CHEMICAL SAFETY AWARENESS AMONG STAFF AND STUDENTS IN SECONDARY SCHOOLS IN THE STATE OF PENANG

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by

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LIST OF ABBREVIATIONS

CHRA	Chemical Health Risk Assessment
CSDS	Chemical Safety and Data Sheet
DOSH	Department of Occupational Safety and Health
DBP	Dewan Bahasa dan Pustaka
JAKIM	Jabatan Kemajuan Islam Malaysia
KBSM	Kurikulum Bersepadu Sekolah Menengah
MSDS	Material Safety Data Sheet
NIOSH	National Institute of Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limits
PPE	Personal Protective Equipment
SDS	Safety Data Sheet
SPSS	Statistical Package for the Social Sciences
SPM	Sijil Pelajaran Malaysia
UK	United Kingdom
USA	United Stated of America
USECHH	Use and Standard of Exposure of Chemicals Hazardous to Health
USM	Universiti Sains Malaysia

LIST OF SYMBOLS

%	Percentage
®	Registered
&	And
ºC	Degree Celsius
M	Mean
SD	Standard Deviation

KESEDARAN DARI SEGI KESELAMATAN KIMIA DI ANTARA STAF DAN PELAJAR DI SEKOLAH-SEKOLAH MENENGAH DI NEGERI PULAU PINANG

ABSTRAK

Kajian mengenai kesedaran keselamatan kimia di antara staf dan pelajar di sekolah menengah di negeri Pulau Pinang telah dijalankan. Borang tinjauan telah diberikan kepada staf dan pelajar di 20 sekolah terpilih di semua daerah di Pulau Pinang dan borang-borang tersebut telah dikumpul. Tinjauan telah dijalankan untuk menentukan tahap kesedaran di kalangan staf dan pelajar serta elemen keselamatan yang mempunyai tahap kesedaran yang tinggi dan rendah. Kesedaran diuji menggunakan elemen yang melibatkan pengurusan makmal dan pengurusan kimia, peralatan perlindungan peribadi (PPE), prosedur dan amalan kerja yang selamat, kaedah kawalan operasi, latihan dan pendidikan, kecemasan dan pertolongan cemas, Lembaran Data Keselamatan Kimia(CSDS), tanda amaran dan penyimpanan rekod. Ujian "One Sample T-test" dan "Independent T-test" telah dijalankan untuk mendapatkan keluaran tahap keseluruhan untuk staf dan pelajar dan untuk membandingkan tahap keluaran untuk staf dan pelajar menggunakan perisian SPSS. Kaedah Regresi Pelbagai Linear juga digunakan untuk mengukuhkan analisis data. Keputusan menunjukkan bahawa pelajar mempunyai tahap kesedaran yang rendah dalam elemen kecemasan dan bantuan pertolongan pertama, pengurusan kimia, tanda amaran dan prosedur dan amalan kerja yang selamat. Staf pula mempunyai tahap kesedaran yang rendah dalam pengurusan kimia dan kaedah kawalan operasi. Kajian ini juga menunjukkan bahawa staf dan pelajar mempunyai kesedaran yang tinggi dalam elemen PPE dan kesedaran yang rendah dalam elemen pengurusan kimia.

CHEMICAL SAFETY AWARENESS AMONG STAFF AND STUDENTS IN SECONDARY SCHOOLS IN THE STATE OF PENANG

ABSTRACT

A study on chemical safety awareness among staff and students in secondary schools in Penang was conducted. Survey forms were given to staff and students in 20 chosen schools in all districts of Penang. The forms were collected safely. The surveys were done to determine the level of awareness and the elements that have the higher and lower awareness among staff and students. The awareness was tested using elements that involve laboratory management and chemical management, Personal Protective Equipments(PPE), safe procedure and practices, operational control methods, training and education, emergency and first aid, Chemical Safety Data Sheet, warning signs and recordkeeping. One Sample T-test and Independent T-test were used to obtain the overall level output for staff and students and to compare the output level for staff and students using SPSS software. Multiple Linear Regression was also done to strengthen the data analysis. The results show that students have low level of awareness in the elements of emergency and first aid, chemical management, warning signs and safe procedure and practices. Staff have low level of awareness in chemical management and operational control methods. This study also shows that staff and students have high awareness in the element of PPE and low awareness in the element of chemical management.

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION : AN OVERVIEW

As Malaysia is approaching to a well-established nation in terms of globalisation and modernisation of infrastructure, occupational safety and health becomes an important element that needs to be taken care of. The increase in occupational disease in a workplace is also another concern for all workforces in all major countries including Malaysia.

