

**FACTORS ASSOCIATED WITH CHEMICAL SAFETY STATUS IN SMALL  
AND MEDIUM PRINTING ENTERPRISES IN PENANG**

**by**

**HAZLINA BINTI YON**

**Thesis submitted in fulfilment of the  
requirements for the degree of  
Master of Science**

**JANUARY 2007**

## **ACKNOWLEDGEMENTS**

In the name of Allah, the Most Beneficent and the Most Merciful.

I would like to take this opportunity to extend my utmost gratitude and sincere appreciations to the following people who have given me encouragement and support that made the completion of this thesis possible. To my respectable study supervisors, Professor Omar bin Shawkataly and Associate Professor Abd. Rahman bin Othman from the Universiti Sains Malaysia, for their patience, endless effort and support, my deepest gratitude and appreciation are extended to them. Without them, this thesis could not be made possible and could not be completed in time. May Allah bless both of them.

I also would like to extend my appreciation to Dr. Norziani, Dr. Yen, Dr. Fatan Hamamah, Dr. Fatimah, and Madam Puya for coaching and sharing their valuable knowledge. To my ex-colleague, Tuan Hj. Abd. Rashid bin Othman who has dedicated his time to help me with the survey, may Allah bless him and his family. To my friends Mazni, Balasuperamaniem and Alan Lee, who are always there during the difficult times, a deep gratitude and heartfelt appreciation and may God bless them in their undertakings. To my ex-boss, En Zabidi Dato' Md. Adib who has inspired me to grasp this golden opportunity, my deepest gratitude and thanks is extended to him. May Allah the Almighty repay all your good deeds and support given to me during the course of my study. A scholarship from the Public Service Department is gratefully acknowledged.

Last but not least, to my husband and four children, my sisters, my other family members and to my late parents, for their everlasting love, understanding and support. To my four children, thank you for being patient with Mama. This thesis is dedicated to the four of them.

# TABLE OF CONTENTS

	Page
<b>ACKNOWLEDGEMENTS</b>	ii
<b>TABLE OF CONTENTS</b>	iii
<b>LIST OF TABLES</b>	vii
<b>LIST OF FIGURES</b>	ix
<b>LIST OF ABBREVIATION</b>	x
<b>LIST OF APPENDICES</b>	xi
<b>LIST OF PUBLICATIONS &amp; SEMINARS</b>	xi
<b>ABSTRAK</b>	xii
<b>ABSTRACT</b>	xiii
<b>CHAPTER ONE : INTRODUCTION</b>	
1.0 An overview	1
1.1 Effects of chemicals to health and environment	5
1.2 Research problems	7
1.2.1 Importance of study in chemical safety	7
1.2.2 Importance of study in small and medium enterprises (SMEs)	9
1.2.3 The importance of printing industry	12
1.2.4 Research questions	14
1.3 Research objectives	15
1.4 Significance of the study	16
1.5 Scope and limitations	16
<b>CHAPTER TWO : LITERATURE REVIEW</b>	
2.0 Introduction	18
2.1 Definitions of terms	18
2.2 Review of literature	19
2.2.1 History of occupational safety and health in Malaysia	20
2.2.2 The evolution of OSH legislation in Malaysia and other countries	24
2.2.3 Chemical safety legislations in Malaysia	28
2.2.4 The international chemical safety legislations	32
2.2.4.a ILO instruments	32
2.2.4.b The United Kingdom (UK)	33

2.2.4.c	European Union (EU)	34
2.2.4.d	Australia	34
2.2.4.e	United States	35
2.2.4.f	Guidelines or codes of practices	36
2.2.5	Chemical safety legislations and their elements	37
2.2.6	The growth of chemical industry in Malaysia	39
2.2.7	Accidents statistics in Malaysia	41
2.2.8	Accidents statistics globally	44
2.2.9	Global chemical safety activities	46
2.2.10	Occupational safety and health (OSH) in Malaysia	47
2.2.11	Cost of poor chemical safety	51
2.2.12	Health hazards due to chemical exposure	54
2.2.13	Occupational safety and health in small medium enterprises	56
2.2.14	OSH in large organisations	58
2.2.15	Research on OSH and chemical safety in Malaysia	60
2.2.16	Processes involved in printing industry and their hazards	61
2.3	Factors associated with chemical safety status	64
2.3.1	Chemical safety status	65
2.3.2	Management of chemicals	67
2.3.3	Hazard identification and process hazard analysis	69
2.3.4	Operational control methods	71
2.3.5	Personal protective equipment	75
2.3.6	Safe procedures and practices	77
2.3.7	Monitoring of workers exposure	78
2.3.8	Medical surveillance	80
2.3.9	Training and education	82
2.3.10	Emergency measures and first aid	84
2.3.11	Workers participation	85
2.3.12	Chemical safety data sheets (CSDS)	87
2.3.13	Warning signs	88
2.3.14	Recordkeeping	89
2.4	Theoretical framework	90
2.5	Research model	95
2.6	Trends to be observed	95

