blue colour to appear and their temperature (Experiment 5)	Skin	RR2 Risk Not Significant	No	C3 Risk significant now and not adequately controlled	
				Eyes		No		

			Preparation 0.2M of Potassium Iodide by lab assistant	Skin		No		
				Eyes		No		
Potassium Chloride 0.2M	1	2	Mix with the Potassium Iodide, Potassium Persulfate and starch in a test tube to test the Reaction Kinetics by record the time taken for the deep blue colour to appear and their temperature (Experiment 5)	Skin	RR2 Risk Not Significant	Yes	C1 Risk not significant now and not likely to increase in future	
			Used by students in the Reaction Kinetics test (Experiment 5)	Skin		Yes		
Potassium Persulfate	3	2	Mix with the Potassium Iodide, Potassium Persulfate and starch in a test tube to test the Reaction Kinetics by record the time taken for the deep blue colour to appear and their temperature (Experiment 5)	Skin	RR3 Risk Significant Category 1	No	C3 Risk significant now and not adequately controlled	
				Eyes		No		
				Inhalation		Yes		
				Ingestion		Yes		
			Preparing 0.1M solution by lab assistant	Eyes		No		
				Skin		No		
				Inhalation		No		
				Ingestion		No		

Sodium Sulfate 0.1M	2	2	Mix with the Sodium Thiousulfate in a test tube to test the Reaction Kinetics by record the time taken for the deep blue colour to appear and their temperature(Experiment 5)	Skin	RR2 Risk Not Significant	No	C3 Risk significant now and not adequately controlled	
				Eyes		No		
			Preparation of 0.1M Sodium Sulfate by lab assistant	Skin		No		
				Eyes		No		
Sodium Thiosulfate	4	2	Mix with the Sodium Sulfate in a test tube to test the Reaction Kinetics by record the time taken for the deep blue colour to appear and their temperature(Experiment 5)	Eyes	RR3 Risk Significant Category 1	No	C3 Risk significant now and not adequately controlled	
				Skin		No		
				Inhalation		No		
				Ingestion		No		
			Preparing 0.005M solution by lab assistant	Eyes		No		
				Skin		No		
				Inhalation		No		
				Ingestion		No		
Copper (II) Nitrate 1.0M	4	2	30mL is used and the copper strip is place in this solution to	Skin	RR3 Risk Significant Category 1	No	C3 Risk significant now and not	

			test the Electrochemical (Experiment 6)	Eyes		No	adequately controlled	
				Ingestion		No		
			Preparing the solution by lab assistant	Skin		No		
				eyes		No		
				Ingestion		No		
Iron(II) Sulfate 1. 0M	2	2	Add this solution into porous pot and nail is place in this solution to test the Electrochemical (Experiment 6)	Skin	RR2 Risk Not Significant	No	C3 Risk significant now and not adequately controlled	
				Eyes		No		
			Preparation of 0.5M Iron(II) Sulfate by student (Experiment 6)	Skin		No		
				Eyes		No		
			Preparation to 0.1M Iron(II) Sulfate by student (Experiment 6)	Skin		No		
				Eyes		No		
			Preparation of 1.0M Ion (II) Sulfate by lab assistant	Eyes		No		

				Skin		No		
Zinc Sulfate 0.1M	1	2	Used by students in the Electrochemical test (Experiment 6)	Skin	RR2 Risk Not Significant	Yes	C1 Risk not significant now and not likely to increase in future	
			Preparation of 0.1M Zinc Sulfate by lab assistant	Skin		Yes		
Magnesium Sulfate 1.0M	1	2	Used by students in the Electrochemical test (Experiment 6)	Skin	RR2 Risk Not Significant	Yes	C1 Risk not significant now and not likely to increase in future	
			Preparation 1.0M of Magnesium Sulfate by lab assistant	Skin		Yes		
Iron(III) sulfate 1.0M	2	2	Used by students in the Electrochemical test (Experiment 6)	Skin	RR2 Risk Not Significant	No	C3 Risk significant now and not adequately controlled	
			Preparation 1.0M of Iron (III) Sulfate by lab assistant	Skin		No		
Methanol	4	2	1mL is place in evaporating dish and ignite the alcohol to test combustion of Alcohols (Experiment 7)	Skin	RR3 Risk Significant Category 1	No	C3 Risk significant now and not	

				Inhalation		No	adequately controlled	
				Ingestion		Yes		
			3mL is mix with the 12mL water, 1 drop of 10% sodium hydroxide, 1 drop of dilute sulfuric acid and 1 drop potassium permanganate solution to test oxidation of Alcohol with Potassium Permanganate (Experiment 7)	Skin		No		
				Inhalation		No		
				Ingestion		Yes		
			2mL is used to form Methyl salicylate (Experiment7)	Skin		No		
				Inhalation		No		
				Ingestion		Yes		
			Preparation of Methanol by lab assistant	Skin		No		
				Inhalation		No		
				Ingestion		Yes		
Ethanol	3	2	1mL is place in evaporating dish and ignite the alcohol to test	Eyes	RR3 Risk Significant Category 1	No	C3 Risk significant now and not	

			combustion of Alcohols (Experiment 7)	Skin		No	adequately controlled	
				Inhalation		No		
			3mL is used to form Ethyl acetate (Experiment7)	Eyes		No		
				Skin		No		
				Inhalation		No		
			Preparation of Ethanol by lab assistant	Eyes		No		
				Skin		No		
				Inhalation		No		
Isopropanol	3	2	1mL is place in evaporating dish and ignite the alcohol to test combustion of Alcohols (Experiment 7)	Eyes	RR3 Risk Significant Category 1	No	C3 Risk significant now and not adequately controlled	

			3mL is mix with the 12mL water, 1 drop of 10% sodium hydroxide, 1 drop of dilute sulfuric acid and 1 drop potassium permanganate solution to test oxidation of Alcohol with Potassium Permanganate (Experiment 7)	Eyes		No		
			Preparation of Isopropanol by lab assistant	Eyes		No		
10% Sodium Hydroxide	4	2	1 drop is mix with the dilution of methanol (in first test tube) to test the oxidation of Alcohols with Potassium Permanganate (Experiment 7)	Skin	RR3 Risk Significant Category 1	No	C3 Risk significant now and not adequately controlled	
				Eyes		No		
			Mixing 1 drop of the chemical with the 8mL of 0.1M Silver Nitrate and several drop of dilute ammonium hydroxide to produce Tollens Reagent (Experiment7)	Skin		No		
				Eyes		No		
			Preparation of 10% Sodium Hydroxide by lab assistant	Skin		No		
				Eyes		No		

Dilute sulfuric acid	4	2	1 drop is mix with the dilution of methanol (in second test tube) to test the oxidation of Alcohols with Potassium Permanganate (Experiment 7)	Skin	RR3 Risk Significant Category 1	No	C3 Risk significant now and not adequately controlled	
				Eyes		No		
			Preparation of Dilute Sulfuric acid by lab assistant	Skin		No		
				Eyes		No		
Potassium Permanganate	4	2	1 drop is mix with the all (four test tube) dilution of methanol to test the oxidation of Alcohols (Experiment 7)	Ingestion	RR3 Risk Significant Category 1	Yes	C3 Risk significant now and not adequately controlled	
				Skin		No		
				Eyes		No		
				Inhalation		No		
			Preparation of Potassium Permanganate by lab assistant	Ingestion		Yes		
				Skin		No		
				Eyes		No		
				Inhalation		No		
Glacial Acetic Acid	1	2	0.5mL is used to form Ethyl acetate & Isoamyl acetate (Experiment 7)	Skin	RR2 Risk Not Significant	Yes	C1 Risk not significant now and not likely	

			Preparation of Glacial Acetic Acid by lab assistant	Skin		Yes	to increase in future	
Concentrated Sulfuric Acid	4	2	5mL is mix with 45mL of tap water in a styrafom cup and record the maximum temperature to test Heat of reaction (Experiment3)	Skin	RR3 Risk Significant Category 1	No	C3 Risk significant now and not adequately controlled	
				Eyes		Yes		
				Inhalation		Yes		
			10 drops is used to form Ethyl acetate Isoamyl acetate & Methyl salicylate (Experiment 7)	Skin		No		
				Eyes		Yes		
				Inhalation		Yes		
			Preparation of Concentrated Sulfuric Acid by lab assistant	Skin		No		
				Eyes		Yes		
				Inhalation		Yes		

