THE IMPROVEMENT OF CHEMICAL MANAGEMENT SYSTEM IN A SMALL PRINTING INDUSTRY USING VOLATILE ORGANIC COMPOUNDS

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF SCIENCE
(INDUSTRIAL HYGIENE AND SAFETY)
FACULTY OF GRADUATE STUDIES
MAHIDOL UNIVERSITY
2012

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entitled

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was submitted to the Faculty of Graduate Studies, Mahidol University
for the degree of Master of Science (Industrial Hygiene and Safety)
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ACKNOWLEDGEMENTS

The success of this thesis can be succeeded by the attentive support from my major advisor, Assoc. Prof. Pramuk Osiri and my co-advisor, Assoc. Prof. Chalermchai Chaikittiporn, Assoc. Prof. Vichai Pruktharathikul. I deeply thank them for their encouragement, advice and guidance from the initial to the final level enabled me to develop an understanding of this research.

I would like to thank the entire owner of printing factories who was the sampling in this study for their participation. Thanks are also to Environment and Sanitation Section of Bangkok Metropolitan Administration that gave the necessary data about the printing industry in Bangkok area and the Center of Excellence on Environmental Health, Toxicology and Management of Chemicals (ETM) under the supervision of Science and Technology Postgraduate Education and Research Development Office (PERDO), Office of the Higher Education Commission, Ministry of Education that gave a scholarship for this research.

Special thanks should be given to all the friends I have met over my many years at Faculty of Public Health for their help and encouragement. Finally, words alone cannot express the thanks I owe to my family for their unending encouragement, assistance and support.

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ABSTRACT

This research aimed to improve the management of chemicals for a printing factory and to reduce the health risks that might arise with workers who are exposed to chemicals during their work. Two small-sized offset printing factories located in Bangkok were assessed using the chemical storage checklist form following the guideline in the Department of Industrial Works, Manual for the storage of hazardous chemicals and materials, B.E. 2550. Then a form was created for health risk assessment using the principles and concepts of Thai Industrial Standard (TIS) 18004. Both checklists would be used to assess before and after the improvement in chemical management.

The study found that the improvements in chemical storage increased the level of compliance with the law in both printing factories ($p < 0.05$). The improvement in work processes decreased the risk level that required the risk control measures (unacceptable risk, high risk, medium risk) in all work processes in printing factory B ($p < 0.05$). The results can be used as a guideline to improve the management of chemicals in small printing factories.

KEY WORDS: IMPROVEMENT OF CHEMICAL MANAGEMENT / SMALL-SIZED PRINTING FACTORY / RISK ASSESSMENT / VOLATILE ORGANIC COMPOUNDS

186 pages

การปรับปรุงการจัดการสารเคมีในโรงพิมพ์ขนาดเล็กที่มีการใช้สารอินทรีย์ระเหยง่าย
THE IMPROVEMENT OF CHEMICAL MANAGEMENT SYSTEM IN A SMALL PRINTING INDUSTRY USING VOLATILE ORGANIC COMPOUNDS

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บทคัดย่อ

วัตถุประสงค์ของการวิจัยเพื่อปรับปรุงการจัดการสารเคมีให้เหมาะสมกับโรงพิมพ์และลดความเสี่ยงต่อสุขภาพที่อาจเกิดขึ้นกับพนักงานที่ต้องทำงานสัมผัสกับสารเคมี โดยทำการศึกษาในโรงพิมพ์ระบบออฟเซต ขนาดเล็กในเขตพื้นที่กรุงเทพมหานครจำนวน 2 โรงพิมพ์ โดยสร้างแบบประเมินการจัดเก็บสารเคมีโดยใช้คู่มือการเก็บรักษาสารเคมีและวัตถุอันตราย พ.ศ. 2550 เป็นแนวทางและสร้างแบบประเมินความเสี่ยงในขั้นตอนการทำงานกับสารเคมีมาประเมินความเสี่ยงที่เกิดขึ้นในขั้นตอนการทำงานกับสารเคมี โดยใช้แนวคิดของมอก.18004 โดยประเมินก่อนที่จะเสนอแนะแนวทางการปรับปรุงให้กับโรงพิมพ์และหลังการปรับปรุงการจัดการสารเคมี

ผลการศึกษาพบว่าการปรับปรุงการจัดเก็บสารเคมีทำให้ระดับการเป็นไปตามกฎหมายในการจัดเก็บสารเคมีของโรงพิมพ์เอและบีเพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติ ($p < 0.05$) และการปรับปรุงขั้นตอนการทำงานกับสารเคมีทำให้ระดับความเสี่ยงที่จำเป็นต้องได้รับการแก้ไข (ความเสี่ยงที่ยอมรับไม่ได้, ความเสี่ยงสูง, ความเสี่ยงปานกลาง) ที่พบในขั้นตอนการทำงานกับสารเคมีของโรงพิมพ์บีลดลงอย่างมีนัยสำคัญทางสถิติ ($p < 0.05$) ผลการศึกษาสามารถนำไปใช้เป็นแนวทางการปรับปรุงการจัดการสารเคมีที่เหมาะสมสำหรับโรงพิมพ์ขนาดเล็ก

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CHAPTER I
INTRODUCTION

1.1 Research rationale

Nowadays, the development of the industry is fast growing. Each organization wanted to be a leading of the business. Therefore, the demand for raw materials will increase. And of course, waste which is the outcome of the production will increase. If the industry's owner lack of efficient management, it will affect to the worker and people who expose to the contaminants and also adversely affect the country in terms of manpower.

Printing industry is one of several industries that are fast growing. In the year 2544 B.E., 2463 printing factories were register in Thailand. The majority was small and medium-sized printing factories and trends of registration increased every year. In the year 2551 B.E., the statistic showed export publication valued U.S 2,777.09 million which increased from the year 2550 B.E. to 43.27 percent and accounted for 1.89 percent of the total export value[1]. From these data, it showed that printing industry was growing.

If the printing industry is fast growing, the requirement for raw material will increase too. Important raw material of the production was volatile organic compound (VOCs), for example benzene, toluene, ethylbenzene, xylene which are a vital ingredient of chemicals that used as raw material in various printing process. These chemicals are released from the ink used in printing process[2]. Also these chemicals are usually used as a solvent in printing process which is important step in the printing production. Vapors of these substances affect to people who expose to them and affect to the environment.

When VOCs entered into the body, they will cause different symptoms depended on the type and amount received into the body, such as benzene, it is toxic to the body system and cause eye irritation, skin irritation upon skin contact, damage

liver and also affect to the nervous system. They are caused of many nervous system symptoms such as dizziness, headache and confused etc[3].

Benzene can also destroy the bone marrow, brake red blood cells, caused anemia and benzene will reduce the ability of the repair of genetic disorder[4].

According to the report of the incidence of toxic substances as organic solvent from the year 2540 B.E. to December 2549 B.E. showed that the incidence in November 2542 B.E. was highest and began to decrease until the year 2546 B.E. and the incident began increase again[5]. All parties involved must recognize and try to control.

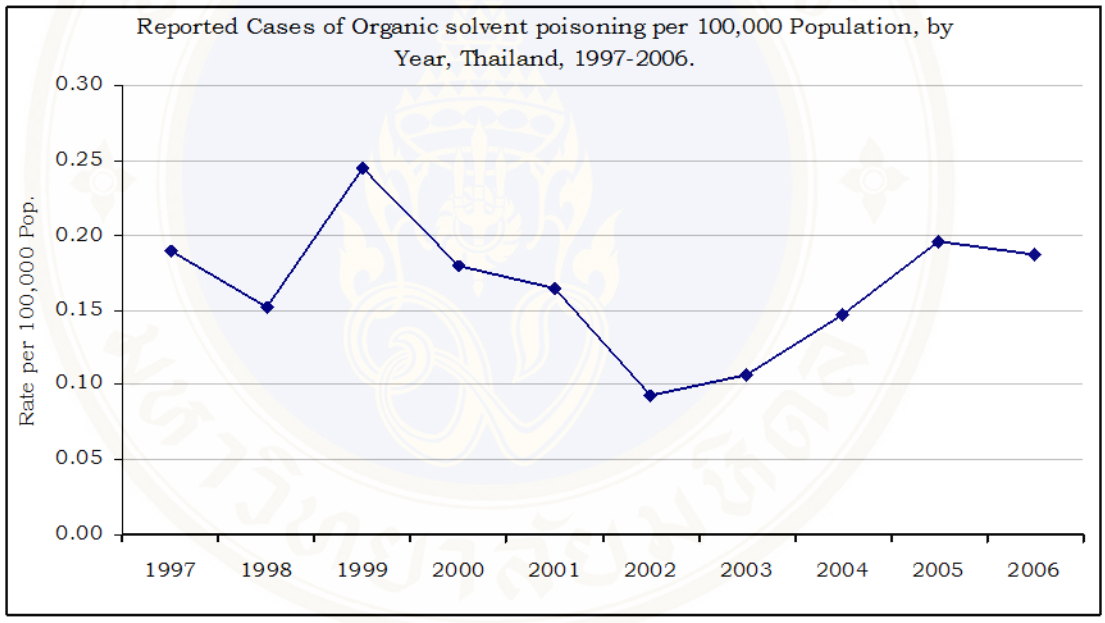

Figure 1.1 Reported Cases of Organic solvent poisoning per 100,000 Population, by year, Thailand, 1977 – 2006

In the year 2549 B.E., the report of the disease which occurred from VOCs showed that the numbers of patients caused by the toxic effect of benzene were 113 cases. The rate was 0.24 cases per one hundred thousand people and this rate was listed as number 11th of all 60 diseases caused by the disease have been reported. The numbers of patients that cause from nitroderivatives and aminoderivatives of benzene and its homologues were 17 patients. The rate was 0.24 cases per one hundred thousand people.

In the year 2550 B.E., there were 132 patients that affected by the poisoning of benzene. The rate was 0.28 cases per one hundred thousand people. 15 patients were affected from toxic effect of homologues of benzene. The rate was 0.03 cases per one hundred thousand people. So, the rate of the year 2550 B.E. was more than the rate of the year 2549 B.E[6].

For the environment impact, VOCs which are released into the air can cause photochemical oxidant when they on the reaction of nitrogen dioxide gas in the sunshine state[7]. This photochemical oxidant was harmful to plants.

From the negative effects of VOCs to human and the environment, the owner must realize the importance of control and management regarding to use and disposal these VOCs since transport, storage, using and waste discarding. The solution has been necessary to manage and control effectively. Currently there are no legal and practical guidance for small establishments. However, there are some laws and guidelines for the medium and large establishments such as the notification of the Department of Industrial Works; Manual for the storage of chemicals and hazardous materials, 2550 B.E[8]. Therefore, the researcher chose to apply this law to control and manage the use of chemicals in small-sized printing factories to protect the worker from exposure to the chemicals and safe for the environment.

1.2 Objectives

1.2.1 To improve the management of chemicals to suit for the printing factory.

1.2.2 To reduce the health risks that may arise with workers who expose to chemicals during working.

1.3 Conceptual framework

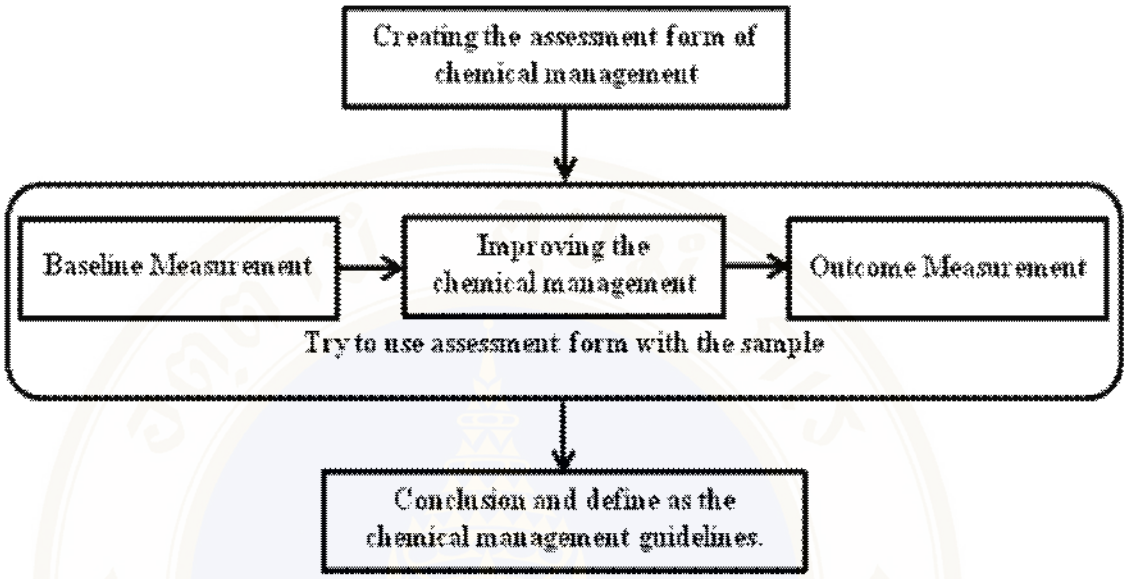

Figure 1.2 The research framework

1.4 Hypothesis

1.4.1 Chemicals storage will be more compliance with the regulation after improve the chemical management.

1.4.2 Health risk level that is found in work process will be decrease after improve the chemical management.

1.5 Scope of research

This research was conducted in a small-sized offset printing factory, where located in Bangkok. This research study about chemical management of printing factory for example the storing chemical storage of printing factory and the evaluation of health risk arising from the chemical management of printing factory since receiving chemicals from the supplier, moving to store, storage of chemicals, transfer of chemicals, using and disposal of waste from the production of printing.

1.6 Expected outcome of this study

1.6.1 The printing factory's owner will have the safety guideline for chemicals management and suitable of their printing factory.

1.6.2 The printing factory's owner will have a guideline in the provision of prevention measure of their employees in the printing factory.

1.6.3 Improvement of chemical management induce the awareness of the printing factory's owner about toxicity of VOCs that effect to employees in the printing factory.

1.6.4 Improvement of chemical management induce the awareness of the printing factory's owner about the importance and the necessity to control VOCs that employees must exposed in the workplace.

1.7 Term and Definitions

1.7.1 Printing factory : Offset printing factory.

1.7.2 Small-sized printing factory : The printing factory that has workers less than 50 workers.

1.7.3 Chemical management checklist : Checklist that compose of chemicals storage checklist and work process with chemicals checklist.

1.7.4 Chemicals storage checklist : Checklist that use to verify the storage of chemicals in printing factory that practices according to the notification of the Department of Industrial Works; Manual for the storage of chemicals and hazardous materials, 2550 B.E[8].

1.7.5 Work process with chemicals checklist : Checklist that use to search for dangerous and risk in the work process of printing factory.

1.7.6 Hazard identification : The procedure that use to finding exist dangerous in work process and identification those hazard by using Chemicals storage checklist.

1.7.7 Risk assessment : The process to analyze the factor or circumstances that are causing harm to the health of employees.

1.7.8 Risk : The result of probability of dangerous and harmful effects on the health of employees.

1.7.9 Health risk : The result of chance or probability of harm and dangerous which affect the health of employees. The health risk is divided into five level such as low risk, acceptable risk (which do not require control or revision), medium risk, high risk and unacceptable risk (which require control measures or need to rectify.

1.7.10 Low risk level : The risk level that does not require any action.

1.7.11 Acceptable risk level : The risk level which is acceptable without any additional measure. Considering about the risk that may be made while the entrepreneur think it worthwhile to do or adjust the chemical management while the adaptation must not pay for expenses to increase.

1.7.12 Moderate risk level : The risk level must attempt to reduce the risk and require active effort to reduce risk. The entrepreneur must carefully consider the cost of prevention and control measures and must determine limit of the budget. Proceeding of risk reduction measure must be made within the prescribed time.

1.7.13 High risk level : The risk level that must implement to reduce the risk. If those risks that are associated with work, it will be solved urgently.

1.7.14 Unacceptable risk level : Risk level that must be discontinued or stopped working and must manage measure to mitigate the risk immediately and will not begin working until the risk is reduced.

1.7.15 Improvement of chemical management : The adjustment of chemicals management of printing factory which are composed of improvement of chemicals storage and improvement of work process.

1.7.16 Improvement of chemicals storage : Adjustment method of chemicals storage to according to the notification of the Department of Industrial Works; Manual for the storage of chemicals and hazardous materials, 2550 B.E.[8] and use this manual as a guideline.

1.7.17 Improvement of work process : Improve work process to be a safety work process by improving the work step, improving tools or equipment that will allow employees to work safety etc.

1.7.18 Work procedure : The document that describes the process and procedures for the operation in a particular subject to ensure safe operation.

CHAPTER II
LITERATURE REVIEW

2.1 Printing

2.1.1 Definition of printing

Printing is the practice of impressing letters, characters, numbers, diagrams or pictures on paper or other material by any means[9].

Printing is the duplication of model into a lot of the same material (image or text) on the flat surface material or similar to the flat surface by using mechanical tools[10].

2.1.2 Printing system

Nowadays, printing is divided into several categories. The printing system can divided into three current main systems as follows[11].

1) Conventional printing system

Printing using this system utilizes a mould and the very important element of pressure. Printing using this system includes the following:

1.1) Relief printing. This printing system uses a plate system that swell upwards. This system has two popular types. Letterpress and Flexography.

1.1.1) Letterpress was the first used in Thailand. This printing system separates each plate to cast. Then brings them back in order to get each word until the printed page is complete.

1.1.2) Flexography was developed from Letterpress and is rubber stamp printing. The plate is made from a rubber or polymer which will roll around plate mould. It is light in weight and this printing system can print a large amount without changing the plate.

1.2) Planographic Printing. This printing system uses a plate that resembles a flat surface. The visual image is not in the same plane. The type of this printing system has two types called Lithography Printing and Offset Printing.

1.2.1) Lithography Printing was the original type of planographic printing. The plate is made from stone and is very heavy. This process requires several steps to produce the plate. This system can print only one copy at a time.

1.2.2) Offset Printing is indirect printing. The plate for this printing system is flat. The picture or text is transmitted from the plate through the blanket which is used as an intermediary on the materials. Text and images that appear on the plate can be read as normal. But text and images on the intermediary will read left to the right.

1.3) Intaglio Printing. With this printing system the text and images are deep down from the surface of plate such as Gravure Printing.

2) Serigraphic Printing or screen printing.

The plate for this printing system is perforated or closed .The part that is not a picture. Ink will only pass through the perforated areas.

3) Non-impact Printing system.

This printing system does not need to use a plate or pressure. Examples of digital printing are, Inkjet Printing, Toner Printing, and Laser Printing etc.

2.1.3 Types of Offset Printers

Offset printers can be divided into two types according to how they feed papers into the printer and the structure of the printing unit as following[12].

1) Sheet-fed offset press.

This type of printer requires each sheet of paper to be fed into the printer. The user can use the printer to follow the objectives of the work such as color (print between one and five colors), sizes of paper are: small–sized as 8.5 inch multiplies by 13.5 inch and large-sized as 31 inch multiplies by 43 inch.

2) Web-fed offset press.

This type of printer has special equipment such as an automatic paper feed unit. So the printer can print at high speed and can print large quantities in a limited time. This type of printer is designed to print one or two pages at time.

2.1.4 Sizes of offset printer

Offset printers have the following sizes[13].

1) Small-sized offset printer

This kind of printer has a simple system, is easy to use and suitable for printing small-sized materials not exceeding 13 x 17 inches such as envelops etc.

2) Cut-four sized offset printer

This kind of printer has a more complex system than the small-sized printer. It can be used to print almost any type of job and can print 1 to 4 colors. This kind of printer is suitable for general printing jobs of less than 5,000 sets such as books, or general printing jobs of about 15 x 21 inches or 18 x 25 inches in size.

3) Cut-two sizes offset printer

This kind of offset printer uses a high precision and high speed system. This printer can print jobs which are larger than the cut-four sized therefore saving time printing. This kid of printer is suitable for printing material that is use in general business such as signboards and all kinds of print jobs. It can print materials sizes around 25 x 36 inches. Most printing factories prefer to use this size of printer.

4) Cut-one sized offset printer

This kind of printer has a complex system rather than other kind. It is often used to print books and posters in large quantities. It can print sizes around 30 x 40 inches.

2.1.5 Principle of offset printing

The principle of offset printing is that water and oil will never mix on a sheet of plate, which will have two parts. The area that does not have image will receive water and the area that has the image will receive chemicals as inks.

2.1.6 The functions of both sides of the plate

1) The area that does not have the image and receives water will dismiss the ink out of the area.

2) The areas that have images will receive ink and dismiss water out of the area.

2.1.7 Principle of relaying picture of the offset printer

The offset printer is a basic general printer that has a three cylinder system. The details are as follows[14].

1) Plate cylinder. The Plate cylinder looks like a metal cylinder that supports a metal plate. The position of this cylinder is specifically located to maintain contact with the water and the ink roller. During printing, this plate will encircle the plate cylinder and relay the picture from the plate to the blanket cylinder.

2) Blanket cylinder. The Blanket cylinder looks like a metal cylinder that supports a blanket sheet. This cylinder is located to contact between the plate cylinder and the printed materials. This cylinder receives ink, the image will be reversed then relayed to the printed materials.

3) Impression cylinder. The Impression cylinder looks like a metal cylinder. This cylinder presses printed materials which intervene between this cylinder and blanket cylinder and contacts the blanket cylinder.

When printing starts the plate will be receive water before it receives ink. After it receives ink the plate will relay the picture to the blanket cylinder then the blanket cylinder will relay the picture to the printing material by supporting this cylinder. It is an indirect printing system.

2.1.8 Work process of the offset printing system

Work Steps of offset printing system resemble other printing systems. This study will discuss the steps of the small-sized offset printing factory. With other sized printing factories the process is different and uses different chemicals. The steps of this printing system can be divides to four main steps as follows.

1) The process of color scanning

2) The process of creating plate.

3) Printing process.

4) Cleaning process.

The details of each step are as follows.

1) The process of color scanning

This step will start with color separation of the original. It will create a visual screen on different color films such as black, magenta, yellow or cyan. When the four color films overlap each other the image has the same colors as the original. Color separation uses a scanner, a separation color program, a proof printer and an image setter.

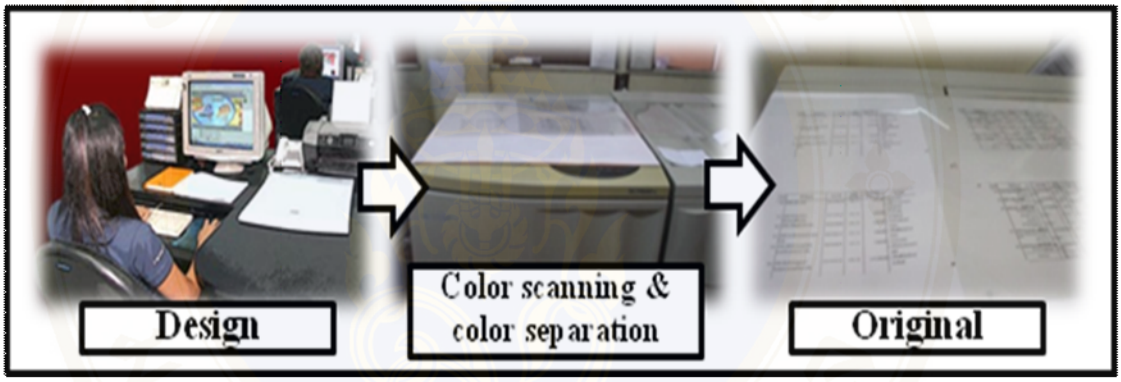

Figure 2.1 The process of color scanning

2) The process of plate-making.

The offset printing system creates a plate like the original. This plate has four colors and can be divided into two styles as follows.

2.1) Albumin plate. This type of plate is often made from metal material.

2.2) Plastic plate. This type of plate is often made from plastic material.

After getting the original design the pattern is copied on aluminum sheet with UV light for five minutes. The aluminum plate must then be cleaned with a plate cleaner solution which has an important ingredient called Liquid Polyethylene. After the plate is cleaned its surface is coated with Glue called Gum Arabic which is a yellow color, sticky and odorless and protects the surface of plate.

This glue acts like a film when coated onto the surface of the plate and prevent figures on plate from scratching and deterioration and to extend the use of plate.

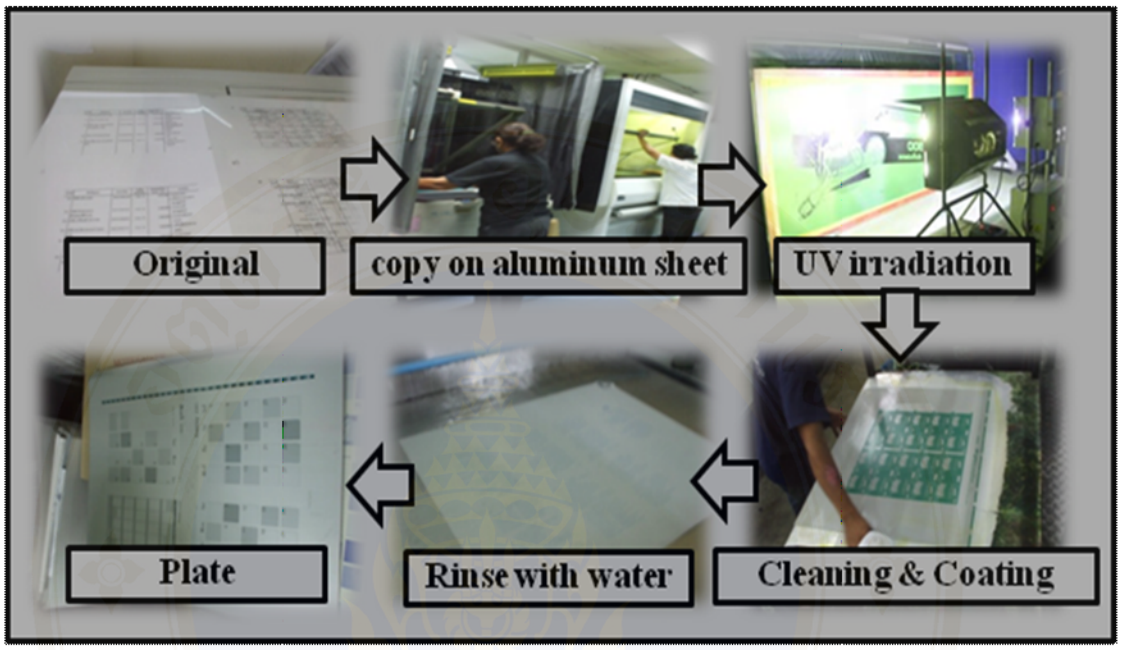

Figure 2.2 The process of plate-making

3) Printing process.

This step is a function of the printer. First step is to insert the plate into the printer. The water cylinder will serve water to non-printing areas. A coating of oil is put on the surface of the printing areas. When the plate reaches the ink cylinder, ink will flow into the plate. This ink will stick on the area which is coated with oil but will not stick on any other area. Fountain solution is used in this step to lubricate which helps the ink to thoroughly touch with the plate before the plate touches the blanket. It also prevents the ink from drying at this stage. Paper will be entered into printer between the blanket and the impression cylinder. The blanket will copy the pattern from the plate to the paper which exits as printed matter.

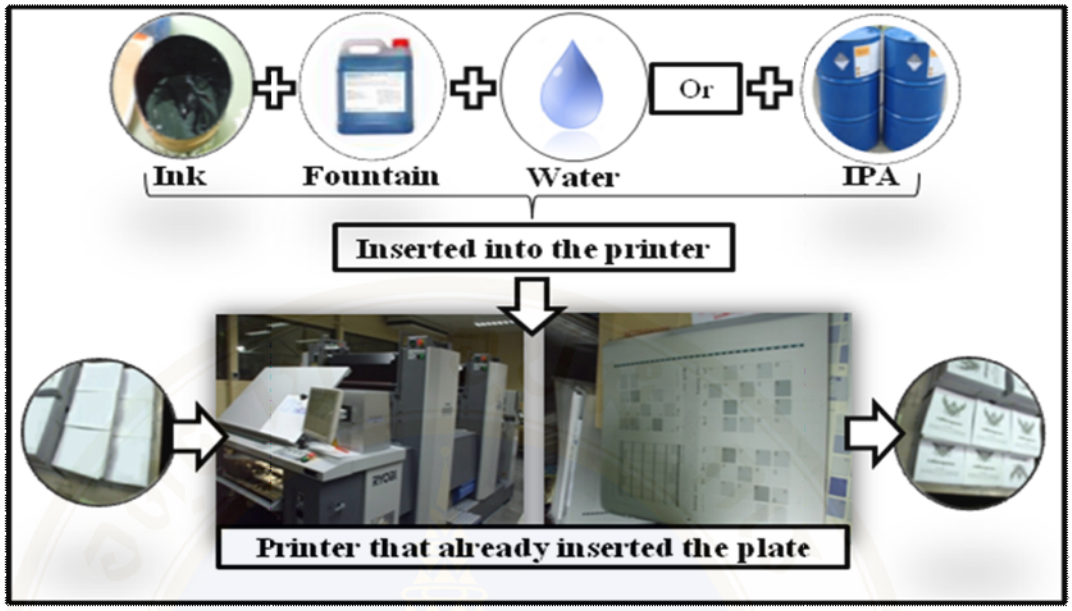

Figure 2.3 Printing process

4) Cleaning process.

This process is the last step to finish processing. The worker uses a cloth or a washcloth dipped in a solution that contains volatile organic compounds. Lastly the worker must clean the plate to eradicate ink that is stuck on the plate.

4.1) Cleaning of the plate. This is done by simply using a sponge or washcloth dipped into the solution and wiped over the surface of the plate.

Figure 2.4 Cleaning of the plate

4.2) Cleaning of the blanket. The blanket will copy the pattern from the plate to the paper therefore the excess ink sticks on the blanket therefore it must be cleaned before each print job.

Figure 2.5 Cleaning of the blanket

4.3) Cleaning of the Plate cylinder, Blanket cylinder and Impression cylinder. These are wiped clean using a washcloth dipped in kerosene after the completion of each printed job.

4.4) Cleaning of the ink roller and water roller. The function of the Ink cylinder is to receive ink and thoroughly spread ink to the plate cylinder. Therefore, before starting a new print job, it must be cleaned to eradicate the residual ink and remove any dirt.

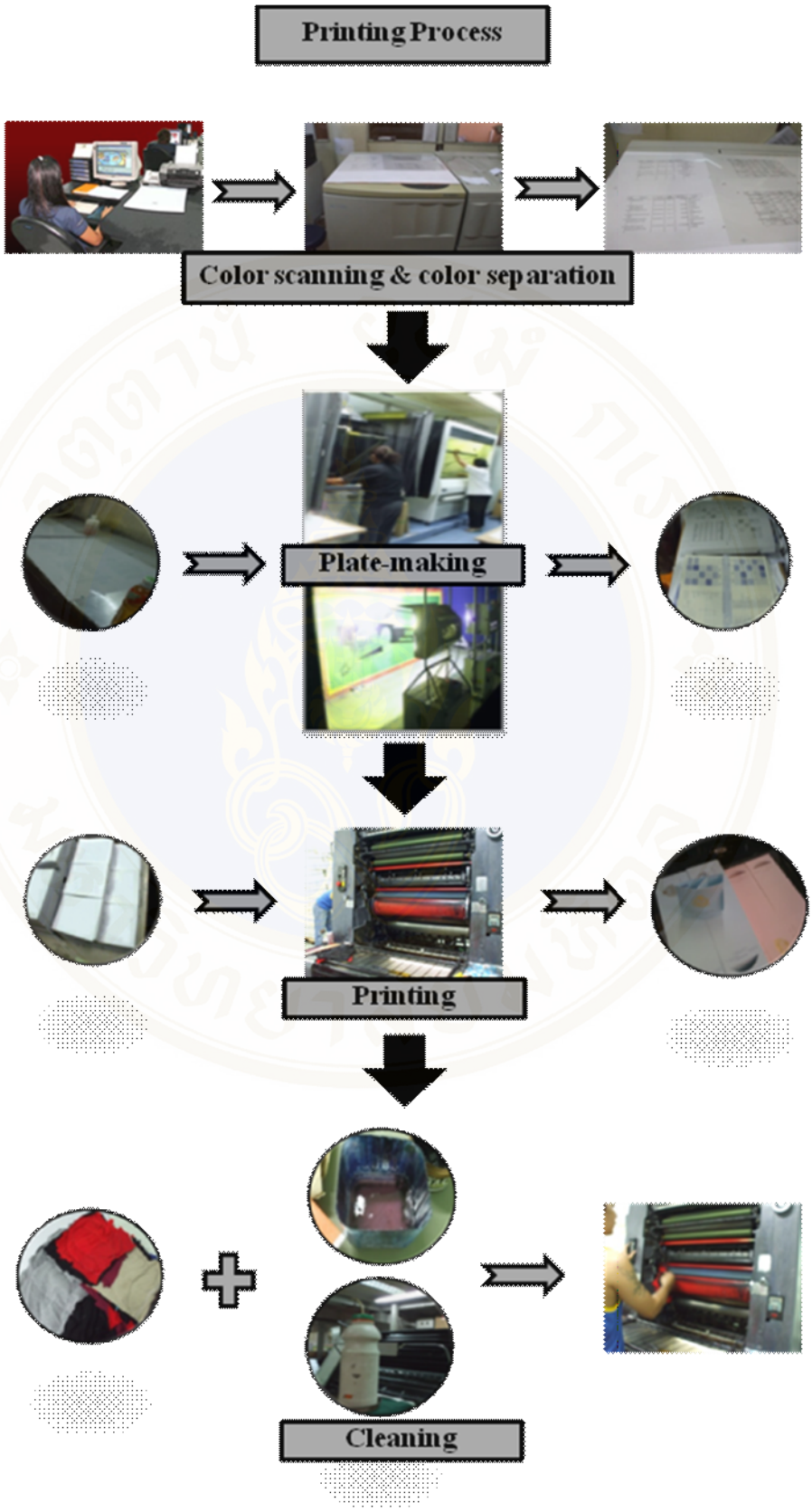

Figure 2.6 Process of offset printing

2.2 Chemicals used in work procedure of offset printing system

Each step of the work process already mentioned in Section 2.1.8 use difference chemicals which are depend on the objectives of each step. Chemicals are used in each step are as follows.