## **CHAPTER THREE: METHODOLOGY**

3.0	Introduction	97
3.1	Definitions of small and medium enterprises	97
3.2	Research design	97
	3.2.1 Sampling procedure	98
	3.2.2 Unit of analysis and respondents	99
3.3	Instrumentation	100
3.4	Pilot testing	107
3.5	The approach	108
3.6	Data collection and rate of return	109
3.7	Data analyses	111
3.8	Conclusion	112

## **CHAPTER FOUR: RESULTS AND DISCUSSION**

4.0	Introduction	113
4.1	Demographic summary of respondents	113
4.2	Test for validity	117
	4.2.1 Factor analysis results and discussions	125
4.3	Test for reliability	128
4.4	Discriminant function analysis	129
	4.4.1 Test for normality	130
	4.4.2 Test for homogeneity of variances or covariances	132
	4.4.3 Discriminant analysis results	133
	4.4.4 Discussion on discriminant analysis results	138
4.5	Trends observed	146
4.6	Conclusion	151

## **CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS**

5.0	Introduction	152
5.1	Other observations	152
5.2	Recapitulation of the research findings	153
5.3	Contributions of the study	161
	5.3.1 Contributions to the academia	161
	5.3.2 Contributions to the OSH practitioners	162
	5.3.3 Contributions to the policymakers or regulating body	163

5.4	Implications of the study	164
5.4.1	Implications for academia	164
5.4.2	Implications for OSH practitioners	165
5.5	Limitations and future directions	165
5.6	Conclusion	167
	<b>REFERENCES</b>	<b>169</b>
	<b>APPENDICES</b>	<b>181</b>

## LIST OF TABLES

	Page	
Table 1.1	Accidents and fatality reported to SOCSO	2
Table 1.2	Notification of occupational diseases in 2003	3
Table 2.1	Elements of chemical legislations or standards and countries applied	38
Table 3.1	Pilot test result –Reliability statistics	108
Table 3.2	Distribution of questionnaires	110
Table 3.3	Grouping categories of chemical safety status	112
Table 4.1	Summary of the respondents - Responsible persons for OSH	114
Table 4.2	Summary of the respondents – Number of employees, years in business, type of processes and type of ownership	115
Table 4.3	Summary of the respondents – Occurrences of major and minor accidents, occurrences of occupational diseases and notices received	116
Table 4.4	Summary of the respondents – Usage of banned chemical, OSH policy and committee, availability of CHRA reports and availability of chemical inventory	117
Table 4.5	Summary of the respondents – Types of personal protective equipment (PPE) provided	118
Table 4.6	Results of KMO and Bartlett's Test	122
Table 4.7	Results of KMO and Bartlett's Test after four KMO statistic values were dropped.	123
Table 4.8	Summary results of the rotated factor analysis (varimax) showing labels for each factor with respective factor loadings exceeding 0.7	124
Table 4.9	Result of the comparison of original variables and extracted factors and percentage of variance accounted for by each factor	127
Table 4.10	Test for reliability	129
Table 4.11	Results of tests for normality	131
Table 4.12	Box's test of equality of covariance matrices	133
Table 4.13	Classification results with the hit ratio for the original groups	135

<b>Table 4.14</b>	<b>Hit ratio for cross validation (leave-one-out classification)</b>	<b>135</b>
<b>Table 4.15</b>	<b>Wilks' Lambda</b>	<b>136</b>
<b>Table 4.16</b>	<b>Canonical Discriminant Function Coefficients</b>	<b>137</b>
<b>Table 4.17</b>	<b>Structure matrix</b>	<b>137</b>
<b>Table 4.18</b>	<b>Summary of trends to be observed</b>	<b>146</b>