Isoamyl Alcohol	4	2	3mL is used to form Isoamyl acetate (Experiment7)	Ingestion	RR3 Risk Significant Category 1	Yes	C2 Risk significant but already adequately controlled could increase in future	
			Preparation of Isoamyl Alcohol by lab assistant	Ingestion		Yes		
Salylic Acid Crystal	3	2	Used about 1cm deep in the test tube tu form Methyl salicylate (Experiment7)	Eye	RR3 Risk Significant Category 1	No	C3 Risk significant now and not adequately controlled	
				Ingestion		Yes		
			Preparation of Salylic Acid Crystal by lab assistant	Eye		No		
				Ingestion		Yes		
Silver Nitrate 0.1M	2	2	Mixing 8mL of the chemical with the 1 drop of 10%NAOH and several drops of dilute ammonium hydroxide to	Eyes	RR2 Risk Not Significant	No	C3 Risk significant now and not adequately controlled	

			produce Tollens Reagent (Experiment 7)	Skin		No		
			Preparation 0.1M of Silver Nitrate by lab assistant	Eyes		No		
				Skin		No		
Ammonium Hydroxide	4	2	Mixing several drop of the chemical with the 8mL of 0.1M Silver Nitrate and 1 drop of 10% Sodium Hydroxide to produce Tollens Reagent (Experiment7)	Skin	RR3 Risk Significant Category 1	No	C3 Risk significant now and not adequately controlled	
				Eye		No		
				Inhalation		No		
			Preparation of Ammonium Hydroxide by lab assistant	Skin		No		
				Eye		No		
				Inhalation		No		
10% Formaldehyde	5	2	2 drops of the chemical is used to test with the Tollens Reagent (Experiment 7)	Skin	RR4 Risk Significant Category 1	No	C3 Risk significant now and not adequately controlled	
				Eyes		No		

				Inhalation		No		
			Preparation 0of 10% Formaldehyde by lab assistant	Skin		No		
				Eyes		No		
				Inhalation		No		
Acetone	3	2	2 drops of the chemical is used to test with the Tollens Reagent (Experiment 7)	Skin	RR3 Risk Significant Category 1	No	C3 Risk significant now and not adequately controlled	
				Eyes		No		
				Inhalation		No		
				Ingestion		Yes		
			Preparation of Acetone by lab assistant	Skin		No		
				Eyes		No		
				Inhalation		No		
				Ingestion		Yes		
Nitric Acid (7697-37-2)	4	2	30mL is used by mix it with the Sodium Hydroxide and measure the temperature of it (Experiment 3)	Skin	RR3 Risk Significant Category 1	No	C3 Risk significant now and not adequately controlled	
				Eyes		No		

			Preparation of Nitric Acid by lab assistant	Skin		No		
				Eyes		No		
Sodium Hydroxide 1.25M	4	2	100 mL is used by mix it with the Sodium Hydroxide and measure the temperature of it (Experiment 3)	Skin	RR3 Risk Significant Category 1	No	C3 Risk significant now and not adequately controlled	
				Eyes		No		
			Preparation 1.25M of Sodium Hydroxide by lab assistant	Skin		No		
				Eyes		No		

FORM E: RISK MATRIX						
WORK UNIT: Chemistry subject						
		EXPOSURE RATINGS				
		1	2	3	4	5
HAZARD RATINGS	1		RR=2 Potassium Bicarbonate, Potassium Chloride 0.2M, Zinc Sulfate 0.1M, Magnesium Sulfate 1.0M, Glacial Acetic Acid			
	2		RR=2 Acetic Acid 0.1M, Potassium Iodide 0.2M, Sodium Sulfate 0.1M, Iron (II) Sulfate 1.0M, Iron (III) sulfate 1.0M, Silver Nitrate 0.1M			
	3		RR=3 Potassium Persulfate, Ethanol, Isopropanol, Salylic Acid Crystal, Acetone			
	4		RR=3 Hydrochloric acid 6M, Hydrochloric acid 3M, Hydrochloric acid 0.1M, Sulfuric acid, Ammonium Nitrate crystal, Sodium Thiosulfate, Copper (II) Nitrate 1.0M, Methanol, 10% Sodium Hydroxide, Dilute sulfuric acid, Potassium Permanganate, Concentrated Sulfuric Acid, Isoamyl Alcohol, Ammonium Hydroxide, Nitric Acid, Sodium Hydroxide 1.25M			**RISK SIGNIFICANT -CATEGORY 2**
	5		RR=4 Phenolphthalein solution, 10% Formaldehyde			

FORM F: ACTIONS TO BE TAKEN		
WORK UNIT: Chemistry subject	**EXISTING MEASURES**	**ACTION TO BE TAKEN**
1. TECHNICAL MEASURES (Comment on whether the control was appropriate and adequate) 1.1 Elimination /Substitution	There is no plan to eliminate/substitute the used of the chemicals	No recommendation
1.2 Elimination /Enclosures	The activity is carried out through in enclosed and isolated area	No recommendation
1.3Ventilation	Normal general ventilation is available at the area	No recommendation
1.4 Work practice/ System of work	There are establish SOP/procedures on Lab Safety	It is recommended that safety procedures to be at the work station
1.5 Personal protection	Latex glove, Surgical mask	Cartridge Organic Vapour Mask, Nitrile glove and Eye protective equipment should be provide and used when handling the hazardous chemicals.
2. MAINTENANCE OF CONTROL EQUIPMENT (Whether maintenance was appropriate & adequate)	No regular inspection, examination and testing of the Fume hood was done	1) Management to appoint the specific staff to conduct regular inspection of fume hood as the requirement of USECHH Regulations 2000 2) Management to engage Industrial Hygiene Technician 2 (IHT2) to conduct examination and testing of the fume hood as the requirement of USECHH Regulation 2000.
3. MONITORING OF AIR CONTAMINANT (Provide summary and attach details as appendix. Whether monitoring was appropriate & adequate)	Exposure monitoring was not being conducted in the lab	No recommendation

4. BILOGICAL MONITORING (Provide summary and attach details as appendix. Whether monitoring was appropriate & adequate)	Biological monitoring was not conducted	No recommendation
5. HEALTH SURVEILLANCE (Summarise the conclusion, and attach details as an appendix if appropriate)	Health surveillance was not conducted	No recommendation
6. INFO, INSTRUCTION & TRAINING (Describe existing training, procedures for work unit)	Lab Assistance and students was attended the chemical handling	It is recommended the Lab Assistance and students be provided with adequate training on chemical safety at least once in two years; PPE usage, storage and maintenance; Awareness of safe working and Lab Safety
7. EMERGENCY & FIRST AID PROCEDURES (Describe existing procedure)	Emergency response procedures are establish	The management should provide maintenance and service to the emergency eyewash and to ensure that the water pressure is adequate.
SUMMARY OF PREVIOUS ASSESSMENT DONE ON WORK UNIT	C3	UMK management need to follow the suggestion by the assessor.
ASSESSMENT DATE(S)	PREVIOUS: Nil	CURRENT NEXT
NAME OF ASSESSOR(S)	Nurul Nazleatul Najiha Mohd Nazif	
NRIC NO		
JKKP Registration Number		
Signature		
ACKNOWLEDGEMENT OF RECEIPT BY EMPLOYER (Name, IC No.,Signature & Date)		

APPENDIX C

FORM A: LIST OF CHEMICALS							
Work unit: Waste management & pollution prevention subject							
No.	Name of Chemical & indicator ingredient	Physical Form	Source of Information	Classification of Hazard	Risk Phrases	Skin Notation	Hazard Rating
1	Ammonia Cyanurate reagent pillows	solid (powder)	SDS HACH	Corrosive	R35 - Cause severe skin burns and eye damage	sk	4
2	Ammonia Salicylate reagent pillows	solid (powder)	MSDS HACH	Harmful	R22 - Harmful if swallowed	sk	3
					R20 - Harmful by inhalation		
					R21 - Harmful in contact with skin		
					R36 - Irritating to eyes		
					R38 - Irritating to skin		
					R37 - Irritating to respiratory system		
3	Digestion Solution for COD (20-1500 mg/l Range)	Liquid	SDS HACH	Toxic	R23 - Toxic by inhalation	sk	4
					R35 - Cause severe skin burns and eye damage		
					R46 (2)- Cause mutagenic		
					R45(2) - Cause carcinogenic		

<table>
<tr><th colspan="5">FORM B: WORK UNIT DESCRIPTION</th><th rowspan="2">7. EMPLOYEE HEALTH FEEDBACKS (Any ill-effects experienced)</th></tr>
<tr><td colspan="5">WORK UNIT: Waste management & pollution prevention subject</td></tr>
<tr><td>1. WORK AREA</td><td colspan="3">Environmental laboratory</td><td>No illness effects to the Lab Assistance & students</td></tr>
<tr><td>2. JOB TITLE</td><td colspan="3">Lab Assistance & Students</td><td>8. REPORT OF HEALTH EFFECTS (summaries of effects reported)</td></tr>
<tr><td colspan="4">3. NUMBER OF EMPLOYEES (attach list as appendix)</td><td rowspan="2">No Lab Assistance & students having health effects</td></tr>
<tr><td>Male:</td><td>5</td><td>Female</td><td>44</td></tr>
<tr><td colspan="4">4. CATEGORY OF WORKERS IN WORK UNIT (tick)</td><td>9. WORKRS WITH SUSPECTIBLE CONDITION (describe condition)</td></tr>
<tr><td>Lab Assistance</td><td>√</td><td></td><td></td><td>No workers with susceptible condition</td></tr>
<tr><td>Student</td><td>√</td><td></td><td></td><td>10. POSIBILITIES OF ABNORMAL EXPOSURE (other than normal work)</td></tr>
<tr><td></td><td></td><td></td><td></td><td>No possibilities of abnormal exposure</td></tr>
<tr><td></td><td></td><td></td><td></td><td>11. POSIBILITIES OF MIXED EXPOSURE (other chemicals effecting same organ)</td></tr>
<tr><td></td><td></td><td></td><td></td><td>No other chemical affecting the same organ</td></tr>
<tr><td></td><td></td><td></td><td></td><td>12. POSIBILITIES OF INGESTION EXPOSURE (describe situation)</td></tr>
<tr><td colspan="4">5. WORKING HOUR</td><td>No possibilities. The workers are not taking meals and drinks in the plant area</td></tr>
<tr><td colspan="4">3 hour</td><td>13. INFORMATION, INSTRUCTION & TRAINING GIVEN</td></tr>
<tr><td colspan="4">Work Arrangements (tick): Normal [√] Shift work [ ]</td><td>Lab assistance have attended training on Safe Handling of Chemical, while the student haven't expose with safety awareness programme.</td></tr>
<tr><td colspan="4">6. BRIEF PROCESS DESCRIPTION</td><td>14. OTHER COMMENTS</td></tr>
<tr><td colspan="4">This work unit conducts experiment for the teaching purpose. The laboratory assistant prepare the solution for the experiment by students</td><td></td></tr>
</table>