2.2.1 Chemicals used in plate-making process

Chemicals are used in this process are plate cleaner solution, Gum Arabica.

1) Plate cleaner solution. Plate cleaner solution is used to clean the plate to eradicate the dirt off the surface of the plate. The ingredients of plate cleaner solution are sulphuric acid solution, sodium carbonate, glycerine pure, white oil, emontional dioxide, calcium bicarbonate, stearic acid, and distilled water.

Figure 2.7 Plate cleaner solution

2) The Arabica gum. The Arabica gum is used to coat the surface of the plate to protect the surface from starch, humidity and other chemicals and help to extend the useful life of the plate.

Figure 2.8 Glue or Gum Arabica

2.2.2 Chemicals used in the printing process

The chemicals used in this process are as follows.

1) Ink. Ink is the heart of work production that has various types depending on the printing system.

However in offset printing system, ink is divided into two categories which are conventional ink and UV ink. Conventional ink is specifically designed to dry by oxidation and it can be divided into two categories based on raw materials for example the production of petroleum-based, this type is popular and production of soybean-based is much less toxic than petroleum-based ink and emits fewer VOCs. UV ink is specifically designed to dry by UV radioactivity[15].

Figure 2.9 Offset Ink

All type of ink has three similar main components but the proportions and other details vary depending on whether the ink is produced by any factor. The main components of the ink are colorant, vehicle and additives[14]. The details are as follows.

1.1) Colorant is a substance that gives the ink its color. It is a pigment which is made from two types of chemicals, organic pigment and inorganic pigment. Organic pigment gives the ink its bright color. Ink that is made from organic pigment does not erode the printing press but it is not so durable. The color will fade fast when subjected to sunlight. Inorganic pigment is much more durable and long-lasting.

1.2) The next component, "vehicle" is classified as a combination of adhesives and solvents or oil. The vehicle will take the ink to the printed materials. The vehicle affects the drying, flowing state and viscosity of the ink.

There are several types of vehicle, for example non-drying oil, drying oil, solvent resin, glycol, diluents, water-soluble gum and water.

1.3) Solvent resin is used in the ink that dries by evaporation such as offset ink which has the ingredients of the other solvents and adhesive. It controls the suitable evaporation rate of ink. There are several types of solvent such as hydrocarbon, ketone, ester and alcohol.

1.4) Additives are added to the ink to give it better properties and to adjust the ink to have better properties when applied to print on printed materials. Commonly used additives are dryer, anti-oxidant, surfactant, defoamer, photoinitiator and whitening agent. The details are as follows.

1.4.1) Dryer will prevent the sheets of paper sticking together and protect from scratching. The substance used for the dryer is wax.

1.4.2) Anti-oxidant will be used to mix with the ink to prevent the ink drying too quickly.

1.4.3) Surfactant is the substance that increases the wetting properties of the ink and increases the distribution of the color powder.

1.4.4) Defoamer is a substance which used to eliminate bubbles that occur during the process of ink production and printing process.

1.4.5) The photoinitiator function to stimulate molecular interactions until the ink has dried on the printed materials.

2) Whitening agent. Whitening agent is used to increase the brightness of the white color area on a printed job.

3) Fountain solution.

The principle of offset printing system is that water and oil do not mix together therefore, moisture is important. Fountain solution is an important substrate and provides the moisture to the printing system. That provides moisture to the area without picture thoroughly to prevent direct contact from ink on a non-printing area. Fountain solution can reduce the temperature, and also removed the dirt from the plate. Important components of Fountain solution are gum, acid, buffer, substrate which reduces surface tension of water and additives[16]. The details are as follows.

3.1) Gum act as a thin coating on the area of the plat without a picture to prevent the ink reaching that area that and helps to protect the surface of the plate from heat and dust.

3.2) Acid ensures that the area that without the picture can receive water and reduces the pH of that water.

3.3) Buffer will control pH conditions of the fountain solution within a constant range to ensure that the gum is extremely activate.

3.4) Substrate reduces the surface tension of the water is used to reduce the surface tension of water.

3.5) Other additives in the fountain solution have additional features, such as corrosion inhibitor, film former, sequestrant, biocide.

Figure 2.10 Fountain solution

From a study about the gradient of fountain solution, , it was found that Fountain solution contain several type of harmful chemicals such as xylene sulfonate, cumene sulfonate, acetate, malate, succinate, glutarate, adipate, citrate, glycolate, chloride, nitrate, sulfate, orthophosphate and tripolyphosphate[17].

4) Isopropyl alcohol: IPA.

IPA is a clear liquid, colorless and smells like alcohol. IPA has a high flammable. IPA is usually mixed with fountain solution because IPA can reduce surface intension of water and increase viscosity and flow of the liquid film on the ink cylinder and plate quickly. IPA can evaporate quickly therefore it can increase speed

of printing and reduce the heat in the printer at the same time and also reduces the electrical conductivity and reduces occurrence of bubbles in the fountain solution[18].

Figure 2.11 Isopropyl alcohol

2.2.3 Chemicals used in the cleaning process

The cleaning process is classified to four steps and chemicals that are used in each step are different. Chemicals that are used in cleaning process are as follows.

1) Plate cleaner solution. When cleaning the plates one usually uses plate cleaner solution to eradicate the dirt and surplus ink out of the plate. The components of plate cleaner solution are suphuric acid solution, sodium cabonate, gecerine pure, white oil, emontional dioxide, calcium bicabonate, stearic acid, distilate water.

2) Benzene or white gasoline. Small-sized printing factories usually use benzene or white gasoline which do not smell and have a higher purity than benzene. These contain paraffin, aromatic, olefins.

Figure 2.12 White gasoline and benzene

3) Kerosene. Kerosene use for cleaning the cylinder. Kerosene is clear liquid, no color and consists of paraffin, cycloparaffin, aromatic and naphthalene phenol[19].

Figure 2.13 Kerosene

4) Thinner. To clean the rollers one usually uses thinner to remove the stain out of the rollers. Thinner consists of methyl isobutyl, ketone, xylene, ethyl benzene, alkyl benzene[20].

Figure 2.14 Thinner

2.3 Volatile Organic Compounds : VOCs

2.3.1 Meanings of Volatile Organic Compounds : VOCs

Volatile Organic Compounds : VOCs refers to chemicals compounds that contain carbon and vapor pressure more than 2 mmHg. (0.27 kPa) at 25°C but do not include Methane, Carbon monoxide, Carbon dioxide, Carbonic acid, Metal carbide and Sodium carbonate[21].

Volatile Organic Compounds : VOCs refers to the organic compounds which are any carbon except carbon monoxide (CO), carbon dioxide (CO_2), carbonic acid, metallic carbides or carbonates and ammonium carbonate which is involved in the occurrence of photochemicals in the air[22].

Volatile Organic Compounds, VOCs are a group of organic compounds that can be volatile and spread into the atmosphere., VOCs can evaporate at room temperature. VOCs usually consist of atoms of oxygen and chlorine together.

2.3.2 Types of Volatile Organic Compounds : VOCs

VOCs are usually divided into two groups depending on their molecular characteristics. The details of each type are as follows[23].

1) Group of Non-chlorinated Volatile Organic Compounds or Non-halogenated hydrocarbons.

This VOCs group does not have chlorine molecules. Non-halogenated hydrocarbons has two groups. One group has elements of Aromatic Hydrocarbons and the other group has elements of Aliphatic Hydrocarbons. Aromatic Hydrocarbons group is made up of, toluene, benzene, ethyl benzene, xylene, styrene. Aliphatic Hydrocarbons group consists of gasoline and hexane etc.

2) Group of Chlorinated Volatile Organic Compounds or Halogenated Hydrocarbons.

This VOCs group has chlorine molecules. This VOCs group has a structure that bonds carbon and halogen elements. It is durable and more stable than the first group with a higher toxicity than the first group.

Volatile organic compounds affect human health because VOCs can evaporate at room temperature and easily enter into human through inhalation. When

VOCs enter into the body, they are metabolized by the liver. The mechanisms for the metabolism will differ depending on the type of chemicals. Then it is excreted in urine. Whilst the VOCs are in the body, they can have various effects depending on the type of chemicals inhaled.

2.3.3 Physical characteristics

The physical characteristics of the VOCs are similar. They are in liquid form at room temperature, looks clear and have a distinctive smell. They are high inflammable chemicals. They dissolve quickly as do other liquids such as alcohol, chloroform, ether, acetone, carbon sulfide and acetic acid.

2.3.4 The way that VOCs enter the body

The ways that VOCs can enter the body are similar as other substances. VOCs can enter into the body by inhalation which is the most common way. Next most common method is through the skin and by ingestion. After each aromatic hydrocarbon compounds enter into the body, it will spread rapidly to the organs, particularly the organs that have a component of fat and high blood circulation for example, the brain, liver, kidney, bone marrow, heart, and muscles. After that these chemicals will be change structure because of enzymes the liver produces such as Cytocrome P-450 dependent monooxygenase. They are finally eliminated through the kidney and excreted as urine.

2.3.5 Hazardous to human health

Exposure to VOCs can affect human health. The effects that occur are divided into two levels such as the immediate effects after exposure and the long term effects after expose to VOCs for an extended time. Health effects resulting from exposure to VOCs are as follows.

1) Acute toxicity

If a worker makes contact with liquid form of these chemicals, it will irritate to the skin very much. The skin will be red. Later the skin will become dry with blisters sore and cause dermatitis.

If these chemicals are splashed in the eyes, they will cause eye pain, tear, inflammation and possible loss of sight.

If these chemicals enter into the body from contaminated water and food, they will cause abdominal pain due to gastric erosion, dizziness, nausea, vomiting, seizure, cardiac arrest and may die.

If worker inhales the vapors of these chemicals they can cause irritation of the respiratory tract and will cause harm to the central nervous system. If received in higher levels of concentration they will cause drowsiness, hallucinations, fast heartbeat, headache, dizziness, confusion and unconscious mind. If received at very high levels of concentration the chemicals will cause seizures, loss of conscious, respiratory failure or atrial fibrillation[24].

2) Chronic toxicity

If worker exposed to VOCs by inhalation for a long time, it will cause dizziness headache, dizzy, nausea, vomiting, fatigue, appetite etc. If exposed to high concentration of ethyl benzene for a long time, it will cause pulmonary edema and pulmonary hemorrhage etc[25].

If exposed to VOCs by dermal contact for a long time, fat of skin will be destroyed. Skin will dry, red, scaly, bulla and fissured dermatitis.

If VOCs enter into the digestive tract for a long time from eating contaminated food and water, they can cause irritation to the gastrointestinal tract.

If employees are continually exposed to VOCs for a long time, they will affect the functioning of major organ as follows.

2.1) Effect to the nervous system.

Long-term exposure to these chemicals can affect the functioning of the nervous system. This will cause changes in perception such as intelligence deterioration, learning ability decreased, attention deficit, memory impairment, mental deterioration and balance disorders. There will be malfunction of the nerves such as reduction of the ability to recognize smells, optic nerve degeneration and deafness etc. This will cause changes in behavior or personality such as moodiness, reduction in the ability to respond to stimulation, apprehensiveness and psychiatric changes etc. It also affects the peripheral nervous system such as pararesthesia and muscle weakness etc.

2.2) Effect to the respiratory system.

If workers are exposed to VOCs by inhalation for a long time, it will cause irritation to the respiratory membrane, bronchitis, pleural effusion, pulmonary hemorrhage and may be cause respiratory failure.

2.3) Effect to blood system.

VOCs group such as benzene and xylene can reduce the performance of bone marrow. It can cause myelogenous leukemia and acute myeloblastic leukemia (AML). And benzene also has been classified as suspected carcinogen class I : IARC.

2.4) Effect to liver and kidney.

Liver is the important organ that changes VOCs to their derivatives and kidney function to excrete these out of body. When exposed to VOCs for a long time liver and kidney disorders such as hepatomegaly, kidney malfunction, kidney disease may occur.

2.5) Effects on the reproductive system.

If workers are exposed to VOCs for a long time, it may lead to infertility, fetal death, congenital abnormalities, malformations of reproductive structures and altered growth.

2.4 Risk

2.4.1 Meanings of risk

Risk is probability of occurrence of a dangerous event which causes a harmful effect to people or the environment. That is a result from exposure to chemicals or mixtures[26].

Risk means the likelihood that someone or something which is valuable being directly affected from the hazard[27].

Risk refers to the results of probability and the impact of harmful and dangerous substances to the health of employees.

In conclusion, risk means the combination of possible occurrences and undesirable events and the consequences that result from that undesirable event.

2.4.2 Meanings of risk assessment

Risk assessment is a process that includes hazard identification, impact assessment, evaluation of the exposure and risk characterization[28].

Risk assessment refers to the process analysis of the factors or circumstances that affects the health of employees. The risk assessment must analyze the frequency or likelihood of harm and violence of the hazard that occurs. This may affect individuals and the environment.

2.4.3 Risk assessment process

This research will explain risk assessment method which follows the method of Thai industrial standard in title of Occupational health and safety management system: General guidelines on principles, system and supporting techniques (TIS. 18004)[29]. So this section will discuss the risk assessment methods of TIS. 18004. The risk assessment processes consists of the following three steps.

1) Hazard identification.
2) Risk characterization.
3) Estimation of risk level.

The details of each step are as following.

1) Hazard identification

Hazard identification is an enumeration of hazards, events that are in stages of operation, tools, equipment that could cause injury or illness[30]. Techniques for hazard identification have many level of difficulty and have different objectives. Techniques for hazard identification are Checklist, What-If Analysis, Hazard and Operability : HAZOP, Fault-Tree Analysis : FTA, Failure Modes and effects Analysis : FMEA and Event-Tree Analysis : ETA.

In this study the researcher selects to use checklist to identify the hazard. So this section will discuss the details of checklist technique. The details of checklist are as following.

1.1) General characteristics of checklist

Checklist is a technique for hazard identification which easy to use and can apply to all types of hazard, materials, machinery and equipment. Thus

this technique has been used widely. Checklist is making the lists of things which the user wants to check as a list of questions, then save the result into the checklist.

Checklist Analysis is one technique for hazard identification. Checklist can be applied to all matters regarding work procedures. This will ensure that equipment is effective and the employees work following the correct work procedures. Checklist analysis can also be applied to survey documents, check the premises and can be applied during all stages of production. The checklist can help the user to improve systems and test the performance of equipment. The user can easily identify concealed hazards using checklist analysis. Therefore it is popular to use as the main way for hazard identification and as a supplement technique after using other methods. To create an effective checklist the user must gather knowledge, relevant information which requires experience of the equipment and system. Resolution within the checklist will be correlated with the details and complexity of what to check. Create a checklist must be determine the purpose and restrictions of the checklist. Once the checklist has been created that checklist should be considered independently by others who are expert in that field. Once implemented, most checklist will be used by employees who do not have much prior experience so the employees must be adequately trained[31].

1.2) Process of making a checklist

The processes of making checklist are as follows.

1.2.1) Clearly define the scope of the checking by selecting the process, step operation, equipment, materials which the user wants to check Determination of raw materials, chemicals, materials, machinery, equipment and operating procedures to be used as the data for making the comprehensive checklist.

1.2.2) Summary of important data such as safety data of each chemical or raw material in order to define a list of questions.

1.2.3) Summary of important data of tools, machinery or equipment which is used in the process or procedure to know about the dangers that may arise from these things.

1.2.4) Collection laws or regulations with relevant information that relate to the process, equipment, chemicals inspections and to follow the current industry regulations.

1.2.5) Lead the relevant information such as law, standard, regulation, work instruction to determine the questions about the checks. Those questions are must be easy to understand to use effectively.

1.2.6) Check the accuracy of the checklist by letting experts review them. The expert will be skilled about the subject to review.

1.2.7) To improve the checklist follows the advice from the expert. After editing the checklist, test the checklist by bringing the checklist to a real workplace to find any bugs or further data that may be needed. Update the checklist as necessary.

1.3) Leading the checklist to identify the hazard

Bring the checklist which has been validated by an expert to inspect the work. Examine each question in the checklist, then save the audit results into the checklist. The criteria for the review are as follows.

If the result of checking is accurate and in compliance with the question of the checklist, make a check mark in the box “Yes”.

If the result of checking is not correct and not in compliance with the question of the checklist, make a check mark in the box “No”. If something is lacking or for any other reason, the inspector will add “notes in the relevant box.

If it is found that the question does not apply make a check mark in the box “N/A”. If there is any reason, the inspector will complete the note in the relevant box in the box.

After the checking is complete, identify the hazards by listing the items that are not in compliance with any question or that have been ticked, “No” to identify the hazard.

1.4) Supporting documentation in making a checklist.

Making a checklist that is appropriate and covers the topic to be checked. Most checklists need to use multiple data for background information and guidelines. But choosing supporting documentation depends on the objective of the checklist. The required information needed to make the checklist is as follows[32].

1.4.1) Legal, rules, regulations or standards of other agencies which relate to the matter that is to be checked.

1.4.2) Process chemistry description such as information about the chemicals which are used in the production of raw materials, products, outcome and problems or dangers which may arise.

1.4.3) Material safety data sheet of chemicals.

1.4.4) Operating procedures such as manufacturing processes and work procedures both in normal operating conditions and abnormal operating conditions, Control and emergency management, the start and shutdown of equipment or devices.

1.4.5) Operating Job Description such as duties, responsibility and other general information of operators.

1.4.6) Process Flow Diagrams, piping and other instrumentation diagrams such as charts showing the pipe system which is connected to other devices and the details of that system.

1.4.7) Other documentation such as maps, layout drawings of the operation and equipment within the plant, electrical systems within the plant, other systems regarding the safety of the plant.

1.5) The advantages of using checklist.

Checklist is the easiest technique to identify the hazard. This technique is easy to apply, even if the users are not well trained and inexperienced[33].

1.6) The disadvantages of using checklist.

Checklist cannot be applied to identify complex hazards. Sometimes using a checklist with very specific questions may cause the user to feel that checking is not flexible. When the checklist is implemented the user may find that there are additional points to check that are not on the checklist[33].

2) Risk characterization

Risk characterization is rating the risk level. Two aspects of the rating must be considered such as the opportunity of dangerous occurrence and the severity of dangerous occurrence[34].

2.1) Rating the severity level of a dangerous occurrence

Rating of the severity level will consider from the severity of the hazard or incident that occurred. The things that must to consider are as following.

2.1.1) Damage to human

When considering the result of damage to human the checklist should consider about the parts of the body that have been affected by the malicious or unwanted events and severity of injuries and illnesses.

2.1.2) Damage to property

When considering the result of damage to property the checklist should consider both direct damage and indirect damage. The examples are as follows.

- The amount and welfare cost that paid to those injured by accidents.
- Costs from lost work time.
- The cost of repairing the building, machinery and equipment that has been damaged.
- The cost of raw materials or products that have been damaged and losses in production due to interruptions.
- Reputation, image and commercial interest including loss of opportunity in trade.

2.1.3) Damage to the environment in the workplace

When considering the result damage to the environment in the workplace the checklist should consider about the impact may affect the performance of the employee such as high or low temperature, high or low moisture, vibration, concentration of chemicals in the atmosphere etc.

The example of the severity level of dangerous occurrence shows in the following table.

Table 2.1 Example of rating the severity affecting humans

The level of severity	The type of injury/illness/loss
1. Low severity	Causing injury/minor illness, wound or skin scraped, eye irritation, bruise, disturbance (e.g. headache, itching) occasional illness and causing lost property not more than 5,000 baht.
2. Moderate severity	Causing excessively lacerated wound, burned wound, severe joint sprain, hit, bone cracked, skin inflammation, deaf, asthma, dermatitis, abnormality of hands and arms, illness which can lead to minor disability and causing lost property more than 5,000 baht, but less than 50,000 baht.
3. High severity	Causing mortality, lost organs (amputation, torn, decreased capability) towards disability, broken bone, toxicity, injured several parts of the body, cancer causing from related works, other diseases which can harm life expectancy, virulent diseases which cause sudden death and cause property lost more than 50,000 baht.

2.2) Rating the opportunity level of dangerous occurrence.

Rating the opportunity level we must consider several criteria. The criteria that we need to consider are as follows.

2.1) Number of employees or stakeholders.

2.2) The frequency and duration of exposure to hazard.

2.3) Effect of exposure.

2.4) Work process, practice and safety audit.

2.5) Training of work process, work procedure, safety rules.

2.6) The failure of the components of place or equipment and other safety equipment.

2.7) The provision of personal protective equipment which is appropriate to the nature of work.

2.8) An action that is unsafe or work procedure that does not conform to standard.

2.9) Training and awareness about safety in the operation and using of equipments and chemicals.

2.10) Tools, equipment, machines, environment designed to be secure.

An example of the criteria when considering the opportunity of dangerous occurrence shows in the following table.

Table 2.2 Rating of dangerous opportunities

Criteria of considering the opportunity	Weight
1.Number of employees that required for the activity in the area. ≥ 3 employees = 3 3 employees = 2 1 employees = 1	3
2.Duration of exposure to hazard or working time. Working time > 30 hrs/week. = 3 Working time 10-30 hrs/week. = 2 Working time < 10 hrs/week = 1	3
3.Effect of exposure After exposure, immediately affect to body = 3 Affect to the body, if exposure for a long time = 2 After exposure, especially affect to tools, property = 1	3
4.Work process and practice No written working processes or not documented = 3 Working processes were written but inappropriately documented = 2 Appropriate working process , documented = 1	3

Table 2.2 Rating of dangerous opportunities (cont.)

Criteria of considering the opportunity	Weight
5.Training of work process, work procedure, safety rules No training = 3 Training but no specific training needs = 2 Training and specific training needs = 1	3
6.Observe and monitor the compliance with standard work procedure and rules. No observation and no monitoring = 3 Continuous monitoring but still found not compliance with standard or no continuous monitoring. = 2 Continuous monitoring, found practice follow the standard= 1	3
7.Personal protective equipment and using No /Inappropriate /was not used/wrong method = 3 Appropriate and used in right method = 1	2
8.Designed to provide safety equipment for the machines, tool, environment. No /Inappropriate or was not used = 3 Appropriated and has been using = 1	3
9.Safety check No checking = 3 checked but not documented = 2 checked and documented = 1	3
10.Safety warning No or Inappropriate = 3 Appropriate = 1	2

Each criterion is determined and weighed. Considering the opportunity of a dangerous occurrence is achieved by using the following formula.

$$\text{Percentage of accidental possibility} = \frac{\text{score x weight}}{\text{full score x weight}}$$

Then the percentage is changed into opportunity level of dangerous occurrence that is divided in to 3 levels by the hereafter table 2.3.

Table 2.3 Hazard probability ratings

The level of risk	The percentage of risk
Low risk	33 – 56 %
Moderate risk	>56 – 78%
High risk	>78 – 100%

3) Estimation of risk level.

The estimation of risk level can be done in several ways but in this study we will use Risk Matrix. The risk level is estimated from bringing the severity level (from table 2.1) multiplied with opportunity level (from table 2.3). The results can be found from the following table.

Table 2.4 Sample of Risk Matrix Table

Risk Matrix		Chance/likelihood		
		Low	**Moderate**	**High**
Severity/impact	**Low**	Low risk	Acceptable risk	Moderate risk
	Moderate	Acceptable risk	Moderate risk	High risk
	High	Moderate risk	High risk	Unacceptable risk

To find the level of risk we consider the opportunity level from the landscape of the table and then consider the severity level from the vertical of the table. The associate point is the risk level.

2.5 Review of literatures

Piangpen Puasopis[35] conducted a support system to store chemicals for Thai industries which are convenient, quick, accurate, safe and comply with legal requirements. By developing the support system of chemical storage and applying this to three real plants. The study has found that the three factories did not comply with the regulations and the building structure was unsuitable for chemical storage.

Kanathit Kerdkly[36] studied workplace improvement to reduce the risk level, risk areas and increase the productivity of the plastic recycling industry. The samples were specifically selected from plants which had 35 workers. The techniques of hazard identification used in this study were as follows: What if analysis, Fault tree analysis and Failure mode effect analysis and risk assessment by using a Risk Matrix. Risk assessment after the improvement of the workplace found the risk total was 38 items, the unacceptable risk level decreased from 2 items to 0 items, the high risk level decreased from 12 items to 0 items, acceptable risk level decreased from 24 items to 8 items and reduced all 8 risk areas in the workplace. Productivity was increased from 250 kg/hr/person to 433 kg/hr/person.

Najah Ahman, et al.[37] studied safety management systems in a small-sized natural rubber latex glove factory by using hazard identification methods and safety inspection checklist to ensure compliance with the occupational safety and health act. It was found that the safety management of the factory was not in compliance with the occupational safety and health act because the factory lacked management, commitment and employer involvement, lack of communication and an indifferent safety attitude in both employers and employees.

Mahinda SENEVIRATNE, et al.[38] the Workers Health Centre assessed hazard exposure in the workplace of two metal industries (SMEs) and injected a low-cost monitoring program for noise, airborne dust, fibers and chemicals. The results of

this study showed that the hazard exposure of both workplaces was over the statutory limits and their low literate workers unhealthy accessed to OHS information. It was found that the owner of the two SMEs gave the low priority when dealing with OHS issues and they failed to understand the risk management process.

Pornpimol Kongtip, et al.[39] studied occupational health and safety management in small and medium size enterprises (SMEs) in 51 provinces all over Thailand, producing 24 products, the 5-year highest value of exported commodities of Thailand (2000–2004) to present an overview of the situation. A self-administered questionnaire developed to gain information about information related to employment, welfare and health facilities, health education, accident statistics, occupational health and safety activities. And there was a factory visit to audit and monitor environment in order to investigate the actual situation of participating enterprises according to the questions in the questionnaire. Results showed that the response rate was low, the welfare facilities and health management were adequate, the highest numbers of accident cases were from the production enterprise with 150–199 employees and from the industrial sector of engineering, the number of SMEs which had a fire alarm and training about fire prevention was too low, some enterprises still need to improve their working conditions, most of enterprise performed about accident report, accident investigations and safety inspection. This participating enterprises had better occupational health and safety management than expected, probably because their products were in the group of the twenty four highest exporting commodities of Thailand or they were forced by customers.

L. M. B. Rongo, et al.[40] studied in small-scale industries in Dar es Salaam, Tanzania by interview three hundred and ten workers to assessed the exposure to occupational and environmental hazard, the use of protective equipment and health complaints. The results showed that small number of worker use personal protective equipment, most of workers had occupational problems preferable amongst welders and metalworkers. The needs of workers were permanent workplace, information about the hazard related their work, water and sanitation and legislation which proper with their industries.

M. TISCHER, et al.[41] the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) developed a Chemical Management Guide (CM Guide) for

small and medium-sized enterprises in developing countries and tested the CM Guide in three textile-processing companies, one tannery and one paint producer and drum recycler. Results showed that MSDSs were not available in most of the smaller enterprises but medium size enterprise had more MSDSs available. The participating enterprise showed polite interest in chemical issues that related to occupational safety and health because they did not want to pay many costs that related to the improvement, the limited legislation and enforcement, limited incentive for action and few penalties for non-compliance. The way to persuade the owner or manager was with economic arguments related to loss, water and expiry of materials and quality standards expected from importing countries.

CHAPTER III
MATERIALS AND METHODS

3.1 Research plan

This research is the Pre-Experimental study and one group pretest-posttest design. The objective of this research was to improve chemicals management that was appropriated for the printing factories.

3.2 Population and sample characteristic

3.2.1 Population

The population in this study was small-sized offset printing factories that use volatile organic compounds.

3.2.2 Sample

The target group in this study were choose from two printing factories that were in line with inclusion criteria from the small offset printing factory in Bangkok that use volatile organic compound in their process.

3.2.3 Inclusion criteria

1) The sample was the printing factory where use volatile organic compound in the procedure works.

2) The sample was the offset printing factory.

3) The sample was small-sized printing factory where has no more than 50 employees.

4) The sample was the printing factory that voluntary to be a sample in this research.

3.3 Preparation before doing research

Steps of preparation before doing research are as follows.

3.3.1 Searching and studying all relative data about small-sized offset printing factory such as each working process including details of using chemicals in producing processes and personal protective equipment which were used in offset printing factory.

3.3.2 Searching and studying all relative data about the law, regulation, and manual about chemicals management of enterprise. Furthermore, the notification of Department of Industrial Works; Manual for the storage of chemicals and hazardous materials, B.E. 2550[8], the Thai Industrial Standard, called Occupational health and safety management system: General guidelines on principles, systems and supporting techniques.(TIS. 18004)[29] and safety data sheet of the chemicals that were used in the workplace.

3.4 Preparation the assessment form

Chemical management assessment form consisted of two categories such as chemical storage checklist and working process checklist. Chemical storage checklist was regarded to chemical storage quality control based on the regulation. The purpose of working process checklist was to assess risk behind each work process from the process of receiving chemicals from the supplier and transfer to the chemical storage, chemicals storage, chemical application, chemical transfer to another container/smaller container, chemical application in work process and waste discarding. Steps of preparation of the assessment form are as follows.

3.4.1 Steps of creating the chemicals storage checklist

1) Surveying the chemical storage room and summary of important data such as means of chemicals storage and the types of chemicals that kept in their chemicals storage room.

2) Studying about the details of the notification of the Department of Industrial Works; Manual for the storage of chemicals and hazardous materials, B.E.

2550[8] and considering about the details that could be applied with small-sized printing factories.

3) Drafting the checklist by creating a list of questions and determined the scoring about the three main issues of the manual for example the general characteristics of chemical storage room, method of chemicals storage and preventive measure. Each question had different scoring. Maximum score was 1 and the lowest score was 0.

4) Checking the accuracy of the checklist by requesting the expert reviewed them and rectifying followed the recommendation of the expert.

5) Test the checklist by bringing the checklist to five printing factories to find any bugs or further data that might be needed.

6) Checking the accuracy of the checklist again by requesting two experts reviewed them and rectifying followed the recommendation of the expert.

7) Test the checklist again by bringing the checklist to five printing factories to find any bugs or further data that might be needed. Persons who act to test the checklist were the researcher and the owners of each printing factory. The results of the audit would be concluded together between the researcher and the owner of each printing factory.

8) Test the reliability of chemical storage checklist by using Pearson Product Moment Correlation method and Horst method. The reliability of this checklist was 0.71.

3.4.2 Steps of creating the working process checklist

1) Surveying the working area of small offset printing factories and summary of important data such as working process, tools or equipment and the personal protective equipment that used during working.

2) Studying about the details of Thai industrial standard in title of Occupational health and safety management system : General guidelines on principles, system and supporting techniques (TIS. 18004)[29].

3) Drafting the checklist by bringing the concept of risk assessment method of TIS. 18004[29] as a guideline but this checklist differ from TIS. 18004[29].

Criteria in determining the likelihood of the danger of this checklist would be specific with the work process of small offset printing factories.

4) Checking the accuracy of the checklist by requesting the expert reviewed them and rectifying followed the recommendation of the expert.

5) Test the checklist by bringing the checklist to five printing factories to find any bugs or further data that might be needed.

6) Checking the accuracy of the checklist again by requesting two experts reviewed them and rectifying followed the recommendation of the expert

7) Test the checklist again by bringing the checklist to five printing factories to find any bugs or further data that might be needed. Persons who act to test the checklist were the researcher and the owners of each printing factory. The results of the audit would be concluded together between the researcher and the owner of each printing factory.

3.4.3 General characteristic of the chemicals storage checklist

This checklist composed of questions about the three main issues of the manual for example the general characteristics of chemical storage room, method of chemicals storage and preventive measure. The main issue about the general characteristics of chemical storage room has five minor issues (total is 15 questions). The main issue about method of chemicals storage has five minor issues (total is 15 questions) and the main issues about defensive measure has five minor issues (total is 15 questions). Each question has different scoring. Maximum score is 1 and the lowest score is 0. The total score of this checklist is 53. This checklist is showed in appendix A.

3.4.4 General characteristic of the working process checklist

This assessment form used to assess risk behind each work process. The determining criteria about the opportunity of each work process will be specific with the work process of small-sized offset printing factories and adapted from the determining criteria of opportunity of TIS.18004[29] method which is shown in table 2.2. The following tables are the criteria of consider the opportunity of each work process of small-sized offset printing factories.

Table 3.1 Criteria of considering the opportunity of dangerous occurrence of receiving chemicals from the supplier and transfer to the chemical storage process

Evaluation criteria and score		Weight
1. Written working processes exist		3
Score	3 = No written working processes or not documented	
	2 = Written working processes exist, but inappropriately documented	
	1 = Written appropriate working process exist and appropriately documented	
2. Provided parking areas for the supplier's car that come to deliver the product far away from traffic area		2
Score	3 = Not provided parking areas	
	2 = Parking areas has been provided but disregarded	
	1 = Parking areas has been provided and followed	
3. Transferring chemical by worker and using safe method		3
Score	3 = Unsafe transferring method	
	1 = Transferring by safe method	
4. Chemical substances have been hauled from carrier truck by worker and using safe method		3
Score	3 = Unsafe method	
	1 = Safe method and package intact	
5. Trolleys have been checked before use		
Score	3 = Trolleys have not been checked.	3
	2 = Trolleys have been check but not documented	
	1 = Trolleys have been check and recorded continuously.	