## LIST OF FIGURES

	Page	
Figure 2.1	Organisation chart of the Ministry of Human Resources	23
Figure 2.2	Schematic diagram of theoretical framework.	94
Figure 4.1	Scree test	121
Figure 4.2	Histogram of factor score 1 (SOP)	132
Figure 4.3	Normal Q-Q plot of factor score1 (SOP)	132
Figure 4.4	Groups profiling of correct prediction	139
Figure 4.5	Groups profiling of observed status lower than predicted status	143
Figure 4.6	Groups profiling of observed status higher than predicted status	145
Figure 4.7	Box plots of factor scores for "SOP" against predicted chemical safety status	148
Figure 4.8	Box plots of factor scores for "MMS" against predicted chemical safety status	149
Figure 4.9	Box plots of factor scores for "WPHID" against predicted chemical safety status	149
Figure 4.10	Box plots of factor scores for "CSDS" against predicted chemical safety status	150
Figure 4.11	Box plots of factor scores for "OCM" against predicted chemical safety status	150

## **LIST OF ABBREVIATION**

<b>CIMAH:</b>	<b>Control of Industrial Major Accident Hazards</b>
<b>CPL:</b>	<b>Classification, Packaging, and Labelling</b>
<b>CSDS:</b>	<b>Chemical Safety Data Sheets</b>
<b>DOSH:</b>	<b>Department of Occupational Safety and Health</b>
<b>FMA:</b>	<b>Factories and Machinery Act</b>
<b>ILO:</b>	<b>International Labour Organisation</b>
<b>ILO- FINNIDA:</b>	<b>International Labour Organisation-Finnish International Development Agency</b>
<b>IPCS:</b>	<b>International Programme on Chemical Safety</b>
<b>MMS:</b>	<b>Monitoring and Medical Surveillance</b>
<b>MOIS:</b>	<b>Ministry of Internal Security</b>
<b>NIOSH:</b>	<b>National Institute of Occupational Safety and Health</b>
<b>NSC:</b>	<b>National Safety Council</b>
<b>OCM:</b>	<b>Operational Control Measures</b>
<b>OECD:</b>	<b>Organisation for Economic Cooperation and Development</b>
<b>OSH:</b>	<b>Occupational Safety and Health</b>
<b>OSHA:</b>	<b>Occupational Safety and Health Act</b>
<b>PPE:</b>	<b>Personal Protective Equipment</b>
<b>SHC:</b>	<b>Safety and Health Committee</b>
<b>SHP:</b>	<b>Safety and Health Policy</b>
<b>SHW:</b>	<b>Safety, Health and Welfare</b>
<b>SME:</b>	<b>Small and Medium Enterprise</b>
<b>SMIDEC:</b>	<b>Small and Medium Industries Development Corporation</b>
<b>SOCISO:</b>	<b>Social Security Organisation</b>
<b>SOP:</b>	<b>Safe Work Procedures</b>
<b>UK:</b>	<b>United Kingdom</b>
<b>UNCED:</b>	<b>United Nations Conference on Environment and Development</b>
<b>UNEP:</b>	<b>United Nations Environment Programme</b>
<b>USA:</b>	<b>United States of America</b>
<b>USECHH:</b>	<b>Use and Standard of Exposure of Chemicals Hazardous to Health</b>
<b>WHO:</b>	<b>World Health Organisation</b>
<b>WPHID:</b>	<b>Workers Participation and Hazard Identification</b>

## LIST OF APPENDICES

	Page	
Appendix A	Questionnaires	181
Appendix B	Letters	190
	B1: Letter accompanying questionnaires for data collection	190
	B2: Letter sent to Ministry of Internal Security	191
Appendix C	SPSS output for descriptive summary	192
Appendix D	SPSS output for test of validity	197
	Table D1: Total variance explained	197
	Table D2: Total variance explained	201
	Table D3: Rotated component matrix	205
	Figure D1 : Scree plot of eight factors extracted	208
Appendix E	SPSS output for:	206
	Table E1: Component score coefficient matrix	209
	Table E2: Z scores and computation of factor scores	211
	Table E3: Factor scores	212
Appendix F	SPSS output for test for reliability	215