FORM C: WORKPLACE ASSESSMENT											
WORK UNIT (JOB): **Waste management & pollution prevention subject**				**ASSESSMENT TEAM**: NURUL NAZLEATUL NAJIHA MOHD NAZIF				DATE: **2/10/16**			
WORK AREA: **Environmental laboratory**				PERSONNEL: En. Muhammad Che Isa En. Mohamad Rohanif b. Mohamed Al							
Chemical Hazardous to Health	Task	Frequency/ Duration	Routes of Entry	Existing Controls	Suitable & Effective Yes/No	Main. Testing & Exam	Adequate?	Degree Chemical Release	Degree Contact/ Absorb	MR	ER
Ammonia Cyanurate reagent pillows	Use for the spectrophotometer by student	FR =2 >1 x per year	Eye	No	Yes	No	Yes	Low	Low	1	2
			Skin	Latex glove	No	Yes	No				
	Preparation of Ammonia Cyanurate reagent pillow by lab assistance	FR =2 >1 x per year	Eye	No	No	No	No	Low	Low	1	2
			Skin	Latex glove	No	Yes	No				
Ammonia Salicylate reagent pillows	Use for the spectrophotometer by student	FR =2 >1 x per year	Eye	No	Yes	No	Yes	Low	Low	1	2
			Skin	Latex glove	No	Yes	No				
			Inhalation	Surgical Mask	No	No	No				
			Ingestion	No	No	No	No				
	Preparation of Ammonia Salicylate reagent pillow by lab assistance	FR =2 >1 x per year	Eye	No	No	No	No	Low	Low	1	2
			Skin	Latex glove	No	Yes	No				
			Inhalation	Surgical Mask	No	No	No				
			Ingestion	No	No	No	No				

Digestion Solution for COD (20-1500 mg/l Range)	Use for the spectrophotometer by student	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eye	No	Yes	No	Yes				
			Inhalation	Surgical Mask	No	No	No				
	Preparation of Digestion Solution for COD by lab assistance	FR =2 >1 x per year	Skin	Latex glove	No	Yes	No	Low	Low	1	2
			Eye	No	No	No	No				
			Inhalation	Surgical Mask	No	No	No				

FORM D: WORKPLACE ASSESSMENT RESULT								
WORK UNIT (JOB): **Waste management & pollution prevention subject**				ASSESSMENT TEAM: Nurul Nazleatul Najiha Mohd Nazif			DATE: 2/10/2016	
WORK AREA: Environmental laboratory				PERSONNEL: En. Muhammad Che Isa En. Mohamad Rohanif b. Mohamed Al				
Chemical Hazardous to Health	HR	ER	Task	Routes of Exposure	Risk Decision	Control Adequacy	Conclusion	Action to be Taken
Ammonia Cyanurate reagent pillows	4	2	Use for the spectrophotometer	Eye Skin	RR3 Risk Significant Category 1	Yes No	C3 Risk significant now and not adequately controlled	Recommendations for all chemicals: 1) Chemical handling training must be conducted at least once in two years to all Lab Assistance and students. 2). Chemical register should be updated in accordance to the USECHH Regulations 2000. 3). Safety Data Sheet (SDS) must be in both language Bahasa Malaysia and English and also must display at the facility where the chemicals are used or stored. 4). During experiments or handling of highly hazardous chemicals or very toxic or toxic chemicals, cartridge type respirators Organic Vapour should be provide and using rather than used
			Preparation of Ammonia Cyanurate reagent pillow by lab assistance	Eye Skin		No No		
Ammonia Salicylate reagent pillows	3	2	Use for the spectrophotometer	Eye Skin Inhalation Ingestion	RR3 Risk Significant Category 1	Yes No No Yes	C3 Risk significant now and not adequately controlled	

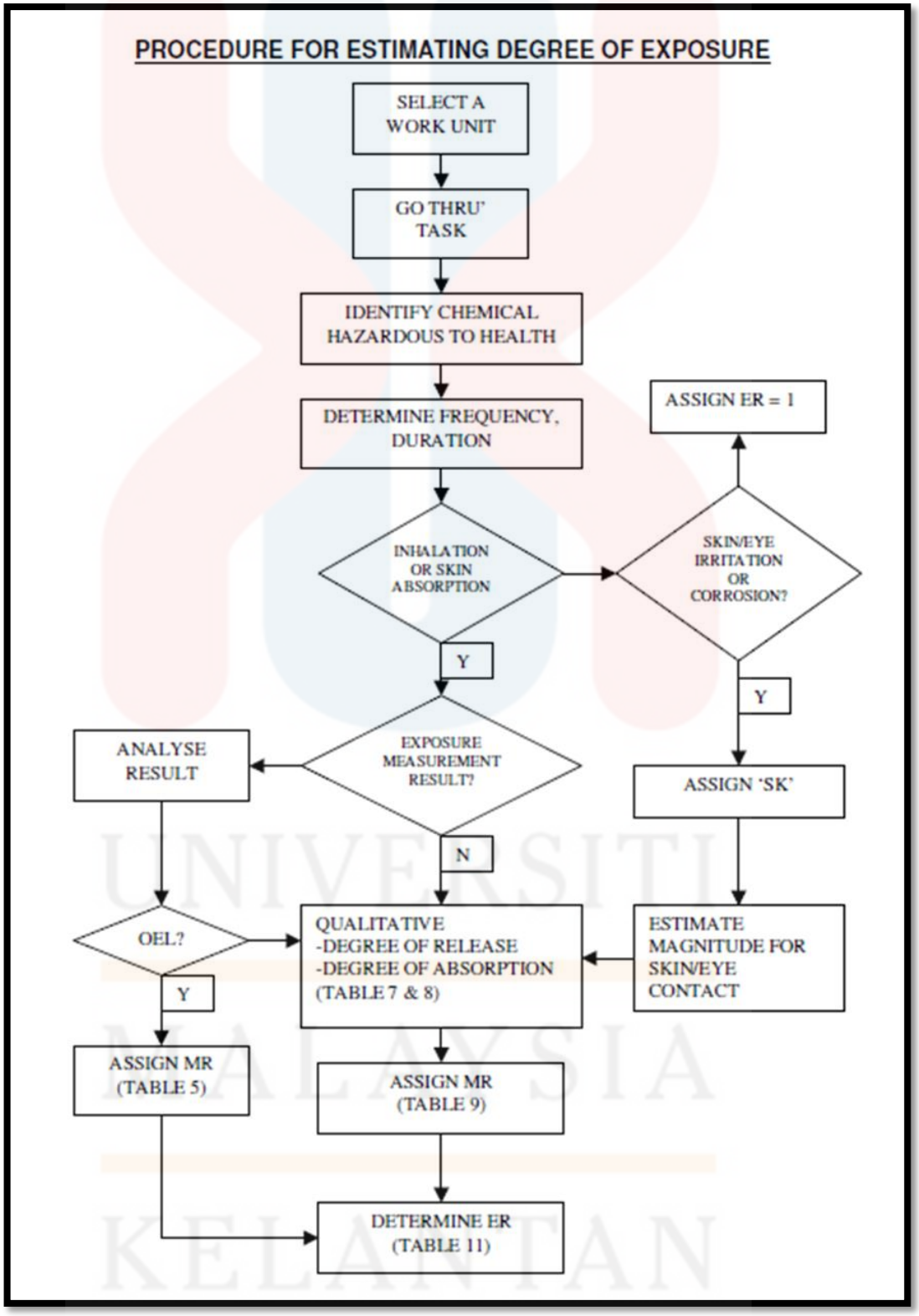
			Preparation of Ammonia Salicylate reagent pillow by lab assistance	Eye		Yes No No Yes		surgical mask. Also eye protective equipment and Nitrile glove should be provide and using during handling the chemical. 5). Management need to improve the pressure of water at safety eye-wash 6) Training in using PPE should be conducted to the Lab Assistant and students. 7) CHRA should be review every five years or when there is a change in procedures or as directed by DOSH
Digestion Solution for COD (20-1500 mg/l Range)	4	2	Use for the spectrophotometer	Skin Eye Inhalation	RR3 Risk Significant Category 1	No Yes No	C3 Risk significant now and not adequately controlled	
			Preparation of Digestion Solution for COD by lab assistance	Skin Eye Inhalation		No Yes No		