Table 3.2 Criteria of consider opportunities of dangerous occurrence of chemical storage process

Evaluation criteria and score		Weight
1. Written working processes exist		3
Score	3 = No written working processes or not documented	
	2 = Written working processes exist, but inappropriately documented	
	1 = Written appropriate working process exist and appropriately documented	
2. Packages, labels have been checked before taking to storage room		3
Score	3 = Not checking	
	2 = Packages, labels have been checked but not documented	
	1 = Packages, labels have been checked and documented continuously	
3. Label of chemicals have been checked before taking to storage room		3
Score	3 = Not checking	
	2 = Label of chemicals have been checked but not documented	
	1 = Label of chemicals have been checked and documented continuously	
4. Chemical substances were stored by classification		3
Score	3 = Not classified	
	1 = Classified before taking to storage room	
5. Separate the interactive chemicals		3
Score	3 = Interactive chemicals have not been separated	
	1 = Interactive chemicals have been separated	
6. Inflammable chemicals have been separated from the others chemicals		3
Score	3 = Inflammable chemicals have not been separated	
	1 = Inflammable chemicals have been separated	

Table 3.2 Criteria of consider opportunities of dangerous occurrence of chemical storage process (cont.)

Evaluation criteria and score		Weight
7. Chemical substance is contained in breakable package e.g. glass container has been kept in covered shelf or safety partition shelf.		3
Score	3 = Put on the floor	
	2 = Uncovered or no partition shelf	
	1 = Covered shelf or safety partition shelf	
8. Partitions strength have been checked		3
Score	3 = Partitions strength have not been checked	
	2 = Partitions strength have been checked	
	1 = Partitions strength have been checked and documented continuously	
9. Chemical substances have been arranged by the sign "Top side" / lids have been on top.		3
Score	3 = Unorganized arrangement /lids have not been on the bottom.	
	1 = All lids have been on top.	
10. Doors of shelf have been closed properly after finished arranging		3
Score	3 = Doors have not been closed.	
	2 = Doors have not been closed properly.	
	1 = Doors have been closed properly.	

Table 3.3 Criteria of consider opportunities of dangerous occurrence of chemical application process

Evaluation criteria and score		Weight
1. The process of bringing chemical that kept in chemical storage room to use is systematic		3
Score	3 = Non systematic	
	2 = Systematic but inappropriately documented	
	1 = Systematic and appropriately documented	
2. Expired date checking has been systematic		3
Score	3 = Non systematic	
	2 = Systematic but inappropriately documented	
	1 = Systematic and appropriately documented	
3. Chemical substance identification tag and label have been read before using		3
Score	3 = Chemical substances has been taken without reading.	
	2 = Just only one thing has been read.	
	1 = Chemical substance identification tag and label have been read before using.	
4. The lid has been closed properly after finished using then put back to the shelf		3
Score	3 = Container have no lid when put back	
	2 = The lid has not been closed properly	
	1 = The lid has been closed properly	
5. Chemical substance has been put back at the correct place and has not mixed with the others kind.		3
Score	3 = Put back without classification.	
	1 = Classification before putting back in the correct place.	

Table 3.3 Criteria of consider opportunities of dangerous occurrence of chemical application process (cont.)

Evaluation criteria and score		Weight
6. Transferring by using the proper trolley that has been checked before using		3
Score	3 = Not checking	
	2 = Trolley has been checked, but not documented	
	1 = Trolley has been checked and documented continuously	

Table 3.4 Criteria of consider opportunities of dangerous occurrence of chemical transfer to another container/smaller container process

Evaluation criteria and score		Weight
1. Written working processes exist		3
Score	3 = No written working processes or not documented	
	2 = Written working processes exist, but inappropriately documented	
	1 = Written appropriate working process exist and appropriately documented	
2. Worker has transferred chemical substance in specified area		3
Score	3 = No specified area	
	2 = Transferring area has been specified but worker has not used	
	1 = Transferring area has been specified and has in use	
3. Transferring area has had a good ventilation /opened area		3
Score	3 = Transferring area has not had ventilation	
	1 = Transferring area has had a good ventilation/opened area	

Table 3.4 Criteria of consider opportunities of dangerous occurrence of chemical transfer to another container/smaller container (cont.)

Evaluation criteria and score		Weight
4. Using the tray under the chemical substance container in case of any leakage.		3
Score	3 = Not have the tray /the tray has been inappropriate/ the tray has not been used.	
	1 = The tray has been appropriate and has been using	
5. Measuring container or transferring equipment has suited to chemical and container		3
Score	3 = Not have measuring container /measuring container has been inappropriate/ measuring container has not been used.	
	1 = Measuring container has been appropriate and has been used.	
6. Container's lid has been closed properly after finished transferring		3
Score	3 = No lid covered	
	2 = Lid has not been closed properly	
	1 = Lid has not been closed properly	
7. Worker has worn carbon mask and chemical resistant glove during transfer chemical substance.		2
	3 = Worker has not had PPE/inappropriate PPE/worker has not used PPE/worker has used PPE with wrong method.	
	1 = Worker has had appropriate PPE and has used PPE in right method	
8. Transferring of inflammable chemical substance, the electric equipment (explosion proof type) has been used.		3
Score	3 = Not have explosion proof electric equipment/worker has not used	
	1 = Explosion proof electric equipment has been used.	

Table 3.4 Criteria of consider opportunities of dangerous occurrence of chemical transfer to another container/smaller container (cont.)

Evaluation criteria and score		Weight
9. Workers must not wear electrostatic clothes during transfer chemical substance		3
Score	3 = Worker has not had appropriate cloths/disregarded	
	1 = Worker has had appropriate clothes and has used.	

Table 3.5 Criteria of consider opportunities of dangerous occurrence of plate-making process

Evaluation criteria and score		weight
1. Written working processes exist		3
Score	3 = No written working processes or not documented	
	2 = Written working processes exist, but inappropriately documented	
	1 = Written appropriate working process exist and appropriately documented	
2. Worker has worn carbon mask, chemical resistant glove during clean up the plate		2
Score	3 = Worker has not had PPE/inappropriate PPE/worker has not used PPE/worker has used PPE with wrong method.	
	1 = Worker has had appropriate PPE and has used PPE in right method	
3. During apply glue on the plate, worker has worn carbon mask and chemical resistant glove.		2
Score	3 = Worker has not had PPE/inappropriate PPE/worker has not used PPE/worker has used PPE with wrong method.	
	1 = Worker has had appropriate PPE and has used PPE in right method	

Table 3.5 Criteria of consider opportunities of dangerous occurrence of plate-making process (cont.)

Evaluation criteria and score		weight
4. Glue container has had lid covered.		3
Score	3 = Container has not had lid/container has had inappropriate lid/lid has not been used/ has been used with wrong method	
	1 = Container has had appropriate lid and has been used in right method	
5. Glue container has had lid covered properly after finished using		3
Score	3 = Container has not had lid/Inappropriate lid/lid has not been used	
	2 = Lid has not been closed properly.	
	1 = Lid has been closed properly	
6. Plate cleaner solution container has had lid covered.		3
Score	3 = Container has not had lid/container has had inappropriate lid/lid has not been used/ has been used with wrong method	
	1 = Container has appropriate lid and used in right method	
7. Plate cleaner container's lid was closed properly after finished using.		3
Score	3 = Not have lid/Inappropriate lid/lid has not been used	
	2 = Lid has not been closed properly.	
	1 = Lid has been closed properly	
8. Sponges or washrags have been kept in covered container when not using.		3
Score	3 = No container/ Uncovered container/ container has had inappropriate lid/ lid has not been used	
	2 = Container has been improperly covered	
	1 = Container has been covered properly	

Table 3.6 Criteria of consider opportunities of dangerous occurrence of printing process

Evaluation criteria and score		Weight
1. Written working processes exist		3
Score	3 = No written working processes or not documented	
	2 = Written working processes exist, but inappropriately documented	
	1 = Written appropriate working process exist and appropriately documented	
2. Worker has worn carbon mask and chemical resistant glove during working on process		2
Score	3 = Worker has not had PPE/inappropriate PPE/worker has not used PPE/worker has used PPE with wrong method.	
	1 = Worker has had appropriate PPE and has used PPE in right method	
3.Container has been covered immediately after finished transferring chemical substance to printing machine		3
Score	3 = Container has not been covered after finished transferring	
	2 = Container has been improperly covered	
	1 = Container has been appropriate covered	
4.Printing machine's hole has been covered immediately after finished transferring chemical substance to printing machine		3
Score	3 = Printing machine's hole has not been covered after finished transferring	
	2 = Printing machine's hole has been improperly covered	
	1 = Printing machine's hole has been appropriate covered	

Table 3.6 Criteria of consider opportunities of dangerous occurrence of printing process (cont.)

Evaluation criteria and score		Weight
5. Local exhaust ventilation system has been provided for preventing chemical diffusion from printer		2
Score	3 = Local exhaust ventilation system has not been provided /inappropriate local exhaust ventilation system/ has not used local exhaust ventilation system.	
	1 = Appropriated local exhaust ventilation system and has been used in right method	
6. Absorbing substance has been used, in case of spilling, leaking of chemicals		3
Score	3 = Has not had absorbing substance/ inappropriate absorbing substance/ worker has not used absorbing substance.	
	1 = Appropriated absorbing substance and has been used in right method	
7. Contaminated chemicals inventory or absorbing substance has been putted in container that has lid.		3
Score	3 = Uncovered container/ No container	
	2 = Lid has not been used / Improperly closed	
	1 = Container has been covered properly	
8. Preparation has been provided in case of spilling or leaking		3
Score	3 = No written working processes or not documented	
	2 = Written working processes exist, but inappropriately documented	
	1 = Written appropriate working process exist and appropriately documented	

Table 3.7 Criteria of consider opportunities of dangerous occurrence of plate cleaned up process

Evaluation criteria and score		Weight
1. Worker has worn glove and face mask during cleaning up the plate		2
Score	3 = Worker has not had PPE/inappropriate PPE/worker has not used PPE/worker has used PPE with wrong method.	
	1 = Worker has had appropriate PPE and has used PPE in right method	
2. Written working processes exist		3
Score	3 = No written working processes or not documented	
	2 = Written working processes exist, but inappropriately documented	
	1 = Written appropriate working process exist and appropriately documented	
3. Plate cleaner container has had lid covered		3
Score	3 = Container has not had lid/container has had inappropriate lid/lid has not been used/ has been used with wrong method	
	1 = Container has had appropriate lid and has been used in right method	
4. Plate cleaner container has had lid covered properly after finished using		3
Score	3 = Container has not had lid/Inappropriate lid/lid has not been used	
	2 = Lid has not been closed properly.	
	1 = Lid has been closed properly	
5. Sponges or washrags have been kept in covered container when not using.		3
Score	3 = Kept in uncovered container/no container for kept sponges	
	2 = Lid has not been used /Improperly closed	
	1 = Container has been covered properly	

Table 3.8 Criteria of consider opportunities of dangerous occurrence of ink roller cleaning process

Evaluation criteria and score		Weight
1. Written working processes exist		3
Score	3 = No written working processes or not documented	
	2 = Written working processes exist, but inappropriately documented	
	1 = Written appropriate working process exist and continuously documented	
2. During clean up the ink roller, worker has worn glove and face mask		2
Score	3 = Worker has not had PPE/inappropriate PPE/worker has not used PPE/worker has used PPE with wrong method.	
	1 = Worker has had appropriate PPE and has used PPE in right method	
3. Ink roller cleanser detergent (Thinner) has been contained in covered container		3
Score	3 = Container has not had lid/container has had inappropriate lid/lid has not been used/ has been used with wrong method	
	1 = Container has appropriate lid and has been used in right method	
4. Ink roller cleanser detergent container has been lid covered properly after finished using		3
Score	3 = Container has not had lid/Inappropriate/lid has not been used	
	2 = Lid has not been closed properly.	
	1 = Lid has been closed properly	

Table 3.8 Criteria of consider opportunities of dangerous occurrence of ink roller cleaning process (cont.)

Evaluation criteria and score		Weight
5. Sponges or washrags using for clean the ink roller have been kept in covered container when not using		3
Score	3 = No container/ Uncovered container/ container has had inappropriate lid/ lid has not been used	
	2 = Container has been improperly covered	
	1 = Container has been covered properly	

Table 3.9 Criteria of consider opportunities of dangerous occurrence of blanket cleaning process

Evaluation criteria and score		Weight
1. Written working processes exist		3
Score	3 = No written working processes or not documented	
	2 = Written working processes exist, but inappropriately documented	
	1 = Written appropriate working process exist and continuously documented	
2. During clean up the blanket, worker has worn glove and face mask		2
Score	3 = Worker has not had PPE/inappropriate PPE/worker has not used PPE/worker has used PPE with wrong method.	
	1 = Worker has had appropriate PPE and has used PPE in right method	

Table 3.9 Criteria of consider opportunities of dangerous occurrence of blanket cleaning process (cont.)

Evaluation criteria and score		Weight
3. Blanket cleanser detergent (white gasoline) has been contained in covered container		3
Score	3 = Container has not had lid/container has had inappropriate lid/lid has not been used/ has been used with wrong method	
	1 = Container has had appropriate lid and has been used in right method	
4. Washrags using for clean the ink roller have been kept in covered container when not using		3
Score	3 = No container/ Uncovered container/ container has had inappropriate lid/ lid has not been used	
	2 = Container has been improperly covered	
	1 = Container has been covered properly	
5. Sponges or washrags using for clean the plate have been kept in covered container		3
Score	3 = Container has not had lid/container has had inappropriate lid/lid has not been used/ has been used with wrong method	
	1 = Container has appropriate lid and has been used in right method	
6. Contaminated chemical washrags have been putted in container that have lid.		3
Score	3 = No container/ Uncovered container/ container has had inappropriate lid/ lid has not been used	
	2 = Container has been improperly covered	
	1 = Container has been covered properly	

Table 3.10 Criteria of consider opportunities of dangerous occurrence of cylinder cleaning process

Evaluation criteria and score		Weight
1. Written working processes exist		3
Score	3 = No written working processes or not documented	
	2 = Written working processes exist, but inappropriately documented	
	1 = Written appropriate working process exist and appropriately documented	
2. During clean up the cylinder, worker has worn glove and face mask		2
Score	3 = Worker has not had PPE/inappropriate PPE/worker has not used PPE/worker has used PPE with wrong method.	
	1 = Worker has had appropriate PPE and has used PPE in right method	
3. Cylinder cleanser detergent (Kerosene) has been contained in covered container		3
Score	3 = Container has not had lid/container has had inappropriate lid/lid has not been used/ has been used with wrong method	
	1 = Container has appropriate lid and has been used in right method	
4. Cylinder cleanser detergent container has been lid covered properly after finished using.		3
Score	3 = No container/ Uncovered container/ container has had inappropriate lid/ lid has not been used	
	2 = Container has been improperly covered	
	1 = Container has been covered properly	

Table 3.10 Criteria of consider opportunities of dangerous occurrence of cylinder cleaning process (cont.)

Evaluation criteria and score		Weight
5. Grinder and roller using for clean the Insulator have been kept in covered container		3
Score	3 = Container has not had lid/container has had inappropriate lid/lid has not been used/ has been used with wrong method	
	1 = Container has appropriate lid and has been used in right method	
6. Contaminated chemicals washrags were putted in container that have lid.		3
Score	3 = No container/ Uncovered container/ container has had inappropriate lid/ lid has not been used	
	2 = Container has been improperly covered	
	1 = Container has been covered properly	

Table 3.11 Criteria of consider opportunities of dangerous occurrence of waste discarding process

Evaluation criteria and score		Weight
1. Written wasting products management processes exist		3
Score	3 = No written working processes or not documented	
	2 = Written working processes exist, but inappropriately documented	
	1 = Written appropriate working process exist and appropriately documented	
2. Emptied chemical disposal container disposal has been separated from the others kinds of waste		3
Score	3 = Not separated/has been mixed up with the others kinds	
	1 = Has been separated from the others kinds	

Table 3.11 Criteria of consider opportunities of dangerous occurrence of waste discarding process (cont.)

Evaluation criteria and score		Weight
3. The garbage bin for chemical container or contaminated materials has been metallic that has had proper lid.		3
Score	3 = No container/inappropriate container/ has not been used/ has been used with wrong method	
	1 = Appropriate container and has been used in right method	
4. Wasting products have been taken away from working area at least once a day.		3
Score	3 = Collected more than 1 day	
	1 = Taken away at least once a day	
5. Rubbish area and working area have been separated and organized		3
Score	3 = Both in the same area	
	2 = Located in different area but unorganized / Both settle in the same area but organize well.	
	1 = Both area have been separated and organized.	
6. Chemical waste products have been separated then eliminated by specialist organization.		3
Score	3 = Reused /Mixed up with the others waste.	
	1 = Eliminated by specialist organization/Exterminated follow the direction written on label.	

Each criterion is determined and weighed. Considering the opportunity of dangerous occurrence of each work process is achieved by using the following formula (the same formula which showed in page 34).

$$\text{Percentage of possibility of dangerous occurrence} = \frac{\text{score x weight}}{\text{full score x weight}} \text{ x } 100$$

Then the percentage is changed into opportunity level of dangerous occurrence that is divided into three levels by the hereafter table 3.12.

Table 3.12 Probability level

Level probability of dangerous occurrence	Percentage of possibility of dangerous occurrence
Low	33 – 56 %
Moderate	>56 – 78%
High	>78 – 100%

Consideration of severity level of dangerous occurrence can be divided into three levels as the table 3.13 below.

Table 3.13 Severity level

The level of severity	The type of injury/illness/loss
1. Low severity	Causing injury/minor illness, wound or skin scraped, eye irritation, bruise, disturbance (e.g. headache, itching) occasional illness and causing lost property not more than 5,000 baht.
2. Moderate severity	Causing excessively lacerated wound, burned wound, severe joint sprain, hit, bone cracked, skin inflammation, deaf, asthma, dermatitis, abnormality of hands and arms, illness which can lead to minor disability and causing lost property more than 5,000 baht, but less than 50,000 baht.
3. High severity	Causing mortality, lost organs (amputation, torn, decreased capability) towards disability, broken bone, toxicity, injured several parts of the body, cancer causing from related works, other diseases which can harm life expectancy, virulent diseases which cause sudden death and cause property lost more than 50,000 baht.

After considering about the opportunity level and severity level, the risk level of each work process can be found from the following table.

Table 3.14 Risk Matrix

Risk Matrix		Chance/likelihood		
		Low	**Moderate**	**High**
Severity/impact	**Low**	Low risk	Acceptable risk	Moderate risk
	Moderate	Acceptable risk	Moderate risk	High risk
	High	Moderate risk	High risk	Unacceptable risk

The result of this checklist will be the represent of risk level of each work process. This checklist is showed in appendix B.

3.5 Preparation the intervention program

The chemical storage improvement of printing factories aimed to develop the chemical storage management, which perform according to regulations. The notification of Department of Industrial Works; Manual for the storage of chemicals and hazardous materials, B.E. 2550[8] is applied for the purpose of achievement of the guidelines.

The work process improvement of printing factories aimed to reduce chemical spreads into the air, as well as reduce worker's exposure to the chemical.

However, the owner or managers and related workers have to collaborate on the execution of chemical management. The greater details of chemical improvement are as follows.

3.5.1 Chemical managing improvement including of three titles by the following.

1) Organizing chemicals storage room i.e. shelf, creating warning signs etc, in order to tidy and lessen spreading of chemical into the air, as well as reduce worker's exposure to the chemical.

2) Categorizing chemicals into the same type by according to the manual and the procedures were written in documents as follow.

2.1) Survey every chemicals that has been used in the company and the managing principle using in the company.

2.2) Summary of important data of chemical which is used in the process or procedure to know about the dangers that may arise from these chemicals

2.3) Divide chemical type based on Manual for the storage of chemicals and hazardous materials, according to the notification of Department of Industrial Works, 2550 B.E.[8]

2.4) Store chemicals according to the type defined in the organized storage room.

3) Rectify chemical label that illustrated safety data detail .This is very important for workers safety by the follow guideline.

3.1) Survey all the chemical labels and fixed up if some missing.

3.2) Inform staffs that not to take the label tag off, when found some chemical container has no label, the worker need notify supervisor or person who has responsible.

3.5.2 Rectifying of working processes and how to work with chemical safety.

Safety working processes standard is the means that guiding workers to do safety work reduce worker's exposure to the chemical. Improving and creating safely working processes standard is follow this guideline.

1) Interrogate staffs and workers about process such as the work step of the process of receiving chemicals from the supplier and transfer to the chemical

storage, chemicals storage, chemical application, chemical transfer to another container/smaller container, chemical application in work process and waste discarding.

2) Encourage to improve the particular of working processes in order to reduce worker's exposure to the chemical and the most safety method that was discussed from most of worker to conclude the suitable way to make the safely working processes standard.

3) Document the safely working processes standard in paper and post it at working area.

4) Inform worker to perform.

3.5.3 Correcting the means of using the personal protective equipment.

Provide appropriate personal protective equipment for each worker. As most of the chemicals in printing factories are volatile organic compound substance for example benzene, kerosene, thinner, plate cleaner solution, fountain solution. So workers have to protect their self by the proper equipment when they on working process. Personal protective equipment for working that should be provided are as following.

1) Face mask.

Face mask that can prevent harmful chemical such as carbon mask because during printing process then the ink that including the solvent, fountain solution, kerosene or isopropyl alcohol can be spread in to air. It is possible that would be inhaled when they on working process thus they have to use the face mask for prevent the vapors. Carbon mask is showed in figure 3.1.

2) Chemical resistant glove.

Chemical resistant glove as during have work the worker will expose to solvent such as kerosene, white gasoline that harmful when workers have been expose for a long time. Chemical resistant glove is showed in figure 3.2.

Figure 3.1 Carbon mask

Figure 3.2 Chemical resistant glove

Furthermore the owner must demonstrate the using direction and the correct way for maintenance including documented in papers.

3.5.4 Improving equipment is useful for worker that they can work safe.

The objective of this step is reducing chemical spreading into air and decrease the exposure with chemicals during working. It should be improve the proper management for the container of chemicals, the emptied container, contaminated equipment etc.

Figure 3.3 The emptied container, contaminated equipment

3.5.5 Reorganize the warning signs of dangerous in work place.

Provide the warning sign for hazardous chemicals and materials in work place.

3.5.6 Fire prevention management.

Improve fire prevention management system. The details are as the following.

1) Portable fire extinguisher has been provided appropriately for chemical type and amount of chemical substance that storage in work place.

2) Portable fire extinguisher has been provided in proper area and convenient for moving.

3) Provide the sign for the location of portable fire extinguishers.

3.5.7 Educating workers about the chemical that they might be exposed during working.

The chemical safety training to the worker that might reduce worker's exposure to the chemical during working as need them to realize about reducing chemical spreads into the air and less expose for the workers in the correct way by training in this following topics.

1) Chemical harmful effect for every chemical substance that workers might be exposed.

2) Directions for chemical prevention and the useful of personal protective equipment also how to keep it in the correct way.

3.6 Guidelines for improving the chemical management for small-sized printing factory

3.6.1 Guidelines for chemical storage management for small-sized printing factory

The guideline for the storage of chemicals of small-sized printing factories used to guide the implementation to the enterprises. The purpose of the guidelines is improving the chemical storage to follow the checklist which this checklist was created to apply the law as a guide and applied to suit with the small-sized printing factories. Guidelines for chemical storage management for small-sized enterprises are as follows.

1) Characterizations of chemical storage room.

1.1) Location. Properly separate areas to store chemicals out of the working area by separate enclosed room or separate area with proper care.

1.2) Wall.

1.2.1) Wall of the room used to store non-combustible materials, its wall can resist fire at least 30 minutes.

1.2.2) Wall of the room used to store flammable substances, its wall can resist fire at least 90 minutes.

1.3) Floor.

1.3.1) The floor is strong enough to support the weight. The floor is made of cement or wood that permanent and stable.

1.3.2) The floor of the storage room is not cracked, rough, wet or slippery.

1.3.3) Flooring materials must be resistant to water and chemicals.

1.3.4) The floor should be electrical conductivity, if stored flammable liquid or gas.

1.4) Doors and emergency exit.

1.4.1) The room must have two entrances which includes the emergency exit.

1.4.2) The width of the emergency door should not be less than 1.10 meters.

1.4.3) Door used as an emergency exit easily must be openable from the inside in one way.

1.4.4) From the inside and the outside, each emergency exit has no obstruction.

1.4.5) Each emergency exit has a visible and clear symbol indicating as an emergency exit.

1.5) Roof

1.5.1) Materials used to make the roof can resistant to fire for 30 minutes.

1.5.2) The roof of a storage facility can release heat and smoke.

1.5.3) The main structure supporting the roof should be protected with non-combustible materials.

1.5.4) Roof should not have blemish.

1.6) Ventilation System

The storage room should have the ventilation system. Natural ventilation such as vents on the roof, vents on the wall, vents on the wall which near the floor, ventilation through the gap of two layers of the roof that are overlap or using mechanical ventilation.

1.7) Lighting system and electrical equipments.

1.7.1) Explosion protected electrical equipments are equipped in any area where flammable substances are handled.

1.7.2) Lights should be installed above hazardous materials at least 0.5 meters and they do not cause chemical heat up.

1.7.3) If had Metal Halide lamps and Mercury lamps in the storage room, they should have covers.

1.7.4) Electrical equipment installed within the storage room should be grounded.

1.7.5) Electrical equipment installed within the storage room should be in good condition.

1.8) Warning system

1.8.1) Fire alarm system should be equipped in storage room.

1.8.2) Sound alarm fire should be equipped in storage room.

1.8.3) An alarm system (press type) should be installed in storage room.

1.8.4) An alarm system should be test more than 1 time per month.

1.8.5) Storage room should have heat or smoke detectors.

1.9) Fire extinguisher.

1.9.1) The storage room should have dry chemical fire extinguisher size 12 kg. at least 1 piece per 200 square meters.

1.9.2) Fire extinguishers are inspected semi-annually.

1.9.3) Installing fire extinguishers, the upper handle should be high from the ground 1 to 1.4 meters.

1.9.4) Fire extinguishers should be installed in such a way that employees can conveniently move the fire extinguishers.

1.9.5) Each fire extinguisher should have fire extinguisher signs and that signs should be clearly visible.

1.9.6) Guidepost should be made to indicate location of fire extinguishers and that guidepost should be clearly visible.

1.9.7) Map should be made to show location of fire extinguishers and that map should be properly sized unit.

2) Chemical storage method

2.1) Different types of chemicals should be separately stored in different area.

2.2) Flammable chemicals should be separately stored from all other chemicals.

2.3) Chemicals which can react dangerously with each other should not be store together with other chemicals.

2.4) Ordering the chemicals within the chemicals storage room should not obstruct the work, also move objects and use the emergency equipment.

2.5) Container or packaging of chemicals that can easily break should be store in the storage cabinets with closed lids or store on shelves with rail to avoid the potential for falling or dropping chemicals.

2.6) Containers of hazardous chemicals should be made of strength materials and no corrosion.

2.7) Materials causing inflammation such as paper, clothes should not be store in the storage room.

2.8) All types of chemicals should have label affixed to the container.

2.9) Label of chemicals should clearly visible.

2.10) Label of chemicals should show scientific name, warning sign, statement that mention about the toxicity of the product, caution and vendor.

2.11) Material safety data sheet should be available for every kind of chemical and worker should take advantage of them. Material safety data sheet should be store in a place where employees can access them.

3) Defensive measures

3.1) Cleaning. The storage room should be cleaned at least once a week.

3.2) Traffic Routing.

3.2.1) Traffic should be routed and should not keep the chemicals at the areas that are route traffics.

3.2.2) Color of route traffic. The color of route traffics should be a color that worker can clearly see and contrast with the color of floor.

3.2.3) Safe distance should be kept and showed between traffic paths.

3.3) Safety signs

3.3.1) Warning signs or hazardous symbols for types of hazardous chemicals should be represented.

3.3.2) Warning signs or hazardous symbols for types of hazardous chemicals should be printed in red letters.

3.3.3) Signs "Storage of chemicals" should be clearly represented in a proper size.

3.3.4) Signs "No smoking" should be clearly represented in a proper size.

3.6.2 Guidelines for work process management for small-sized printing factory

The guideline for the work process management for the small printing factory used to guide the implementation to the enterprise. The purpose of the guidelines is improving the work process to be a safety work process. Guidelines for work process management for small enterprise are as follows.

1) Receiving and handling chemicals to the chemicals storage room process.

1.1) The working process standard should be written to be a standard of enterprise, documented them and post them in the working area.

1.2) An exchanging zone should be provided far away from traffic area and should force employee to follow.

2) Chemical storage process

2.1) The working process standard should be written to be a standard of enterprise, documented them and post them in the working area.

2.2) Packages of chemicals should be checked before taking to storage room.

2.3) Label of chemicals should be checked before taking to storage room.

2.4) Each chemical substance should be stored follow their classification.

2.5) Chemicals which can react dangerously with each other should not be store together with other chemicals.

2.6) Inflammable chemicals should be separately stored from all other chemicals.

2.7) Chemical substances contained in breakable package e.g. glass container should be kept in the storage cabinets with closed lids or store on shelves with rail to avoid the potential for falling or dropping chemicals.

2.8) Rail of shelves should have been checked before and after using.

2.9) To orderly keep any chemicals on a shelf, the opening side of chemical container should be carefully concerned as well as ensure that container lid was closed tightly to protect chemical spills or leaks.

2.10) Shelf doors should be properly closed after finished arranging.

3) Chemicals application process

3.1) The working process standard should be written to be a standard of enterprise, documented them and post them in the working area.

3.2) Expiry date checking should be systematic. By determine the person who responsible for checking, verify the time of checking, determine the procedure when find the chemicals that expired including arrangement of the chemicals that will expired before other prior to being used before.

3.3) The label affixed to chemical containers and the shelves should be carefully read before using.

3.4) The lid of container should be properly closed before put it back to the shelf.

3.5) Chemical substances should be put back at the correct place and should not store with other types of chemicals.

3.6) Transferring by using the proper trolley and trolley should have been checked before using.

4) Transferring process

4.1) The working process standard should be written to be a standard of enterprise, documented them and post them in the working area.

4.2) Worker should transfer chemical substances in specified area.

4.3) Transferring area should have good ventilation or should be an uncovered area.

4.4) Secondary container should be provided and placed under primary container during chemical transfer process.

4.5) Equipments/tools that enable chemicals transfer process such as filter funnel should be provided and used during chemical transfer from large-sized to small-sized container

4.6) Measuring container or transferring equipment should suit to chemical and container.

4.7) Container's lid should be closed properly after finished transferring.

4.8) Personal protective equipments such as solvent resistant glove and carbon mask should be prepared for worker.

4.9) Worker should wear carbon mask and chemical resistant glove while transfer chemical substances.

4.10) Transferring of inflammable liquids, the electric equipments should be explosion protected.

4.11) Workers must not wear electrostatic cloths during transfer inflammable chemical substances.

4.12) Adsorbent should be provided to protect chemical spills or leaks during chemical transfer to another container.

4.13) In case of dividing some chemicals from a large-sized container, smaller chemical containers should be labeled.

5) Plate-making process

5.1) The working process standard should be written to be a standard of enterprise, documented them and post them in the working area.

5.2) Worker should wear carbon mask and chemical resistant glove during clean up the plate

5.3) During apply glue on the plate, worker should wear chemical resistant glove and carbon mask.

5.4) Glue container should have lid covered.

5.5) Glue container's lid should be tightly closed after finished using

5.6) Plate cleaner solution container should have lid covered.

5.7) Plate cleaner container's lid should be tightly closed after finished using.

5.8) Covered container should be provided to kept reusable washcloths.

5.9) Reusable washcloths should be orderly kept in covered container.

5.10) Bucket with lid should be prepared to keep cleaning sponges.

5.11) After finished using, the lid of bucket always should be tightly closed.

6) Printing process

6.1) The working process standard should be written to be a standard of enterprise, documented them and post them in the working area.

6.2) Personal protective equipments such as solvent resistant glove and carbon mask should be prepared for worker.

6.3) Worker should wear carbon mask and chemical resistant glove during working.

6.4) Container's lid should be immediately closed after finished transferring chemical substances to printing machine.

6.5) Printing machine's hole should be immediately closed after finished transferring chemical substance to printing machine.

6.6) Local ventilation system should be provided in specific area for the removal of chemical vapors.

6.7) Adsorbent should be provided to protect chemical spills or leaks during chemical transfer to another container.

6.8) Absorbing substance should be used to eradicate chemicals, in case of spilling, leaking of chemicals while working.

6.9) Contaminated chemicals inventory or absorbing substance should be putted in container that have lid.

6.10) Preparation process should be provided in case of spilling or leaking of chemicals.

7) Plate cleaning process

7.1) The working process standard should be written to be a standard of enterprise, documented them and post them in the working area.

7.2) Personal protective equipments such as solvent resistant glove and carbon mask should be prepared for worker.

7.3) Worker should wear carbon mask and chemical resistant glove during cleaning the plate.

7.4) Plate cleaner container should have lid covered.

7.5) Plate cleaner container's lid should be tightly closed after finished using.

7.6) Bucket with lid should be prepared to keep reusable sponges.

7.7) Reusable washcloths should be orderly kept in covered bucket and the lid of bucket always should be tightly closed after finished using.

8) Ink roller cleaning process

8.1) The working process standard should be written to be a standard of enterprise, documented them and post them in the working area.

8.2) During cleaning the ink roller, worker should wear carbon mask and chemical resistant glove.

8.3) Ink roller cleanser detergent (thinner) should contain in covered container.

8.4) Ink roller cleanser detergent container's lid should be tightly covered after finished using.