## LIST OF PUBLICATIONS & SEMINARS

- 1.1 Factors influencing chemical safety status in small medium enterprises in Penang.  
Publication: NIOSH Malaysia December 2006 Bulletin.  
Seminar: 9<sup>th</sup> Conference and Exhibition for Occupational Safety and Health- Energising OSH through Effective leadership, Sunway Pyramid Convention Centre, Petaling Jaya, Selangor, Malaysia.  
12-14 September 2006.
- 1.2 Factors influencing chemical safety status in small medium enterprises in Penang. Case of printing industry.  
Seminar: Persidangan Kebangsaan Pembangunan Persekitaran dan Masyarakat, Paradise Sandy Beach Resort, Penang, Malaysia.  
17 - 18 January 2007.

# **FAKTOR-FAKTOR YANG BERKAITAN DENGAN STATUS KESELAMATAN KIMIA DI SYARIKAT-SYARIKAT PERCETAKAN KECIL DAN SEDERHANA DI PULAU PINANG**

## **ABSTRAK**

Satu kajian berkenaan status keselamatan kimia bagi syarikat kecil dan sederhana telah dijalankan dalam tahun 2005 sehingga tahun 2006. Borang kajiselidik telah diagihkan kepada 254 buah syarikat percetakan tetapi hanya 122 keping borang sahaja yang telah diisi dan dikembalikan kepada penyelidik. Kajiselidik tersebut bertujuan untuk mengenalpasti faktor-faktor yang berkaitan dengan status keselamatan kimia di syarikat-syarikat kecil dan sederhana dengan mengukur tahap pengetahuan dan tahap kesedaran mengenai keselamatan kimia ke atas orang yang bertanggungjawab terhadap keselamatan dan kesihatan pekerjaan di sesebuah tempat kerja. Pengadaan prosedur kerja selamat, pengadaan program pemantauan pendedahan pekerja dan program pengawasan kesihatan, penyumbangan aktif pihak pekerja dan pengadaan proses pengenalpastian hazard, pengadaan risalah data keselamatan kimia dan pengadaan kaedah kawalan di tempat kerja telah didapati mempunyai kaitan dengan status keselamatan kimia di syarikat-syarikat kecil dan sederhana. Hasil dari kajian ini dapat menunjukkan bahawa majikan memainkan peranan yang penting dalam memastikan halatuju yang konsisten terhadap keselamatan kimia di tempat kerja. Kajian ini juga dapat membuktikan bahawa keselamatan dan kesihatan pekerjaan terutamanya keselamatan kimia di syarikat-syarikat kecil dan sederhana masih di tahap yang amat rendah. Kajian ini juga menyediakan satu alat penilaian keselamatan kimia yang mudah diimplementasikan oleh syarikat-syarikat kecil dan sederhana yang boleh membantu syarikat-syarikat tersebut untuk mematuhi kehendak-kehendak undang-undang keselamatan kimia di dalam negara.

# **FACTORS ASSOCIATED WITH CHEMICAL SAFETY STATUS IN SMALL AND MEDIUM PRINTING ENTERPRISES IN PENANG**

## **ABSTRACT**

A study on the status of chemical safety of small medium enterprises (SMEs) was conducted in 2005 to 2006. Surveys forms were distributed to 254 enterprises but only 122 forms were filled and returned. The survey was aimed to determine factors associated with the chemical safety status in those enterprises by measuring the knowledge and level of awareness towards chemical safety of the person responsible for occupational safety and health (OSH) at the respective workplaces. Establishment of safe working procedures, establishment of monitoring of workers exposure programme and medical surveillance programme, participation of workers and establishment of process hazard identification, establishment of chemical safety data sheets and establishment of operational control methods at work were found to be associated with the chemical safety status in small medium enterprises (SMEs). The findings of this study revealed that management plays an integral role in ensuring a coherent and consistent approach to chemical safety at the workplaces. This study also provides evidence that OSH in particular chemical safety in SMEs is still lacking. It also provides an easy-to-implement assessment tool for chemical safety in SMEs which can assist the SMEs to comply with the local requirements of chemical safety.