Although industrial sectors are prone to more occupational diseases, the education department is also likely to be affected. According to the statistics from the Social Security Organisation (SOCSO) Malaysia, the number of accidents that occurred in the educational establishment is approximately 300 cases per year. [1]

Table 1.1 shows the number of accidents reported in education establishment that consists of schools from the year 2010 till 2014.[2] – [6] The numbers of cases are increasing every year probably due to lack of awareness among staff and students in the workplace. SOCSO has developed several preventive approaches, whereby 150 of the 360 training programmes that are done yearly focuses on students and staff in an educational workplace, and systematic approaches are applied during the whole process.[3] Occupational injury and diseases poses a major factor for morbidity in Malaysia, involving students and staff. Students are the major contributors for the accidents as reported by SOCSO in the year 2010, 2011 and

2014. Meanwhile, the fatality rate is also increasing per year. Although the number of fatality is low compared to other workplaces such as the manufacturing industry, the educational workplace is the starting point for an individual to learn the basics of safety and its importance.

Table 1.1: Number of accidents reported in Education Institution from the year 2011 till 2014. *[2] – [6]*

YEAR	ACCIDENTS BY GENDER		TOTAL NUMBER OF ACCIDENTS
	MALE	FEMALE	
2010	143	131	274
2011	155	132	287
2012	206	151	357
2013	167	144	311
2014	171	142	313

SOCSO also reported statistics of occupational diseases that involves chemical accidents in a workplace. SOCSO reported a substantial number of 98 cases of occupational disease cases that involves chemical agents for the year 2011.[2] Although most of the cases are not crucial and has less permanent disability features, the “near-miss” situations are also vital and should also be prevented in a workplace. If employees understand their roles and responsibilities in ensuring safety at a workplace, the prevention of unnecessary incidents involving accidents, injury and death can be prevented thoroughly.

Table 1.2 shows the notifications of occupational diseases involving chemical agents from the year 2010 till year 2014.[2] – [6] The numbers of chemical cases involves many hazardous chemicals that are also being used in chemical laboratories in schools.

Table 1.2: Notifications of Occupational Diseases involving Chemical Agents from the year 2010 till year 2014. *[2] – [6]*

YEAR	NUMBER OF CASES
2010	84
2011	98
2012	85
2013	78
2014	73

The high number of cases involving the educational department is an important factor to be looked upon. Chemical cases involving explosions in chemical laboratories, chemical lab fire issues, chemical spills on students and staff and chemical inventory errors are the four main elements that were contributing to chemical accident cases in Malaysia.

This brings up many issues that discusses whether the staff and students were handling the chemicals incorrectly according to the procedure, or whether the chemicals in the lab were labelled correctly in terms of its level of hazard and reactivity, or whether poor conditions of the workplace contributed to the accidents, or whether the students and staff have knowledge and awareness on chemical safety in their workplace. These are some of the aspects that are identified in this study on the research done regarding chemical safety among staff and students.

As safety and health is a significant aspect in every workplace in the world, Malaysia came up with several acts and measures to improve the national occupational safety and health systems. Malaysia introduced the Occupational Safety and Health Act 1994 (OSHA Act 1994) as a major move towards the development of the occupational safety and health systems. The main objective of this act is to provide the legislative structure to inspire, support and to promote high standards of safety and health at work. [7] The aim is to secure the safety, health and welfare of persons at work against risk to safety and health. OSHA is the backbone of all the occupational safety measures in a workplace, especially the academic institutions as these are the places that are likely to be affected besides the manufacturing industries. Although the quantities of chemicals that are used in the educational workplaces are less compared to the manufacturing industries, the experiments involve many chemicals that have hazardous and toxic properties which could affect the health of the students and staff.

However, the number of accidents and occupational diseases in educational workplaces are still increasing despite the efforts made by the government to improve the occupational safety and health systems. As mentioned earlier, chemical accidents are also the major contributor to the occupational diseases reported in SOCSO from the year 2010 up till 2014.

In everyday life, individuals have grown to accept and handle chemicals in their own way, but the irony is that the harmful nature of certain chemicals are overlooked and taken for granted. For example in the 70s to 80s, students used to play and handle mercury with their bare hands without understanding the hazards that are present in the chemical. Unfortunately everyone is not privileged to understand the consequences of the chemical effects. Therefore, the starting place should be the

secondary schools as the students are prone to be exposed to many chemicals. Besides students, staff are also exposed to harmful chemicals which can affect their health. Chemical exposure can be hazardous to health and harmful without the proper understanding on the usage and handling.