8.5) Covered container should be provided to kept reusable washcloths.

8.6) Reusable washcloths always should be orderly kept in covered container.

8.7) Washcloths used to clean the ink roller should have been kept in covered container when not using.

9) Blanket cleaning process

9.1) The working process standard should be written to be a standard of enterprise, documented them and post them in the working area.

9.2) During cleaning the blanket, worker should wear carbon mask and chemical resistant glove.

9.3) Blanket cleanser detergent (white gasoline) should be contained in covered container.

9.4) Blanket cleanser detergent container's lid should be tightly covered after finished using.

9.5) Covered container should be provided to kept reusable washcloths.

9.6) Reusable washcloths always should be orderly kept in covered container.

9.7) Washcloths used to clean the ink roller should have been kept in covered container when not using.

10) Cylinder cleaning process

10.1) The working process standard should be written to be a standard of enterprise, documented them and post them in the working area.

10.2) During cleaning the cylinder, worker should wear carbon mask and chemical resistant glove.

10.3) Cylinder cleanser detergent (Kerosene) should be contained in covered container.

10.4) Blanket cleanser detergent container's lid should be tightly covered after finished using.

10.5) Covered container should be provided to kept reusable washcloths.

10.6) Reusable washcloths always should be orderly kept in covered container

10.7) Washcloths using for clean the cylinder should have been kept in covered container when not using.

11) Process of wasting disposal

11.1) The working process standard should be written to be a standard of enterprise, documented them and post them in the working area.

11.2) Empty container should be separated from the others kinds of wastes.

11.3) Wastes should be separated into two types such as general waste and contaminated chemical waste.

11.4) The garbage bin for chemical container or contaminated materials should be a metal that has proper lid.

11.5) Wasting products should be taken away from working area at least once a day.

11.6) Area for keeping rubbish and workplace should be separated and organized properly.

11.7) The disposal of chemical wastes should be eliminated by separate them out off other types of wastes and sent to eliminate by specialist organization. Chemical wastes should not be reused. If the printing factories wanted to eliminate by themselves, they should strictly follow materials safety data sheet of the chemicals.

3.7 Intervention of the program and data collection

This step is about insertion the intervention program with the sample. Before and after insert the intervention program, the data about chemical management of both printing factories will be collected by using the chemical management checklist. The detail of data collection and injection the intervention program are as follows.

3.7.1 Choosing two printing factories which are meet in the criteria in Bangkok area.

3.7.2 Inform the owner for asking cooperation and permission to the project.

3.7.3 Explore working environment and both generality of physical and chemistry side, especially work process that uses volatile organic compounds.

3.7.4 The first collected data is to get the data base of each printing factories obtained by the following steps.

1) Surveying the chemical storage room by using chemical storage checklist.

2) Exploring the chemical exposed in working area by using working process checklist.

Responsible person to assess chemical management were the researcher and the owner. Both of auditors will survey the chemical storage room and working areas at the same time. After completing the assessment, auditors will have the conference to conclude the results obtained from the assessment.

3.7.5 Seeking how to develop process of chemical management that is suitable with the printing factories.

3.7.6 Having a meeting with the owner and someone whom get into for presenting developing process of management and making decision together for the possible and proper ways to improve the chemical management. The improvement ways are as follows.

1) Improving process and safety practice in working with chemical.

2) Correcting the way in using the personal safety equipment for working with chemical.

3) Adjust chemical tools that help workers from being exposed to chemical.

4) The warning sign have been provided in working area.

5) Improve fire prevention system.

6) Giving education for workers who exposed to chemical during working.

3.7.7 Improving the chemical management follow the conclusion that everybody will make decisions together.

3.7.8 The second collected data is to get the feedback detail after the chemical management has been improved by this following operation.

1) Surveying the chemical storage room by using chemical storage checklist.

2) Exploring the chemical exposed in working area by using working process checklist.

Responsible person to assess chemical management were the researcher and the owner. Both of auditors will survey the chemical storage room and working areas at the same time. After completing the assessment, auditors will have the conference to conclude the results obtained from the assessment.

3.7.9 Analyze and summarize the data that has been collected from the first and second time.

3.8 Data analysis

Data analysis has been divided into two titles that are composed of chemical storage management analysis and risk level in work process management and use SPSS version 12 to analyze the data.

3.8.1 Data analysis about the result of chemical storage assessment.

1) Descriptive Statistics by considering variation of the level result from first and second data collection in percentage.

2) The statistic that used to compare two groups of data (Related group) is Pair t-test.

3.8.2 Data analysis about work process assessment.

1) Descriptive Statistics by considering variation of the level result from first and second data collection in percentage.

2) Test the significance of data changing before and after improving the work processes by using Binomial test.

CHAPTER IV
RESULTS

This research studied about chemical management within two printing factories. The results revealed in 6 sections as follows:

4.1 The general characteristics of the printing factories

4.2 The assessment of pre- and post-improvements in chemical management for a chemical storage facility

4.3 Results of statistic analysis in assessing chemical storage

4.4 Work process assessment of pre- and post-improvements in chemical management

4.5 Results of statistic analysis of work process assessment

4.6 Improvements of chemical management in printing factories

4.1 The general characteristics of the printing factories

After surveying both printing factories, it was found that both printing factories were small-sized with no more than fifty employees. Both printing factories have worked for eight hours per day and had one shift per day. The general characteristics of both printing factories were as follows.

4.1.1 The general characteristics of the printing factory A

Printing factory A was located in the metropolitan area. The factory was two floors building. For its chemical operation, the area was located on the first floor. The building was made of concrete and had only one entrance. Overall, the printing factory A had four printers namely; one was Idenberg printer, which was IPA based offset printer for one-sized job; one was Roland printer, which was water-based offset printer for one-sized job; two were Superjet printer, which were offset printer for four-sized job.

Printing factory A possessed two chemical storage rooms. Inflammable chemicals were separately kept from other chemicals. Both chemical storage rooms were closed rooms with only one entrance. Both chemical storage rooms were located under the ladder. The size of both storage rooms were two square meters. The non-inflammable chemical storage room has only one shelf but another chemical storage room did not have any cabinet.

To store non-inflammable chemicals, the workers of printing factory A stored chemicals on the shelf and the floor. They did not keep chemicals properly as well as other materials such as washcloths, brooms altogether within the chemicals storage room.

To store inflammable chemicals, the workers of printing factory A stored chemicals on the floor. They did not keep the chemicals properly.

4.1.2 The general characteristics of the printing factory B

The same as printing factory A, printing factory B was located in the metropolitan area. The factory was one floor building. Printing factory B had three printers namely, two were five-color offset printers for one-sized job, based on isopropyl alcohol, other one was cut water based offset printer for one-sized job.

Printing factory B had two chemical storage rooms. Both two rooms were separated to keep inflammable chemicals from other chemicals. Both chemical storage rooms were separated from the working area. Both chemical storage rooms were not closed rooms and had only one entrance. Size of non-inflammable storage room was 4.5 square meters and had four shelves within the room. In the room, three sides of wall had the air vents. The size of inflammable storage room was four square meters and did not have any shelf or other materials within the room.

To store non-inflammable chemicals, the workers of printing factory B stored the chemicals on the shelf and the floor. They did not keep chemicals and other materials properly such as washcloths, brooms altogether within the room. It was also found that they kept some thinner within this room.

To store inflammable chemicals, the workers of printing factory B stored the chemicals on the floor and did not keep the chemicals properly.

Chemicals used in printing factory B were ink, isopropyl alcohol, water, fountain solution, thinner, kerosene, white gasoline, plate cleaner solution, gum Arabica. In the printing process, ink, isopropyl alcohol and fountain solution were used with IPA-based printer. Ink, water and fountain solution were used with water-based printer. In the process of cleaning rollers, thinner was used to clean rollers. In the process of cleaning blanket, white gasoline was used to clean blankets. In the process of cleaning cylinders, kerosene was used to clean the cylinders and other materials used in this work included sponges and washcloths.

4.1.3 Work processes in two printing factories

The printing factory A had 10 work processes i.e. process of receiving chemicals from suppliers and transferring chemicals to the storage room, chemicals storage process, chemical application process, chemical transfer process, plate-making process, printing process, plate cleaning process, roller cleaning process, blanket cleaning process, cylinder cleaning process and waste discarding process. The printing factory A did not have plate-making process because they did not make their own plate. The printing factory B had 11 work processes because they made the plate for their own use. The following figures show work processes.

Figure 4.1 Process of receiving chemical from suppliers and transferring chemicals to the storage room

Both printing factories had similar work process. The suppliers' workers would move chemicals into the storage room in a way shown in the figure 4.1. If chemical containers were large, trolley was used to move chemicals.

Figure 4.2 Chemical storage process

Both printing factories had similar work process. In this process, after chemicals were received, workers would store chemicals into the chemicals storage room in a way as shown in the figure 4.2. It was found that workers of both printing factories did not focus on performing their task in chemical storage procedure properly. For keeping chemicals orderly, it was found that workers did not keep chemicals orderly and they did not concern about the position of lid. Also they put chemicals on the floor which obstructed traffic in the chemicals storage room.

For chemical application process, it was found that workers did not read chemical name label before picking them from a shelf and each shelf did not have any the label showing the name of chemicals.

For chemical transfer process, it was found that workers did not use any personal protective equipment while transferring chemical. They did not use measuring instruments to prevent chemical spills and accidents. Also they did not concern about chemical diffusion into the atmosphere as they did not close the lid after this transfer was completed. The process of chemical transfer showed in the following figure.

Figure 4.3 Chemical transfer process

In plate-making process, printing factory A did not have this process. For printing factory B, it was found that the machine was used to make plates. Therefore, workers have been exposed to chemical at low level. The following figure showed the plate making machine.

Figure 4.4 Plate-making machine

In printing process, this process started from inserting plate into the printer, then inserted chemicals (ink, fountain solution etc.) and inserted paper into the printer. After that it would be a printed job as needed. It was observed that workers did not use any personal protective equipment while working. For printing factory A, ink, isopropyl alcohol and fountain solution were used with Idenberg printer. For printing factory B, ink, isopropyl alcohol and fountain solution were used with IPA-based printer. Ink, water and fountain solution were used with water-based printer.

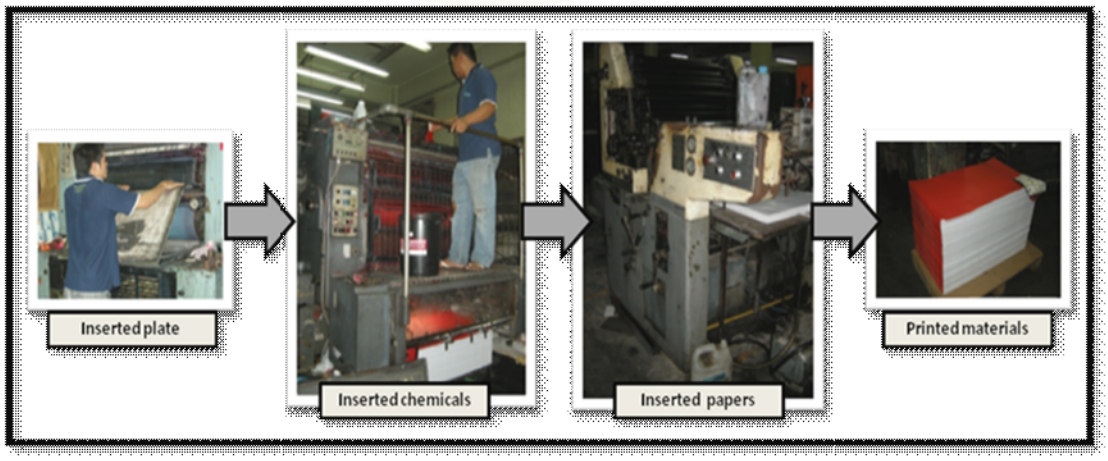

Figure 4.5 Printing process

In cleaning process, this process had four sub-processes namely; plate cleaning, roller cleaning, blanket cleaning and cylinder cleaning. Workers would have to wipe the parts of printer before starting work every day and wipe these parts after each printed job was complete. To perform this work, sponges or washcloths were dip into chemicals. Alternatively, chemical was poured down on the area and then wiped by washcloths. The following figure showed the cleaning process.

In the process of cleaning rollers, isopropyl alcohol was used to wipe roller. In the process of cleaning blanket, white gasoline was used to wipe blanket. In the process of cleaning cylinders, kerosene was used to wipe cylinders.

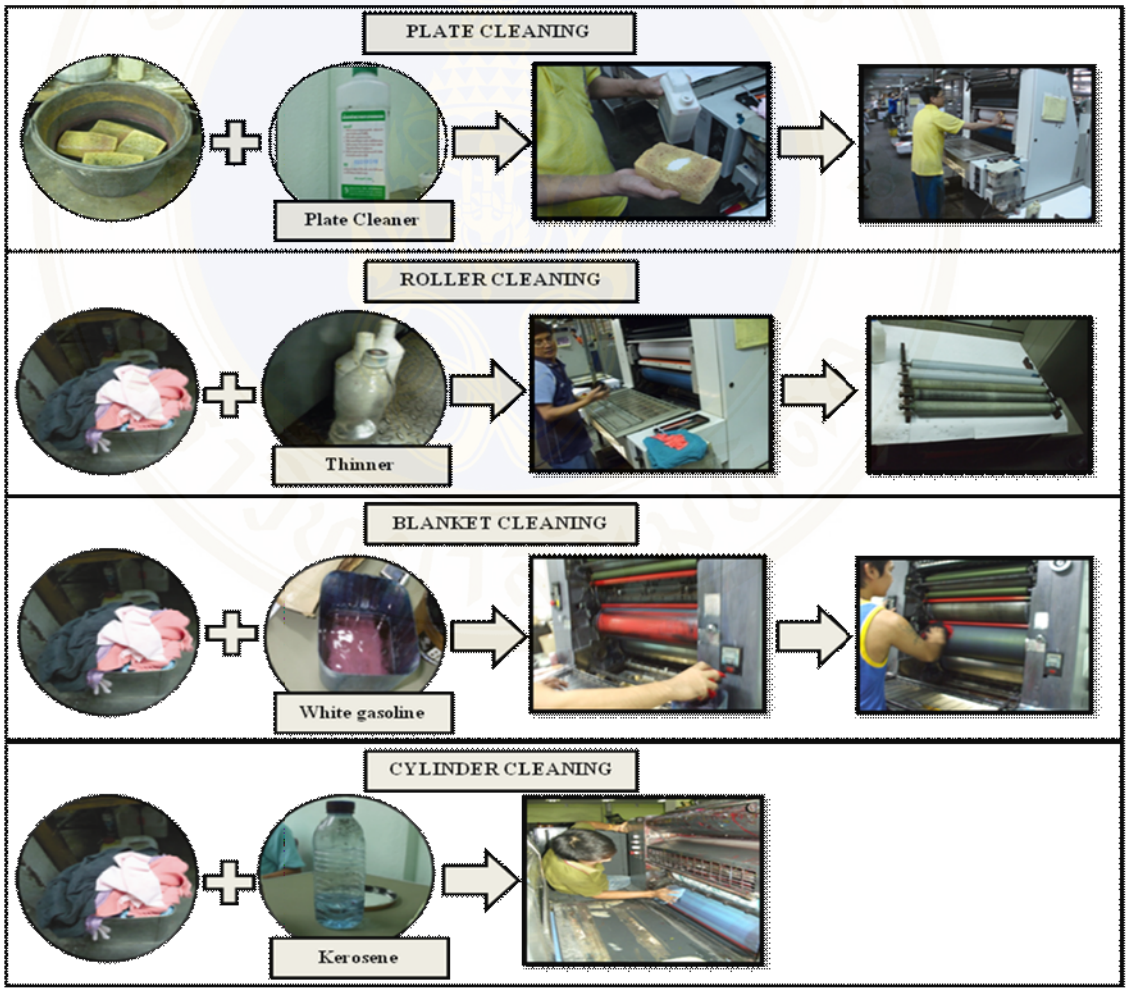

Figure 4.6 Cleaning Process

In waste discarding process, it was found that both printing factories did not separate the bin and their bin did not have the lid. They only separated the paper

from other wastes because of commercial purpose. Therefore other wastes would be sent to the other companies to properly manage.

4.2 The assessment of pre- and post-improvements in chemical management for a chemical storage facility

Chemical storage checklist is a checklist used to check level of compliance with the notification of Department of Industrial Works; Manual for the storage of chemicals and hazardous materials, B.E. 2550[8]. Checklist showed scores at different level. The printing factories were required to comply with the regulations. Table 4.1 revealed chemical storage assessment in a printing factory A. Table 4.2 revealed chemical storage assessment in a printing factory B.

Table 4.1 Level of compliance with chemicals storage regulations in printing factory A

Assessment items	Total score	Level of Compliance with chemical storage regulations	
		Pre-improve-ment	Post-improve-ment
1.Chemicals storehouse			
1.1 Location (1) - There is a separated area to store chemical.	1	1	1
1.2 Wall (2) - For a room used to store non-combustible materials, its walls are required to resist fire at least 30 minutes. - For a room used to store flammable substances, its walls are required to resist fire at least 90 minutes.	1 1	1 1	1 1

Table 4.1 Level of compliance with chemicals storage regulations in printing factory A (cont.)

Assessment items	Total score	Level of Compliance with chemical storage regulations	
		Pre-improve-ment	Post-improve-ment
1.Chemicals storehouse			
1.3 Floor (4)			
- The floor is required to be strong enough to support the weight.	1	1	1
- The floor of the storage room is not cracked, rough, wet or slippery.	1	0.5	0.5
- Flooring materials must be resistant to water and chemicals.	1	1	1
- The electrical conductivity of the ground, in case of storing flammable liquid or gas.	1	0	0
1.4 Doors and emergency exits (5)			
- Number of doors.	1	-	-
- The width of exits.	1	-	-
- Each door used as an emergency exit easily must be openable from the inside in one way.	1	-	-
- From the inside and the outside, each emergency exit has no obstruction.	1	-	-
- Each emergency exit has a visible and clear symbol indicating as an emergency exit.	1	-	-
1.5 Roof (4)			
- Materials used to make the roof are resistant to fire for 30 minutes.	1	1	1

Table 4.1 Level of compliance with chemical storage regulations in printing factory A (cont.)

Assessment items	Total score	Level of Compliance with chemical storage regulations	
		Pre-improve-ment	Post-improve-ment
1.Chemical storage facility			
1.5 Roof (4)			
- The roof of a storage facility can release heat and smoke.	1	0	0
- The main structure supporting the roof is protected with non-combustible materials.	1	1	1
- No blemish was found in the roof.	1	1	1
1.6 Ventilation System (1)			
- The storage facility has a ventilation system.	1	0	0
1.7 Lighting systems and electrical equipment (5)			
- Explosion protected electrical equipment are equipped in any area where flammable substances are handled.	1	0	0
- Lights are installed above hazardous materials at least 0.5 meters and they do not cause chemical heat up.	1	1	1
- Metal Halide lamps and Mercury lamps must have their cover.*	1	-	-
- Electrical equipment installed within a storage facility is grounded.*	1	-	-
- Electrical equipment installed within a storage facility is in good condition.*	1	-	-

Table 4.1 Level of compliance with chemical storage regulations in printing factory A (cont.)

Assessment items	Total score	Level of Compliance with chemical storage regulations	
		Pre-improve-ment	Post-improve-ment
1.Chemical storage facility			
1.8 Warning system (5)			
- Fire alarm system is equipped in a storage facility.	1	-	-
- Sound of fire alarm is loud.	1	-	-
- An alarm system is installed properly (press type).	1	-	-
- An alarm system is tested properly.	1	-	-
- Heat or smoke detectors are available.	1	-	-
1.9 Portable fire extinguishers (7)			
- The amount of portable fire extinguishers is appropriate.	1	1	1
- Portable fire extinguishers are inspected semi-annually.	1	1	1
- For installation of a portable fire extinguisher, a handle is installed above the ground from 1 to 1.4 meters.	1	0	0
- Employees can conveniently move the portable fire extinguishers.	1	1	1
- Portable fire extinguisher signs are showed in a chemical storage facility.	1	0	1
- Guidepost indicating the location of portable fire extinguishers is available.	1	0	0
- The map showing the location of portable fire extinguishers is properly sized unit.	1	0	0

Table 4.1 Level of compliance with chemical storage regulations in printing factory A (cont.)

Assessment items	Total score	Level of Compliance with chemical storage regulations	
		Pre-improve-ment	Post-improve-ment
2. How to store chemicals			
- Different types of chemicals are separately stored in different area.	1	0	1
- Flammable chemicals are separately stored from all other chemicals. Do not store flammable chemicals together with other chemicals.	1	1	1
- Chemicals which can react dangerously with each other are not stored in similar location.*	1	-	-
- Keep chemicals orderly so that they will not obstruct the work, also move objects and use the emergency equipment.	1	0.75	1
- Chemicals are stored in the containers with closed lids, kept in the storage cabinets or on shelves with rail to avoid the potential for falling or dropping chemicals.	1	0	0
- Containers of hazardous chemicals are made of strong materials and no corrosion.	1	1	1
- Do not store materials causing inflammation in the storage facility such as paper, clothes.	1	0	1
- All types of chemicals have label affixed to the container.	1	1	1
- Label of chemicals is clearly visible.	1	1	1

Table 4.1 Level of compliance with chemicals storage regulations in printing factory A (cont.)

Assessment items	Total score	Level of Compliance with chemical storage regulations	
		Pre-improve-ment	Post-improve-ment
2. How to store chemicals			
- Label of chemicals shows scientific name and warning sign about the toxicity of the product.	1	0.75	1
- Material safety data sheet is available for every kind of chemical.	1	0	1
3. Preventive measures			
3.1 Cleaning (1)			
- The storage facilities are cleaned.	1	0	1
3.2 Traffic Routing (3)			
- Traffic is routed.	1	-	-
- Traffic is routed along its color markers.	1	-	-
- Safe distance is kept between traffic paths.	1	-	-
3.3 Safety signs (4)			
- Warning signs or hazardous symbols for types of hazardous chemicals are represented.	1	0	1
- Warning signs or hazardous symbols for types of hazardous chemicals are represented and they are printed in red letters.	1	0	1
- Signs "Storage of chemicals" are clearly represented in a proper size.	1	0	1
- Signs "No smoking" are clearly represented in a proper size.	1	0	1
Total	**49**	**18**	**27.50**

According to the table 4.1, total assessment list consists of 13 items. However, only ten assessment items were evaluated. The remaining three assessment items were not evaluated because printing factory A did not manage about these. They included door and emergency exit, warning system, traffic route. From the table 4.1, total score was 49. A score of pre-improvement in chemical management was 18 (36.73%). After improving chemical management, the score of compliance with chemical storage regulations was increased to 27.50 (56.12%).

Table 4.2 Level of compliance with chemical storage regulations in printing factory B

Assessment items	Total score	Level of Compliance with chemical storage regulations	
		Pre-improve-ment	Post-improve-ment
1. Chemical storage facility			
1.1 Location (1) - There is a separated area to keep chemical.	1	1	1
1.2 Wall (2) - For a room used to store non-combustible materials, its walls are required to resist fire at least 30 minutes. - For a room used to store flammable substances, its walls are required to resist fire at least 90 minutes	1 1	1 1	1 1
1.3 Floor (4) - The floor is required to be strong enough to support the weight. - The floor of the storage room is not cracked, rough, wet or slippery.	1 1	1 1	1 1

Table 4.2 Level of compliance with chemical storage regulations in printing factory B (cont.)

Assessment items	Total score	Level of Compliance with chemical storage regulations	
		Pre-improve-ment	Post-improve-ment
1. Chemical storage facility			
1.3 Floor (4)			
- Flooring materials must be resistant to water and chemical.	1	1	1
- The electrical conductivity is grounded, in case of storing flammable liquid or gas.	1	0	0
1.4 Doors and emergency exit (5)			
- Number of doors.	1	-	-
- The width of exits.	1	-	-
- Each door used as an emergency exit easily must be openable from the inside in one way.	1	-	-
- From the inside and the outside, each emergency exit has no obstruction.	1	-	-
- Each emergency exit has a visible and clear symbol indicating as an emergency exit.	1	-	-
1.5 Roof (4)			
- Materials used to make the roof are resistant to fire for 30 minutes.	1	1	1
- The roof of a storage facility can release heat and smoke.	1	1	1
- The main structure supporting the roof is protected with non-combustible materials.	1	1	1
- No blemish was found in the roof.	1	1	1

Table 4.2 Level of compliance with chemical storage regulations in printing factory B (cont.)

Assessment items	Total score	Level of Compliance with chemical storage regulations	
		Pre-improve-ment	Post-improve-ment
1.Chemicals storehouse			
1.6 Ventilation System (1) - The storage room has a ventilation system.	1	1	1
1.7 Lighting systems and electrical equipment (5) - Explosion protected electrical equipment are equipped in any area where flammable substances are handled.	1	0	0
- Lights are installed above hazardous materials at least 0.5 meters and they do not cause chemical heat up.	1	1	1
- Metal Halide lamps and Mercury lamps must have their cover.*	1	-	-
- Electrical equipment installed within a storage facility is grounded.*	1	-	-
- Electrical equipment installed within a storage facility is in good condition.*	1	-	-
1.8 Warning system (5) - Fire alarm system is equipped in a storage facility.	1	-	-
- Sound of fire alarm is loud.	1	-	-
- An alarm system is installed properly (press type).	1	-	-
- An alarm system is tested properly.	1	-	-
- Heat or smoke detectors are available.	1	-	-

Table 4.2 Level of compliance with chemical storage regulations in printing factory B (cont.)

Assessment items	Total score	Level of Compliance with chemical storage regulations	
		Pre-improve-ment	Pre-improve-ment
1.Chemical storage facility			
1.9 Portable fire extinguishers(7)			
- The amount of portable fire extinguishers is appropriate.	1	1	1
- Portable fire extinguishers are inspected semi-annually.	1	1	1
- For installation of a portable fire extinguisher, a handle is installed above the ground from 1 to 1.4 meters.	1	1	1
- Employees can conveniently move the portable fire extinguishers.	1	0	0
- Portable fire extinguisher signs are showed in a chemical storage facility.	1	1	1
- Guidepost indicating the location of portable fire extinguishers is available.	1	0	1
- The map showing the location of portable fire extinguishers is properly sized unit.	1	0	0
2. How to store chemicals			
- Different types of chemicals are separately stored in different area.	1	0.75	1
- Flammable chemicals are separately stored from all other chemicals. Do not store flammable chemicals together with other chemicals.	1	0.75	1

Table 4.2 Level of compliance with chemicals storage regulations in printing factory B (cont.)

Assessment items	Total score	Level of Compliance with chemical storage regulations	
		Pre-improve-ment	Pre-improve-ment
2. How to store chemicals			
- Chemicals which can react dangerously with each other are not stored in similar location.*	1	-	-
- Keep chemicals orderly so that they will not obstruct the work, also move objects and use the emergency equipment.	1	0.75	1
- Chemicals are stored in the containers with closed lids, kept in the storage cabinets or on shelves with rail to avoid the potential for falling or dropping chemicals.	1	0.25	0.25
- Containers of hazardous chemicals are made of strong materials and no corrosion.	1	1	1
- Do not store materials causing inflammation in the storage facility such as paper, clothes.	1	0	1
- All types of chemicals have label affixed to the container.	1	0.75	1
- Label of chemicals is clearly visible.	1	0.75	1
- Label of chemicals shows scientific name and warning sign, statement that mention about the toxicity of the product, caution and vendor.	1	0.75	1
- Material safety data sheet is available for every kind of chemical.	1	0	1

Table 4.2 Level of compliance with chemicals storage regulations in printing factory B (cont.)

Assessment items	Total score	Level of Compliance with chemical storage regulations	
		Pre-improve-ment	Pre-improve-ment
3. Preventive measures			
3.1 Cleaning. (1) - The storage facilities are cleaned.	1	0	1
3.2 Route traffic. (3) - Traffic is routed. - Traffic is routed along its color markers. - Safe distance is kept and showed between traffic paths	 1 1 1	 - - -	 - - -
3.3 Safety signs (4) - Warning signs or hazardous symbols for types of hazardous chemicals are represented. - Warning signs or hazardous symbols for types of hazardous chemicals are represented and they are printed in red letters. - Signs "Storage of chemicals" are clearly represented in a proper size. - Signs "No smoking" are clearly represented in a proper size.	 1 1 1 1	 0 0 0 0	 1 1 1 1
Total	**49**	**21.75**	**32.25**

The same as a printing factory A, a printing factory B had only 10 assessment items for assessment. A printing factory B could not assess the remaining three items namely, door and emergency exit, warning system, traffic route because it did not manage about these. From the table 4.2, total score was 49. A score of pre-

improvement in chemical management was 21.75 (44.39%). After improving chemical management, a score of compliance with chemical storage regulations was increased to 32.25 (65.82%).

4.3 Results of statistic analysis in assessing chemical storage

The objective of this section was to compare means of pre- and post improvements in chemical storage. In this study, Pair t-test was used to study effect of pre- and post-improvements in chemical management on chemical storage. The results are as follows.

Table 4.3 Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	BEFORE - AFTER	-10.0000	.70711	.50000	-16.3531	-3.6469	-20.000	1	.032

From the table 4.3, Sig.(2-tailed) was equal to 0.032 and it was less than $\alpha = 0.05$. So, the score of post-improvement was higher than the score of pre-improvement in chemical management in both printing factories with statistical significance at 95% confidence level (p-value = 0.016).

4.4 Work process evaluation of pre- and post-improvements in chemical management

Work process checklist is a checklist used to assess risk behind each work process from the process of receiving chemicals from the supplier and transfer to the chemical storage, chemicals storage, chemical application, chemical transfer to another container/smaller container, chemical application in work process and waste

discarding. The outcome of this checklist showed risk at different level for each work process. The result of work process assessment of printing factory A and B were shown in table 4.4 and table 4.5.

Table 4.4 Risk level found in work process of printing factory A

Work process	Pre- improvement			Post-improvement		
	Likelihood	Impact	Risk level	Likelihood	Impact	Risk level
1.Receiving chemical from suppliers and transfer chemical to storage room	Medium	Low	Acceptable	Medium	Low	Acceptable
2.Chemical storage	Medium	Low	Acceptable	Low	Low	Low
3.Chemical application	Medium	Low	Acceptable	Low	Low	Low
4.Chemical transfer	High	Medium	High	Medium	Medium	Medium
5. The purpose of using chemical						
-Printing	High	Medium	High	Medium	Medium	Medium
-Plate cleaning	High	Medium	High	Medium	Medium	Medium
-Roller cleaning	High	Medium	High	High	Medium	High
-Blanket cleaning	High	Medium	High	High	Medium	High
-Cylinder cleaning	High	Medium	High	Medium	Medium	Medium
6.waste discarding	Medium	Low	Acceptable	Low	Low	Low

Table 4.5 Risk level found in work process of printing factory B

Work process	Before improvement			After improvement		
	Likelihood	Impact	Risk level	Likelihood	Impact	Risk level
1. Receiving chemical from suppliers and transfer chemical to storage room	Medium	Low	Acceptable	Low	Low	Low
2.Chemical storage	High	Low	Medium	Low	Low	Low
3. Chemical application	Medium	Low	Acceptable	Low	Low	Low
4.Chemial transfer	High	Medium	High	Low	Medium	Acceptable
5.The purpose of using chemical						
-Plate creating	Low	Low	Low	Low	Low	Low
-Printing	High	Medium	High	Low	Medium	Acceptable
-Plate cleaning	High	Medium	High	Low	Medium	Acceptable
-Roller cleaning	High	Medium	High	Low	Medium	Acceptable
-Blanket cleaning	High	Medium	High	Low	Medium	Acceptable
-Cylinder cleaning	High	Medium	High	Low	Medium	Acceptable
6.waste discarding	Medium	Low	Acceptable	Low	Low	Low

4.5 Results of statistic analysis of work process assessment

Pre- and post-improvement data in work process was significantly tested. The objective was to study effect of chemical management improvement. Risk level found in work process must be solved. Table 4.6 showed risk level for each work process (summarized from table 4.4 and table 4.5).

Table 4.6 Risk level for each work process

Risk level	Printing factory A		Printing factory B	
	Pre-improvement	Post-improvement	Pre-improvement	Post-improvement
Low	0	3	1	4
Acceptable	4	1	3	7
Medium	0	4	1	0
High	6	2	6	0
Unacceptable	0	0	0	0
Total	**10**	**10**	**11**	**11**

For pre-improvement, printing factory A had six processes (60%) at high risk level and a reduction of such risk level was required. For post-improvement, risks of four work processes at high level were decreased to medium level. However, it was found high risk level in two work processes.

For pre-improvement, printing factory B had seven processes (63.64%) at high risk level and a reduction of such risk level was required. For post-improvement, there was no found risk at high level for any work process.

From table 4.6, data was divided into two parts namely, level of risk, which risk reduction was required (i.e. unacceptable, high, medium) and the level of risk, which risk reduction was not required (i.e. acceptable, low). The data was analyzed by using Binomial Test.

4.5.1 Results of statistic analysis of work process assessment for printing factory A

From the following table 4.7, p-value was equal to 0.377, which was higher than α (α = 0.05). Therefore, after improving chemical management in printing factory A, risk level found in work process was not lower than risk level before improving chemical management.