# CHAPTER ONE

## INTRODUCTION

### 1.0 An overview

As a result of high economic growth, increased pace of worldwide trade liberalisation, rapid industrialisation and modernisation of agriculture, the number of occupational diseases and accidents are increasing in many developing countries. This increasing pace of world's development also has a direct impact on working conditions in developed countries including Malaysia. Available accident statistics from the Social Security Organisation (SOCSO) Malaysia from year 1999 to 2004 in the manufacturing sector shows that this sector contributed the highest number of accidents. For example, in 2004 the manufacturing sector contributed 40% of the total number of cases reported (SOCSO, 2005).

Table 1.1 shows the accident statistics as reported to SOCSO from year 1999 to 2004. The total number of accidents reported has declined from 92,074 cases in 1999 to 69,132 cases in 2004. This decline reflects the positive impact of the continuous joint efforts undertaken by the workmen compensation scheme or SOCSO, the Department of Occupational Safety and Health (DOSH), the National Institute of Occupational Safety and Health (NIOSH), employees' unions and employers' associations in promoting occupational safety and health awareness at the work place. However, reported accidents due to chemicals were on the increase. For instance, there were 406 cases of accidents due to chemicals in 2000 and there were 892 cases in 2003 (SOCSO, 2003d). This reflects an increased in the number of accidents by chemical agents among the industries in Malaysia.

Table 1.1

*Accidents and fatality reported to SOCSO*

Description	1999	2000	2001	2002	2003	2004
No. of accidents reported	92,074	95,006	85,229	81,810	73,858	69,132
No. of industrial accidents in manufacturing Sector	Not available	41,331	35,642	33,523	29,780	26,690
No. of fatality in manufacturing sector	Not available	282	243	214	213	195
No. of fatality reported	Not available	1004	958	858	822	846

Note. From SOCSO, 2005.

In Malaysia, the rate of fatal accident per thousand workers in 2004 was 6.9 (SOCSO, 2005). To be on par with the developed nations i.e. less than five accidents per thousand workers, more effort has to be made by relevant regulatory agencies, employers, non-governmental organizations and employees to ensure compliance to laws and regulations. If employers and employees understand their roles and responsibilities in ensuring hazards at workplaces are identified, assessed and controlled, it will definitely contribute to the prevention of untoward incidents causing injury, illness, death and property damage at the workplace.

Notifications of occupational diseases received by the Department of Occupational Safety and Health (DOSH) in 2003 were 181 incidents. Table 1.2 shows notifications of occupational diseases in 2003. The number of diseases related to chemicals was 108 cases (i.e. Occupational Lung Disease, Occupational Skin Disease, Chemical Poisoning and Pesticide, Occupational Cancer) which were about 60% of the notified incidents. Occupational skin diseases came second among the 60 % after physical diseases (DOSH, 2003b). These high numbers of occupational diseases

prompted us to look into this problem and hoping that this research will be able to answer several questions regarding this issue such as: Are these diseases caused by chemicals used and handled by workers at the workplace? Do poor workplace conditions contribute to occupational diseases faced by these workers? Does inadequate chemical safety at workplaces contribute to an increased number of occupational diseases? These are some of the questions that need to be explored further in this study to ascertain chemical safety status pertaining to Occupational Safety and Health Act 1994 in manufacturing settings particularly in printing industry.

Table 1.2

*Notification of occupational diseases in 2003*

Type of Diseases	Number of Notification received by DOSH	Number of case investigated
Occupational Lung Disease	13	13
Occupational Skin Disease	59	47
Physical	62	39
Chemical Poisoning & Pesticide	35	29
Ergonomic Problem	11	11
Psychosocial Problem	0	0
Occupational Cancer	1	1
Total	181	147

Note. From DOSH, 2003b.

Occupational accidents and work related disease figures as reported by World Bank Division in collaboration with International Labour Organisation (ILO) in year 2001 in Malaysia showed a marked figure of 1230 deaths caused by dangerous substances and about 5279 were work related diseases (ILO, 2001). Work-related accidents and



diseases have economic, social and moral consequences. Economic losses caused by absenteeism, insurance costs, production losses and low protection levels are equivalent to more than four percent of the world's Gross National Product (GNP) (Fong, 2003a). The available accident statistics throughout the world including Malaysia clearly demonstrates that the number of workers exposed to health hazards such as toxic chemicals, dust and noise are increasing. The ILO also estimates accidents and diseases cause over two million fatalities worldwide annually. Most victims are workers from the poorer countries who are the least protected, least informed and least trained. Similarly, the ILO reported that hazardous substances cause the deaths of an estimated 440,000 workers each year (ILO, 2005a).