FORM E: RISK MATRIX						
WORK UNIT: **Waste management & pollution prevention subject**						
		EXPOSURE RATINGS				
		1	**2**	**3**	**4**	**5**
HAZARD RATINGS	**1**	RISK NOT SIGNIFICANT				
	2					
	3		RR=3 Ammonia Salicylate reagent pillows			
	4		RR=3 Ammonia Cyanurate reagent pillows, Digestion Solution for COD (20-1500 mg/l Range)			RISK SIGNIFICANT CATEGORY 2
	5					

FORM F: ACTIONS TO BE TAKEN		
WORK UNIT:	**EXISTING MEASURES**	**ACTION TO BE TAKEN**
1. **TECHNICAL MEASURES** (Comment on whether the control was appropriate and adequate)	There is no plan to eliminate/substitute the used of the chemicals	No recommendation
1.1 Elimination /Substitution		
1.2 Elimination /Enclosures	The activity is carried out through in enclosed and isolated area	No recommendation
1.3Ventilation	Normal general ventilation is available at the area	No recommendation
1.4 Work practice/ System of work	There are establish SOP/procedures on Lab Safety	It is recommended that safety procedures to be at the work station
1.5 Personal protection	Latex glove, Surgical Mask	Cartridge Organic Vapour Mask, Nitrile glove and Eye protective equipment should be provide and using when handling the hazardous chemicals.
2. MAINTENANCE OF CONTROL EQUIPMENT (Whether maintenance was appropriate & adequate)	No regular inspection, examination and testing of the Fume hood was done	1) Management to appoint the specific staff to conduct regular inspection of fume hood as the requirement of USECHH Regulations 2000
		2) Management to engage Industrial Hygiene Technician 2 (IHT2) to conduct examination and testing of the fume hood as the requirement of USECHH Regulation 2000.
3. MONITORING OF AIR CONTAMINANT (Provide summary and attach details as appendix. Whether monitoring was appropriate & adequate)	Exposure monitoring was not being conducted in the lab	No recommendation

4. BILOGICAL MONITORING (Provide summary and attach details as appendix. Whether monitoring was appropriate & adequate)	Biological monitoring was not conducted	No recommendation	
5. HEALTH SURVEILLANCE (Summarise the conclusion, and attach details as an appendix if appropriate)	Health surveillance was not conducted	No recommendation	
6. INFO, INSTRUCTION & TRAINING (Describe existing training, procedures for work unit)	Lab Assistance and students was attended the chemical handling	It is recommended the Lab Assistance and students be provided with adequate training on chemical safety at least once in two years; PPE usage, storage and maintenance; Awareness of safe working and Lab Safety	
7. EMERGENCY & FIRST AID PROCEDURES (Describe existing procedure)	Emergency response procedures are establish	The management should provide maintenances and service to the emergency eyewash and to ensure that the water pressure is adequate.	
SUMMARY OF PREVIOUS ASSESSMENT DONE ON WORK UNIT	C3	UMK management need to follow the suggestion by the assessor	
ASSESSMENT DATE(S)	PREVIOUS: Nil	CURRENT :	NEXT :
NAME OF ASSESSOR(S)	Nurul Nazleatul Najiha Mohd Nazif		
NRIC NO			
JKKP Registration Number			
Signature			
ACKNOWLEDGEMENT OF RECEIPT BY EMPLOYER (Name, IC No.,Signature & Date)			

APPENDIX D


PROCEDURE FOR ESTIMATING DEGREE OF EXPOSURE
SELECT A WORK UNIT
GO THRU' TASK
IDENTIFY CHEMICAL HAZARDOUS TO HEALTH
DETERMINE FREQUENCY, DURATION
INHALATION OR SKIN ABSORPTION
SKIN/EYE IRRITATION OR CORROSION?
ASSIGN ER = 1
Y
Y
EXPOSURE MEASUREMENT RESULT?
ANALYSE RESULT
ASSIGN 'SK'
N
OEL?
QUALITATIVE -DEGREE OF RELEASE -DEGREE OF ABSORPTION (TABLE 7 & 8)
ESTIMATE MAGNITUDE FOR SKIN/EYE CONTACT
Y
ASSIGN MR (TABLE 5)
ASSIGN MR (TABLE 9)
DETERMINE ER (TABLE 11)

APPENDIX E

FACULTY OF EARTH SCIENCE

BACHELOR DEGREE OF APPLIED SCIENCE

(SUSTAINABLE SCIENCE)

Disclaimer:

I am the student of University Malaysia Kelantan (UMK) and presently doing a research on "Assessment of Chemical Health Risk and Chemical Safety Awareness of Laboratory Operator in Umk, Jeli Campus". Your responses will be anonymous and will never be linked to the university or to you personally. I will not use your name or any information that would allow you and university to be identified in any presentation or published work related to the research. Kindly fill in the questionnaire below and assure that the data you generated shall be kept confidential and for research purpose only. I appreciate your time and generosity. Thank you for your cooperation.

If you have any question or require more information about the study itself, please do not hesitate to contact me, Nurul Nazleatul Najiha bt Mohd Nazif (013-9610038).

SECTION 1: DEMOGRAPHIC

Instruction: Please fill in the blank space and tick (□) the appropriate box.

1. Age:

☐	18-24 years old	☐	25-34 years old	☐	35-44 years old
☐	45-54 years old	☐	55-64 years old	☐	65-74 years old and above

2. Gender:

☐	Female	☐	Male

3. Race:

☐	Malay	☐	Chinese	☐	Indian	☐	Others

4. Occupation:

☐	Lecturer	☐	Lab assistance / Science officer
☐	1st year student	☐	3rd year student

5. Highest achieve academic qualification:

☐	SPM	☐	Diploma	☐	Master
☐	STPM	☐	Bachelor	☐	PhD
☐	Matriculation/ foundation				

Instruction: For each statement below, please indicate the extent of your level of understanding by placing (□) in the appropriate box (1-10).

1= Strongly disagree **10= Strongly agreed**

SECTION 2: AWARENESS

PART A: Knowledge

Do you:

	1	2	3	4	5	6	7	8	9	10
1. agree that some of the chemical substances can't be mix										
2. agree safety measures should be taken before handling hazardous chemicals										
3. agree an appropriate action is required in the event of an emergency										
4. agree chemicals in the form of vapour, fumes, dust or gas can easily enter the body through breathing.										
5. know that Material Safety Data Sheet (MSDS) provide information about chemicals used in the laboratory										
6. know the level of toxicity of each chemical used										
7. know about the precaution step during handling hazardous substance										
8. agree that rules and regulation in the Occupational Safety and Health Act are related to chemical safety										

9. agree there is a component of chemical safety in UMK Occupational Safety and Health policy										
10. agree that chemical waste disposal procedure in UMK is comply with the regulations										

PART B: SKILLS

You had received training or course related to the following:

	1	2	3	4	5	6	7	8	9	10
1. Chemical hazard										
2. First aid										
3. Emergency respond										
4. Procedure on chemical handling										
5. Procedure on chemical storage										
6. Procedure for the disposal of chemicals										
7. Personal protective equipment										
8. Laboratory chemical safety										
9. Chemical hygiene										
10. Material Safety Data Sheet										

PART C: ATTITUDE

You always doing this in laboratory:

	1	2	3	4	5	6	7	8	9	10
1. Report the incident/ accident that happen in the laboratory										
2. Wear Personal Protective Equipment (PPE) while working with chemicals										
3. Read the label on the chemical container before used										
4. Keep or use the chemical substance with suitable container										
5. Identify the nearest position of the **Fire extinguisher** and **Security alarm bells** at your work place										
6. Identify the **Emergency Shower and eye fountain** nearest position of the at your work place										
7. Identify the nearest position of the **Emergency exits** at your work place										
8. Clean up and reorganize the apparatus after use										
9. Wear the appropriate clothing is important when working in the laboratory										
10. Neatness is important when working in the laboratory in order to avoid the occurrence of an accident/ incident										

SECTION 3: PRACTICE FOR CHEMICAL SAFETY IN UMK JELI CAMPUS

	1	2	3	4	5	6	7	8	9	10
1. UMK provide a manual on chemical safety to each student before the start of experiments										
2. UMK have a committee on occupational safety and health										
3. UMK record all the accident/ incidents occurred in laboratory										
4. UMK investigate all accident/ incident involving chemicals										
5. UMK provide training on chemical safety to student, staff and lecturer involved in chemical usage										
6. UMK comply with rules and regulations in Occupational Safety and Health Act that related to chemical safety										
7. UMK take serious action towards student/ staff who and not follow the rules and regulations in laboratory										
8. There is signage/ poster/ instruction in the laboratory to remind of the importance of **wearing personal protective equipmen**t										

9. There is signage/ poster/ instruction in the laboratory to remind the importance of **cleaning up the laboratory before leaving**										
10. There is signage/ poster/ instruction in the laboratory to **warn about dangerous chemical**										

SECTION 4: COMMENTS AND SUGGESTION OF RESPONDENTS

1. In your opinion, what is the level of awareness on chemical safety and health at the University Malaysia Kelantan of individual listed below?