Table 4.7 Binomial Test of printing factory A

		Category	N	Observed Prop.	Test Prop.	Exact Sig. (2-tailed)
Before Improvement	Group 1	Improvement is not required	4	.40	.50	.754
	Group 2	Improvement is required	6	.60		
	Total		10	1.00		
After improvement	Group 1	Improvement is not required	4	.40	.50	.754
	Group 2	Improvement is required	6	.60		
	Total		10	1.00		

4.5.2 Results of statistic analysis of work process assessment for printing factory B

Table 4.8 Binomial Test of printing factory B

		Category	N	Observed Prop.	Test Prop.	Exact Sig. (2-tailed)
Before improvement	Group 1	Improvement is not required	4	.36	.50	.549
	Group 2	Improvement is required	7	.64		
	Total		11	1.00		
After improvement	Group 1	Improvement is not required	11	1.00	.50	.001
	Total		11	1.00		

From the table 4.8, p-value was equal to 0.0005, which was lower than α (α = 0.05). Therefore, after improving chemical management in printing factory B,

risk level found in work process was lower than risk level before improving chemical management with statistical significance at 95% confidence level (p-value = 0.0005).

4.6 Improvement of chemical management in printing factories

The objectives of improvement of chemical management in printing factory A and B were to perform chemical storage management according to regulations, to reduce chemical spreads into the air, as well as reduce worker's exposure to the chemical. However, improvement of chemical management in each printing factory must be approved from its executives or other authorized people who make a decision to improve chemical management in printing factory.

Improvement of chemical management in printing factory A and B were divided into two parts namely, improvement of chemical storage and work process with chemical. Here, improvement refers to an adjustment of mishandled items/parts with chemical storage checklist but improvement guidelines must be approved from printing factory's executives.

The details of improvement of chemical management in each printing factory were as follows.

4.6.1 Improvement of chemical storage in printing factory A

Improvement of chemical storage in printing factory A was as follows.

1) General improvement of chemical storage room

According to manual item 2, this title discussed about generalization of chemical storage room. The owner of printing factory A decided to make some adjustment as follows.

1.1) A sign indicating a position of portable fire extinguishers is represented in red color (Make adjustment according to *fire management* in manual item 2.9.1.4)

Printing factory A installed one portable fire extinguisher Type ABC within chemicals storage room and one within the inflammable storage room with appropriate numbers and types. But a sign showing a location of portable fire extinguisher was not available as shown in figure 4.7.

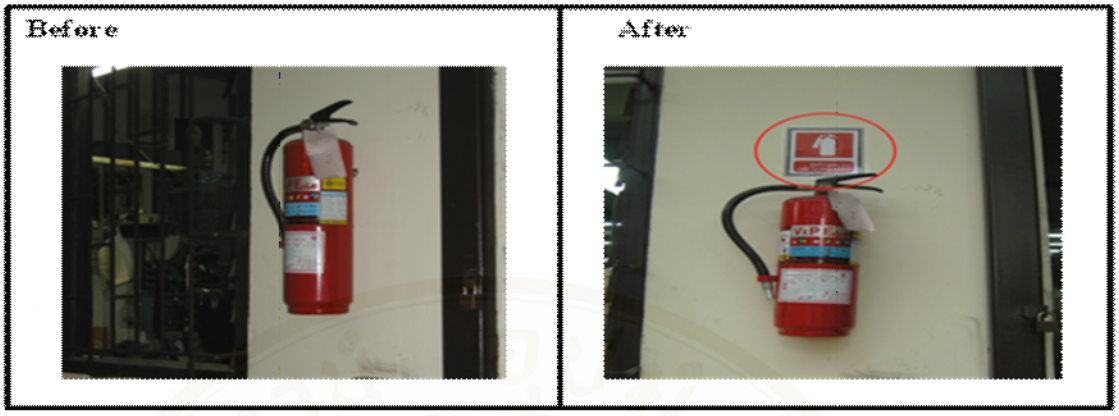

Figure 4.7 A sign showing a location of portable fire extinguisher is marked in printing factory A

2) Improvement of chemical storage procedure

Improvement of chemical storage procedure was to adapt most of all chemical management items managed by printing factory A. The aforementioned adaptations were as following.

2.1) Material safety data sheet was available for every type of chemicals stored in chemical storage room. Material safety data sheet was sent to the owner or authorized people. Moreover, it is necessary that workers recognize advantages of material safety data sheet as well as the place to keep the data sheet. Workers were permitted to read the material safety data sheet (Make adjustment according to *safety data study by classifying chemicals and dangerous materials* in manual item 3.2.1)

Printing factory A's material safety data sheet inspected white gasoline, thinner, kerosene, IPA, ink, fountain solution, plate cleaner.

2.2) Various types of chemicals placed on storage shelves or cabinets were properly named and labeled according to their type. Every type of chemical was stored orderly and safely when workers need to use.

In printing factory A, all chemicals were kept on only one storage shelf with three layers. All chemicals were kept disorderly and categories of chemicals were not apparent. Chemical storage shelves did not provide the chemical label. Thus, in this section, improvement was to ensure that chemical storage shelves have the chemical label as shown in figure 4.8.

Figure 4.8 Chemical storage shelves have the chemical label

2.3) Chemical labels or warning signs for every kind of chemical were marked. Different kinds of chemicals were separately stored in their particular area according to their kind. Every type of chemical was stored orderly and safely when workers need to use.

Within the printing factory A's inflammable chemical storage facility, there was no warning sign or chemical label for hazardous chemicals.

Various types of chemicals were not kept separately according to their types. Improvement of this item was to ensure that hazardous chemicals have warning sign or chemical label as shown in figure 4.9.

Figure 4.9 Warning sign or chemical label for hazardous chemicals were marked in the chemical storage facility

2.4) All chemical containers were labeled clearly and any ruined or decayed labels were replaced by new labels.

The following figure showed replacing the decayed label of chemical.

Figure 4.10 Labeling chemical containers that could not be seen clearly

2.5) All chemicals that obstructed work process or traffic were required to move away and then be stored on the shelf (Make adjustment according to Heading *Hygienic of chemical storage room, Preventive measure* in manual item 4.1.3.5).

Figure 4.11 Chemicals that obstructed work process were required to move and store on the shelf

From figure 4.11, chemicals were kept disorderly on the floor so that they obstructed exit. To make adjustment, scattering chemicals were kept on the shelf as shown in figure 4.11.

2.6) Inventories that might cause inflammation such as the washcloths used to wipe the printer in printing process were moved out of the chemical storage facility (Make adjustment according to Heading *Procedure of chemicals and hazardous materials storage, classification of chemicals and hazardous materials for keeping* in manual item 3.3).

In the printing factory A, other materials were kept together with chemicals. To make adjustment, washcloths were kept away from inflammable materials or moved out of the chemical storage facility as showed in figure 4.12.

Figure 4.12 Inflammable materials were moved out of the chemical storage facility

3) Improvement of preventive measure

3.1) Chemical storage facility was cleaned and arranged orderly (Make adjustment according to Heading *Hygiene of chemical storage room, preventive measure* in manual item 4.1.3.1).

3.1.1) In the printing factory A, other materials such as brooms, buckets, washcloths etc. were kept in the chemical storage facility. To make adjustment, all chemicals were stored neatly and tidily as well as other materials were moved out of the chemicals storage facility as shown in figure 4.13.

Figure 4.13 Chemical storage facility was cleaned and arranged neatly and tidily

3.1.2) A warning sign was marked within the chemical storage facility (Make adjustment according to Heading *safety symbol* in Manual item 4.4).

- The prohibition sign "No smoking" was clearly shown.

- The safety condition sign "Chemical storage room" was clearly shown.

In the printing factory A, warning signs for hazardous chemicals were not shown within the chemical storage facility. To make adjustment, prohibited signs were shown clearly within the chemical storage facility or other places where workers could see them clearly as shown in figure 4.14 and figure 4.15. Figure 4.15 revealed signs showing place to keep chemicals.

Figure 4.14 Prohibition signs "No smoking" Sign was marked inside the chemicals storage facility

Figure 4.15 Safety condition sign "Chemical storage room" Sign was marked inside the chemicals storage facility

4.6.2 Work process improvement in printing factory A

In the printing factory A, since the owner believed that it was not necessary to adjust all work processes, some work processes were adjusted. Work process adjustments in printing factory A were as follows.

1) Improvement of receiving chemicals from suppliers and transfer chemicals to chemical storage facility

Since the owner of printing factory A thought that this process did not cause danger to workers as well as workers who worked in this process were employees of the supplier companies, he did not decide to improve this work process.

2) Improvement of chemical storage process

Although workers in purchasing department had their responsibility to store and sort chemicals, they did not perform their tasks orderly and their work steps would not be followed appropriate principles and documents. Besides, it was found that workers did not concern about safety but simply performs their jobs. Improvements of chemical storage process in printing factory A were as follows.

2.1) To orderly keep any chemicals on a shelf, the container lid must be placed on the top as well as ensure that container lid was closed tightly to protect chemical spills or leaks as shown in figure 4.16

Pre-improvement, worker did not concern about the opening side of chemical container that kept on shelf. Post-improvement, the opening side of

chemical container must be carefully concerned as well as ensure that container lid was closed tightly.

Figure 4.16 Chemical containers were orderly arranged and lid was placed on the top side

2.2) Chemicals were orderly arranged according to their expiration date. Chemicals with earliest expiration date were arranged foremost so that they would be applied before. The following figure showed arranging chemicals according to the expiration date.

Pre-improvement, worker arranged according their convenience. Post-improvement, chemicals were orderly arranged according to their expiration date.

Figure 4.17 Chemicals with earliest expiration date were arranged on the foremost rank

2.3) All chemicals were properly kept on their shelves and were prohibited to scatter on the floor in order to avoid working with obstruction.

3) Improvement of chemical application process

To make adjustment, users were required to read chemical labels and signs before taking chemicals from the shelf.

4) Improvement of chemical transfer process

4.1) Equipment/tools that enable chemicals transfer process such as filter funnel were used during chemical transfer from large-sized to small-sized container in order to protect chemical spills. The following figure showed filter funnel was used during chemical transfer.

Figure 4.18 Filter funnel, Equipment that enables chemical transfer process

4.2) Measurable equipments that enable chemical transfer process were used to transfer chemicals to small-sized container in order to protect chemical spills.

Pre-improvement, worker did not use any measurable equipment. So, chemical would spill during chemical transfer. Post-improvement, worker used measurable equipment, secondary container, personal protective equipments while transferring chemicals.

Figure 4.19 Measurable equipment were used during chemical transfer process

4.3) Secondary container was provided and placed under primary container during chemical transfer process to protect chemical leakage and spills on the ground and to reduce unnecessarily loss of chemicals. The following figure showed secondary container (tray) was used while transferring chemical.

Figure 4.20 Containers (trays) were used to trap chemical during chemical transfer process

4.4) Secondary container (tray) was placed below primary container to trap the chemicals from chemical spills. The following figure showed using secondary container (tray) during chemical transfer.

Figure 4.21 Secondary tray was placed below chemical container to trap the chemicals from chemical spills

Pre-improvement, worker did not use secondary container. So, chemical would spill to ground during chemical transfer. Post-improvement, worker used secondary container while transferring chemicals.

4.5) After chemical transfer process was finished, lid of chemical containers was tightly closed to protect the spread of chemicals into air.

5) Improvement of chemical application in various purpose

The work process had two main works processes such as printing process and cleaning process. Both of work processes were required to make adjustment in the similar manner. Both processes were at the core of the production process and needed to be done concurrently. In both processes, hazardous chemicals were required and employees would be exposed to hazardous chemicals. Improvements of this process were as follows:

5.1) After chemical transfer process was finished, lid of chemical containers was tightly closed to protect the spread of chemicals into air.

The following figure 4.22, pre-improvement figure shown that worker did not close the lid of container after finished usage. Post-improvement figure shown that lid of chemical container was tightly closed after finished usage.

Figure 4.22 After finished usage, lid of chemical container was tightly closed to protect chemical spreads

5.2) Area where chemicals were placed was fixed particularly. Chemical was placed in that fixed area to limit the area of using chemical.

The following figure, pre-improvement figure showed that the printing factory's owner did not fix area to place chemicals. Post-improvement figure showed that placing chemicals in the fixed area.

Figure 4.23 Chemicals were placed in a given area

5.3) Date of activation on the chemical container that needed to reuse was written.

Pre-improvement, worker did not write the date of activation on the chemical container. Post-improvement, date of activation on the chemical container that needed to reuse was written.

Figure 4.24 After opening chemical container, date was clearly specified on the label

5.4) If some part of chemical remains and was reused, worker would apply them in regard to the opening date of activation on the chemical container

Figure 4.25 Remaining chemicals were applied regarding the opening date

5.5) In case of dividing some chemicals from a large-sized container, smaller chemical containers were labeled. Chemical containers would be reused. If the container did not have a chemical label, it is possible that user might be confused because shape of containers was similar. If chemical containers were clearly labeled, the user can know kind of chemical and it provided safety to worker.

Pre-improvement figure showed that worker did not label the chemical container. Post-improvement figure showed chemical container that transfer from large containers was labeled.

Figure 4.26 Chemical container that transfer from large containers was labeled

5.6) Prohibition signs in the working area were clearly labeled to protect fire in the work place because of using inflammable chemical substance as shown in figure 4.27.

Figure 4.27 Prohibition signs "No smoking" were shown in the working areas

6) Waste discarding

6.1) Litter bins were separated into two types namely; general waste and contaminated chemical waste. But for paper scraps left from printing process, the worker would separately discard them to another bin and sell them.

Pre-improvement, litter bin did not be separated. So, all kinds of waste were dumped in only one trash. Post-improvement, Litter bins were separated into two types namely; general waste and contaminated chemical waste as showed in figure 4.28.

Figure 4.28 Litter bins were separated into various kinds of waste

6.2) For discarding the inventory or contaminated chemical container, lid was required to close littler bin.

Pre-improvement, litter bin did not have lid. Post-improvement, lid of litter bin for contaminated chemical waste was provided.

Figure 4.29 Lid was required to cover litter bin

6.3) Every litter bin was labeled to inform a kind of wastes.

From the figure 4.30, the post-improvement figure showed that the covered bin had the label.

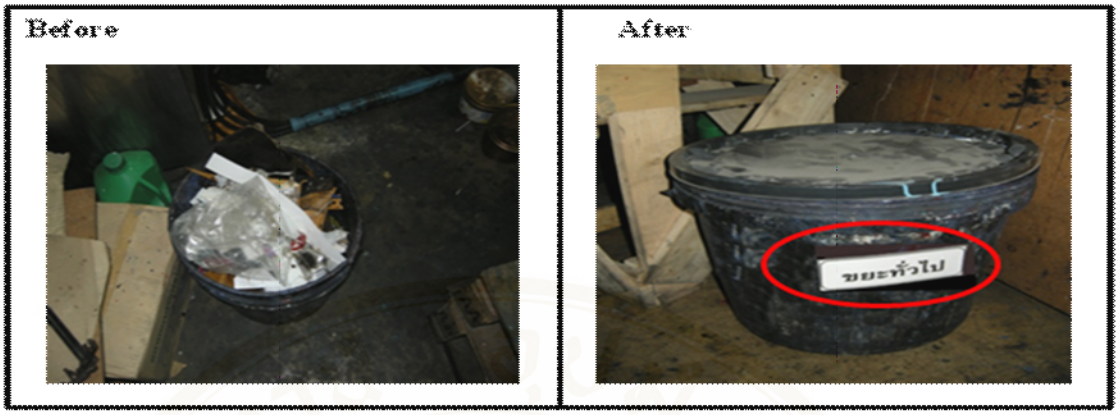

Figure 4.30 Every kind of litter bin was clearly labeled

4.6.3 Improvement of chemical storage in printing factory B.

Chemical storage improvements in printing factory B were as follows:

1) General improvement of chemical storage facility

According to manual item 2, this title discussed about generalization of chemical storage room. The owner of printing factory B decided to make some adjustment as follows.

1.1) A sign indicating a location of portable fire extinguishers is represented in red color (Make adjustment according to Heading *Fire management* in manual item 2.9.1.4)

Figure 4.31 A sign showing a location of portable fire extinguisher is marked in printing factory B

2) Improvement of chemical storage procedure

Improvement of chemical storage procedure was to adapt most of all chemical management items managed by printing factory B. The aforementioned adaptations were as following.

2.1) Material safety data sheet was available for every type of chemicals stored in chemical storage room. Material safety data sheet was sent to the owner or authorized people. Moreover, it is necessary that workers recognize advantages of material safety data sheet as well as the place to keep the data sheet. Workers were permitted to read the material safety data sheet (Make adjustment according to *safety data study by classifying chemicals and dangerous materials* in manual item 3.2.1)

Printing factory B's material safety data sheet inspected white gasoline, thinner, kerosene, IPA, ink, fountain solution, plate cleaner.

2.2) Various types of chemicals placed on storage shelves or cabinets were properly named and labeled according to their type. Every type of chemical was stored orderly and safely when workers need to use.

In printing factory B, all chemicals were kept on storage shelve with two layers. All chemicals were kept disorderly and categories of chemicals were not apparent. Chemical storage shelves did not provide the chemical label. Thus, in this section, improvement was to ensure that chemical storage shelves have the chemical label as shown in figure 4.32.

Figure 4.32 Chemical storage shelves have the chemical label

2.3) Chemical labels or warning signs for every kind of chemical were marked as shown in figure 4.33. Different kinds of chemicals were separately stored in their particular area according to their kind. Every type of chemical was stored orderly and safely when workers need to use.

Figure 4.33 Warning sign or chemical label for hazardous chemicals were marked in the chemical storage facility

2.4) All chemical containers were labeled clearly and any ruined or decayed labels were replaced by new labels.

The following figure showed replacing the decayed label of chemical.

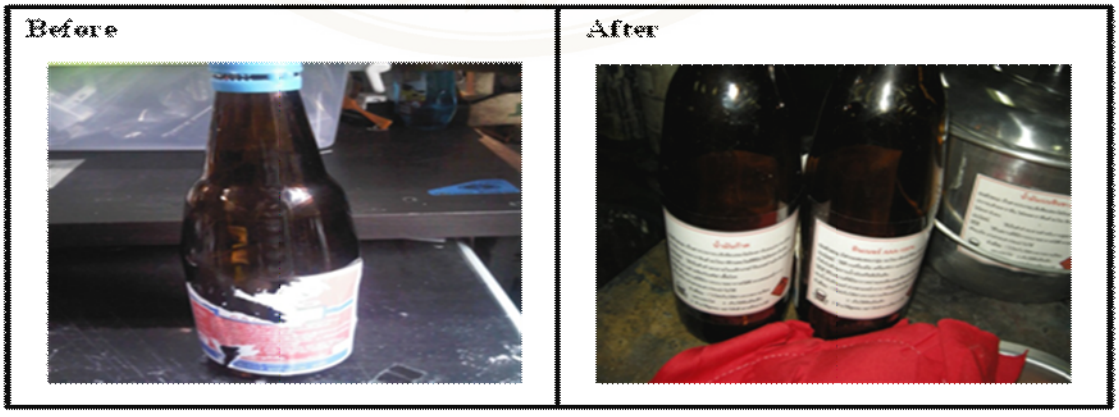

Figure 4.34 Labeling chemicals that could not be seen clearly

2.5) All chemicals as well as emergency equipments that obstructed work process or traffic were required to move away and then be stored on

the shelf (Make adjustment according to Heading *Hygienic of chemical storage room, Preventive measure* in manual item 4.1.3.5).

Figure 4.35 Chemicals that obstructed work process were required to move and store on the shelf

2.6) Inventories that might cause inflammation such as the washcloths used to wipe the printer in printing process were moved out of the chemical storage facility (Make adjustment according to Heading *Procedure of chemicals and hazardous materials storage, classification of chemicals and hazardous materials for keeping* in manual item 3.3).

Figure 4.36 Inflammable materials were moved out of the chemical storage facility

2.7) Inflammable substances such as thinner were moved out of the chemical storage facility and properly kept them in the inflammable chemical

storage room. Pre-improvement of figure 4.37 was shown keeping inflammable chemicals in non-flammable storage room and post-improvement was shown non-flammable storage room that thinner were moved out.

Figure 4.37 Inflammable materials were separated from the chemical storage facility

3) Improvement of preventive measure

3.1) Chemical storage facility was cleaned and arranged orderly (Make adjustment according to Heading *Hygiene of chemical storage room, preventive measure* in manual item 4.1.3.1).

3.2) A warning sign was marked within the chemical storage facility (Make adjustment according to Heading *safety symbol* in manual item 4.4).

- The prohibition sign "No smoking" was clearly shown.
- The safety condition sign "Chemical storage room" was clearly shown.

The following pictures showed the warning signs that labeled in front of the chemicals storage room.

Figure 4.38 Warning signs were marked in front of the chemical storage room

4.6.4 Work process Improvement in printing factory B

Work process improvements in printing factory B were as follows:

1) Improvement of receiving chemicals from suppliers and transfer chemicals to chemical storage facility

Since the owner of printing factory B thought that this process did not cause danger to workers as well as workers who worked in this process were employees of the supplier companies, he decided not to improve this work process.

2) Improvement of chemical storage process

Although workers in purchasing department had their responsibility to store and sort chemicals, they did not perform their tasks orderly and their work steps would not be followed appropriate principles and documents. Besides, it was found that workers did not concern about safety but simply performs their jobs. Improvements of chemical storage process in printing factory B were as follows.

2.1) To orderly keep any chemicals on a shelf, the opening side of chemical container must be carefully concerned as well as ensure that container lid was closed tightly to protect chemical spills or leaks as shown in figure 4.39.

Pre-improvement, worker did not concern about the opening side of chemical container that kept on shelf. Post-improvement, the opening side of chemical container must be carefully concerned as well as ensure that container lid was closed tightly.

Figure 4.39 Container lid was placed on the top

2.2) Chemicals were orderly arranged according to their expiration date. Chemicals with earliest expiration date were arranged foremost so that they would be applied before.

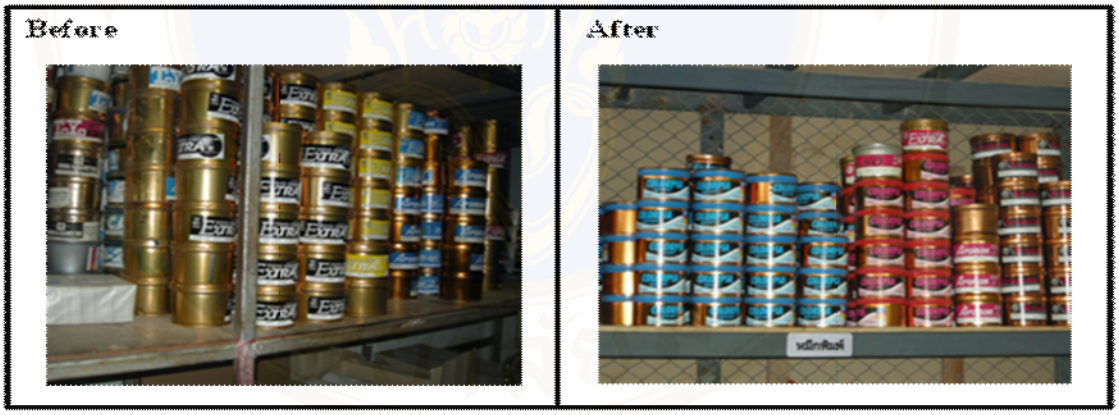

Figure 4.40 Chemicals with earliest expiration date were arranged foremost

Pre-improvement, worker arranged according their convenience. Post-improvement, chemicals were orderly arranged according to their expiration date.

2.3) All chemicals were properly kept on their shelves and were prohibited to scatter on the floor in order to avoid working with obstruction.

2.4) Various types of chemicals were separately stored in accordance with their types.

3) Improvement of chemical application process

The label affixed to chemical containers and the shelves were carefully read. The following figure showed worker was reading the label affixed to chemical containers and the shelves before picking chemical.

Figure 4.41 Labels and chemical signs were carefully read before picking from storage shelves

4) Improvement of chemical transfer process

4.1) Equipment/tools that enable chemicals transfer process such as filter funnel were used during chemical transfer from large-sized to small-sized container in order to protect chemical spills. The following figure showed filter funnel was used during chemical transfer.

Figure 4.42 Equipment that enables chemical transfer process

4.2) Measurable equipment that enable chemical transfer process were used to transfer chemicals to small-sized container in order to protect chemical spills.

Figure 4.43 Measurable equipment were used during chemical transfer process

Pre-improvement, worker did not use any measurable equipment. So, chemical would spill during chemical transfer. Post-improvement, worker used measurable equipment, secondary container, personal protective equipments while transferring chemicals.

4.3) Secondary container was provided and placed under primary container during chemical transfer process to protect chemical leakage and spills on the ground and to reduce unnecessarily loss of chemicals.

Figure 4.44 Containers used for trapping the chemical while transferring

4.4) Secondary container (tray) was placed below primary container to trap the chemicals from chemical spills as shown in figure 4.43.

4.5) After chemical transfer process was finished, lid of chemical containers was tightly closed to protect the spread of chemicals into air.

Figure 4.45 After finished usage, lid of chemical container was tightly closed to protect chemical spreads

4.6) Adsorbent was provided to protect chemical spills or leaks during chemical transfer to another container. The following figure shown adsorbent.

Figure 4.46 Absorbent was provided to protect chemical spills or leaks

4.7) Personal protective equipments such as solvent resistant glove and carbon mask were provided for worker. The following figure shown personal protective equipments.

Figure 4.47 Solvent resistant glove and carbon mask

4.8) Worker wore personal protective equipment (Solvent Resistant Glove and Carbon Mask) while transferring chemicals as shown in figure 4.43.

5) Improvement of chemical application in various purposes

The work process had two main works processes such as printing process and cleaning process. Both of work processes were required to make adjustment in the similar manner. Both processes were at the core of the production process and needed to be done concurrently. In both processes, hazardous chemicals were required and employees would be exposed to hazardous chemicals. Improvements of this process were as follows.

5.1) Area where chemicals were placed was fixed particularly by the printing factory B's owner. Chemical was placed in that fixed area to limit the area of using chemical. The following figure shown placing chemicals in a given area.

The following figure, pre-improvement figure showed that the printing factory's owner did not fix area to place chemicals. Post-improvement figure showed that placing chemicals in the fixed area.

Figure 4.48 Chemicals were placed in a specific area

5.2) Date of activation on the chemical container that needed to reuse was clearly written as shown in figure 4.49.

Figure 4.49 The opening date was clearly specified on the label of chemical containers

Pre-improvement, worker did not write the date of activation on the chemical container. Post-improvement, date of activation on the chemical container that needed to reuse was written.

5.3) If chemical remainder was reused, worker would apply them in regard to opening date.

Figure 4.50 Remaining chemicals were applied regarding the opening date

5.4) In case of dividing some chemicals from a large-sized container, smaller chemical containers were labeled as shown in figure 4.51. Chemical containers would be reused. If the container did not have a chemical label, it is possible that user might be confused because shape of containers was similar. If chemical containers were clearly labeled, the user can know kind of chemical and it provided safety to worker.

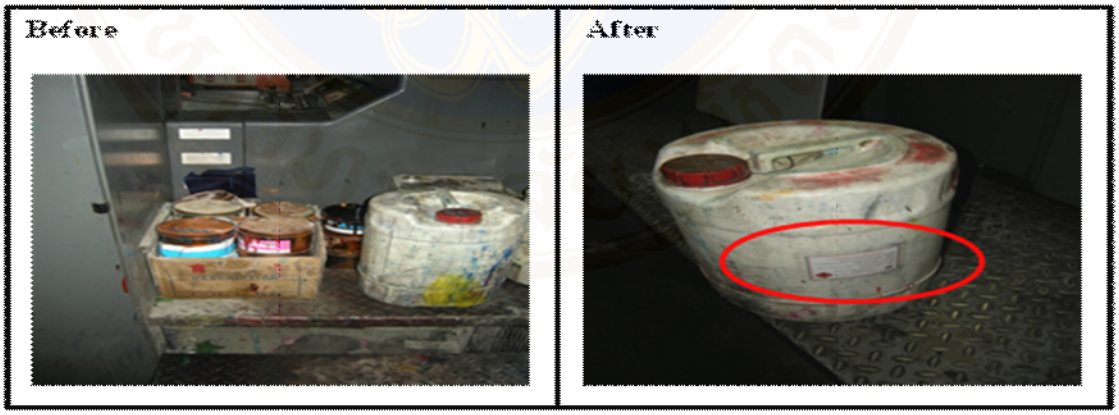

Figure 4.51 Chemical container that transfer from large containers was labeled

Pre-improvement figure showed that worker did not label the chemical container. Post-improvement figure showed chemical container that transfer from large containers was labeled.

5.5) After chemical transfer process was finished, lid of chemical containers was tightly closed to protect the spread of chemicals into air.

5.6) Personal protective equipments such as solvent resistant glove and carbon mask were prepared for worker as showed in figure 4.47.

5.7) Personal protective equipments (solvent resistant glove and carbon mask) were important equipments required by workers during working. The following figure shown worker used personal protective equipments during working.

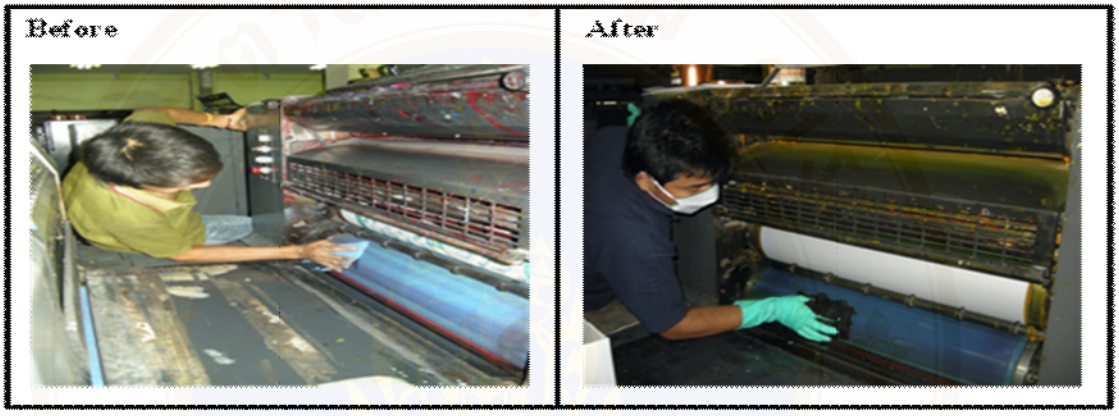

Figure 4.52 Personal protective equipment was used by worker during working

5.8) Washcloths used to wipe printer were orderly kept in closed container to protect chemical spreads and chemical contamination.

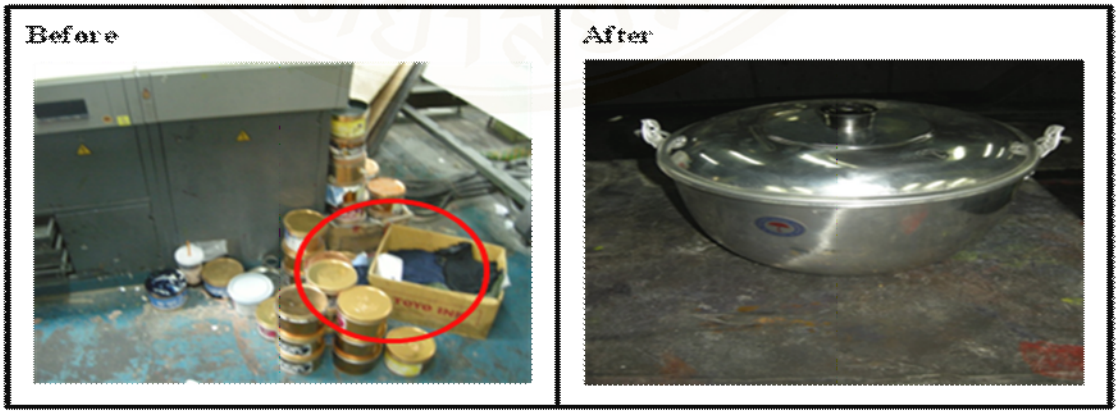

Figure 4.53 Washcloths storage container

Pre-improvement, washcloths did not be keep in closed container. Post-improvement, washcloths were kept in closed container.

5.9) Reusable washcloths were orderly kept in the box and the box lid always was tightly closed.

Figure 4.54 Washcloths were kept orderly in the box and the box lid always was tightly closed

5.10) Bucket was prepared to keep cleaning sponges in order to protect chemical spreads as well as chemical contamination.

Pre-improvement, worker did not use closed container to keep sponges. Post-improvement, plastic bucket (HDPC Type) with lid was prepared to keep cleaning sponges.

Figure 4.55 Tanks for soaking sponges

5.11) After finished using, the lid of bucket always was tightly closed.

5.12) Any white gasoline container was required to have the lid. The following figure shown white gasoline oil container.

Figure 4.56 White gasoline container

Pre-improvement, worker did not use closed container to keep white gasoline. Post-improvement, metal container with lid was prepared to keep white gasoline.

5.13) After finished using, the lid of white gasoline container always was tightly.

5.14) Any thinner container was required to have the lid. The following figure shown Thinner container.

Figure 4.57 Thinner container

Pre-improvement, worker did not use closed container to keep thinner. Post-improvement, glass bottle with lid was prepared to keep white gasoline.

5.15) After finished using, the lid of thinner container always was tightly closed.

5.16) Any kerosene container was required to have the lid. The following figure showed thinner container.

Figure 4.58 Kerosene container

Pre-improvement, worker did not use closed container to keep kerosene. Post-improvement, glass bottle with lid was prepared to keep kerosene.

5.17) After finished using, the lid of kerosene container always was tightly.

5.18) Prohibition signs "No smoking" were marked and posted on the workplace to protect fire because of using inflammable chemical substance in workplace. The following figure showed warning signs "No smoking" were marked and posted on the workplace.