1.1 RESEARCH PROBLEMS

1.1.1 Importance of Study in Chemical Safety

Chemical safety is important to guarantee the safety of human health and the environment. It manages all chemicals, natural or synthetic, and the full series of exposure conditions from the usual appearance of chemicals up to their removal or synthesis, manufacturing production, transport usage and disposal.

Besides, creating and implementing a good chemical safety policy protects human lives and protects the environment. Any activity involving chemicals must be done in a manner that complies with predetermined and approved procedures that ensure the protection of company personnel, the environment and the community.

The usages of chemicals in Malaysia have risen due to many reasons. Firstly, the globalisation and the increase of industries in Malaysia had increased the need of chemicals for the production of quality products for consumers and exporters. Time factor is also another key point that should not be overlooked. As most of the companies have certain time frame for production and product exportation, the workers would have the notion to complete the process of the production without concerning the safety element of the process. Poor safety and health control in a

workplace is mainly due to the high risk nature of the work done and a serious lack of awareness among workers in terms of the behaviour of the workers to overlook the safety element in a workplace.

Meanwhile, chemical safety in schools is an important issue not just for the students, but also for the staff of the school. Chemical laboratories that have a list of hazardous chemicals would also be a guide for students who do not know the harmful effects of those chemicals and the proper method to handle the chemicals. Students and staff should also be aware of any chemical spills and the necessary steps taken to isolate themselves from being affected.

According to The New Straits Times (2016), a chemical accident that occurred in SMK Guar Perahu Indah was declared off limits to teachers and students when fifty-six students had breathing difficulties. The teacher in charge later found out that a mercury spill occurred a day before that caused the incident. [8]. Another incident that happened in SMK Datuk Haji Abdul Samad where chemical spill occurred in the lab area and affected students and staff is also another case that should be taken into concern. [9]Tan Sri Lee Lam Thye, the chairman of the National Institute of Occupational Safety and Health (NIOSH) Malaysia noted that incidents like these are a wakeup call for all schools in Malaysia and needs to be served as a message to all schools.[10] He also insisted that all schools that utilize chemicals in their science laboratories should be conscious of such regulations in the concern of safety, not only the students, but also the staff. The school authorities should implement excellent occupational safety and health practices in their schools.

Therefore, this study is relevant to investigate the current level of chemical safety awareness of students and staff in selected secondary schools in Penang.

1.1.2 Importance of Study in Secondary Schools

Chemistry subject emphasized practices and the use of knowledge to enhance the competency based skills such as thinking skills, information handling skills and problem solving skills. Secondary schools are the starting point of a student to expose themselves to chemicals in their curriculum. Secondary schools usually have larger inventories and more hazardous chemicals than primary schools, but it is important to recognize the presence of chemicals in these schools as well.

Students would be introduced to many chemicals and their properties in chemical laboratories, whereby many experiments involving different chemicals would be done as per the curriculum. According to the DBP Chemistry Text Book for Form 4 and 5, there are 47 experiments that need to be fulfilled by the students throughout the two years of their chemistry learning course in secondary schools.[11][12] Furthermore, it also involves many hazardous chemicals that need demonstrations by the staff and also safe handling procedures by the students.

Priority should be given to secondary students to learn chemistry as the age would be appropriate for students to differentiate the pros and cons of using a chemical, and the maturity of students to learn beyond the theoretical knowledge of chemistry in their whole learning curriculum. Experiments dealing with potassium chlorate, potassium manganate, copper sulphate, naphthalene, sodium hydroxide and other chemicals would be done by students in the laboratories. Students are exposed to many types of chemicals in their laboratory experiments, that ranges from less hazardous to highly hazardous chemicals which needs prior concentration and proper handling in order to prevent chemical accidents and spills.

Although many rules and regulations were introduced and made for school laboratories in secondary schools, the numbers of chemical accidents in secondary schools are still increasing. A safe and secured working environment is needed thoroughly for all secondary schools in Malaysia, including the schools in the rural areas. Therefore, this study is relevant to identify the level of chemical safety awareness among staff and students in secondary schools.