	Very good	Good	Satisfy	Unsatisfactory	Very unsatisfactory
Lecturer					
Staff					
Undergraduate/ Postgraduate					

2. Tick (□) **ONE** answer based on your opinion, what is the most effective way to motivates students, staff and lecturers on chemical safety and health?

□ Regulatory or enforcement

□ Poster and seminars on chemical safety and health

□ Enhance knowledge and application training

□ Adaptation of safe work systems and procedure

□ Other (state:_____)

Thank you

APPENDIX F

Group Statistics of lecturer and lab assistance or science officer based on knowledge					
	Occupation	N	Mean	Std. Deviation	Std. Error Mean
agree that chemical waste disposal procedure in UMK id comply with regulations	lecturer	8	7.5000	1.51186	.53452
	lab assistance/ science officer	8	7.0000	2.92770	1.03510
agree there is a component of chemical safety in UMK Occupational safety and health policy	lecturer	8	8.5000	1.19523	.42258
	lab assistance/ science officer	8	9.0000	.75593	.26726
know the rules and regulation in the Occupational Safety and Health Act related to chemical safety	lecturer	8	9.3750	.74402	.26305
	lab assistance/ science officer	8	8.1250	2.35660	.83318
know about the precaution step during handling hazardous substance	lecturer	8	9.0000	1.06904	.37796
	lab assistance/ science officer	8	8.5000	1.60357	.56695
know the level of toxicity	lecturer	8	8.7500	1.38873	.49099
	lab assistance/ science officer	7	8.0000	1.91485	.72375
know that Material Safety Data Sheet (MSDS) provide information about chemicals used in the laboratory	lecturer	8	9.7500	.70711	.25000
	lab assistance/ science officer	8	9.2500	.70711	.25000
agree chemicals in the form of vapour, fumes, dust or gas can easily enter the body through breathing.	lecturer	8	9.7500	.70711	.25000
	lab assistance/ science officer	8	9.2500	1.16496	.41188
agree an appropriate action is required in the event of an emergency	lecturer	8	9.6250	.74402	.26305
	lab assistance/ science officer	8	9.5000	.75593	.26726
agree safety measures should be taken before handling hazardous chemicals	lecturer	8	9.5000	.75593	.26726
	lab assistance/ science officer	8	9.6250	.74402	.26305
agree that some of the chemical substances can't mix	lecturer	8	9.5000	.92582	.32733
	lab assistance/ science officer	8	9.1250	1.12599	.39810

T-Test analysis data between lecturer and lab assistant based on knowledge

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
agree that chemical waste disposal procedure in UMK id comply with regulations	Equal variances assumed	2.793	.117	.429	14	.674	.50000	1.16496	-1.99860	2.99860
	Equal variances not assumed			.429	10.485	.676	.50000	1.16496	-2.07950	3.07950
agree there is a component of chemical safety in UMK Occupational safety and health policy	Equal variances assumed	3.500	.082	-1.000	14	.334	-.50000	.50000	-1.57239	.57239
	Equal variances not assumed			-1.000	11.828	.337	-.50000	.50000	-1.59117	.59117
know the rules and regulation in the Occupational Safety and Health Act related to chemical safety	Equal variances assumed	3.027	.104	1.431	14	.174	1.25000	.87372	-.62395	3.12395
	Equal variances not assumed			1.431	8.382	.189	1.25000	.87372	-.74895	3.24895
know about the precaution step during handling hazardous substance	Equal variances assumed	.692	.419	.734	14	.475	.50000	.68139	-.96143	1.96143
	Equal variances not assumed			.734	12.196	.477	.50000	.68139	-.98197	1.98197
know the level of toxicity	Equal variances assumed	.534	.478	.877	13	.396	.75000	.85525	-1.09766	2.59766
	Equal variances not assumed			.858	10.828	.410	.75000	.87457	-1.17867	2.67867
know that Material Safety Data Sheet (MSDS) provide information about chemicals used in the laboratory	Equal variances assumed	.298	.594	1.414	14	.179	.50000	.35355	-.25830	1.25830
	Equal variances not assumed			1.414	14.000	.179	.50000	.35355	-.25830	1.25830
agree chemicals in the form of vapour, fumes, dust or gas can easily enter the body through breathing.	Equal variances assumed	3.155	.097	1.038	14	.317	.50000	.48181	-.53338	1.53338
	Equal variances not assumed			1.038	11.541	.321	.50000	.48181	-.55442	1.55442

agree an appropriate action is required in the event of an emergency	Equal variances assumed	.099	.758	.333	14	.744	.12500	.37500	-.67930	.92930
	Equal variances not assumed			.333	13.996	.744	.12500	.37500	-.67931	.92931
agree safety measures should be taken before handling hazardous chemicals	Equal variances assumed	.099	.758	-.333	14	.744	-.12500	.37500	-.92930	.67930
	Equal variances not assumed			-.333	13.996	.744	-.12500	.37500	-.92931	.67931
agree that some of the chemical substances can't mix	Equal variances assumed	.206	.657	.728	14	.479	.37500	.51539	-.73040	1.48040
	Equal variances not assumed			.728	13.496	.479	.37500	.51539	-.73428	1.48428

Group Statistics of first year and third year student based on knowledge

	Occupation	N	Mean	Std. Deviation	Std. Error Mean
agree that some of the chemical substances can't mix	students 1	44	8.7500	1.41627	.21351
	students 3	44	8.2955	1.78599	.26925
agree safety measures should be taken before handling hazardous chemicals	students 1	44	8.9773	1.63520	.24652
	students 3	43	9.0000	1.32737	.20242
agree an appropriate action is required in the event of an emergency	students 1	44	8.7273	1.79617	.27078
	students 3	44	8.9318	1.38762	.20919
agree chemicals in the form of vapour, fumes, dust or gas can easily enter the body through breathing.	students 1	44	8.6818	1.72226	.25964
	students 3	44	8.4773	1.74527	.26311
know that Material Safety Data Sheet (MSDS) provide information about chemicals used in the laboratory	students 1	44	8.0000	1.98834	.29975
	students 3	44	7.9545	1.66991	.25175
know the level of toxicity	students 1	44	6.5909	1.96857	.29677
	students 3	44	6.9091	1.77604	.26775
know about the precaution step during handling hazardous substance	students 1	44	7.8409	1.75132	.26402
	students 3	43	7.5116	1.86920	.28505
know the rules and regulation in the Occupational Safety and Health Act related to chemical safety	students 1	44	7.9773	1.92280	.28987
	students 3	44	8.1591	1.62743	.24534
agree there is a component of chemical safety in UMK Occupational safety and health policy	students 1	44	8.0000	1.71179	.25806
	students 3	44	7.5455	1.94643	.29344
agree that chemical waste disposal procedure in UMK is comply with regulations	students 1	44	8.0909	1.78909	.26972
	students 3	44	6.6818	2.19696	.33120

T-Test analysis data between first year and third year student based on knowledge

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
agree that some of the chemical substances can't mix	Equal variances assumed	1.581	.212	1.323	86	.189	.45455	.34363	-.22857	1.13766
	Equal variances not assumed			1.323	81.755	.190	.45455	.34363	-.22907	1.13816
agree safety measures should be taken before handling hazardous chemicals	Equal variances assumed	.060	.808	-.071	85	.944	-.02273	.31974	-.65845	.61300
	Equal variances not assumed			-.071	82.251	.943	-.02273	.31897	-.65724	.61179
agree an appropriate action is required in the event of an emergency	Equal variances assumed	.766	.384	-.598	86	.552	-.20455	.34218	-.88477	.47568
	Equal variances not assumed			-.598	80.846	.552	-.20455	.34218	-.88539	.47630
agree chemicals in the form of vapour, fumes, dust or gas can easily enter the body through breathing.	Equal variances assumed	.417	.520	.553	86	.581	.20455	.36965	-.53029	.93938
	Equal variances not assumed			.553	85.985	.581	.20455	.36965	-.53029	.93938
know that Material Safety Data Sheet (MSDS) provide information about chemicals used in the laboratory	Equal variances assumed	1.444	.233	.116	86	.908	.04545	.39144	-.73271	.82362
	Equal variances not assumed			.116	83.507	.908	.04545	.39144	-.73304	.82395
know the level of toxicity	Equal variances assumed	.731	.395	-.796	86	.428	-.31818	.39970	-1.11277	.47640
	Equal variances not assumed			-.796	85.105	.428	-.31818	.39970	-1.11289	.47652
	Equal variances assumed	.700	.405	.848	85	.399	.32928	.38824	-.44265	1.10121

know about the precaution step during handling hazardous substance	Equal variances not assumed			.847	84.343	.399	.32928	.38854	-.44332	1.10188
know the rules and regulation in the Occupational Safety and Health Act related to chemical safety	Equal variances assumed	2.111	.150	-.479	86	.633	-.18182	.37976	-.93676	.57313
	Equal variances not assumed			-.479	83.714	.633	-.18182	.37976	-.93706	.57342
agree there is a component of chemical safety in UMK Occupational safety and health policy	Equal variances assumed	.393	.532	1.163	86	.248	.45455	.39077	-.32228	1.23137
	Equal variances not assumed			1.163	84.619	.248	.45455	.39077	-.32246	1.23155
agree that chemical waste disposal procedure in UMK is comply with regulations	Equal variances assumed	2.905	.092	3.299	86	.001	1.40909	.42713	.55998	2.25820
	Equal variances not assumed			3.299	82.611	.001	1.40909	.42713	.55948	2.25870