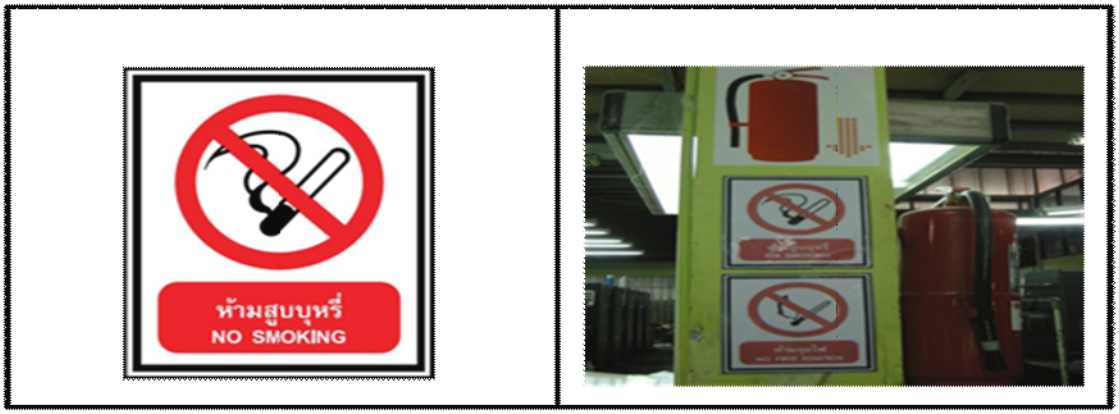

Figure 4.59 "No smoking" signs were shown in the working areas

5.19) Mandatory signs were shown in major working areas to notify workers to wear personal protective equipment.

Figure 4.60 Mandatory signs indicated wearing personal protective equipment were marked in the workplace

5.20) Workers who have expose chemicals during working were recognized in chemical feature and danger, safe work process and using personal protective equipment.

To educate the worker of printing factory B, training course was set up. Worker had to learn about chemical feature and danger, safe work process, using safe equipments and using personal protective equipment. The following figure showed training of employees of printing factory B.

Figure 4.61 Training of employees of printing factory B

6) Waste discarding

6.1) Litter bins were separated into two types namely; general waste and contaminated chemical waste. But for paper scraps left from printing process, the worker would separately discard them to another bin and sell them.

Figure 4.62 Litter bins were separated into various kinds of waste

Pre-improvement, litter bin did not be separated. So, all kinds of waste were dumped in only one trash. Post-improvement, Litter bins were separated into two types namely; general waste and contaminated chemical waste as showed in figure 4.62.

6.2) For discarding the inventory or contaminated chemical container, lid was required to close littler bin.

Figure 4.63 Lid was required to cover litter bin

Pre-improvement, litter bin did not have lid. Post-improvement, lid of litter bin for contaminated chemical waste was provided.

6.3) Every kind of litter bin was labeled to inform a kind of wastes.

Figure 4.64 Every kind of litter bin was clearly labeled

From the figure 4.64, the post-improvement figure showed that the covered bin had the label.

CHAPTER V
DISCUSSION AND CONCLUSION

5.1 Discussion

Nowadays, the development of the printing industry is fast growing. The majority was small and medium-sized printing factories. Currently there are no legal and practical guidance for small establishments. So creating the practical guidance suited for small-sized printing factory is necessary.

The objective of this study was improving the management of chemicals to suit for the printing factories. The method was creating the assessment tools that suit with small-sized offset printing factories and bring them to test in the sample. In addition to bringing to test the assessment tools, the finding also led to be guideline for improving the management of chemicals.

So the discussion is divided into three parts such as creating the assessment form, trial the assessment form with the sample and the result of assessment of chemical management. The details of each part are as follows.

5.1.1 Creating the assessment form

The objective of creating both assessment forms were resemble. The objective was bringing them to assess the management of chemicals in small-sized offset printing factories. Method of creating both assessment forms were resemble by using rules, standard, manual as a guideline.

1) Creating the chemical storage checklist

Small-sized offset printing factories did not have manual that they could use as a guideline. So creating the assessment tool that was specific with characterization of enterprise, the notification of the Department of Industrial Works; Manual for the storage of chemicals and hazardous material storage, 2550 B.E[8] was adopt to use as a guideline. Applied the manual by choosing the issues that small enterprise must managed to follow the law and safety for their worker.

The researcher chose three main issues of the manual to apply as a guideline to create a chemical storage checklist such as characterization of chemical storage room, chemical storage method and preventive measure.

About the main issue about the characterization of chemical storage room, the researcher chose the necessary title such as warning system but did not choose the title about lightning rod and sprinkler system that did not necessary for small-sized enterprises.

After already drafting the checklist and first verified by the expert, it was found that determination criteria of some questions were incomprehensive. After correcting the checklist followed the suggestion of the expert, the researcher brought them to test in five printing factories. It was found that the checklist had some defects. The details are as follows.

1.1) The main issue about characterization of chemical storage room.

It was found that some printing factories did not separate the place to keep chemicals which the checklist did not have criteria about this.

1.2) The main issue about chemicals storage method.

It was found that most printing factories did not have the cabinet that used for store chemicals. So, the researcher would add criteria about storing the chemicals in the cabinet and on shelf.

After already fixed the defects of first testing in five printing factories, the checklist was checked by the expert again. After the last checking by the expert, the expert suggest about means of using the checklist to avoid the bias. Therefore, the last testing in five printing was assessed by two assessors. The last testing in the five printing factories did not found any defects.

2) Creating the working process checklist

This checklist used to assess the risk in working process. This checklist had the same concept with risk assessment method of TIS.18004 but their considering criteria of opportunity level were difference. The considering criteria of opportunity level of this checklist would specific with the working process of small-sized offset printing factories.

After already drafting the checklist and first verified by the expert, the expert suggest to fix some defaults. The details are as follows.

- Bring to use process.

Changed considering criterion from "Expired date checking before keeping to "Expired date checking is systematic".

- Printing process.

Add one considering criterion about the management of the chemicals that spilling or leaking.

- Waste discarding.

Fixed the criterion about "chemical waste products are separated then eliminated by specialist organization" by changing from "Eliminated by correct method to "Eliminated by specialist organization or exterminated follow the direction written on label" because the small-sized printing factories could not eliminate the waste by themselves.

After fixed the checklist followed the suggestion of the expert, trialed it again by using it to assess risk of work process in five printing factories. It was found that the checklist had some defects. The details are as follows.

- Transportation and storage process.

Elided the considering criterion about "Transferring chemical by forklift and using safety method" because small-sized printing factories did not use forklift to transfer the chemicals.

- Bring to use process.

Add considering criterion about "Transferring by using the proper trolley that has been checked before using" because it was found that the small-sized printing factories used trolley to move the chemicals to use.

- Transferring process.

Add considering criterion about "Using the bottom container under the chemical substance container in case of any perforation" because it was found that chemicals spilled into the ground while transferring.

After already fixed defects of first testing in five printing factories, the checklist was checked by the expert again. After the last checking by the expert, the expert suggested about means of using the checklist to avoid the bias. Therefore, the

last testing in five printing was assessed by two assessors. The last testing in the five printing factories did not found any defects.

5.1.2 Trial the assessment form with the sample

Test the checklists with the printing factory A and B by using them to assess the chemical management before and after the improving. In order to avoid bias, the owners were required to collect data with researchers. Therefore, the owner had been introduced about how to use checklists.

Using the chemical storage checklist was easy than using the work process checklist because of work process checklist was more complex than chemical storage checklist. The researcher tried to create the checklist that user could easiest understand by adjusting the table on one page and clearly determined the criteria. But still found the problem while using about considering the opportunity level. So solved the problem by showing the formula in the table, separated the column of the score and full score. Therefore, using checklist to assess chemical management after the improving the chemical management could use more easily.

5.1.3 The result of assessment of chemical management

The results of assessment of chemical management are divided into two parts such as the result of chemical storage assessment and the result of work process assessment. The details are as follows.

1) The result of chemical storage assessment

The findings from the two printing factories were as aforementioned above. Thus, storage of these chemicals must be stored correctly, at least storage of these chemicals should be legal but in the study found that storage of chemicals in both printing factories did not follow the checklist that adopt from the notification of the Department of Industrial Works; Manual of chemicals and hazardous materials storage, 2550 B.E[8].

The results showed that both printing factories did not extremely compliance with the law. Chemicals storage method was often based on convenience of use, without regarded to safety and compliance with the law. It was necessary to improve the chemicals storage of both printing factories.

1.1) Chemical storage room

It was found that the chemicals storage room of printing factory A and B were modified from operation area. It was not specially built to use for storing chemicals. There were some issues that were not compliance with the law which compare to the study of Piangpen Puasopis[34], it found that the building structure of chemicals storage room was not required under standard.

The improvement of chemicals storage room of both printing factories could not adjust to comply with the guideline in every item due to many limitations. From inquiring the owner of both printing factories, they thought that it was not worth the investment to improve the storage of chemicals. Therefore the improvements that they could do were the improvement that did not use high investment and did not require a long period of time such as labeling to show a location of portable fire extinguishers. The other such as the improvement of floor, roof, ventilation system, electricity system that must use high investment, they thought that it was not worthwhile with small-sized factories to invest a lot of improvement of chemical storage of their printing factories and that was not causing a serious accident or incident to their employees. Other improvement such as door and emergency exit, warning system, route traffic specification, the owner of both printing factories thought that they were not necessary to improve. The most importance that they need to do was installation of portable fire extinguishers which they had already done.

1.2) Chemical storage procedure

It was found that some printing factory altogether kept the inflammable chemicals with other type of chemicals, although they had especial inflammable chemicals storage room. This was consistent with the study of Piangpen Puasopis[34] which found that factory improperly apportion area to keep chemicals. It was found that both printing factories did not focus on chemical storage procedure which was properly. Besides, they did not focus on hazard communication, chemical hazard and chemicals information[41]. They did not take advantages of the details that showed on the label. And both printing factories did not have any material safety data sheet of chemicals that they used[42].

Both printing factories could be resolved this issue more than the other issues. Because of they did not use high investment and could do

immediately. Improvements of chemical storage procedure was to separated storage of chemicals by the types of chemicals, brought other materials that not a chemicals or may cause fire (such as washcloth, paper boxes, brooms, etc) out of the chemicals storage room, labeling the name of chemicals at each rack, labeling or make signs that indicated the type of hazardous chemicals inside the chemical storage room and labeling of chemicals that could not be clearly seen.

1.3) Preventive measure

This assessment issue consisted of three assessment items such as maintain cleanliness, route traffics and the safety signs. It was found that both printing factories lacked of cleaning the chemical storage room, no route traffic specification and they did not label any safety signs in their chemical storage room.

Improvement of this issue, both printing factories could not adjust to comply with the checklist in every item. They chose to improve some items that they did not use high investment and could do immediately such as gave the knowledge to the employees and enhancing cleaning the chemicals storage room and labeling warning signs.

Considering about the results about pre-post improvement chemical storage assessment of both printing factories (total score was 49 points), printing factory A got 18 points and printing factory B got 21.75 points which were less than 50% of all assessment items. Because of both printing factories did not manage follow the checklist in several issues. After improving the chemical management, it was found that printing factory A got 27.50 points and printing factory B got 32.25 points which were more than 50% of all assessment items.

2) Health risk level found in work process

In the process of using chemicals, it was found that all work processes had risk and each process had difference risk level. Levels of health risk found in each work process are as following.

2.1) The process of receiving chemicals from suppliers and transfer to chemical storage rooms.

This process found acceptable risk and the owner of both printing factories thought that they did not necessary to resolve any items because of their worker were skillful and serious incident was never occur in their plants. The

workers whom undertook to transfer and transport chemicals to the storage room were the employees of supplier company, not employees of their printing factories.

2.2) Process of storing chemicals

Printing factory B found medium risk level because printing factory B stored thinner with non-flammable chemicals. Therefore, the chance of incident was high. Printing factory A found acceptable risk level. In this process, the owner of both printing factories decided to improve chemical storage. Because if they improved this process, it could reduce the risk of bring to use process.

Storage chemical process of both printing factories were similar. Both printing factories could adjust to comply with all plans because improvements did not affect the working time and did not use high investments and could be done by few operators. Moreover, the improvements would increase the safety to employees and reduced the chances of incident. The results of the adjustment this process, it was satisfactory and in accordance with the expectations that printing factory A could reduce the risk level from acceptable risk level to low risk level and printing factory B could reduce the risk level.

2.3) Process of chemical application

Both printing factories were found acceptable risk. The owners of both printing factories thought that they could follow the guideline. Then the owners of both printing factories decided to improve their work process to reduce risk level and increased a safety in their plants.

Improvement of this process was changing how the chemicals used by giving the education to the employees. The details of improvement in both printing factories were different. Printing factory A could not provide the training. The owner of printing factory A reasoned that provided the training would impact on working time. Then giving the knowledge to employees of printing factory A was done by labeling a sign board about safety work step and announced by the employer in the monthly meeting. This was different from printing factory B that could train and educate the worker to the utmost. But the results of reducing risk level improvement in both printing factories were not different. The risk level of both printing factories was decreased from acceptable risk level to low risk level.

2.4) Chemical transfer process

Chemical transfer process in both printing factories were found high risk level. Worker had a high chance of injury from direct exposure to chemicals during transfer chemicals. Chemicals might spill, leakage and spread out into the air and workers did not wear any personal protective equipment. The owners of both printing factories decided to improve this step to reduce the risk level.

Improvement of this process was to reduce the chances of injury by changing work behavior and changing equipment or tools. Improvements of both printing factories were different. Printing factory A did not change the chemicals container but printing factory B could change containers, equipment and method of work. After improvement, printing factory A could reduce risk level from high risk level to medium risk level. The fact, the level of risk after improvements of printing factory A still required an effort to reduce their risk but the owner though that their employees never have a serious injury or illness from chemicals. Therefore, they accepted that risk level after the improvement. In fact, if printing factory A had more improvement by enforcing employees to wear chemicals resistant glove and carbon mask during transfer chemicals, they would reduce the chance of injury and reduce the risk level to acceptable risk level like printing factory B. Printing factory B could reduce the risk level more than printing factory A because the owner of printing factory B focused on improving work process more than the owner of printing factory A. Risk level of printing factory B reduced from high risk level to acceptable risk level. This was in accordance with the expectations. However, funnel that used in printing factory B did not use stainless steel funnel resisted to chemicals of high price, so the owner chose to use plastic funnel.

2.5) Process of using chemicals

This process consists of three sub processes such as process of plate-making, cleaning process and printing process. The details are as follows.

2.5.1) Process of plate-making

Only printing factory A had this process. It was low risk level because they used machines to make plate. Employees had less opportunity to expose chemicals and chemicals used in this process did not harm to the

body. So the owner though that not necessary to improve this process to reduce the risk level.

2.5.2) Printing process

Both printing factories had high risk level. VOCs were used in this process and workers had more chances to expose the substance from lacking of proper management of chemicals. It was found that worker usually left ink container without the lid. In their working area did not installed local ventilation system in working area to properly remove chemicals vapors from the printer. Printing factory B was only found natural ventilation to ventilate air in working area and working area of printing factory A was a closed room. In addition, employees exposed to hazardous chemicals without controlled and they did not have personal protective equipment. Therefore, it was necessary to reduce the risk level of this process.

The owner of both printing factories decided to improve this process but improvement of this process was quite difficult because they need to improve the equipment, tools and changing work method. Some printing factories could not be fully operated as expected. Employees of some printing factory did not voluntary to wear personal protective equipment. In addition, the owner did not strict about wearing personal protective equipment of employees. The owner did not provide personal protective equipments for their employees, which was usually found in SME in Thailand[38]. Because they thought that danger from exposure to chemicals at work was less than danger that employees received from the lifestyle behaviors such as alcohol abuse and smoking. Therefore, the level of risk after improvement was not quite as expected. Printing factory A that could not be fully improvement, so they could reduce high risk level to medium risk level. Printing factory B could be fully improvement, so they could reduce the risk level from high risk level to acceptable risk level. In fact, if printing factory A had more improvement by enforcing employees to wear chemicals resistance glove and carbon mask during working and providing the absorber for used when chemicals spilled and preparing procedure of a spill of chemicals, they would reduce the chance of injury and the risk level to acceptable risk level.

2.6) Cleaning process

Both printing factories had high risk level. VOCs were used in this process and workers had more chances to expose chemicals from lacking of proper management. It found that worker did not wear personal protective equipments, usually used the container of chemicals to ease and did not concern about safety such as perforated the lid of containers of chemicals, so resulting in the spreading of chemicals vapors into the air at any time. Therefore, they should improve the management of chemicals in this process to reduce the opportunity of dangerous occurrence and reduced the level of risk.

This process consisted of several sub processes of work. In all sub processes used chemicals that harmful to the health. The owner of both printing factories decided to improve this process. The guidelines for improvement of this process were similar to the guideline for improvement of the printing process and had the same handicaps. So, the results of the improvement in this process were not quite as expected because they could not improve all items to follow the guideline. Especially, printing factory A could not change chemical containers to reduce spreading of chemicals and could not force workers to wear personal protective equipment. The items of improving that they could do were labeling the warning sign and changing some work steps such as labeling the opened date at the label of container. So, printing factory B could reduce the level of risk more than printing factory A because they could improve under the guideline more than printing factory B. They could change the chemical containers and could correct the work steps and also they could educate worker to wear personal protective equipment while working.

Cleaning process was a sub process that clearly shown the result of improving of chemicals management. This could be seen from the level of the risk post- improvement of this process.

Process of plate cleaning, printing factory A could reduce level of risk from high risk level to medium risk level. Printing factory B could reduce level of risk from high risk level to acceptable risk level. If printing factory A decided to partially improve management of chemicals, they could slightly decrease the level of the risk. If printing factory A had more improvement by forcing employees to wear chemical resistance glove and carbon mask during working and always close the lid of

the container, they would reduce the chance of injury and could reduce the risk level to acceptable risk level.

Process of cylinder cleaning, printing factory A could reduce level of risk from high risk level to medium risk level. Printing factory B could reduce level of risk from high risk level to acceptable risk level. If printing factory A had more improvement by forcing employees to wear chemical resistance glove and carbon mask during working and changing the kerosene container and always close the lid of chemical containers, they would reduce the chance of injury and could reduce the risk level to acceptable risk level.

Process of roller cleaning, printing factory A could not reduce level of risk. Printing factory B could reduce level of risk from high risk level to acceptable risk level.

Process of blanket cleaning, printing factory A could not reduce level of risk. Printing factory B could reduce level of risk from high risk level to acceptable risk level.

The process of roller cleaning and process of blanket cleaning, printing factory A could not decrease level of risk because they could not reduce chances of injury by changing the container to reduce the spread of chemical and could not force their employees to wear personal protective equipment during the operation. If they did, they would reduce chances of injury and reduce the risk level to acceptable risk level like printing factory B. Printing factory B could continue to improve almost all the recommended guidelines. So, they could reduce the risk level to be obvious.

2.7) Process of waste disposal

Although in this process of both printing factories had acceptable risk level but the owner of both printing factories decided to improve under the guideline recommended because it could be done easily and simple. However, some improvements could not proceed according to the law at all. Both printing factories could not change the trash for materials contaminated with chemicals to be a metal bin that had swing lid because it was expensive and it was not worthy with the investment. So they brought a big metal container of chemicals (200 liter container size) to use as a trash container with the lid. However, the result of improvement was

in accordance with expectations. Both printing factories could reduce the level of risk from acceptable risk level to low risk level.

Although, both printing factories could not continue to improve as planed but the overall results of improvements of working process of two printing factories were as expected. Improvements of working process could reduce risk level like the study of Kanathit Kerdklai[35] that improved working area in small plastic recycling industry which could reduce the level of risk.

This study found that, small-sized enterprises lacking of implementation about safety chemical management. The important reasons were the attitudes of employers towards safety and gave the low priority of the safety when dealing with safety management[42]. They thought that their employees exposed to the dangers of malicious behavior more than exposure to the hazards of working experience. So owners of small-sized printing factories did not strict about how it works and there was no safety guideline to employees and their employees unhealthy accessed to safety information[43]. The improvements were difficult because their owner did not require additional investment[44] and they lacked of commitment to action about safety management because no related law with their enterprise and lacked of any coordination with the relevant authorities. Therefore, it was necessary to approach the laws or guideline to suit with small-sized enterprises.

5.2 Conclusion

From results of this study, chemical storage of both printing factories before improvement did not compliance with the chemical storage checklist adapt from the notification of Department of Industrial Works; Manual for the storage of chemicals and hazardous materials, 2550 B.E.[8] When they already had improved chemical management, score of compliance with checklist increased with significant statistic confidence is 95%. Work processes of both printing factories, before improvement found difference risk level and needed to correct especially chemical transferring to another container/smaller container process and chemical application in various purposes which had high risk level and medium risk level that needed to

urgent correct. When they had already improved chemical management, risk level was decreased.

Although printing factory A and B could not improve the management of chemicals followed the plan at all but results of improvements of chemical management could make the chemicals storage of printing factory A and B more compliance with the manual and could decrease health risk level that is found in work process with chemicals.

5.3 The suggestion research result to use

In order to control compliance with law of chemical storage and reduce health risk level and reduce worker's exposure to the chemical, the owner or other authorized people should manage as follows.

5.3.1 The notification of Department of Industrial Works; Manual for the storage of chemicals and hazardous materials, 2550 B.E.[8] should be adopt as a guideline for control chemical storage to justice compliance with law and safety.

5.3.2 Printing factories should have risk control measures to control risk that may arise with worker. The worker should participate in changing of their step work and documented them for use as a practice guideline for worker.

5.3.3 Printing factories should give the knowledge to their worker about the danger of chemicals used in the production, safety work procedure, the advantage of using personal protective equipment. Employees should realize about the importance of safe working procedure and realize the advantage of using personal protective equipments.

5.3.4 The printing factories should have measures to encourage and maintain controlling of their employees to use personal protective equipments and follow safe work procedure in their work seriously.

5.4 Limitation of this research

This study is the study that choose the sample by case study, do not random sampling thus bringing the result to use must have the carefulness.

5.5 The suggestion in next study

The result of this study is pleasingly. After improvement, chemical storage was more compliance with law and risk level of each work process was reduced. Therefore this study can use as a guideline to improve chemical management in other small-sized offset printing factories. However, if someone interest to study in this case next time, may use these suggestions as a guideline.

5.5.1 This research studied only risk assessment before and after improvement of chemical management. In the next study may use quantify the concentration of chemical in air by collecting air sample pre-post improvement to compare about results of improving the management of chemical instead of risk level or in conjunction with risk level.

5.5.2 Guideline of improving the management of chemicals in this study, only regard to reduce spreading of chemical into air. The present study may take into account the spread of chemical into water and soil.

5.5.3 The sample of this study is two small-sizes offset printing factories in Bangkok area. This will not be a good representation of all population. Thus in the next study may study all population to obtain the data of every target group.

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APPENDICES

APPENDIX A
CHEMICAL STORAGE CHECKLIST

แบบฟอร์ม Risk - A แบบประเมินการจัดเก็บสารเคมีของโรงพิมพ์

โรงพิมพ์.....ครั้งที่ตรวจสอบ.....ผู้ตรวจสอบ.....วันที่.....

ลำดับ	รายการคำถาม	คะแนน	ผล	หมายเหตุ
1	สถานที่ตั้ง	1		
1.1	มีการแยกพื้นที่ในการเก็บสารเคมี สถานที่เก็บสารเคมีแยกเป็นห้องปิดมิดชิด มีการแยกพื้นที่ในการเก็บสารเคมีเป็นสัดส่วน สถานที่เก็บสารเคมีไม่แยกเป็นห้องปิดมิดชิด/เก็บโดยไม่แยกพื้นที่เก็บ	 1 0.5 0		
	รวม			
2	ผนังอาคาร	2		
2.1	ผนังอาคารที่ใช้เก็บสารไม่ติดไฟทนไฟได้อย่างน้อย 30 นาที ผนังอาคารทนไฟได้อย่างน้อย 30 นาที ผนังอาคารไม่สามารถทนไฟได้	 1 0		
2.2	ผนังอาคารที่ใช้เก็บสารไวไฟทนไฟได้อย่างน้อย 90 นาที ผนังอาคารทนไฟได้อย่างน้อย 90 นาที ผนังอาคารไม่สามารถทนไฟได้	 1 0		
	รวม			
3	พื้น	4		
3.1	พื้นแข็งแรงเพียงพอต่อการรับน้ำหนัก พื้นเป็นปูนหรือไม้ที่มีการก่อสร้างอย่างแน่นหนา พื้นเป็นปูนหรือไม้ที่มีการก่อสร้างไว้ใช้ชั่วคราว พื้นเป็นปูนหรือไม้ที่ไม่แข็งแรง มีการยุบของพื้น	 1 0.5 0		
3.2	พื้นของสถานที่เก็บรักษาสารเคมีเรียบ/ไม่ขรุขระ/ไม่แตกร้าว/ไม่เปียกหรือลื่น/ไม่ดูดซับของเหลว พื้นทั้งหมดเรียบ/ไม่ขรุขระ/ไม่แตกร้าว ไม่เปียกลื่น ไม่ดูดซับของเหลว 75% ของพื้นทั้งหมดเรียบ ไม่ขรุขระ ไม่แตกร้าว ไม่เปียกหรือลื่น ไม่ดูดซับของเหลว	 1 0.75		

Risk – A แบบประเมินการจัดเก็บสารเคมีของโรงพิมพ์ (ต่อ)

ลำดับ	รายการคำถาม	คะแนน	ผล	หมายเหตุ
	50% ของพื้นทั้งหมดเรียบ ไม่ขรุขระ ไม่แตกร้าว ไม่เปียกหรือลื่น ไม่ดูดซับของเหลว	0.5		
	25% ของพื้นทั้งหมดเรียบ ไม่ขรุขระ ไม่แตกร้าว ไม่เปียกหรือลื่น ไม่ดูดซับของเหลว	0.25		
	พื้นทั้งหมดไม่เรียบ ขรุขระ มีรอยแตกร้าว เปียกหรือลื่น และดูดซับของเหลว	0		
3.3	วัสดุที่ใช้ทำพื้นต้องทนทานต่อน้ำและสารเคมี			
	ใช้ปูนเป็นวัสดุทำพื้น	1		
	ใช้ไม้เป็นวัสดุทำพื้น	0.5		
	วัสดุที่ใช้ทำพื้นทั้งหมดไม่ทนทานต่อน้ำและสารเคมี	0		
3.4	การนำไฟฟ้าของพื้น กรณีที่มีการเก็บของเหลวหรือก๊าซไวไฟ			
	พื้นสามารถนำไฟฟ้าได้	1		
	พื้นไม่สามารถนำไฟฟ้าได้	0		
	รวม			
4	ประตูและทางออกฉุกเฉิน	5		
4.1	จำนวนประตูเข้าออก			
	มีประตูเข้าออก 2 ประตูรวมถึงประตูที่ใช้เป็นทางออกฉุกเฉิน	1		
	มีประตูเข้าออกน้อยกว่า 2 ประตูรวมถึงประตูที่ใช้เป็นทางออกฉุกเฉิน	0		
4.2	ความกว้างของประตูฉุกเฉิน			
	ประตูฉุกเฉินทั้งหมดมีความกว้างไม่น้อยกว่า 1.10 เมตร	1		
	ประตูฉุกเฉินทั้งหมดมีความกว้างน้อยกว่า 1.10 เมตร	0		
4.3	ประตูที่ใช้เป็นทางออกฉุกเฉินเปิดออกได้ง่ายทางเดียวจากทางด้านใน			
	ประตูที่ใช้เป็นทางออกฉุกเฉินทั้งหมดเปิดออกได้ง่ายทางเดียวจากทางด้านใน	1		
	ประตูที่ใช้เป็นทางออกฉุกเฉินทั้งหมดไม่สามารถเปิดออกได้ง่ายทางเดียวจากทางด้านใน	0		
4.4	ไม่มีสิ่งกีดขวางประตูฉุกเฉินทั้งด้านนอกและด้านใน			
	ประตูฉุกเฉินทั้งหมดไม่มีสิ่งกีดขวางทั้งทางด้านนอกและด้านใน	1		
	ประตูฉุกเฉินทั้งหมดมีสิ่งกีดขวางทั้งทางด้านนอกและ/หรือด้านใน	0		

Risk – A แบบประเมินการจัดเก็บสารเคมีของโรงพิมพ์ (ต่อ)

ลำดับ	รายการคำถาม	คะแนน	ผล	หมายเหตุ
4.5	บริเวณใกล้ประตูฉุกเฉิน มีการติดสัญลักษณ์ที่มองเห็นได้ชัดเจนและมองเห็นได้ในความมืด ประตูฉุกเฉินทั้งหมด มีการติดสัญลักษณ์ที่มองเห็นได้ชัดเจนและมองเห็นได้ในความมืดบริเวณใกล้ประตู 75% ของประตูฉุกเฉิน มีการติดสัญลักษณ์ที่มองเห็นได้ชัดเจนและมองเห็นได้ในความมืดบริเวณใกล้ประตู 50% ของประตูฉุกเฉิน มีการติดสัญลักษณ์ที่มองเห็นได้ชัดเจนและมองเห็นได้ในความมืดบริเวณใกล้ประตู 25% ของประตูฉุกเฉิน มีการติดสัญลักษณ์ที่มองเห็นได้ชัดเจนและมองเห็นได้ในความมืดบริเวณใกล้ประตู ประตูฉุกเฉินทั้งหมด ไม่มีการติดสัญลักษณ์ที่มองเห็นได้ชัดเจนและมองเห็นได้ในความมืดบริเวณใกล้ประตู	1 0.75 0.5 0.25 0		
	รวม			
5	หลังคา	4		
5.1	วัสดุที่ใช้ทำหลังคาสามารถไฟได้นาน 30 นาที วัสดุที่ใช้ทำหลังคาทั้งหมดสามารถไฟได้นาน 30 นาที วัสดุที่ใช้ทำหลังคาทั้งหมดไม่สามารถไฟได้นาน 30 นาที	1 0		
5.2	หลังคาของสถานที่เก็บรักษาสารเคมีสามารถระบายความร้อน/ควันได้ หลังคาของสถานที่เก็บรักษาสารเคมีทุกแห่งสามารถระบายความร้อนและควันได้ หลังคาของสถานที่เก็บรักษาสารเคมีทุกแห่งไม่สามารถระบายความร้อนและควันได้	1 0		
5.3	โครงสร้างหลักที่รองรับหลังคาได้รับการปกป้องด้วยวัสดุที่ไม่ติดไฟ โครงสร้างหลักทั้งหมดที่รองรับหลังคาได้รับการปกป้องด้วยวัสดุที่ไม่ติดไฟ โครงสร้างหลักทั้งหมดที่รองรับหลังคาไม่ได้รับการปกป้องด้วยวัสดุที่ไม่ติดไฟ	1 0		
5.4	หลังคาต้องไม่มีฝ้าหลังคา หลังคาของสถานที่เก็บรักษาสารเคมีทุกแห่งไม่มีฝ้าหลังคา หลังคาของสถานที่เก็บรักษาสารเคมีทุกแห่งมีฝ้าหลังคา	1 0		
	รวม			

Risk – A แบบประเมินการจัดเก็บสารเคมีของโรงพิมพ์ (ต่อ)

ลำดับ	รายการคำถาม	คะแนน	ผล	หมายเหตุ
6	ระบบระบายอากาศ	1		
6.1	มีระบบระบายอากาศ มีการระบายอากาศด้วยวิธีการแบบธรรมชาติ มีช่องว่างระบายอากาศอยู่บนหลังคา/อยู่ตำแหน่งผนังอาคารส่วนที่ต่ำลงมา/อยู่บริเวณใกล้พื้น/หลังคากรงนก) หรือด้วยวิธีกล(พัดลมระบายอากาศ) วิธีใดวิธีหนึ่ง ไม่มีระบบระบายอากาศ	1 0		
	รวม			
7	ระบบไฟฟ้า แสงสว่าง และอุปกรณ์ไฟฟ้า	6		
7.1	บริเวณที่เก็บสารไวไฟ มีการติดตั้งระบบไฟฟ้าชนิดป้องกันระเบิด บริเวณที่เก็บสารไวไฟทุกแห่ง มีการติดตั้งระบบไฟฟ้าชนิดป้องกันระเบิด 75% ของสถานที่เก็บสารไวไฟ มีการติดตั้งระบบไฟฟ้าชนิดป้องกันระเบิด 50% ของสถานที่เก็บสารไวไฟ มีการติดตั้งระบบไฟฟ้าชนิดป้องกันระเบิด 25% ของสถานที่เก็บสารไวไฟ มีการติดตั้งระบบไฟฟ้าชนิดป้องกันระเบิด บริเวณที่เก็บสารไวไฟทุกแห่ง ไม่มีการติดตั้งระบบไฟฟ้าชนิดป้องกันระเบิด	1 0.75 0.5 0.25 0		
7.2	หลอดไฟติดตั้งอยู่ในตำแหน่งที่สูงกว่าวัตถุอันตรายอย่างน้อย 0.5 เมตร และไม่ทำให้เกิดความร้อนต่อสารเคมีที่เก็บ หลอดไฟทั้งหมดติดตั้งอยู่ในตำแหน่งที่สูงกว่าวัตถุอันตรายอย่างน้อย 0.5 เมตร 75%ของหลอดไฟทั้งหมดติดตั้งอยู่ในตำแหน่งที่สูงกว่าวัตถุอันตรายอย่างน้อย 0.5 ม. 50%ของหลอดไฟทั้งหมดติดตั้งอยู่ในตำแหน่งที่สูงกว่าวัตถุอันตรายอย่างน้อย 0.5 ม. 25%ของหลอดไฟทั้งหมดติดตั้งอยู่ในตำแหน่งที่สูงกว่าวัตถุอันตรายอย่างน้อย 0.5 ม. หลอดไฟทั้งหมดติดตั้งอยู่ในตำแหน่งที่สูงกว่าวัตถุอันตรายน้อยกว่า 0.5 เมตร	1 0.75 0.5 0.25 0		