There is a growing concern about safety and health at work in almost all parts of the world including the developed countries. In Malaysia, a number of steps have been taken towards the improvement of the national occupational safety and health systems. The steps include reviewing and upgrading of legislation, collaborating with and getting support from workmen's compensation scheme and promoting awareness on safety and health. A new and more comprehensive act i.e. the Occupational Safety and Health Act (OSHA) was introduced in 1994 to complement the existing act on safety and health i.e. the Factories and Machinery Act 1967, and to be the prime mover towards the improvement of the national occupational safety and health systems. The primary aim of the new act is to promote safety and health awareness and to instil a safety and health culture among the entire Malaysian workforce. The new act will also ensure that all parties concerned, mainly employers, and workers are more responsible and accountable in their efforts to provide and maintain a safe and healthy workplace for the ever-growing labour force (Occupational Safety and Health Act [OSHA], 2001).

Despite the efforts made in improving occupational safety and health systems in Malaysia, the numbers of occupational diseases and accidents are still increasing as illustrated by the statistics obtained from the SOCSO as mentioned earlier. This clearly indicates that there are still many organisations adopting an ad-hoc approach to safety

and health at the workplace. According to the Minister of Human Resources in his press release, some employers are more interested in profits rather than the safety, health and welfare of their employees. Only multinationals put the principle of self regulation into practice. The small and medium industries are finding it difficult to implement the principle of self regulation (Fong, 2001b).

Chemicals have become part of our modern lifestyle. The world's chemical production has grown steadily since the Second World War and forecasted to show a rising trend in years to come (Amweelo, 2001). More than 400 million tones of chemicals are now being produced annually throughout the world. Rantanen (1997) reported that there were ten million chemicals at the moment in the American Chemical Society (ACS) computer registry and about 500 to 2000 new entities were added each year. These data implies that the use of chemicals in the world is increasing. According to the ACS, the industrialised countries used and produced about 80% of the world's chemicals (cited in Rantanen,1997). Hence, there is a need of good and sound chemical safety programme in industries to minimise various health effects and risks associated with the introduction of these new chemicals.

### **1.1 Effects of chemicals to health and environment**

Chemicals are widely used in most manufacturing industries, research institutes and universities as well as other places. However, many chemicals post significant hazards such as fire, explosions, environmental pollution and loss of assets. Hazardous chemicals also affect human's health. Many workers suffered from mild and chronic poisoning, ailments, occupational diseases including cancer caused by chemicals. According to Nguyen (1997), a very high proportion of occupational diseases are caused by chemicals.

The horrible disaster that occurred in 1984 when gas leaked from the Union Carbide Pesticide Plant in Bhopal, India killed thousands of lives and affected hundreds of thousands more. The Mississauga Railway chlorine transport accident in Canada in

1979, the Seveso dioxin accident in Italy in 1976, the explosion of gasoline tank in Mexico City in 1984, the Chernobyl nuclear power plant accident in Ukraine in 1986, the Basle fire accident of a chemical storage in 1986, and so forth had raised awareness and alertness among many countries of the importance of chemical safety (Rantanen, 1997). Special legislations have been introduced in many countries as lessons were learnt from those horrible catastrophes.

In Malaysia, 22 people were killed and 103 people were injured when fire engulfed a fireworks factory and the surrounding neighbourhood in Sungai Buloh which was about 20 km from Kuala Lumpur on the 7<sup>th</sup> May 1991 (DOSH, 1995). This incident which is also known as the Sungai Buloh Tragedy is an example of the damage to life and property as a result of a chemical accident.

Human resource is a priceless asset. Realising this, the Malaysian Government have taken several steps to deal with the problem of chemical safety. Among the steps taken are the introduction of three regulations and one prohibition order under the Occupational Safety and Health Act of 1994. These legislations will be elaborated in Chapter 2. The Use and Standard of Exposure of Chemicals Hazardous to Health Regulations (USECHH) of 2000 referred as USECHH 2000 was gazetted in April 2000 to control the use of hazardous industrial chemicals at workplaces and to set exposure standards to protect the health of workers and other persons at the place of work. The emergence of this new regulation has driven industrial organizations to improve their chemical safety management. Employers must change their approach from a reactive approach to a proactive approach. Proactive here means the organizations have to anticipate accidents or near misses and introduce procedures, strategies and systems to tackle chemical hazards.