1.2 RESEARCH QUESTIONS

Many researches are done in workplaces in terms of safety aspects and occupational diseases. Weak safety culture has been considered as a contributory factor in accidents by many industrial accident investigations, and it is now generally accepted that organizations with a strong safety culture are more effective in preventing workplace accidents and injuries. However, in the educational workplace, secondary schools are important to be researched in terms of safety and occupational health. Thus, this study has some theoretical relevance to investigate the level of chemical safety awareness among staff and students in secondary schools in terms of the independent variables involved in chemical safety and the types of chemicals used in the schools with its chemical properties. This study acquires to answer the following questions:

1. Are the students and staff aware of the chemicals used in their chemistry laboratories?

2. Are the students and staff aware of the chemical properties and their hazardous effects of using certain chemicals in the chemistry laboratories?

3. Are the students and staff aware of the proper lab and chemical system in the chemistry laboratories?

4. Are the students and staff aware of the correct way to maintain good housekeeping in the chemistry laboratories?

5. Are the students and staff aware of the suitable usage of Personal Protective Equipments (PPE) in the chemistry laboratories?

6. Are the students and staff aware of the safe procedures and practices that should be done in the chemistry laboratories?

7. Are the students and staff aware of proper safety education and trainings in the chemistry laboratories?

8. Are the students and staff aware of emergency procedures and the First Aid system in the chemistry laboratories?

9. Are the students and staff aware of the proper warning signs and its significance in the chemical laboratories?

10. Are the staff aware of proper record keeping for reference in the chemistry laboratories?

The ten research questions are important for this study.

1.3 RESEARCH OBJECTIVES

The following are the objectives of the study:

1. To study the understanding of chemical safety level in secondary schools among staff and students in Penang.
2. To categorize the element that has the highest and lowest awareness among staff and students in secondary schools in Penang.
3. To determine the level of safety awareness among staff and students in secondary schools in Penang.
4. To identify whether student or staff has higher chemical safety awareness in secondary schools in Penang.

1.4 SIGNIFICANCE OF STUDY

This research was mainly done to determine the chemical safety levels among students and staff in the educational environment. There are many safety issues that could be overlooked among the staff and students, which could be harmful to health and could also cause side effects in the later age. All these aspects can be minimized through this research, whereby all the safety issues would be analyzed and precautionary steps would be taken into account to reduce the safety issues. Besides, a better management of chemical procedures can be achieved by this research as students and staff would understand the safety issues present and would act according to the characteristic of the chemical. Furthermore, the current safety level can be notified for researchers for future research.

Since this research focuses on chemical safety and awareness, a better safety environment can be achieved among staff and students in the country. A safety concerned society can be created in Malaysia, whereby the awareness of chemical safety would be taken into account for every steps and decision that are made by the individual. This research can also generate future generation of students that would be precise to manage chemicals and invoke special interest to improve the safety rules that are present in the society. Meanwhile, the schools in Malaysia would have safety approved laboratories and buildings that could reduce many chemical related issues among the country. This research can also be a useful innovation for the education department in Malaysia.

1.5 SCOPE AND LIMITATIONS

This research is done for secondary school students and staff, on the awareness of safe usage and proper handling chemical. This research focuses on the chemicals used in the lab based on the chemistry course curriculum and the experiments that are conducted prior to the textbook given to the students. For this study, twenty secondary schools in Penang were researched and analyzed. The researchers are carried out by questionnaires for students and staff separately that focuses on different area of study and an independent variable for deeper and further research. The study also focuses only on Form 4 Science stream students as approved by the Ministry of Education (MOE) Malaysia.

CHAPTER 2

LITERATURE REVIEW

2.1 LITERATURE REVIEW

Literature review of this study begins with the history of OSHA 1994 from the initiation up till the finalisation of OSHA. Later, it will focus on the evolution of OSH and the famous chemical safety accidents in the world. Then, the chemical legislations in Malaysia are focused, followed by the secondary schools in Penang and the experiments involved in the laboratory. It will then focus on the elements that influence the chemical safety awareness among staff and students in Penang.

2.1.1 History of Occupational Safety and Health in Malaysia

The occupational safety and health was initiated in the late 19th century around 120 years ago. It started off with steam boiler safety, followed by machinery safety. Then, it went on with industrial safety and hygiene and finally occupational safety and health that enclosed every working sector. The role, history and development can be described in five eras. [13]

The first era would be the steam boiler safety era, which initiated before the year 1914. Tasks related to occupational safety was first recognized in Malaysia in the year 1878, after Mr. William Givan was selected as Machinery Inspector. His post was to examine the safety features of steam boilers, which was typically used in tin mines. Then, the Perak state government shaped a system of inspection by

individual surveyors. Workers with steam boiler credentials were given permit to survey boilers. In 1892, there were 83 steam boilers in the state of Perak. The steam boilers were used in tin mines excluding 6 units, which were used to manufacture sugar. Unfortunately, the boiler surveyor system was concluded in 1900 with the selection of Mr. C. Finchman as the supervisor for boilers.