Risk – A แบบประเมินการจัดเก็บสารเคมีของโรงพิมพ์ (ต่อ)

ลำดับ	รายการคำถาม	คะแนน	ผล	หมายเหตุ
7.3	หลอดไฟหรือโคมไฟชนิด Metal Halide และ Mecury ต้องมีฝาครอบ			
	หลอดไฟหรือโคมไฟชนิด Metal Halide และ Mecury ทั้งหมดมีฝาครอบ	1		
	75% ของหลอดไฟหรือโคมไฟชนิด Metal Halide และ Mecury ทั้งหมดมีฝาครอบ	0.75		
	50% ของหลอดไฟหรือโคมไฟชนิด Metal Halide และ Mecury ทั้งหมดไม่มีฝาครอบ	0.5		
	25% ของหลอดไฟหรือโคมไฟชนิด Metal Halide และ Mecury ทั้งหมดไม่มีฝาครอบ	0.25		
	หลอดไฟหรือโคมไฟชนิด Metal Halide และ Mecury ทั้งหมดไม่มีฝาครอบ	0		
7.4	อุปกรณ์ไฟฟ้าที่ติดตั้งภายในสถานที่เก็บสารเคมี มีการต่อสายดิน			
	อุปกรณ์ไฟฟ้าทั้งหมดมีการต่อสายดิน	1		
	75% ของอุปกรณ์ไฟฟ้าทั้งหมดมีการต่อสายดิน	0.75		
	50% ของอุปกรณ์ไฟฟ้าทั้งหมดมีการต่อสายดิน	0.5		
	25% ของอุปกรณ์ไฟฟ้าทั้งหมดมีการต่อสายดิน	0.25		
	อุปกรณ์ไฟฟ้าทั้งหมดไม่มีการต่อสายดิน	0		
7.5	อุปกรณ์ไฟฟ้าที่ติดตั้งในสถานที่เก็บสารเคมี ได้รับการติดตั้งในตำแหน่งที่ปลอดภัย			
	อุปกรณ์ไฟฟ้าทั้งหมดได้รับการติดตั้งในตำแหน่งที่ปลอดภัย	1		
	75% ของอุปกรณ์ไฟฟ้าทั้งหมดได้รับการติดตั้งในตำแหน่งที่ปลอดภัย	0.75		
	50% ของอุปกรณ์ไฟฟ้าทั้งหมดได้รับการติดตั้งในตำแหน่งที่ปลอดภัย	0.5		
	25% ของอุปกรณ์ไฟฟ้าทั้งหมดได้รับการติดตั้งในตำแหน่งที่ปลอดภัย	0.25		
	อุปกรณ์ไฟฟ้าทั้งหมดติดตั้งในตำแหน่งที่ไม่ปลอดภัย	0		
7.6	อุปกรณ์ไฟฟ้าที่ติดตั้งภายในสถานที่เก็บสารเคมีอยู่ในสภาพดี			
	อุปกรณ์ไฟฟ้าทั้งหมดอยู่ในสภาพดี	1		
	75% ของอุปกรณ์ไฟฟ้าทั้งหมดอยู่ในสภาพดี	0.75		
	50% ของอุปกรณ์ไฟฟ้าทั้งหมดอยู่ในสภาพดี	0.5		
	25% ของอุปกรณ์ไฟฟ้าทั้งหมดอยู่ในสภาพดี	0.25		
	อุปกรณ์ไฟฟ้าทั้งหมดเสื่อมสภาพ	0		
	รวม			

Risk – A แบบประเมินการจัดเก็บสารเคมีของโรงพิมพ์ (ต่อ)

ลำดับ	รายการคำถาม	คะแนน	ผล	หมายเหตุ
8	ระบบเตือนภัย	5		
8.1	มีการติดตั้งระบบสัญญาณแจ้งเหตุเพลิงไหม้			
	สถานที่เก็บรักษาสารเคมีทั้งหมดมีการติดตั้งระบบสัญญาณแจ้งเหตุเพลิงไหม้	1		
	75% ของสถานที่เก็บรักษาสารเคมีทั้งหมดติดตั้งระบบสัญญาณแจ้งเหตุเพลิงไหม้	0.75		
	50% ของสถานที่เก็บรักษาสารเคมีทั้งหมดติดตั้งระบบสัญญาณแจ้งเหตุเพลิงไหม้	0.5		
	25% ของสถานที่เก็บรักษาสารเคมีทั้งหมดติดตั้งระบบสัญญาณแจ้งเหตุเพลิงไหม้	0.25		
	สถานที่เก็บรักษาสารเคมีทั้งหมดไม่ติดตั้งระบบสัญญาณแจ้งเหตุเพลิงไหม้	0		
8.2	เสียงสัญญาณแจ้งเหตุเพลิงไหม้			
	ทั่วทุกพื้นที่ได้ยินเสียงสัญญาณแจ้งเหตุเพลิงไหม้	1		
	เสียงสัญญาณเตือนภัย ได้ยินในบางพื้นที่	0.5		
	ทั่วทุกพื้นที่ไม่ได้ยินเสียงสัญญาณแจ้งเหตุเพลิงไหม้	0		
8.3	การติดตั้งระบบสัญญาณเตือนภัยแบบกด			
	การติดตั้งระบบสัญญาณเตือนภัยแบบกดทุกระยะ 30 เมตร	1		
	การติดตั้งระบบสัญญาณเตือนภัยแบบกดทุกระยะมากกว่า 30 เมตร	0.5		
	ไม่มีการติดตั้งระบบสัญญาณเตือนภัยแบบกด	0		
8.4	มีการทดสอบการทำงานของระบบสัญญาณเตือนภัย			
	มีการทดสอบการทำงานของระบบสัญญาณเตือนภัย≥เดือนละครั้ง	1		
	มีการทดสอบการทำงานของระบบสัญญาณเตือนภัย<เดือนละครั้ง	0.5		
	ไม่มีการทดสอบการทำงานของระบบสัญญาณเตือนภัย	0		
8.5	มีอุปกรณ์ตรวจจับความร้อน/ควันไฟ			
	มีอุปกรณ์ตรวจจับความร้อน/ควันไฟที่มีประสิทธิภาพและใช้การได้ดี	1		
	มีอุปกรณ์ตรวจจับความร้อน/ควันไฟแต่ไม่มีประสิทธิภาพ	0.5		
	ไม่มีอุปกรณ์ตรวจจับความร้อน/ควันไฟ	0		
	รวม			

Risk – A แบบประเมินการจัดเก็บสารเคมีของโรงพิมพ์ (ต่อ)

ลำดับ	รายการคำถาม	คะแนน	ผล	หมายเหตุ
9	อุปกรณ์ดับเพลิง	6		
9.1	จำนวนเหมาะสม			
	มีผงเคมีแห้งชนิด ABC ขนาด 12 กก. อย่างน้อย 1 เครื่องต่อพื้นที่ 200 ตารางเมตร	1		
	มีผงเคมีแห้งชนิด ABC ขนาด 12 กก. น้อยกว่า 1 เครื่องต่อพื้นที่ 200 ตารางเมตร	0.5		
	ไม่มีผงเคมีแห้งชนิด ABC ขนาด 12 กก.ในพื้นที่	0		
9.2	มีการตรวจสอบอุปกรณ์ดับเพลิงไม่น้อยกว่า 6 เดือนต่อ 1 ครั้ง			
	อุปกรณ์ดับเพลิงทั้งหมดได้รับการตรวจสอบไม่น้อยกว่า 6 เดือนต่อ 1 ครั้ง	1		
	75% ของอุปกรณ์ดับเพลิงทั้งหมดได้รับการตรวจสอบไม่น้อยกว่า 6 เดือนต่อ 1 ครั้ง	0.75		
	50% ของอุปกรณ์ดับเพลิงทั้งหมดได้รับการตรวจสอบไม่น้อยกว่า 6 เดือนต่อ 1 ครั้ง	0.5		
	25% ของอุปกรณ์ดับเพลิงทั้งหมดได้รับการตรวจสอบไม่น้อยกว่า 6 เดือนต่อ 1 ครั้ง	0.25		
	อุปกรณ์ดับเพลิงทั้งหมดได้รับการตรวจสอบมากกว่า 6 เดือนต่อ 1 ครั้ง	0		
9.3	ติดตั้งอุปกรณ์ดับเพลิงในตำแหน่งนับจากคันบีบสูงจากพื้นดิน 1 - 1.4 เมตร			
	อุปกรณ์ดับเพลิงทั้งหมดติดตั้งในตำแหน่งที่เหมาะสม	1		
	75% ของอุปกรณ์ดับเพลิงทั้งหมดติดตั้งในตำแหน่งที่เหมาะสม	0.75		
	50% ของอุปกรณ์ดับเพลิงทั้งหมดติดตั้งในตำแหน่งที่เหมาะสม	0.5		
	25% ของอุปกรณ์ดับเพลิงทั้งหมดติดตั้งในตำแหน่งที่เหมาะสม	0.25		
	อุปกรณ์ดับเพลิงทั้งหมดติดตั้งในตำแหน่งที่ไม่เหมาะสม	0		
9.4	อุปกรณ์ดับเพลิงสามารถเคลื่อนย้ายได้ง่ายและสะดวกในการใช้งาน			
	อุปกรณ์ดับเพลิงทั้งหมดสามารถเคลื่อนย้ายได้ง่ายและสะดวกในการใช้งาน	1		
	75% ของอุปกรณ์ดับเพลิงทั้งหมดสามารถเคลื่อนย้ายได้ง่ายและสะดวกที่จะใช้งาน	0.75		
	50% ของอุปกรณ์ดับเพลิงทั้งหมดสามารถเคลื่อนย้ายได้ง่ายและสะดวกที่จะใช้งาน	0.5		

Risk – A แบบประเมินการจัดเก็บสารเคมีของโรงพิมพ์ (ต่อ)

ลำดับ	รายการคำถาม	คะแนน	ผล	หมายเหตุ
	25% ของอุปกรณ์ดับเพลิงทั้งหมดสามารถเคลื่อนย้ายได้ง่ายและสะดวกที่จะใช้งาน	0.25		
	อุปกรณ์ดับเพลิงทั้งหมดสามารถเคลื่อนย้ายได้ยากและไม่สะดวกในการใช้งาน	0		
9.5	ป้ายแสดงที่เก็บอุปกรณ์ดับเพลิง			
	ที่เก็บอุปกรณ์ดับเพลิงทั้งหมดมีป้ายแสดงที่เก็บ	1		
	75% ของที่เก็บอุปกรณ์ดับเพลิงทั้งหมดมีป้ายแสดงที่เก็บ	0.75		
	50% ของที่เก็บอุปกรณ์ดับเพลิงทั้งหมดมีป้ายแสดงที่เก็บ	0.5		
	25% ของที่เก็บอุปกรณ์ดับเพลิงทั้งหมดมีป้ายแสดงที่เก็บ	0.25		
	ที่เก็บอุปกรณ์ดับเพลิงทั้งหมดไม่มีป้ายแสดงที่เก็บ	0		
9.6	ป้ายบอกทางไปยังที่เก็บอุปกรณ์ดับเพลิง			
	ที่เก็บอุปกรณ์ดับเพลิงทั้งหมดมีป้ายบอกทางไปยังที่เก็บ	1		
	75% ของที่เก็บอุปกรณ์ดับเพลิงทั้งหมดมีป้ายบอกทางไปยังที่เก็บ	0.75		
	50% ของที่เก็บอุปกรณ์ดับเพลิงทั้งหมดมีป้ายบอกทางไปยังที่เก็บ	0.5		
	25% ของที่เก็บอุปกรณ์ดับเพลิงทั้งหมดมีป้ายบอกทางไปยังที่เก็บ	0.25		
	ที่เก็บอุปกรณ์ดับเพลิงทั้งหมดไม่มีป้ายบอกทางไปยังที่เก็บ	0		
	รวม			
10	การรักษาความสะอาด	1		
10.1	การดูแลรักษาความสะอาดของพื้นที่			
	มีการดูแลรักษาความสะอาดอย่างสม่ำเสมออย่างน้อยสัปดาห์ละ 1 ครั้ง	1		
	มีการดูแลรักษาความสะอาดอย่างสม่ำเสมอน้อยกว่าสัปดาห์ละ 1 ครั้ง	0.5		
	ไม่มีการดูแลรักษาความสะอาดของพื้นที่	0		
	รวม			
11	เส้นทางการจราจร	3		
11.1	การกำหนดเส้นทางการจราจร			
	มีการกำหนดเส้นทางการจราจรทุกที่ที่เก็บสารเคมี	1		
	75% ของสถานที่เก็บสารเคมีมีการกำหนดเส้นทางการจราจร	0.75		
	50% ของที่เก็บสารเคมีทั้งหมดมีมีการกำหนดเส้นทางการจราจร	0.5		
	25% ของที่เก็บสารเคมีทั้งหมดมีการกำหนดเส้นทางการจราจร	0.25		
	ไม่มีการกำหนดเส้นทางการจราจรภายในสถานที่เก็บสารเคมี	0		

Risk – A แบบประเมินการจัดเก็บสารเคมีของโรงพิมพ์ (ต่อ)

ลำดับ	รายการคำถาม	คะแนน	ผล	หมายเหตุ
11.2	การใช้สีในการกำหนดเส้นทางการจราจร			
	สีที่ใช้กำหนดเส้นทางการจราจรทั้งหมดเป็นสีที่เห็นได้ชัดตัดกับสีพื้น	1		
	75% ของเส้นทางการจราจรทั้งหมดเป็นสีที่เห็นได้ชัดตัดกับสีพื้น	0.75		
	50% ของเส้นทางการจราจรทั้งหมดปีนสีที่เห็นได้ชัดตัดกับสีพื้น	0.5		
	25% ของเส้นทางการจราจรทั้งหมดเป็นสีที่เห็นได้ชัดตัดกับสีพื้น	0.25		
	เส้นทางการจราจรทั้งหมดเป็นสีที่มองเห็นได้ไม่ชัดเจน	0		
11.3	การวางตำแน่งเส้นทางการจราจรอยู่ตำแหน่งที่สามารถแสดงระยะที่ปลอดภัย			
	การวางตำแน่งเส้นทางการจราจรทั้งหมดสามารถแสดงระยะที่ปลอดภัย	1		
	75% ของการวางตำแน่งเส้นทางการจราจรทั้งหมดสามารถแสดงระยะที่ปลอดภัย	0.75		
	50% ของการวางตำแน่งเส้นทางการจราจรทั้งหมดสามารถแสดงระยะที่ปลอดภัย	0.5		
	25% ของการวางตำแน่งเส้นทางการจราจรทั้งหมดสามารถแสดงระยะที่ปลอดภัย	0.25		
	การวางตำแน่งเส้นทางการจราจรทั้งหมดไม่สามารถแสดงระยะที่ปลอดภัย	0		
	รวม			
12	วิธีการเก็บรักษาสารเคมี	11		
12.1	แยกเก็บสารเคมี ตามแต่ละชนิดหรือประเภทของสารเคมี			
	สารเคมีทุกชนิดที่นำเข้าเก็บในสถานที่เก็บรักษาแยกเก็บตามประเภทของสารเคมี	1		
	75% ของสารเคมีทุกชนิดที่นำเข้าเก็บในสถานที่เก็บรักษาแยกเก็บตามประเภท	0.75		
	50% ของสารเคมีทุกชนิดที่นำเข้าเก็บในสถานที่เก็บรักษาแยกเก็บตามประเภท	0.5		
	25% ของสารเคมีทุกชนิดที่นำเข้าเก็บในสถานที่เก็บรักษาแยกเก็บตามประเภท	0.25		
	สารเคมีทุกชนิดที่นำเข้าเก็บในสถานที่เก็บรักษาไม่มีการแยกเก็บตามประเภท	0		

Risk – A แบบประเมินการจัดเก็บสารเคมีของโรงพิมพ์ (ต่อ)

ลำดับ	รายการคำถาม	คะแนน	ผล	หมายเหตุ
12.2	มีการแยกเก็บสารเคมีที่มีคุณสมบัติไวไฟไว้จากสารเคมีอื่น			
	มีการแยกเก็บสารเคมีที่มีคุณสมบัติไวไฟทั้งหมดจากสารเคมีอื่น	1		
	75% ของสารเคมีที่มีคุณสมบัติไวไฟทั้งหมด เก็บแยกจากสารเคมีอื่น	0.75		
	50% ของสารเคมีที่มีคุณสมบัติไวไฟทั้งหมด เก็บแยกจากสารเคมีอื่น	0.5		
	25% ของสารเคมีที่มีคุณสมบัติไวไฟทั้งหมด เก็บแยกจากสารเคมีอื่น	0.25		
	ไม่มีการแยกเก็บสารเคมีที่มีคุณสมบัติไวไฟไว้จากสารเคมีอื่น	0		
12.3	มีการแยกเก็บรักษาสารเคมีที่อาจเกิดปฏิกิริยาต่อกันไว้ไม่ปะปนกัน			
	สารเคมีที่อาจเกิดปฏิกิริยาต่อกันทั้งหมด มีการแยกเก็บไว้ไม่ปะปนกัน	1		
	75% ของสารเคมีที่อาจเกิดปฏิกิริยาต่อกันทั้งหมด มีการแยกเก็บไว้ไม่ปะปนกัน	0.75		
	50% ของสารเคมีที่อาจเกิดปฏิกิริยาต่อกันทั้งหมด มีการแยกเก็บไว้ไม่ปะปนกัน	0.5		
	25% ของสารเคมีที่อาจเกิดปฏิกิริยาต่อกันทั้งหมด มีการแยกเก็บไว้ไม่ปะปนกัน	0.25		
	สารเคมีที่อาจเกิดปฏิกิริยาต่อกันทั้งหมด ไม่มีการแยกเก็บจากกัน	0		
12.4	จัดเรียงสารเคมีไว้ในสภาพที่ไม่กีดขวางการทำงาน การขนย้ายสิ่งของและการใช้อุปกรณ์ฉุกเฉิน			
	สารเคมีทั้งหมดจัดเรียงสารเคมีไว้ในสภาพที่ไม่กีดขวางการทำงาน	1		
	75% ของสารเคมีทั้งหมดจัดเรียงสารเคมีไว้ในสภาพที่ไม่กีดขวางการทำงาน	0.75		
	50% ของสารเคมีทั้งหมดจัดเรียงสารเคมีไว้ในสภาพที่ไม่กีดขวางการทำงาน	0.5		
	25% ของสารเคมีทั้งหมดจัดเรียงสารเคมีไว้ในสภาพที่ไม่กีดขวางการทำงาน	0.25		
	สารเคมีทั้งหมดจัดเรียงสารเคมีไว้ในสภาพที่กีดขวางการทำงาน	0		
12.5	มีการเก็บภาชนะหรือหีบห่อสารเคมีที่ในตู้ที่มีฝาปิดมิดชิด/ในชั้นวางที่มีราวกั้น			
	สารเคมีทั้งหมดเก็บอยู่ในตู้ที่มีฝาปิดมิดชิด/ในชั้นวางที่มีราวกั้น	1		
	75% ของสารเคมีทั้งหมดเก็บอยู่ในตู้มีฝาปิดมิดชิด/ชั้นวางที่มีราวกั้น	0.75		
	50% ของสารเคมีทั้งหมดเก็บอยู่ในตู้มีฝาปิดมิดชิด/ชั้นวางที่มีราวกั้น	0.5		

Risk – A แบบประเมินการจัดเก็บสารเคมีของโรงพิมพ์ (ต่อ)

ลำดับ	รายการคำถาม	คะแนน	ผล	หมายเหตุ
	25% ของสารเคมีทั้งหมดเก็บอยู่ในตู้มีฝาปิดมิดชิด/ชั้นวางที่มีราวกั้น	0.25		
	สารเคมีทั้งหมดไม่ได้เก็บอยู่ในตู้ที่มีฝาปิดมิดชิด/ในชั้นวางที่มีราวกั้น	0		
12.6	ภาชนะที่บรรจุสารเคมีอันตรายทำด้วยวัสดุที่แข็งแรง ไม่ชำรุด ผุกร่อน			
	ภาชนะที่บรรจุสารเคมีอันตรายทั้งหมดทำด้วยวัสดุที่แข็งแรง ไม่ชำรุด ผุกร่อน	1		
	75% ของภาชนะที่บรรจุสารเคมีอันตรายทั้งหมดทำด้วยวัสดุที่แข็งแรง ไม่ชำรุด	0.75		
	50% ของภาชนะที่บรรจุสารเคมีอันตรายทั้งหมดทำด้วยวัสดุที่แข็งแรง ไม่ชำรุด	0.5		
	25% ของภาชนะที่บรรจุสารเคมีอันตรายทั้งหมดทำด้วยวัสดุที่แข็งแรง ไม่ชำรุด	0.25		
	ภาชนะที่บรรจุสารเคมีอันตรายทั้งหมดทำด้วยวัสดุที่ไม่แข็งแรง มีการชำรุด	0		
12.7	ไม่นำวัสดุที่ทำให้เกิดการลุกติดไฟได้ เช่น กระดาษ ไว้ในสถานที่เก็บรักษาสารเคมี			
	ไม่นำวัสดุที่ทำให้เกิดการลุกติดไฟได้ เช่น กระดาษ ไว้ในสถานที่เก็บรักษาสารเคมี	1		
	มีการนำวัสดุที่ทำให้เกิดการลุกติดไฟได้เช่น กระดาษ ไว้ในสถานที่เก็บรักษาสารเคมี	0		
12.8	สารเคมีที่เก็บในสถานที่เก็บรักษามีฉลากของสารเคมีติดอยู่ที่ภาชนะ			
	สารเคมีทั้งหมดมีการติดฉลากของสารเคมีไว้ที่ภาชนะบรรจุ	1		
	75% ของสารเคมีทั้งหมดมีการติดฉลากของสารเคมีไว้ที่ภาชนะบรรจุ	0.75		
	50% ของสารเคมีทั้งหมดมีการติดฉลากของสารเคมีไว้ที่ภาชนะบรรจุ	0.5		
	25% ของสารเคมีทั้งหมดมีการติดฉลากของสารเคมีไว้ที่ภาชนะบรรจุ	0.25		
	ไม่มีการติดฉลากของสารเคมีที่ภาชนะบรรจุ	0		
12.9	ฉลากของสารเคมีมองเห็นได้ชัดเจน			
	ฉลากของสารเคมีที่เก็บไว้ในสถานที่เก็บรักษาทั้งหมดมองเห็นได้ชัดเจน	1		
	75% ของฉลากของสารเคมีที่เก็บไว้ในสถานที่เก็บรักษาทั้งหมดมองเห็นได้ชัดเจน	0.75		

Risk – A แบบประเมินการจัดเก็บสารเคมีของโรงพิมพ์ (ต่อ)

ลำดับ	รายการคำถาม	คะแนน	ผล	หมายเหตุ
	50% ของฉลากของสารเคมีที่เก็บไว้ในสถานที่เก็บรักษาทั้งหมดมองเห็นได้ชัดเจน	0.5		
	25% ของฉลากของสารเคมีที่เก็บไว้ในสถานที่เก็บรักษาทั้งหมดมองเห็นได้ชัดเจน	0.25		
	ฉลากของสารเคมีที่เก็บไว้ในสถานที่เก็บรักษาทั้งหมดมองเห็นได้ไม่ชัดเจน	0		
12.10	มีชื่อทางเคมีหรือวิทยาศาสตร์ สัญลักษณ์ความเป็นอันตราย คำสัญญาณ ข้อความแสดงความเป็นอันตราย ข้อควรระวัง ชื่อผู้จำหน่าย บนฉลากของสารเคมี			
	ฉลากของสารเคมีทั้งหมดมีรายละเอียดดังกล่าว	1		
	75% ของฉลากของสารเคมีทั้งหมดมีรายละเอียดดังกล่าว	0.75		
	50% ของฉลากของสารเคมีทั้งหมดมีรายละเอียดดังกล่าว	0.5		
	25% ของฉลากของสารเคมีทั้งหมดมีรายละเอียดดังกล่าว	0.25		
	ฉลากของสารเคมีทั้งหมดไม่มีรายละเอียดดังกล่าว	0		
12.11	มีเอกสารข้อมูลความปลอดภัยของสารเคมีทุกรายการ			
	มีเอกสารข้อมูลความปลอดภัยของสารเคมีทุกรายการ	1		
	75% ของสารเคมีทั้งหมดมีเอกสารข้อมูลความปลอดภัย	0.75		
	50% ของสารเคมีทั้งหมดมีเอกสารข้อมูลความปลอดภัย	0.5		
	25% ของสารเคมีทั้งหมดมีเอกสารข้อมูลความปลอดภัย	0.25		
	ไม่มีเอกสารข้อมูลความปลอดภัยของสารเคมีทั้งหมด	0		
	รวม			
13	เครื่องหมายความปลอดภัย	4		
13.1	มีป้ายหรือสัญลักษณ์ที่แสดงถึงอันตรายตามชนิดของสารเคมี			
	สารเคมีทั้งหมดมีป้ายหรือสัญลักษณ์ที่แสดงถึงอันตราย	1		
	75% ของสารเคมีทั้งหมดมีป้ายหรือสัญลักษณ์ที่แสดงถึงอันตราย	0.75		
	50% ของสารเคมีทั้งหมดมีป้ายหรือสัญลักษณ์ที่แสดงถึงอันตราย	0.5		
	25% ของสารเคมีทั้งหมดมีป้ายหรือสัญลักษณ์ที่แสดงถึงอันตราย	0.25		
	สารเคมีทั้งหมดไม่มีป้ายหรือสัญลักษณ์ที่แสดงถึงอันตราย	0		
13.2	ป้ายหรือสัญลักษณ์ที่แสดงอันตรายตามชนิดของสารเคมี เป็นตัวอักษรสีแดงหรือสีดำขนาดใหญ่			
	ป้ายทั้งหมดเป็นตัวอักษรสีแดงหรือดำขนาดใหญ่	1		

Risk – A แบบประเมินการจัดเก็บสารเคมีของโรงพิมพ์ (ต่อ)

ลำดับ	รายการคำถาม	คะแนน	ผล	หมายเหตุ
	75% ของป้ายทั้งหมดเป็นตัวอักษรสีแดงหรือดำขนาดใหญ่	0.75		
	50% ของป้ายทั้งหมดเป็นตัวอักษรสีแดงหรือดำขนาดใหญ่	0.5		
	25% ของป้ายทั้งหมดเป็นตัวอักษรสีแดงหรือดำขนาดใหญ่	0.25		
	ป้ายหรือสัญลักษณ์ตัวอักษรไม่เป็นสีแดงหรือสีดำขนาดใหญ่	0		
13.3	มีป้ายบอก "สถานที่เก็บสารเคมี"แสดงไว้ให้เห็นอย่างชัดเจน มีขนาดเหมาะสม			
	ป้ายทั้งหมดแสดงไว้ให้เห็นอย่างชัดเจน มีขนาดเหมาะสม	1		
	75% ของป้ายทั้งหมดแสดงไว้ให้เห็นอย่างชัดเจน มีขนาดเหมาะสม	0.75		
	50% ของป้ายทั้งหมดแสดงไว้ให้เห็นอย่างชัดเจน มีขนาดเหมาะสม	0.5		
	25% ของป้ายทั้งหมดแสดงไว้ให้เห็นอย่างชัดเจน มีขนาดเหมาะสม	0.25		
	ป้ายทั้งหมดแสดงไว้ให้เห็นอย่างชัดเจน มีขนาดเหมาะสม	0		
13.4	มีป้ายบอก "ห้ามสูบบุหรี่"แสดงไว้ให้เห็นอย่างชัดเจน			
	ป้ายทั้งหมดแสดงไว้ให้เห็นอย่างชัดเจน มีขนาดเหมาะสม	1		
	75% ของป้ายทั้งหมดแสดงไว้ให้เห็นอย่างชัดเจน มีขนาดเหมาะสม	0.75		
	50% ของป้ายทั้งหมดแสดงไว้ให้เห็นอย่างชัดเจน มีขนาดเหมาะสม	0.5		
	25% ของป้ายทั้งหมดแสดงไว้ให้เห็นอย่างชัดเจน มีขนาดเหมาะสม	0.25		
	ป้ายทั้งหมดแสดงไว้ให้เห็นอย่างชัดเจน มีขนาดเหมาะสม	0		
	รวม			
	รวมทั้งหมด			

APPENDIX B
WORK PROCESS CHECKLIST

โรงพิมพ์...ครั้งที่................ผู้ตรวจสอบ.......................................วันที่...............

Risk – B1 แบบประเมินขั้นตอนการทำงานในระบบการจัดการสารเคมี ขั้นตอนการรับสารเคมีและขนย้ายเข้าเก็บ

ลำดับ	รายการพิจารณา	การพิจารณาโอกาสในการเกิดอันตราย					โอกาส	ความรุนแรง	ความเสี่ยง
		เกณฑ์พิจารณาโอกาสเกิดอันตราย	น้ำหนัก	คะแนนที่ได้ x น้ำหนัก (A)	คะแนนเต็ม x น้ำหนัก (B)	%โอกาสที่ได้ $\frac{A\ รวม}{B\ รวม} \times 100$			
1	มีขั้นตอนการทำงานเป็นลายลักษณ์อักษร	3 = ไม่กำหนดขั้นตอนหรือไม่มีเป็นเอกสาร 2= มีการกำหนดขั้นตอนเป็นเอกสารแต่ไม่เหมาะสม 1 = มีการกำหนดขั้นตอนเป็นเอกสารและเหมาะสม	3						
2	มีการกำหนดโซนหรือพื้นที่ในการรับส่งสินค้า อยู่นอกเหนือพื้นที่ที่ใช้ในการจราจร	3 = ไม่มีการกำหนดพื้นที่ในการรับส่งสินค้า 2 = มีการกำหนดพื้นที่แต่ไม่ปฏิบัติตาม 1 = มีการกำหนดพื้นที่และปฏิบัติตาม	2						
3	ขนย้ายสารเคมีลงจากรถโดยใช้คนในการขนย้ายด้วยวิธีการที่ปลอดภัย	3 = ยก/ขนย้ายด้วยวิธีการที่ไม่ปลอดภัย 1 = ยก/ขนย้ายด้วยวิธีการที่ปลอดภัย ไม่ตกหล่น	3						
4	ลำเลียงสารเคมีเข้าสู่ที่เก็บโดยใช้คนในการขนย้ายด้วยวิธีการที่ปลอดภัย	3 = ยก/ขนย้ายด้วยวิธีการที่ไม่ปลอดภัย 1 = ยก/ขนย้ายด้วยวิธีการที่ปลอดภัย ไม่ตกหล่น	3						
5	ลำเลียงสารเคมีเข้าสู่ที่เก็บโดยใช้รถเข็นในการขนย้ายมีการตรวจความเรียบร้อยของรถเข็นก่อนนำไปใช้	3 = ไม่มีการตรวจ 2 = มีการตรวจ แต่ไม่มีบันทึก 1 = มีการตรวจสอบมีบันทึกอย่างต่อเนื่อง	3						

Risk – B2 แบบประเมินขั้นตอนการทำงานในระบบการจัดการสารเคมี ขั้นตอนการจัดเก็บสารเคมี

ลำดับ	รายการพิจารณา	.การพิจารณาโอกาสในการเกิดอันตราย					โอกาส	ความรุนแรง	ความเสี่ยง
		เกณฑ์พิจารณาโอกาสเกิดอันตราย	น้ำหนัก	คะแนนที่ได้ x น้ำหนัก (A)	คะแนนเต็ม x น้ำหนัก. (B)	%โอกาสที่ได้ $\frac{\text{A รวม}}{\text{B รวม}} \times 100$			
1	มีขั้นตอนการทำงานเป็นลายลักษณ์อักษร	3 = ไม่กำหนดขั้นตอนหรือไม่มีเป็นเอกสาร 2 = มีการกำหนดขั้นตอนเป็นเอกสารแต่ไม่เหมาะสม 1 = มีการกำหนดขั้นตอนเป็นเอกสารและเหมาะสม	3						
2	ตรวจสอบภาชนะหรือหีบห่อหรือฉลากที่ใช้บรรจุสารเคมีก่อนนำเข้าเก็บ	3 = ไม่มีการตรวจ 2 = มีการตรวจ แต่ไม่มีบันทึก 1 = มีการตรวจสอบและมีบันทึกอย่างต่อเนื่อง	3						
3	ตรวจสอบความเรียบร้อยของฉลากสารเคมีก่อนนำเข้าเก็บ	3 = ไม่มีการตรวจ 2 = มีการตรวจ แต่ไม่มีบันทึก 1 = มีการตรวจสอบและมีบันทึกอย่างต่อเนื่อง	3						
4	การนำสารเคมีเข้าเก็บ นำเข้าเก็บแยกตามประเภทของสารเคมี	3 = นำเข้าเก็บโดยไม่แยกประเภท 1 = นำเข้าเก็บโดยแยกตามประเภทของสารเคมี	3						
5	การนำสารเคมีเข้าเก็บ ไม่เก็บสารเคมีที่มีปฏิกิริยาต่อกันไว้ใกล้กัน	3 = ไม่แยกประเภทในการเก็บสารที่มีปฏิกิริยาต่อกัน 1 = แยกสารที่มีปฏิกิริยาต่อกันออกจากกัน	3						
6	การนำสารเคมีเข้าเก็บไม่นำสารไวไฟเข้าเก็บปะปนกับสารเคมีอื่น	3 = เก็บสารไวไฟปะปนกับสารเคมีชนิดอื่น 1 = แยกสารไวไฟออกจากสารเคมีอื่น	3						