The USECHH Regulations (2000) clearly stipulates the responsibility of employers (including the self-employed person) to protect the safety and health of their employees and any other persons from being affected by chemicals hazardous to

health. In order to comply with USECHH 2000, employers must improve their chemical safety management at their workplaces.

## **1.2 Research problems**

### **1.2.1 Importance of study in chemical safety**

Previous studies by Wafra, Awan and Goodson (1998) showed that occupational safety and health conditions at the small medium enterprises (SMEs) were a cause for concern. Workers in SMEs in different countries were at risk of exposing themselves to hazardous chemicals without proper and effective control measures. The study also found that 70% of chemical containers were not labelled properly. Workers in SMEs were using improvised personal protective equipment and proper personal protective equipments were not available.

Wafra et al. (1998) also discovered that the housekeeping, welfare facilities and personal hygiene of those working in SMEs were poor and neglected. The survey also showed that there were health complaints in different industries among these SMEs workers who were exposed to hazardous chemicals either by inhalation, skin absorption or ingestion via poor personal hygiene.

There is a general belief that chemical safety in SMEs is inadequate. Most workers in SMEs are not aware of chemical safety and employers in SMEs pay little attention to the implementation of any chemical safety relevant legislations on occupational safety and health. The most common aspect of chemical safety which is often lacking in SMEs is lack of personal protective equipment during chemical handling.

In the industrialised countries, stringent legislations and control has slowed down the growth rate of chemical pollution. The exposure levels at workplaces are effectively controlled, which has led to dramatic drop in the incidence of occupationally acute and chronic diseases, such as heavy metals poisonings and peripheral nerves

injuries. These industrialised countries are now concern with the chronic effects of low level of exposures to chemicals such as cancer, allergies, and reproductive behavioural effects (Rantanen, 1997).

In the developing countries including Malaysia, usage and production of chemicals have been on the rise due to three reasons. Firstly, chemical manufacturers are trying to avoid stringent chemical legislations in the industrialised countries. Some countries have created legislations that banned certain hazardous chemicals in the producer country itself. Secondly, an increased in production of chemicals will strengthen the industry, economy and employment of one's country. Thirdly, chemical manufacturers are looking for markets in the developing countries to sell their products as compared to the already saturated industrialised countries (Rantanen, 1997).

Various occupational safety and health measures can be taken to enhance chemical safety in workplaces. Nevertheless, the key factor in ensuring chemical safety is the people themselves. Everyone from high ranking officials, managers, specialists, employers and workers must know how to protect themselves and others (Nguyen, 1997).

In Malaysia, there is a general belief that chemicals safety compliance among the SMEs is not up to the standard of safety and health pertaining to OSHA 1994. The Deputy Prime Minister (Lim, 2002) quoted that the number of reported accidents at the workplace especially in SMEs was worrying and statistics showed that the SMEs had the workplace accident rate of 30% to 50% higher than big companies. Audit done by the DOSH on SMEs in the Klang Valley from May to August 2002 had shown that a majority of SMEs did not take safety and health of workers seriously (Yahaya, 2002). Yet, employers of the SMEs still need to ensure the safety, health, welfare of all their employees and the public that may be affected by their business activities. SMEs are not exempted from complying with any laws or regulations under the OSHA 1994.

A chemical safety survey done by DOSH (1995) on manufacturing sector in the Klang Valley also found that chemical safety status is unsatisfactory. The results from

the survey showed that foreign companies showed better performance than local companies and companies employing more than forty workers demonstrated better performances than those below. It is important to note that the survey done by DOSH (1995) seeks to collect some baseline data of chemical safety status in the beginning of the introduction of OSHA 1994.

This research seeks to investigate chemical safety status in the SMEs manufacturing setting, in particular the printing industry in the state of Penang. Following this, it also seeks to investigate whether factors such as employee involvement, training, management of chemicals at the workplace, establishment of personal protective equipment (PPE) programme, availability of operational control measures and others at the workplace will predict, contribute to or influence the chemical safety status of the printing industries in Penang.