Steam boiler enactment was state oriented initially as each of the four states (Perak, Selangor, Pahang and Negeri Sembilan) used its individual steam boiler law. The first steam boiler law in Malaysia was legislated in Selangor, which is known as the Selangor Boiler Enactment 1892. However, by the year 1908, the Allied Malay States had a standardized steam boiler legislation that was imposed by the inspectors of boilers. [14]

The second safety era was known to be the machinery safety era, which was from the year 1914 to 1952. On the month of January 1914, the steam boiler enactments were eradicated and were substituted with the Machinery Enactment of 1913. Furthermore, inspectors that were appointed were given additional tasks, whereby inspectors had to examine machineries, as well as water turbines, self-combustion engines and other auxiliary related machineries. Moreover, the job designation of Inspector of Boiler was replaced with Inspector of Machinery.

In the year 1932, the 1913 Machinery Enactment was substituted with Machinery Enactment of 1932. Inspection and registration of installation were imposed. The inspectors of machinery were under the management of the Mineral Department as mining was the main industry at that era and most machinery were used in the mining sector.

The third era was known as the industrial safety era which started in 1953 and ended in 1967.The Machinery Branch was under the administration of Mineral Department until 1952, when the branch was removed from the department and was renamed as Machinery Department. In 1953, all of the machinery enactments were substituted with Machinery Ordinance 1953. The responsibility of inspectors were not only narrowed to steam boilers or machinery safety but also covered all phases of workers safety. Machinery Ordinance 1953 lacked integrity in worker's health aspects as it was not fully enforced although there were regulations on safety, health and welfare of workers under the law. The main requirements of the ordinance were as follows:

- An established Board of Inspectors with authority to carry out inspections and to endorse certificates of fitness;
- Regulations can be made;
- Machinery with endorsed certificates can be utilized;
- Only permitted workers can operate machineries;
- Approval from Inspections must be prearranged before a machine can be approved or be modified;
- All accidents prior to workers or property linked to machinery must be informed and investigated;
- No workers should work in an unsafe manner that could cause injury to others;
- All non-complying machineries must not be borrowed, sold or rented;
- Inspectors are given the control to enter premises and to discontinue unsafe machineries.[15]

The fourth era is the industrial safety and hygiene era that lasted from 1970 till 1994. The Factory and Machinery Act was standardized by the Parliament in 1967. Furthermore, restructuring of the department was carried out at the end of year 1960, in which the role and responsibilities of inspectors, administrative system and filing arrangement were reorganized. In 1970, the Factory and Machinery Act and eight regulations under the act were imposed. With the charge of this act, Machinery Ordinance 1953 was changed to Factory and Machinery Department. The inspectors who implemented the act were renamed as Factory and Machinery Inspector. This act was legislated to improve the limitations of the Machinery Ordinance 1953, in the capacity of worker's exposure, as they were not secured if they were working in a workplace that doesn't use machinery. Requirements relating to industrial health were also added.

Usually, the Act was drafted to offer minimum measure of safety, health and welfare of workers at a workplace that consist of 5 employees or more and at grounds where machineries were being used, including factories, building construction sites and engineering constructions areas. The Act was only imposed in Peninsula Malaysia till the year1980 when Sabah and Sarawak were also added in the enforcement. In 1968, Chief Inspectors were comprised of British citizens. By 1968, the positions of inspectors in the Machinery Department were completely filled by locals. In the same year, the post of Medical Officer and Surveillance Unit were formed in the department. However, the unit did not continue to perform under the Labour Ministry as it was positioned under the management of the Health Ministry in the year 1971.

The existence of a few important activities and sections were also seen as per the development of the Anti-Pollution Section and Industrial Hygiene Unit in the year 1971 with an improvement of its grade to Industrial Hygiene Section in the year 1980. The initiation of petroleum safety activities with the formation of Petroleum Safety Section were created in the year 1985 with the addition of special inspection activities to prevent major industrial accident. Petroleum Act under the Safety Measures section was also imposed in the year 1984 and its enforcement was approved by a few government agencies such as the Factory and Machinery Department. This department imposed requirements in the act related to shipping of petroleum using pipeline, petroleum distribution, storage and instruments. The Factory and Machinery inspectors were also appointed as Petroleum Inspectors with these new tasks.