APPENDIX G

Group Statistics of lecturer and lab assistant based their skill					
	Occupation	N	Mean	Std. Deviation	Std. Error Mean
Material Safety Data Sheet	lecturer	8	8.7500	1.90863	.67480
	lab assistance/ science officer	8	6.2500	3.53553	1.25000
Chemical hygiene	lecturer	8	8.5000	1.69031	.59761
	lab assistance/ science officer	8	7.5000	2.87849	1.01770
Laboratory chemical safety	lecturer	8	8.8750	1.64208	.58056
	lab assistance/ science officer	8	8.3750	2.32609	.82240
Personal protective equipment	lecturer	8	8.7500	1.90863	.67480
	lab assistance/ science officer	8	8.5000	1.69031	.59761
Procedure for the disposal of chemicals	lecturer	8	8.7500	1.90863	.67480
	lab assistance/ science officer	8	7.8750	2.41646	.85435
Procedure on chemical storage	lecturer	8	7.8750	2.47487	.87500
	lab assistance/ science officer	7	7.7143	2.81154	1.06266
Procedure on chemical handling	lecturer	8	8.5000	1.60357	.56695
	lab assistance/ science officer	8	8.1250	2.58775	.91491
Emergency respond	lecturer	8	6.7500	2.25198	.79620
	lab assistance/ science officer	8	7.6250	2.32609	.82240
First aid	lecturer	8	6.5000	2.56348	.90633
	lab assistance/ science officer	8	7.8750	2.41646	.85435
Chemical hazard	lecturer	8	7.8750	2.10017	.74252
	lab assistance/ science officer	8	8.0000	2.61861	.92582

T-Test analysis data between lecturer and lab assistant based on their skill

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Material Safety Data Sheet	Equal variances assumed	2.395	.144	1.760	14	.100	2.50000	1.42051	-.54670	5.54670
	Equal variances not assumed			1.760	10.761	.107	2.50000	1.42051	-.63504	5.63504
Chemical hygiene	Equal variances assumed	1.615	.224	.847	14	.411	1.00000	1.18019	-1.53126	3.53126
	Equal variances not assumed			.847	11.315	.414	1.00000	1.18019	-1.58881	3.58881
Laboratory chemical safety	Equal variances assumed	.039	.845	.497	14	.627	.50000	1.00667	-1.65910	2.65910
	Equal variances not assumed			.497	12.589	.628	.50000	1.00667	-1.68203	2.68203
Personal protective equipment	Equal variances assumed	.406	.534	.277	14	.786	.25000	.90139	-1.68328	2.18328
	Equal variances not assumed			.277	13.798	.786	.25000	.90139	-1.68594	2.18594
Procedure for the disposal of chemicals	Equal variances assumed	.372	.552	.804	14	.435	.87500	1.08870	-1.46003	3.21003
	Equal variances not assumed			.804	13.287	.436	.87500	1.08870	-1.47184	3.22184
Procedure on chemical storage	Equal variances assumed	.014	.908	.118	13	.908	.16071	1.36406	-2.78615	3.10758
	Equal variances not assumed			.117	12.119	.909	.16071	1.37655	-2.83526	3.15669

Procedure on chemical handling	Equal variances assumed	.019	.894	.348	14	.733	.37500	1.07633	-1.93349	2.68349
	Equal variances not assumed			.348	11.685	.734	.37500	1.07633	-1.97714	2.72714
Emergency respond	Equal variances assumed	.002	.964	-.764	14	.457	-.87500	1.14467	-3.33007	1.58007
	Equal variances not assumed			-.764	13.985	.457	-.87500	1.14467	-3.33031	1.58031
First aid	Equal variances assumed	.041	.842	-1.104	14	.288	-1.37500	1.24553	-4.04639	1.29639
	Equal variances not assumed			-1.104	13.951	.288	-1.37500	1.24553	-4.04726	1.29726
Chemical hazard	Equal variances assumed	.015	.904	-.105	14	.918	-.12500	1.18679	-2.67042	2.42042
	Equal variances not assumed			-.105	13.370	.918	-.12500	1.18679	-2.68173	2.43173

Group Statistics of first year and third year student based their skill					
	Occupation	N	Mean	Std. Deviation	Std. Error Mean
Chemical hazard	students 1	44	6.8182	1.89581	.28580
	students 3	44	6.4773	2.39659	.36130
First aid	students 1	44	6.9318	2.05050	.30912
	students 3	44	7.0000	2.44949	.36927
Emergency respond	students 1	43	7.6047	1.72018	.26233
	students 3	44	7.2045	2.08627	.31452
Procedure on chemical handling	students 1	43	7.5581	1.54769	.23602
	students 3	43	7.3488	1.85014	.28214
Procedure on chemical storage	students 1	44	7.4091	1.63278	.24615
	students 3	42	6.9762	2.05400	.31694
Procedure for the disposal of chemicals	students 1	44	7.5227	1.60651	.24219
	students 3	44	6.9091	2.11108	.31826
Personal protective equipment	students 1	44	7.6136	1.68738	.25438
	students 3	44	6.9091	2.21851	.33445
Laboratory chemical safety	students 1	44	7.8864	1.60255	.24159
	students 3	43	7.3721	2.12719	.32439
Chemical hygiene	students 1	44	7.8409	1.58398	.23879
	students 3	44	7.2727	1.88462	.28412
Material Safety Data Sheet	students 1	44	6.8864	1.95550	.29480
	students 3	42	6.8571	2.01907	.31155

T-Test analysis data between first year and third year student based their skill

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Chemical hazard	Equal variances assumed	3.005	.087	.740	86	.461	.34091	.46067	-.57488	1.25670
	Equal variances not assumed			.740	81.672	.461	.34091	.46067	-.57558	1.25739
First aid	Equal variances assumed	2.074	.153	-.142	86	.888	-.06818	.48158	-1.02554	.88917
	Equal variances not assumed			-.142	83.418	.888	-.06818	.48158	-1.02596	.88960
Emergency respond	Equal variances assumed	2.131	.148	.975	85	.332	.40011	.41046	-.41601	1.21622
	Equal variances not assumed			.977	82.674	.331	.40011	.40956	-.41453	1.21474
Procedure on chemical handling	Equal variances assumed	1.067	.304	.569	84	.571	.20930	.36785	-.52220	.94081
	Equal variances not assumed			.569	81.459	.571	.20930	.36785	-.52253	.94114
Procedure on chemical storage	Equal variances assumed	3.032	.085	1.084	84	.281	.43290	.39917	-.36090	1.22670
	Equal variances not assumed			1.079	78.237	.284	.43290	.40130	-.36599	1.23179
Procedure for the disposal of chemicals	Equal variances assumed	4.558	.036	1.534	86	.129	.61364	.39993	-.18140	1.40867
	Equal variances not assumed			1.534	80.295	.129	.61364	.39993	-.18220	1.40948

Personal protective equipment	Equal variances assumed	2.633	.108	1.677	86	.097	.70455	.42020	-.13079	1.53988
	Equal variances not assumed			1.677	80.276	.097	.70455	.42020	-.13164	1.54073
Laboratory chemical safety	Equal variances assumed	2.888	.093	1.276	85	.206	.51427	.40318	-.28735	1.31590
	Equal variances not assumed			1.271	78.057	.207	.51427	.40447	-.29096	1.31951
Chemical hygiene	Equal variances assumed	1.216	.273	1.531	86	.129	.56818	.37114	-.16962	1.30598
	Equal variances not assumed			1.531	83.527	.130	.56818	.37114	-.16993	1.30630
Material Safety Data Sheet	Equal variances assumed	.243	.623	.068	84	.946	.02922	.42860	-.82309	.88153
	Equal variances not assumed			.068	83.479	.946	.02922	.42892	-.82381	.88225