Therefore this study is relevant in order to investigate the extent of implementation of chemical safety in manufacturing setting in particular printing industry after more than twelve years of introduction of OSHA 1994 and to discover factors associated with the chemical safety status in the particular industry.

### **1.2.2 Importance of study in small and medium enterprises (SMEs)**

Papers by various international organisations such as the ILO (ILO, 2000) reported that existing legal framework for safety and health in some developing countries is still limited to the protection of workers in certain categories of workers. The enforcement of applicable occupational safety and health legislation is also often limited to large enterprises due to inadequate inspection capacity of the smaller enterprises by the competent authorities. Thus, millions of workers in small and medium scale enterprises are not sufficiently protected by the existing legislation. In addition to that workers of informal sectors are often out of reach of most of safety and health programmes.

Priority on SMEs is given due to their important role in the development of the country's economy (Fong, 2001b). SMEs also provide employment opportunities to about 35% from the total workforce in the manufacturing sector. Statistics from Bank Negara also indicates that SMEs are contributing some 6% of the country's Gross Domestic Product (GDP) (Soon, 2004). According to statistics from the Ministry of International Trade and Industry, SMEs constitute over 90 percent of the total number of companies registered with the Companies Commission of Malaysia. They are contributing about 29 percent of total manufacturing output, 26 percent of value-added and 32.5 percent of total employment in Malaysia. Hence, SMEs play a vital part in Malaysia's economic growth. They are the main service providers and main suppliers to the big organisations (Fong, 2005).

Even though SMEs are important to the country, their contribution to workplace accident statistics is equally substantial. They are also the major contributors to 80% of total accidents in Malaysia. There are 17,400 SMEs registered with the DOSH in 2002. Results from audits conducted by the DOSH for two thousand and six hundred SMEs in 2002 showed poor compliance (Yahaya, 2002).

Research done by Abd Azid (1998) in multinationals showed that safety and health committee roles and government enforcement were the significant contributing factors in the implementation of occupational safety and health (OSH) in electronic manufacturing firms while research by Jamal Khan (2003) in SMEs showed that management commitment, employees involvement, safety training, safety incentives and disincentives were significant determinants of OSH performance in SMEs manufacturing firms. There are thirteen independent variables in this study. Three of the independent variables are the same determinants found in the study done by Jamal Khan (2003). This study seeks to clarify whether these three factors plus ten others will significantly influence chemical safety status in manufacturing setting, in particular the printing industry.

Townsend (1998) found that compliance with occupational safety and health legislations among SMEs were very low due to various reasons such as limited time available for employers of such enterprise to manage OSH in their business, low level of awareness, lack of focus and negative perceptions on OSH issues and regulatory requirements, limited financial, human resources and low level of networking among SMEs, high staff turnover and employment arrangement. This study will also investigate whether the above mentioned reasons apply to the SMEs in Malaysia through the qualitative open-ended questionnaires.

Chan, Leung, Yip, Wong and Chu (1996) analysed safety and health problems in small industries in Hong Kong. Their study showed that health and safety situation in these SMEs was seriously inadequate and not very favourable. The ILO studies also revealed that workers in SMEs are exposed to both traditional and complex patterns of occupational hazards including to various chemicals and their mixtures (Wafra et al., 1998).

It has been noted that previous research in the Malaysian context on the OSH performance do not explore much into the chemical safety aspects in any SMEs manufacturing settings. Much of OSH issues pertaining to chemical safety in SMEs are not fully studied. Hence, this study seeks to explore the reasons behind low chemical safety compliances among SMEs and their perceptions towards chemical safety management. It has also been found that SMEs are finding it difficult to translate theory into practice. Thus, a long term solution is required to help them to overcome this problem. This study also seeks to formulate suggestions or recommendations to enhance chemical safety among the SMEs.

Report from the DOSH (2005b) on compliance to chemical legislations i.e. the USECHH regulations of 2000, showed that 60% of the workplaces visited in 2001 and 2002 in Penang through three simultaneous operations, scored less than 25% in a chemical safety assessment and only 3% of the workplaces visited scored within the range of 80% to 100%. Scores less than 25% showed very poor compliance to the