A proposal to set up the National Institute of Occupational Safety and Health was carried forward by the department of the National Advisory Council of Occupational Safety and Health in 1985. The board agreed to establish the institute in 1991 and the initiation was officiated by the Minister of Human Resource at the end of the year 1992. The institute was a government funded company with the function to carry out training activities, information resource and broadcasting; research and development in the field of occupational safety and health.

A nationalized workshop on occupational safety and health plan growth was structured by the International Labour Organisation (ILO), Factory and Machinery Department and Asia-OSH and on 26-28 April 1993. The intention of this workshop was to generate an information connection related to occupational safety and health practices consecutively to improve information transfer and broadcasting. After the

reorganisation of the department in the year 1969, major changes were conducted due to the country's immediate economic expansion and the enforcement of laws connected to the department.

The fifth era would be the occupational safety and health era which started after the year 1994.The new legislations on occupational safety and health was prepared. Occupational Safety and Health Act 1994 (Act 514) was permitted by the Parliament in the year 1993 and was gazetted on February 1994. The legislation was prepared with an exception that the Factory and Machinery Act 1967 takes in the occupational safety and health in the field of manufacturing, quarrying, mining, and construction industries while the other industries were not covered. Employees that were covered by Factory and Machinery Act 1967 consist of 24% of the nation's entire manpower whereas Occupational Safety and Health 1994 would cover 90% of the entire nation's manpower and would let off employees in the armed forces and ships.

The function of Occupational Safety and Health Act 1994(OSHA 1994) is to endorse and support occupational safety and health awareness amongst workers and to build organisations along with efficient safety and health measures. This would be done by self-regulation systems that match the industry or related administration. This Act that contains 15 sections is a measure that overtakes any disagreement in existing occupational safety and health laws which involves the Factory and Machinery Act 1967. OSHA 1994 also balances any active legislative requirements that arise within its jurisdictions.

This Act also describes the errands of employers, employees, manufacturers, vendors, designers, self-employed workers and importers. Although those responsibilities are minor and common, serious attention is still needed to withstand

the liabilities. There are three major principles that were taken as the base to draft this Act. The primary principle is self-regulation. Employers must build up a superior and orderly management system to grip issues related to occupational safety and health. The process initiated with the development of a safety and health policy and subsequently employers were made to take appropriate arrangements to carry out their tasks. The second principle is consultation where owners, employees and the management must discuss to resolve issues and troubles related to occupational safety and health at the place of work. The third principle is cooperation where employers and employees must collaborate to look out, cultivate and to enhance the quality of occupational safety and health at the workplace. None of the occupational safety and health activities that were carried out would be successful without the cooperation between employers and employees.

This Act also recommends the institution of National Council for Occupational Safety and Health, arrangements of enforcement officers, arrangement of policy and preparation of measures to maintain safety, health and welfare of people at work and others who may be exposed to hazardous activities of people at work.[16] The authority to implement, to examine and the liabilities for violating the law are also evidently defined.

As of April 1994, the Department of Factory and Machinery was renamed as the Department of Occupational Safety and Health (DOSH) and the inspectors are described as Occupational Safety and Health Officers. The sectors that are covered in this Act comprises of manufacturing, mining and quarrying, agriculture, construction, forestry and fishing. Under the utilities section, gas, water, electric and sanitary services are covered. From the transportation section, storage

and communication, retail and wholesale traders are covered. Meanwhile, hotels, restaurants, insurance, real estate, finance, business service, statutory authorities and public services are covered. In a nutshell, the establishment of the OSHA 1994 Act was the benchmark to every safety and health aspect in a workplace.

2.1.2 Evolution of OSH Legislations in Malaysia and Other Countries

OSH legislation in Malaysia was summarized from the 19th century British legislation, according to the DOSH 2003. During the middle ages, deaths from natural diseases were more frequent than from industrial accidents as they were generally working in the agriculture sector. Industrial accidents started to peak from the factory system during the Industrial Revolution in Britain in the 18th century (1700s) when people started to migrate from farm to work in the factories. The Industrial Revolution was the changeover to latest manufacturing processes from the year 1760. This transition changed from hand production process to machines and the growth of machine equipments.