APPENDIX H

Group Statistics of lecturer and lab assistant based on their attitude towards chemical safety					
	Occupation	N	Mean	Std. Deviation	Std. Error Mean
Clean up and reorganize the apparatus after use	lecturer	8	10.0000	.00000	.00000
	lab assistance/ science officer	8	9.0000	.92582	.32733
Neatness is important when working in the laboratory in order to avoid the occurrence of an accident	lecturer	8	9.8750	.35355	.12500
	lab assistance/ science officer	8	9.0000	1.06904	.37796
Wearing the appropriate clothing is important when working in the laboratory	lecturer	8	10.0000	.00000	.00000
	lab assistance/ science officer	8	9.2500	.70711	.25000
Know the nearest position of the Emergency exits at your work place	lecturer	8	9.5000	.75593	.26726
	lab assistance/ science officer	8	9.1250	.83452	.29505
identify the Emergency Shower and eye fountain nearest position of the at your work place	lecturer	8	9.3750	.91613	.32390
	lab assistance/ science officer	8	9.0000	.75593	.26726
identify the nearest position of the Fire extinguisher at your work place	lecturer	8	8.8750	1.24642	.44068
	lab assistance/ science officer	8	8.7500	1.28174	.45316
Keep or use the chemical substance with suitable container/ instrument	lecturer	8	9.5000	.92582	.32733
	lab assistance/ science officer	8	9.0000	1.06904	.37796
Read the label on the chemical container before used	lecturer	8	9.7500	.70711	.25000
	lab assistance/ science officer	8	9.2500	.70711	.25000
Wear Personal Protective Equipment (PPE) while working with chemical	lecturer	8	9.5000	.75593	.26726
	lab assistance/ science officer	8	9.0000	1.30931	.46291
Report the incident that happen in the laboratory	lecturer	8	9.5000	.92582	.32733
	lab assistance/ science officer	8	8.8750	.99103	.35038

T-Test analysis data between lecturer and lab assistant based on their attitude towards chemical safety

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Clean up and reorganize the apparatus after use	Equal variances assumed	21.000	.000	3.055	14	.009	1.00000	.32733	.29795	1.70205
	Equal variances not assumed			3.055	7.000	.018	1.00000	.32733	.22600	1.77400
Neatness is important when working in the laboratory in order to avoid the occurrence of an accident	Equal variances assumed	3.959	.067	2.198	14	.045	.87500	.39810	.02116	1.72884
	Equal variances not assumed			2.198	8.513	.057	.87500	.39810	-.03347	1.78347
Wearing the appropriate clothing is important when working in the laboratory	Equal variances assumed	18.290	.001	3.000	14	.010	.75000	.25000	.21380	1.28620
	Equal variances not assumed			3.000	7.000	.020	.75000	.25000	.15884	1.34116
Know the nearest position of the Emergency exits at your work place	Equal variances assumed	.024	.880	.942	14	.362	.37500	.39810	-.47884	1.22884
	Equal variances not assumed			.942	13.865	.362	.37500	.39810	-.47961	1.22961
identify the Emergency Shower and eye fountain nearest position of the at your work place	Equal variances assumed	1.480	.244	.893	14	.387	.37500	.41993	-.52566	1.27566
	Equal variances not assumed			.893	13.513	.387	.37500	.41993	-.52871	1.27871
identify the nearest position of the Fire extinguisher at your work place	Equal variances assumed	.068	.798	.198	14	.846	.12500	.63210	-1.23073	1.48073
	Equal variances not assumed			.198	13.989	.846	.12500	.63210	-1.23082	1.48082

Keep or use the chemical substance with suitable container/ instrument	Equal variances assumed	.000	1.000	1.000	14	.334	.50000	.50000	-.57239	1.57239
	Equal variances not assumed			1.000	13.720	.335	.50000	.50000	-.57445	1.57445
Read the label on the chemical container before used	Equal variances assumed	.298	.594	1.414	14	.179	.50000	.35355	-.25830	1.25830
	Equal variances not assumed			1.414	14.000	.179	.50000	.35355	-.25830	1.25830
Wear Personal Protective Equipment (PPE) while working with chemical	Equal variances assumed	1.615	.224	.935	14	.365	.50000	.53452	-.64644	1.64644
	Equal variances not assumed			.935	11.200	.369	.50000	.53452	-.67392	1.67392
Report the incident that happen in the laboratory	Equal variances assumed	.048	.830	1.303	14	.213	.62500	.47949	-.40340	1.65340
	Equal variances not assumed			1.303	13.936	.214	.62500	.47949	-.40385	1.65385

Group Statistics of first year and third year student based their attitude towards chemical safety

	Occupation	N	Mean	Std. Deviation	Std. Error Mean
Report the incident that happen in the laboratory	students 1	44	8.2045	1.94792	.29366
	students 3	44	7.8636	1.73327	.26130
Wear Personal Protective Equipment (PPE) while working with chemical	students 1	44	7.9545	1.59876	.24102
	students 3	44	7.9773	1.67733	.25287
Read the label on the chemical container before used	students 1	44	7.8182	1.85864	.28020
	students 3	44	7.8409	1.96413	.29610
Keep or use the chemical substance with suitable container/ instrument	students 1	41	8.3659	1.46212	.22835
	students 3	44	7.9091	1.84035	.27744
identify the nearest position of the Fire extinguisher at your work place	students 1	44	8.2273	1.46055	.22019
	students 3	44	7.6818	1.93826	.29220
identify the Emergency Shower and eye fountain nearest position of the at your work place	students 1	44	8.4091	1.40296	.21150
	students 3	44	7.8182	1.87111	.28208
Know the nearest position of the Emergency exits at your work place	students 1	44	8.0909	1.76290	.26577
	students 3	44	8.0227	1.86134	.28061
Clean up and reorganize the apparatus after use	students 1	44	8.0000	1.81723	.27396
	students 3	44	7.9545	2.03407	.30665
Wearing the appropriate clothing is important when working in the laboratory	students 1	44	7.9318	1.78362	.26889
	students 3	44	8.2500	1.83157	.27612
Neatness is important when working in the laboratory in order to avoid the occurrence of an accident	students 1	44	8.2955	1.77292	.26728
	students 3	44	8.2727	2.03874	.30735

T-Test analysis data between first year and third year student based their attitude towards chemical safety

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Report the incident that happen in the laboratory	Equal variances assumed	.228	.634	.867	86	.388	.34091	.39308	-.44051	1.12233
	Equal variances not assumed			.867	84.854	.388	.34091	.39308	-.44066	1.12248
Wear Personal Protective Equipment (PPE) while working with chemical	Equal variances assumed	.088	.768	-.065	86	.948	-.02273	.34933	-.71718	.67172
	Equal variances not assumed			-.065	85.803	.948	-.02273	.34933	-.71720	.67174
Read the label on the chemical container before used	Equal variances assumed	.974	.326	-.056	86	.956	-.02273	.40766	-.83314	.78768
	Equal variances not assumed			-.056	85.739	.956	-.02273	.40766	-.83317	.78772
Keep or use the chemical substance with suitable container/ instrument	Equal variances assumed	3.436	.067	1.261	83	.211	.45676	.36224	-.26372	1.17725
	Equal variances not assumed			1.271	81.021	.207	.45676	.35933	-.25818	1.17171
identify the nearest position of the Fire extinguisher at your work place	Equal variances assumed	5.214	.025	1.491	86	.140	.54545	.36588	-.18188	1.27279
	Equal variances not assumed			1.491	79.926	.140	.54545	.36588	-.18267	1.27358
identify the Emergency Shower and eye fountain nearest position of the at your work place	Equal variances assumed	4.547	.036	1.676	86	.097	.59091	.35257	-.10997	1.29179
	Equal variances not assumed			1.676	79.738	.098	.59091	.35257	-.11076	1.29257

Know the nearest position of the Emergency exits at your work place	Equal variances assumed	.677	.413	.176	86	.860	.06818	.38649	-.70013	.83649
	Equal variances not assumed			.176	85.747	.860	.06818	.38649	-.70016	.83653
Clean up and reorganize the apparatus after use	Equal variances assumed	1.584	.212	.111	86	.912	.04545	.41120	-.77198	.86289
	Equal variances not assumed			.111	84.930	.912	.04545	.41120	-.77213	.86304
Wearing the appropriate clothing is important when working in the laboratory	Equal variances assumed	1.519	.221	-.826	86	.411	-.31818	.38541	-1.08436	.44800
	Equal variances not assumed			-.826	85.940	.411	-.31818	.38541	-1.08437	.44800
Neatness is important when working in the laboratory in order to avoid the occurrence of an accident	Equal variances assumed	2.115	.150	.056	86	.956	.02273	.40731	-.78698	.83243
	Equal variances not assumed			.056	84.374	.956	.02273	.40731	-.78720	.83266