Legislation before the 19th century tended to protect landlords and specific safety provisions for dangerous machineries were introduced. Nevertheless, the number of industrial accidents had no significant reduction. However, safety management never had any framework to base on safety management before Heinrich. Heinrich researched on the accident records and found out that 88% of the accidents reported were caused by unsafe acts from the workers which directed him to the invention of “Domino Theory of Accident Causation”. According to his theory, an accident is the results of a sequence of events that is dependent on each

other. It is caused by five factors that are ancestry, fault of the person, unsafe acts, accidents and injuries. [17]

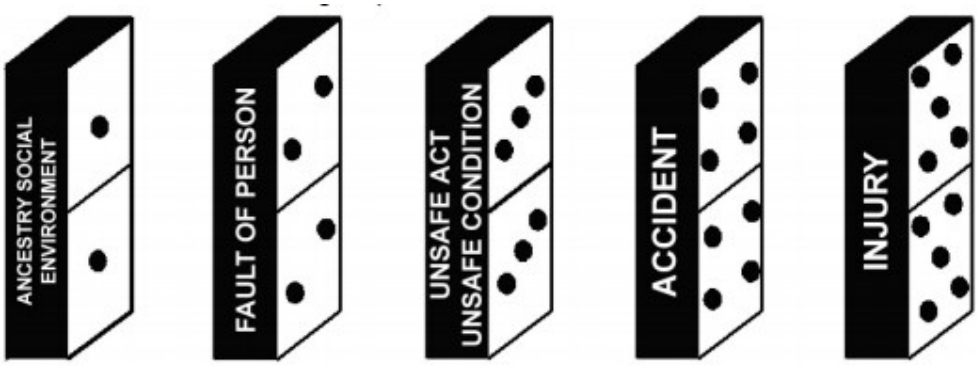

Figure 2.1: Heinrich's Domino Theory

Each domino has only one cause and that cause is the only cause. The root causes of accidents in this model are the ancestry and social environment of the worker, which lead to undesirable character traits such as bad temper and ignorance. The Domino Theory promoted control of workers behaviour. Unfortunately, it focused more on worker behaviour and not management. Therefore, this theory is unfortunate as it absolves management from any tantamount to blame the victims of accidents instead of blaming the management system faults.

This lead to the formation of Loss Control Theory by Frank Bird (1970). Frank E Bird, a company founder of International Loss Control Institute, revised Heinrich's domino theory. Bird's version was vital as it focused in the idea of managerial error into the accident causation sequence. Bird's modified domino theory is not taken into account because Heinrich's model blames workers rather than management. [17]

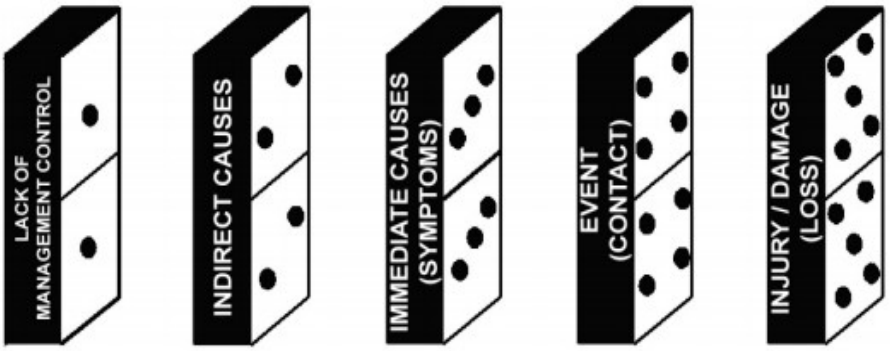

Figure 2.2: Bird's Modified Domino Theory

There were several descriptions of legislations that were established during that time. It mainly involved extensive OSH legislations, fragmentations, limited in coverage for specific hazards and workplaces, out of date, inflexible and wrong information on safety acts. In the report findings, Lord Rubens suggested that legislation in United Kingdom should be based on "Self- Regulation". The outcome of the report resulted in the formulation of the Health and Safety of Workers at Work Act in the UK in 1974. There were many regulations promulgated thereafter specific to certain particularly dangerous substances, including lead and asbestos, dangerous situations and physical dangers such as noise and ionising radiation. However, in 1994, the UK Safety Commission reviewed majority of the safety and health legislations and almost all the pre 974 legislations were removed prior to Robens principle.

Safety legislations and detailed regulations occurred in Malaysia with the formation of Factories and Machineries Act (FMA) 1967 with addition to noise, mineral dust, asbestos, at the end of 1989. This eventually led to the introduction of

Occupational Safety and Health Act (OSHA) 1994 in Malaysia which enacts most of the Robens report.