APPENDIX I

Group Statistics of lecturer and lab assistant based on their practice towards chemical safety					
	Occupation	N	Mean	Std. Deviation	Std. Error Mean
UMK provide a manual for chemical safety to each student before the start of experiments	lecturer	8	7.0000	1.41421	.50000
	lab assistance/ science officer	8	7.6250	2.92465	1.03402
UMK have a Committee on occupational safety and health	lecturer	8	9.0000	1.30931	.46291
	lab assistance/ science officer	8	9.3750	.74402	.26305
UMK record all the incidents occurred in laboratory	lecturer	8	8.0000	2.07020	.73193
	lab assistance/ science officer	8	9.1250	1.45774	.51539
UMK investigate incident /accident involving chemicals	lecturer	8	7.6250	1.92261	.67975
	lab assistance/ science officer	8	8.7500	1.38873	.49099
UMK provide training on chemical safety to student, staff and lecturer involved in chemical usage	lecturer	8	7.5000	1.85164	.65465
	lab assistance/ science officer	8	8.3750	1.92261	.67975
UMK comply with safety and health regulation in Occupational Safety and Health Act that related to chemical safety	lecturer	8	7.0000	1.30931	.46291
	lab assistance/ science officer	8	7.1250	2.99702	1.05961
UMK take serious action towards staff/ student who not follow the rules and regulations in laboratory	lecturer	8	7.2500	1.98206	.70076
	lab assistance/ science officer	8	7.2500	2.86606	1.01330
There is signage/ poster /instruction in the laboratory to remind of importance of wearing personal protective equipment	lecturer	8	8.1250	1.35620	.47949
	lab assistance/ science officer	8	8.7500	1.48805	.52610
There is signage/ poster /instruction in the laboratory to remind of importance of cleaning the laboratory before leaving	lecturer	8	8.3750	1.06066	.37500
	lab assistance/ science officer	8	7.5000	2.97610	1.05221
There is signage/ poster /instruction in the laboratory to warn about dangerous chemical	lecturer	8	8.2500	1.16496	.41188
	lab assistance/ science officer	8	7.8750	1.80772	.63913

T-Test analysis data between lecturer and lab assistant based on their practice towards chemical safety

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
UMK provide a manual for chemical safety to each student before the start of experiments	Equal variances assumed	1.507	.240	-.544	14	.595	-.62500	1.14856	-3.08842	1.83842
	Equal variances not assumed			-.544	10.104	.598	-.62500	1.14856	-3.18060	1.93060
UMK have a Committee on occupational safety and health	Equal variances assumed	.106	.749	-.704	14	.493	-.37500	.53243	-1.51695	.76695
	Equal variances not assumed			-.704	11.094	.496	-.37500	.53243	-1.54566	.79566
UMK record all the incidents occurred in laboratory	Equal variances assumed	2.232	.157	-1.257	14	.229	-1.12500	.89518	-3.04496	.79496
	Equal variances not assumed			-1.257	12.572	.232	-1.12500	.89518	-3.06563	.81563
UMK investigate incident /accident involving chemicals	Equal variances assumed	1.370	.261	-1.342	14	.201	-1.12500	.83853	-2.92346	.67346
	Equal variances not assumed			-1.342	12.741	.203	-1.12500	.83853	-2.94027	.69027
UMK provide training on chemical safety to student, staff and lecturer involved in chemical usage	Equal variances assumed	.081	.780	-.927	14	.370	-.87500	.94373	-2.89910	1.14910
	Equal variances not assumed			-.927	13.980	.370	-.87500	.94373	-2.89937	1.14937

UMK comply with safety and health regulation in Occupational Safety and Health Act that related to chemical safety	Equal variances assumed	2.305	.151	-.108	14	.915	-.12500	1.15631	-2.60504	2.35504
	Equal variances not assumed			-.108	9.578	.916	-.12500	1.15631	-2.71689	2.46689
UMK take serious action towards staff/ student who not follow the rules and regulations in laboratory	Equal variances assumed	.134	.719	.000	14	1.000	.00000	1.23201	-2.64241	2.64241
	Equal variances not assumed			.000	12.449	1.000	.00000	1.23201	-2.67362	2.67362
There is signage/ poster /instruction in the laboratory to remind of importance of wearing personal protective equipment	Equal variances assumed	.000	1.000	-.878	14	.395	-.62500	.71183	-2.15172	.90172
	Equal variances not assumed			-.878	13.881	.395	-.62500	.71183	-2.15294	.90294
There is signage/ poster /instruction in the laboratory to remind of importance of cleaning the laboratory before leaving	Equal variances assumed	3.167	.097	.783	14	.446	.87500	1.11704	-1.52080	3.27080
	Equal variances not assumed			.783	8.750	.454	.87500	1.11704	-1.66296	3.41296
There is signage/ poster /instruction in the laboratory to warn about dangerous chemical	Equal variances assumed	1.080	.316	.493	14	.630	.37500	.76035	-1.25578	2.00578
	Equal variances not assumed			.493	11.959	.631	.37500	.76035	-1.28228	2.03228

Group Statistics of first year and third year student based their practice towards chemical safety					
	Occupation	N	Mean	Std. Deviation	Std. Error Mean
UMK provide a manual for chemical safety to each student before the start of experiments	students 1	44	7.8409	1.52412	.22977
	students 3	44	6.9318	2.55541	.38524
UMK have a Committee on occupational safety and health	students 1	43	7.5814	1.53115	.23350
	students 3	44	6.8636	2.25771	.34036
UMK record all the incidents occurred in laboratory	students 1	42	7.8571	1.57064	.24235
	students 3	43	6.8372	2.17048	.33099
UMK investigate incident /accident involving chemicals	students 1	44	7.6136	1.48192	.22341
	students 3	43	6.7674	2.21292	.33747
UMK provide training on chemical safety to student, staff and lecturer involved in chemical usage	students 1	43	7.6512	1.60184	.24428
	students 3	44	6.5455	2.39626	.36125
UMK comply with safety and health regulation in Occupational Safety and Health Act that related to chemical safety	students 1	44	7.5909	1.60404	.24182
	students 3	44	6.9091	2.23937	.33760
UMK take serious action towards staff/ student who not follow the rules and regulations in laboratory	students 1	44	7.6364	1.67180	.25203
	students 3	44	6.7727	2.13349	.32164
There is signage/ poster /instruction in the laboratory to remind of importance of wearing personal protective equipment	students 1	44	7.9773	1.54752	.23330
	students 3	44	7.3636	2.26285	.34114
There is signage/ poster /instruction in the laboratory to remind of importance of cleaning the laboratory before leaving	students 1	44	7.0455	1.95239	.29433
	students 3	44	7.3182	2.21803	.33438
There is signage/ poster /instruction in the laboratory to warn about dangerous chemical	students 1	44	7.3636	1.85636	.27986
	students 3	44	7.3409	2.11246	.31846

T-Test analysis data between first year and third year student based their practice towards chemical safety

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
UMK provide a manual for chemical safety to each student before the start of experiments	Equal variances assumed	11.843	.001	2.027	86	.046	.90909	.44856	.01738	1.80080
	Equal variances not assumed			2.027	70.156	.046	.90909	.44856	.01450	1.80368
UMK have a Committee on occupational safety and health	Equal variances assumed	4.074	.047	1.731	85	.087	.71776	.41454	-.10645	1.54197
	Equal variances not assumed			1.739	75.808	.086	.71776	.41276	-.10435	1.53987
UMK record all the incidents occurred in laboratory	Equal variances assumed	7.105	.009	2.477	83	.015	1.01993	.41177	.20095	1.83892
	Equal variances not assumed			2.486	76.563	.015	1.01993	.41024	.20298	1.83689
UMK investigate incident /accident involving chemicals	Equal variances assumed	10.504	.002	2.100	85	.039	.84619	.40293	.04507	1.64732
	Equal variances not assumed			2.091	73.156	.040	.84619	.40472	.03963	1.65276
UMK provide training on chemical safety to student, staff and lecturer involved in chemical usage	Equal variances assumed	8.768	.004	2.524	85	.013	1.10571	.43803	.23478	1.97663
	Equal variances not assumed			2.536	75.214	.013	1.10571	.43609	.23702	1.97440
UMK comply with safety and health regulation in Occupational Safety and Health Act that related to chemical safety	Equal variances assumed	3.306	.073	1.642	86	.104	.68182	.41527	-.14371	1.50735
	Equal variances not assumed			1.642	77.929	.105	.68182	.41527	-.14493	1.50857

UMK take serious action towards staff/ student who not follow the rules and regulations in laboratory	Equal variances assumed	3.822	.054	2.114	86	.037	.86364	.40862	.05133	1.67595
	Equal variances not assumed			2.114	81.348	.038	.86364	.40862	.05066	1.67661
There is signage/ poster /instruction in the laboratory to remind of importance of wearing personal protective equipment	Equal variances assumed	7.043	.009	1.485	86	.141	.61364	.41328	-.20794	1.43522
	Equal variances not assumed			1.485	76.003	.142	.61364	.41328	-.20949	1.43676
There is signage/ poster /instruction in the laboratory to remind of importance of cleaning the laboratory before leaving	Equal variances assumed	.503	.480	-.612	86	.542	-.27273	.44547	-1.15829	.61284
	Equal variances not assumed			-.612	84.638	.542	-.27273	.44547	-1.15850	.61304
There is signage/ poster /instruction in the laboratory to warn about dangerous chemical	Equal variances assumed	.554	.459	.054	86	.957	.02273	.42396	-.82007	.86553
	Equal variances not assumed			.054	84.603	.957	.02273	.42396	-.82027	.86573