In United Kingdom, the configuration of the Robens Report in 1972 was a historical event in the UK's occupational health and safety. The Robens Report reviewed occupational health and safety trainings in the UK, which were equivalent to Australian systems. [18]

The financial support of the Robens Report was the UK Government's agreement that active occupational health and safe policies was not enough to avoid the stream of industrial accidents. Before the Robens Report, occupational health and safety laws were based on technological and detailed measurement standards. Australia still follows the similar style of occupational health and safety laws adopted following the Robens Report. [19]

2.1.3 Chemical Safety Accidents

The Oppau explosion happened on September 21, 1921 after a tower silo having 4500 tonnes of a blend of ammonium sulfate and ammonium nitrate fertilizer exploded in Oppau killing 500-600 people. The plant started producing ammonium sulfate in 1911, but throughout World War I once Germany was incapable to obtain sulphur, it began to manufacture ammonium nitrate as well. Meanwhile, minute charges of dynamite were used to reduce the mixture. The method was used experimentally and was considered secure. [20] An estimated 20,000 firings were done before the explosion on September 21. The cause of the explosion is still not clear but a theory is that the mixture was changed and a higher concentration of ammonium nitrate was present.

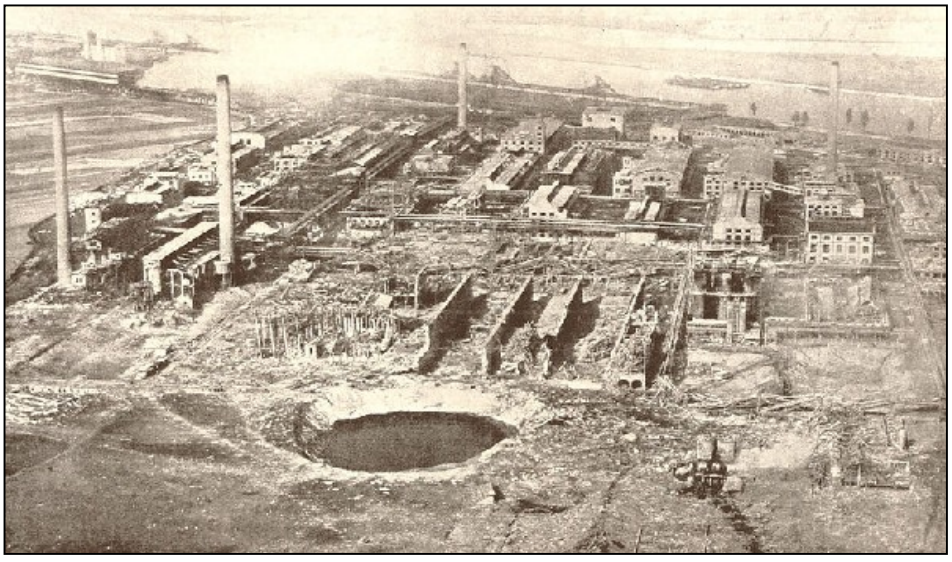

Figure 2.3 : The Oppau Explosion

The Bhopal incident is also another chemical accident that shocked the whole world. It occurred in subsidiary pesticide plant in the India. On 3 December 1984, the plant released forty two tonnes of toxic methyl isocyanate gas, exposing more than fifty thousand people to toxic gases. [21] This tragedy happened as water flowed into the tank containing the Methyl isocyanate. Thus, a chemical reaction happened which resulted in the build-up of Carbon dioxide which increased the temperature inside the tank to reach over 200 °C. As a result, huge amounts of toxic gases were released all over the area. A combination of poisonous gases began to air around the city which caused people to experience burning sensations in their lungs. Thousands died instantly due to the toxicity of the gas. The official abrupt death toll was 2,259. The Bhopal incident is considered as one of the worst chemical disasters in the world.

Focusing on Malaysia, the famous chemical accident was the Sungai Buloh Bright Sparklers Explosion in May 1991. The Bright Sparklers Fireworks fire occurred in Sungai Buloh, Selangor, Malaysia on 7 May 1991. The Bright Sparklers Fireworks Factory in Sungai Buloh, Selangor caught fire and created a huge explosion. Twenty six people were killed and over a hundred people were wounded in the disaster. The explosion was good enough to rip the roofs of some local houses, and ended up damaging over 200 residential properties. The root of the tragedy is assumed to have been caused by explosive chemical rip during an experiment in the factory. The chemicals flashed off fires that quickly spread to a nearby heap of large firecrackers, identified as the "bazookas". The firecrackers induced the set of explosions that ripped apart the factory and the nearby buildings. Twenty six people were killed and eighty three people were injured. [22]