Risk – B2 แบบประเมินขั้นตอนการทำงานในระบบการจัดการสารเคมี ขั้นตอนการจัดเก็บสารเคมี (ต่อ)

ลำดับ	รายการพิจารณา	การพิจารณาโอกาสในการเกิดอันตราย					โอกาส	ความรุนแรง	ความเสี่ยง
		เกณฑ์พิจารณาโอกาสเกิดอันตราย	น้ำหนัก	คะแนนที่ได้ x น้ำหนัก (A)	คะแนนเต็ม x น้ำหนัก. (B)	%โอกาสที่ได้ $\frac{\text{A รวม}}{\text{B รวม}} \times 100$			
7	การเก็บสารเคมีที่มีภาชนะบรรจุที่แตกง่าย เช่น ขวดแก้ว มีการเก็บไว้ในตู้ที่มีฝาปิด หรือบนชั้นวางที่มีแผ่นกั้นกันตกไม่วางไว้บนพื้น	3 = วางไว้บนพื้นโดยตรง 2 = วางไว้ในตู้ที่ไม่มีประตูปิด/ชั้นวางไม่มีราวกั้น 1 = วางไว้ในตู้ที่มีฝาปิด/บนชั้นวางที่มีราวกั้น	3						
8	มีการตรวจสอบความมั่นคงแข็งแรงของแผ่นกั้นตกบนชั้นวาง	3 = ไม่มีการตรวจ 2 = มีการตรวจ แต่ไม่มีบันทึก 1 = มีการตรวจสอบและมีบันทึกอย่างต่อเนื่อง	3						
9	จัดเรียงสารเคมีตามเครื่องหมาย "ด้านนี้อยู่ด้านบน" /จัดเรียงโดยให้ฝาปิดอยู่ด้านบน	3 = จัดเรียงโดยไม่ได้คำนึงถึงด้านของฝาปิด 1 = จัดเรียงโดยให้ฝาปิดอยู่ด้านบน	3						
10	ปิดฝาตู้หรือชั้นวางสารเคมีให้เรียบร้อย เมื่อเก็บสารเคมีเสร็จ	3 = ไม่มีการปิดฝาตู้ 2 = มีการปิดฝาตู้แต่ปิดไม่สนิท/ไม่เรียบร้อย 1 = ปิดฝาตู้แน่นสนิท เรียบร้อย	3						

Risk – B3 แบบประเมินขั้นตอนการทำงานในระบบการจัดการสารเคมี ขั้นตอนการนำสารเคมีไปใช้

ลำดับ	รายการพิจารณา	การพิจารณาโอกาสในการเกิดอันตราย					โอกาส	ความรุนแรง	ระดับความเสี่ยง
		เกณฑ์พิจารณาโอกาสเกิดอันตราย	น้ำหนัก	คะแนนที่ได้ x น้ำหนัก (A)	คะแนนเต็ม x น้ำหนัก. (B)	%โอกาสที่ได้ $\frac{A\ รวม}{B\ รวม} \times 100$			
1	มีขั้นตอนการทำงานเป็นลายลักษณ์อักษร	3 = ไม่กำหนดขั้นตอนหรือไม่มีเป็นเอกสาร 2 = มีการกำหนดขั้นตอนเป็นเอกสารแต่ไม่เหมาะสม 1 = มีการกำหนดขั้นตอนเป็นเอกสารและเหมาะสม	3						
2	มีการกำหนดขั้นตอนการตรวจสอบวันหมดอายุของสารเคมีอย่างเป็นระบบ	3 = ไม่กำหนดขั้นตอนหรือไม่มีเป็นเอกสาร 2 = มีการกำหนดขั้นตอนเป็นเอกสารแต่ไม่เหมาะสม 1 = มีการกำหนดขั้นตอนเป็นเอกสารและเหมาะสม	3						
3	ก่อนหยิบสารเคมีไปใช้มีการอ่านป้ายและฉลากสารเคมีก่อนทุกครั้ง	3 = ไม่มีการอ่านป้ายและฉลากสารเคมี 2 = อ่านอย่างใดอย่างหนึ่งไม่ครบทั้งป้ายและฉลาก 1 = มีการอ่านทั้งป้ายและฉลากสารเคมี	3						
4	มีการปิดภาชนะอย่างแน่นหนาเมื่อใช้สารเคมีเสร็จแล้วและจะนำเข้าเก็บในที่เก็บ	3 = ไม่มีการปิดภาชนะก่อนนำเข้าเก็บ 2 = มีการปิดฝาภาชนะแต่ปิดไม่สนิทแน่นหนา 1 = มีการปิดฝาภาชนะอย่างแน่นหนา	3						

Risk – B3 แบบประเมินขั้นตอนการทำงานในระบบการจัดการสารเคมี **ขั้นตอนการนำสารเคมีไปใช้ (ต่อ)**

ลำดับ	รายการพิจารณา	.การพิจารณาโอกาสในการเกิดอันตราย					โอกาส	ความรุนแรง	ความเสี่ยง
		เกณฑ์พิจารณาโอกาสเกิดอันตราย	น้ำหนัก	คะแนนที่ได้ x น้ำหนัก (A)	คะแนนเต็ม x น้ำหนัก. (B)	%โอกาสที่ได้ A รวม / B รวม x 100			
5	หลังจากใช้เสร็จ จะนำสารเคมีเข้าเก็บนำไปเก็บที่เดิม ไม่ปะปนชนิดอื่นๆ	3 = นำเข้าเก็บโดยไม่แยกประเภท 1 = นำเข้าเก็บโดยแยกตามประเภทของสารเคมี	3						
6	ใช้รถเข็นในการขนย้ายภาชนะขนาดใหญ่ มีการตรวจความเรียบร้อยของรถเข็นก่อนนำไปใช้	3 = ไม่มีการตรวจ 2 = มีการตรวจ แต่ไม่มีบันทึก 1 = มีการตรวจสอบและมีบันทึกอย่างต่อเนื่อง	3						

Risk – B4 แบบประเมินขั้นตอนการทำงานในระบบการจัดการสารเคมี ขั้นตอนการถ่ายเทสารเคมี

ลำดับ	รายการพิจารณา	การพิจารณาโอกาสในการเกิดอันตราย					โอกาส	ความรุนแรง	ความเสี่ยง
		เกณฑ์พิจารณาโอกาสเกิดอันตราย	น้ำหนัก	คะแนนที่ได้ x น้ำหนัก (A)	คะแนนเต็ม x น้ำหนัก. (B)	%โอกาสที่ได้ $\frac{A\ รวม}{B\ รวม} \times 100$			
1	มีขั้นตอนการทำงานเป็นลายลักษณ์อักษร	3 = ไม่กำหนดขั้นตอนหรือไม่มีเป็นเอกสาร 2 = มีการกำหนดขั้นตอนเป็นเอกสารแต่ไม่เหมาะสม 1 = มีการกำหนดขั้นตอนเป็นเอกสารและเหมาะสม	3						
2	มีการถ่ายเทสารเคมีในพื้นที่ที่กำหนด ไม่ถ่ายเทในสถานที่เก็บรักษาสารเคมี	3 = ไม่มีการกำหนดพื้นที่ในการถ่ายเทสารเคมี 2 = มีการกำหนดพื้นที่แต่ไม่ถ่ายเทในที่ที่กำหนด 1 = มีการกำหนดพื้นที่และถ่ายเทสารในที่ที่กำหนด	3						
3	พื้นที่ที่ใช้ในการถ่ายเทมีการระบายอากาศเฉพาะที่/เป็นพื้นที่เปิดโล่งที่มีการระบายอากาศที่ดี	3 = ไม่มีการระบายอากาศ 1 = มีการระบายอากาศ	3						
4	มีภาชนะรองรับด้านล่างของบรรจุภัณฑ์สำหรับดักสารเคมีที่อาจรั่วไหลขณะถ่ายเทสารเคมี	3 = ไม่มี/มีแต่ไม่เหมาะ/เหมาะสมแต่ไม่มีการใช้งาน 1 = มีเหมาะสมและมีการใช้งาน	3						
5	มีอุปกรณ์ช่วยในการตวง/ถ่ายเทสารเคมีเหมาะสมกับชนิดของสารเคมีและภาชนะที่จะถ่ายเท	3 = ไม่มี/มีแต่ไม่เหมาะ/เหมาะสมแต่ไม่มีการใช้งาน 1 = มีเหมาะสมและมีการใช้งาน	3						
6	มีการปิดภาชนะหรือบรรจุภัณฑ์ทันที หลังจากที่มีการถ่ายเทสารเคมีเสร็จเรียบร้อยแล้ว	3 = เปิดทิ้งไว้ไม่ปิดฝา 2 = มีการปิดฝาภาชนะแต่ปิดไม่สนิท/ปิดไม่แน่นหนา 1 = ปิดฝาทันทีหลังจากใช้เสร็จ	3						

Risk – B4 แบบประเมินขั้นตอนการทำงานในระบบการจัดการสารเคมี ขั้นตอนการถ่ายเทสารเคมี (ต่อ)

ลำดับ	รายการพิจารณา	การพิจารณาโอกาสในการเกิดอันตราย					โอกาส	ความรุนแรง	ความเสี่ยง
		เกณฑ์พิจารณาโอกาสเกิดอันตราย	น้ำหนัก	คะแนนที่ได้ x น้ำหนัก (A)	คะแนนเต็ม x น้ำหนัก. (B)	%โอกาสที่ได้ $\frac{\text{A รวม}}{\text{B รวม}} \times 100$			
7	พนักงานมีการสวมใส่ถุงมือและหน้ากากกันสารเคมี ขณะถ่ายเทหรือบรรจุสารเคมี	3 = ไม่มี/มีแต่ไม่เหมาะ/มีเหมาะแต่ไม่ใช้/ใช้ไม่ถูก 1 = มีเหมาะสม/มีการใช้อย่างถูกต้อง	2						
8	การถ่ายเทของเหลวไวไฟ อุปกรณ์ไฟฟ้าที่ใช้ต้องเป็นชนิดป้องกันระเบิด	3 = ไม่มีการใช้อุปกรณ์ไฟฟ้าชนิดป้องกันระเบิด/มีแต่ไม่นำมาใช้ 1 = มีและนำมาใช้อย่างเหมาะสม	3						
9	การถ่ายเทของเหลวไวไฟ พนักงานต้องไม่สวมเสื้อผ้าที่ทำให้เกิดไฟฟ้าสถิตย์	3 = ไม่มี/มีแต่ไม่เหมาะ/เหมาะสมแต่ไม่มีการใช้งาน 1 = มีเหมาะสมและมีการใช้งาน	3						

Risk – B5 แบบประเมินขั้นตอนการทำงานในระบบการจัดการสารเคมี ขั้นตอนการสร้างแม่พิมพ์

ลำดับ	รายการพิจารณา	การพิจารณาโอกาสในการเกิดอันตราย					โอกาส	ความรุนแรง	ความเสี่ยง
		เกณฑ์พิจารณาโอกาสเกิดอันตราย	น้ำหนัก	คะแนนที่ได้ x น้ำหนัก (A)	คะแนนเต็ม x น้ำหนัก. (B)	%โอกาสที่ได้ $\frac{A\ รวม}{B\ รวม} \times 100$			
1	มีขั้นตอนการทำงานเป็นลายลักษณ์อักษร	3 = ไม่กำหนดขั้นตอนหรือไม่มีเป็นเอกสาร 2 = มีการกำหนดขั้นตอนเป็นเอกสารแต่ไม่เหมาะสม 1 = มีการกำหนดขั้นตอนเป็นเอกสารและเหมาะสม	3						
2	ขณะที่มีการทำความสะอาดแผ่นแม่พิมพ์พนักงานสวมถุงมือและหน้ากากกันสารเคมี	3 = ไม่มี/มีแต่ไม่เหมาะ/มีเหมาะแต่ไม่ใช้/ใช้ไม่ถูก 1 = มีเหมาะสม/มีการใช้อย่างถูกต้องกำหนด	2						
3	ขณะที่มีการทากาวเคลือบผิวหน้าแผ่นแม่พิมพ์พนักงานสวมถุงมือและหน้ากากกันสารเคมี	3 = ไม่มี/มีแต่ไม่เหมาะ/มีเหมาะแต่ไม่ใช้/ใช้ไม่ถูก 1 = มีเหมาะสม/มีการใช้อย่างถูกต้อง	2						
4	ภาชนะที่ใช้บรรจุกาวเคลือบผิวหน้าของแม่พิมพ์เป็นภาชนะที่มีฝาปิด	3 = ไม่มี/มีแต่ไม่เหมาะ/มีเหมาะแต่ไม่ใช้/ใช้ไม่ถูก 1 = มีเหมาะสม/มีการใช้อย่างถูกต้อง	3						
5	การปิดฝาภาชนะบรรจุกาวเคลือบผิวหน้าของแม่พิมพ์เมื่อไม่มีการใช้งาน	3 = ไม่มีมีการปิดฝาภาชนะ 2 = มีการปิดฝาภาชนะแต่ปิดไม่สนิท/ไม่แน่นหนา 1 = มีการปิดฝาภาชนะอย่างแน่นหนา	3						

Risk – B5 แบบประเมินขั้นตอนการทำงานในระบบการจัดการสารเคมี ขั้นตอนการสร้างแม่พิมพ์ (ต่อ)

ลำดับ	รายการพิจารณา	.การพิจารณาโอกาสในการเกิดอันตราย					โอกาส	ความรุนแรง	ความเสี่ยง
		เกณฑ์พิจารณาโอกาสเกิดอันตราย	น้ำหนัก	คะแนนที่ได้ x น้ำหนัก (A)	คะแนนเต็ม x น้ำหนัก. (B)	%โอกาสที่ได้ A รวม / B รวม x 100			
6	ภาชนะที่ใช้บรรจุน้ำยาทำความสะอาดแม่พิมพ์เป็นภาชนะที่มีฝาปิด	3 = ไม่มี/มีแต่ไม่เหมาะ/มีเหมาะแต่ไม่ใช้/ใช้ไม่ถูก 1 = มีเหมาะสม/มีการใช้อย่างถูกต้อง	3						
7	มีการปิดฝาภาชนะบรรจุน้ำยาทำความสะอาดแม่พิมพ์เมื่อไม่มีการใช้งาน	3 = เปิดทิ้งไว้ไม่ปิดฝา 2 = มีการปิดฝาภาชนะแต่ปิดไม่สนิท/ปิดไม่แน่นหนา 1 = ปิดฝาทันทีหลังจากใช้เสร็จ	3						
8	ฟองน้ำหรือผ้าที่ใช้เช็ดแผ่นแม่พิมพ์ เมื่อไม่ใช้จะถูกเก็บในภาชนะที่มีฝาปิด	3 = เก็บไว้ในภาชนะที่ไม่มีฝาปิด/ไม่มีภาชนะไว้เก็บ 2 = เก็บไว้ในภาชนะที่มีฝาปิดแต่ไม่ปิดฝา/ปิดฝาไม่แน่นหนา 1 = เก็บไว้ในภาชนะที่มีฝาปิดและปิดฝาภาชนะ	3						

Risk – B6 แบบประเมินขั้นตอนการทำงานในระบบการจัดการสารเคมี **ขั้นตอนการพิมพ์**

ลำดับ	รายการพิจารณา	การพิจารณาโอกาสในการเกิดอันตราย					โอกาส	ความรุนแรง	ระดับความเสี่ยง
		เกณฑ์พิจารณาโอกาสเกิดอันตราย	น้ำหนัก	คะแนนที่ได้ x น้ำหนัก (A)	คะแนนเต็ม x น้ำหนัก. (B)	%โอกาสที่ได้ $\frac{A\ รวม}{B\ รวม} \times 100$			
1	มีขั้นตอนการทำงานเป็นลายลักษณ์อักษร	3 = ไม่กำหนดขั้นตอนหรือไม่มีเป็นเอกสาร 2 = มีการกำหนดขั้นตอนเป็นเอกสารแต่ไม่เหมาะสม 1 = มีการกำหนดขั้นตอนเป็นเอกสารและเหมาะสม	3						
2	พนักงานมีการสวมถุงมือและหน้ากากป้องกันสารเคมีตลอดระยะเวลาการทำงาน	3 = ไม่มี/มีแต่ไม่เหมาะ/มีเหมาะแต่ไม่ใช้/ใช้ไม่ถูก 1 = มีเหมาะสม/มีการใช้อย่างถูกต้องกำหนด	2						
3	ปิดฝาภาชนะบรรจุสารเคมีทันทีที่เทสารเคมีใส่เครื่องพิมพ์เรียบร้อยแล้ว	3 = ไม่มีมีการปิดฝาภาชนะ 2 = มีการปิดฝาภาชนะแต่ปิดไม่สนิท/ไม่แน่นหนา 1 = มีการปิดฝาภาชนะอย่างแน่นหนา	3						
4	ปิดฝาเครื่องพิมพ์ในส่วนที่รองรับสารเคมีทันที เมื่อเทสารเคมีใส่เครื่องเสร็จแล้ว	3 = ไม่มีการปิดฝาเครื่องพิมพ์ 2 = มีการปิดฝาเครื่องพิมพ์แต่ปิดไม่สนิท/แน่นหนา 1 = มีการปิดฝาเครื่องพิมพ์อย่างแน่นหนา	3						
5	มีการใช้ระบบระบายอากาศเฉพาะที่เพื่อป้องกันและกำจัดการสารเคมีที่แพร่กระจายที่ออกมาจากเครื่องพิมพ์	3 = ไม่มี/มีแต่ไม่เหมาะ/เหมาะสมแต่ไม่มีการใช้งาน 1 = มีเหมาะสมและมีการใช้งาน	2						

Risk – B6 แบบประเมินขั้นตอนการทำงานในระบบการจัดการสารเคมี ขั้นตอนการพิมพ์ (ต่อ)

ลำดับ	รายการพิจารณา	การพิจารณาโอกาสในการเกิดอันตราย					โอกาส	ความรุนแรง	ระดับความเสี่ยง
		เกณฑ์พิจารณาโอกาสเกิดอันตราย	น้ำหนัก	คะแนนที่ได้ x น้ำหนัก (A)	คะแนนเต็ม x น้ำหนัก. (B)	%โอกาสที่ได้ $\frac{\text{A รวม}}{\text{B รวม}} \times 100$			
6	หากมีการหกรั่วไหลของสารเคมีมีวิธีการกำจัดที่ถูกต้องโดยใช้สารดูดซับ	3 = ไม่มี/มีแต่ไม่เหมาะสม/มีเหมาะสมแต่ไม่มีการใช้งาน 1 = มีการใช้สารดูดซับที่เหมาะสม	3						
7	วัสดุที่ปนเปื้อนสารเคมีเช่น ผ้า หรือสารดูดซับ ทิ้งลงในภาชนะที่มีฝาปิด	3 = เก็บไว้ในภาชนะที่ไม่มีฝาปิด/ไม่มีภาชนะไว้เก็บ 2 = เก็บไว้ในภาชนะที่มีฝาปิดแต่ไม่ปิดฝา/ปิดฝาไม่แน่นหนา 1 = เก็บไว้ในภาชนะที่มีฝาปิดและปิดฝาภาชนะ	3						
8	มีการเตรียมพร้อมเมื่อเกิดหารหกรั่วไหลของสารเคมี	3 = ไม่กำหนดขั้นตอนหรือไม่มีเป็นเอกสาร 2 = มีการกำหนดขั้นตอนเป็นเอกสารแต่ไม่เหมาะสม 1 = มีการกำหนดขั้นตอนเป็นเอกสารและเหมาะสม	3						

Risk – B7 แบบประเมินขั้นตอนการทำงานในระบบการจัดการสารเคมี **ขั้นตอนการทำความสะอาดแม่พิมพ์**

ลำดับ	รายการพิจารณา	การพิจารณาโอกาสในการเกิดอันตราย					โอกาส	ความรุนแรง	ความเสี่ยง
		เกณฑ์พิจารณาโอกาสเกิดอันตราย	น้ำหนัก	คะแนนที่ได้ x น้ำหนัก (A)	คะแนนเต็ม x น้ำหนัก. (B)	%โอกาสที่ได้ $\frac{A\ รวม}{B\ รวม} \times 100$			
1	มีขั้นตอนการทำงานเป็นลายลักษณ์อักษร	3 = ไม่กำหนดขั้นตอนหรือไม่มีเป็นเอกสาร 2 = มีการกำหนดขั้นตอนเป็นเอกสารแต่ไม่เหมาะสม 1 = มีการกำหนดขั้นตอนเป็นเอกสารและเหมาะสม	3						
2	ขณะที่มีการเช็ดทำความสะอาดแม่พิมพ์พนักงานสวมถุงมือและหน้ากากกันสารเคมี	3 = ไม่มี/มีแต่ไม่เหมาะ/มีเหมาะแต่ไม่ใช้/ใช้ไม่ถูก 1 = มีเหมาะสม/มีการใช้อย่างถูกต้อง	2						
3	ภาชนะที่ใช้บรรจุน้ำยาทำความสะอาดแม่พิมพ์เป็นภาชนะที่มีฝาปิด	3 = ไม่มี/มีแต่ไม่เหมาะ/เหมาะสมแต่ไม่มีการใช้งาน 1 = มีเหมาะสมและมีการใช้งาน	3						
4	มีการปิดฝาภาชนะบรรจุน้ำยาทำความสะอาดแม่พิมพ์เมื่อไม่ได้ใช้งาน	3 = ไม่มีมีการปิดฝาภาชนะ 2 = มีการปิดฝาภาชนะแต่ปิดไม่สนิท/ไม่แน่นหนา 1 = มีการปิดฝาภาชนะอย่างแน่นหนา	3						
5	ฟองน้ำ/ผ้าที่ใช้ทำความสะอาดแผ่นแม่พิมพ์ เมื่อไม่ใช้จะถูกเก็บในภาชนะที่มีฝาปิด	3 = เก็บไว้ในภาชนะที่ไม่มีฝาปิด/ไม่มีภาชนะไว้เก็บ 2 = เก็บไว้ในภาชนะที่มีฝาปิดแต่ไม่ปิดฝา/ปิดฝาไม่แน่นหนา 1 = เก็บไว้ในภาชนะที่มีฝาปิดและปิดฝาภาชนะ	3						

Risk – B8 แบบประเมินขั้นตอนการทำงานในระบบการจัดการสารเคมี ขั้นตอนการทำความสะอาดลูกคลึงหมึก

ลำดับ	รายการพิจารณา	การพิจารณาโอกาสในการเกิดอันตราย					โอกาส	ความรุนแรง	ระดับความเสี่ยง
		เกณฑ์พิจารณาโอกาสเกิดอันตราย	น้ำหนัก	คะแนนที่ได้ x น้ำหนัก (A)	คะแนนเต็ม x น้ำหนัก. (B)	%โอกาสที่ได้ $\frac{\text{A รวม}}{\text{B รวม}} \times 100$			
1	มีขั้นตอนการทำงานเป็นลายลักษณ์อักษร	3 = ไม่กำหนดขั้นตอนหรือไม่มีเป็นเอกสาร 2 = มีการกำหนดขั้นตอนเป็นเอกสารแต่ไม่เหมาะสม 1 = มีการกำหนดขั้นตอนเป็นเอกสารและเหมาะสม	3						
2	ขณะที่มีการเช็ดทำความสะอาด ลูกคลึงหมึก พนักงานสวมถุงมือและหน้ากากกันสารเคมี	3 = ไม่มี/มีแต่ไม่เหมาะ/มีเหมาะแต่ไม่ใช้/ใช้ไม่ถูก 1 = มีเหมาะสม/มีการใช้อย่างถูกต้อง	2						
3	ภาชนะที่ใช้บรรจุน้ำยาทำความสะอาดลูกคลึงหมึกเป็นภาชนะที่มีฝาปิด	3 = ไม่มี/มีแต่ไม่เหมาะ/เหมาะสมแต่ไม่มีการใช้งาน 1 = มีเหมาะสมและมีการใช้งาน	3						
4	มีการปิดฝาภาชนะบรรจุน้ำยาทำความสะอาดลูกคลึงหมึกเมื่อไม่ได้ใช้งาน	3 = ไม่มีมีการปิดฝาภาชนะ 2 = มีการปิดฝาภาชนะแต่ปิดไม่สนิท/ไม่แน่นหนา 1 = มีการปิดฝาภาชนะอย่างแน่นหนา	3						
5	ฟองน้ำ/ผ้าที่ใช้ล้างทำความสะอาดลูกคลึงหมึกเมื่อไม่ใช้จะถูกเก็บในภาชนะที่มีฝาปิด	3 = เก็บไว้ในภาชนะที่ไม่มีฝาปิด/ไม่มีภาชนะไว้เก็บ 2 = เก็บไว้ในภาชนะที่มีฝาปิดแต่ไม่ปิดฝา/ปิดฝาไม่แน่นหนา 1 = เก็บไว้ในภาชนะที่มีฝาปิดและปิดฝาภาชนะ	3						

Risk – B9 แบบประเมินขั้นตอนการทำงานในระบบการจัดการสารเคมี ขั้นตอนการทำความสะอาดผ้ายาง

ลำดับ	รายการพิจารณา	การพิจารณาโอกาสในการเกิดอันตราย					โอกาส	ความรุนแรง	ความเสี่ยง
		เกณฑ์พิจารณาโอกาสเกิดอันตราย	น้ำหนัก	คะแนนที่ได้ x น้ำหนัก (A)	คะแนนเต็ม x น้ำหนัก. (B)	%โอกาสที่ได้ A รวม / B รวม x 100			
1	มีขั้นตอนการทำงานเป็นลายลักษณ์อักษร	3 = ไม่กำหนดขั้นตอนหรือไม่มีเป็นเอกสาร 2 = มีการกำหนดขั้นตอนเป็นเอกสารแต่ไม่เหมาะสม 1 = มีการกำหนดขั้นตอนเป็นเอกสารและเหมาะสม	3						
2	ขณะที่เช็ดทำความสะอาดผ้ายางพนักงานสวมถุงมือและหน้ากากกันสารเคมี	3 = ไม่มี/มีแต่ไม่เหมาะ/มีเหมาะแต่ไม่ใช้/ใช้ไม่ถูก 1 = มีเหมาะสม/มีการใช้อย่างถูกต้อง	2						
3	ภาชนะที่ใช้บรรจุน้ำยาทำความสะอาดผ้ายางเป็นภาชนะที่มีฝาปิด	3 = ไม่มี/มีแต่ไม่เหมาะ/เหมาะสมแต่ไม่มีการใช้งาน 1 = มีเหมาะสมและมีการใช้งาน	3						
4	มีการปิดฝาภาชนะบรรจุน้ำยาทำความสะอาดผ้ายางเมื่อไม่ได้ใช้งาน	3 = ไม่มีมีการปิดฝาภาชนะ 2 = มีการปิดฝาภาชนะแต่ปิดไม่สนิท/ไม่แน่นหนา 1 = มีการปิดฝาภาชนะอย่างแน่นหนา	3						
5	ผ้าที่ใช้เช็ดทำความสะอาดผ้ายาง เมื่อไม่ใช้จะถูกเก็บในภาชนะที่มีฝาปิด	3 = ไม่มี/มีแต่ไม่เหมาะ/มีเหมาะแต่ไม่ใช้/ใช้ไม่ถูก 1 = มีเหมาะสม/มีการใช้อย่างถูกต้อง	3						
6	วัสดุที่ปนเปื้อนสารเคมีเช่น ผ้าที่ใช้เช็ดที่ไม่ใช้แล้ว ทิ้งลงในภาชนะที่มีฝาปิด	3 = เก็บไว้ในภาชนะที่ไม่มีฝาปิด/ไม่มีภาชนะไว้เก็บ 2 = เก็บไว้ในภาชนะที่มีฝาปิดแต่ไม่ปิดฝา/ปิดฝาไม่แน่นหนา 1 = เก็บไว้ในภาชนะที่มีฝาปิดและปิดฝาภาชนะ	3						

Risk – B10 แบบประเมินขั้นตอนการทำงานในระบบการจัดการสารเคมี ขั้นตอนการทำความสะอาดโมหรือลูกกลิ้ง

ลำดับ	รายการพิจารณา	การพิจารณาโอกาสในการเกิดอันตราย					โอกาส	ความรุนแรง	ความเสี่ยง
		เกณฑ์พิจารณาโอกาสเกิดอันตราย	น้ำหนัก	คะแนนที่ได้ x น้ำหนัก (A)	คะแนนเต็ม x น้ำหนัก. (B)	%โอกาสที่ได้ $\frac{\text{A รวม}}{\text{B รวม}} \times 100$			
1	มีขั้นตอนการทำงานเป็นลายลักษณ์อักษร	3 = ไม่กำหนดขั้นตอนหรือไม่มีเป็นเอกสาร 2 = มีการกำหนดขั้นตอนเป็นเอกสารแต่ไม่เหมาะสม 1 = มีการกำหนดขั้นตอนเป็นเอกสารและเหมาะสม	3						
2	ขณะที่เช็ดทำความสะอาดโมหรือลูกกลิ้ง พนักงานสวมถุงมือและหน้ากากกันสารเคมี	3 = ไม่มี/มีแต่ไม่เหมาะ/มีเหมาะแต่ไม่ใช้/ใช้ไม่ถูก 1 = มีเหมาะสม/มีการใช้อย่างถูกต้อง	2						
3	ภาชนะที่ใช้บรรจุน้ำยาทำความสะอาดโม หรือลูกกลิ้งเป็นภาชนะที่มีฝาปิด	3 = ไม่มี/มีแต่ไม่เหมาะ/เหมาะสมแต่ไม่มีการใช้งาน 1 = มีเหมาะสมและมีการใช้งาน	3						
4	ปิดฝาภาชนะบรรจุน้ำยาทำความสะอาดโม หรือลูกกลิ้งเมื่อไม่ใช้งาน	3 = ไม่มีมีการปิดฝาภาชนะ 2 = มีการปิดฝาภาชนะแต่ปิดไม่สนิท/ไม่แน่นหนา 1 = มีการปิดฝาภาชนะอย่างแน่นหนา	3						
5	ผ้าที่ใช้เช็ดทำความสะอาดโมหรือลูกกลิ้ง เมื่อไม่ใช้จะถูกเก็บในภาชนะที่มีฝาปิด	3 = ไม่มี/มีแต่ไม่เหมาะ/มีเหมาะแต่ไม่ใช้/ใช้ไม่ถูก 1 = มีเหมาะสม/มีการใช้อย่างถูกต้อง	3						
6	วัสดุที่ปนเปื้อนสารเคมีเช่น ผ้าที่ใช้เช็ดทำความสะอาดที่ไม่ใช้แล้ว ทิ้งลงในภาชนะที่มีฝาปิด	3 = เก็บไว้ในภาชนะที่ไม่มีฝาปิด/ไม่มีภาชนะไว้เก็บ 2 = เก็บไว้ในภาชนะที่มีฝาปิดแต่ไม่ปิดฝา/ปิดฝาไม่แน่นหนา 1 = เก็บไว้ในภาชนะที่มีฝาปิดและปิดฝาภาชนะ	3						

Risk – B11 แบบประเมินขั้นตอนการทำงานในระบบการจัดการสารเคมี ขั้นตอนการทิ้งของเสีย

ลำดับ	รายการพิจารณา	การพิจารณาโอกาสในการเกิดอันตราย					โอกาส	ความรุนแรง	ระดับความเสี่ยง
		เกณฑ์พิจารณาโอกาสเกิดอันตราย	น้ำหนัก	คะแนนที่ได้ x น้ำหนัก (A)	คะแนนเต็ม x น้ำหนัก. (B)	%โอกาสที่ได้ $\frac{A\ รวม}{B\ รวม} \times 100$			
1	มีขั้นตอนการทำงานเป็นลายลักษณ์อักษร	3 = ไม่กำหนดขั้นตอนหรือไม่มีเป็นเอกสาร 2 = มีการกำหนดขั้นตอนเป็นเอกสารแต่ไม่เหมาะสม 1 = มีการกำหนดขั้นตอนเป็นเอกสารและเหมาะสม	3						
2	มีการแยกทิ้งบรรจุภัณฑ์ของสารเคมีโดยไม่ปะปนกับของเสียชนิดอื่นๆ	3 = ไม่แยก/ทิ้งปะปนกับของเสียอื่นๆ 1 = แยกทิ้งเฉพาะบรรจุภัณฑ์ของสารเคมี ไม่ปะปน	3						
3	บริเวณหรือภาชนะสำหรับทิ้งบรรจุภัณฑ์หรือสิ่งที่ปนเปื้อนกับสารเคมีเป็นภาชนะโลหะที่มีฝาปิดมิดชิด	3 = ไม่มี/มีแต่ไม่เหมาะ/เหมาะสมแต่ไม่มีการใช้งาน 1 = มีเหมาะสมและมีการใช้งาน	3						
4	มีการนำของเสียที่เก็บรวบรวมไว้ออกไปจากบริเวณทำงานของลูกจ้างไม่น้อยกว่าวันละ 1 ครั้ง	3 = นำออกไปน้อยกว่าวันละ 1 ครั้ง 1 = นำออกไปอย่างน้อยวันละ 1 ครั้ง	3						

Risk – B11 แบบประเมินขั้นตอนการทำงานในระบบการจัดการสารเคมี **ขั้นตอนการทิ้งของเสีย (ต่อ)**

ลำดับ	รายการพิจารณา	.การพิจารณาโอกาสในการเกิดอันตราย					โอกาส	ความรุนแรง	ความเสี่ยง
		เกณฑ์พิจารณาโอกาสเกิดอันตราย	น้ำหนัก	คะแนนที่ได้ x น้ำหนัก (A)	คะแนนเต็ม x น้ำหนัก. (B)	%โอกาสที่ได้ A รวม / B รวม x 100			
6	แยกพื้นที่เก็บขยะออกจากพื้นที่ผลิตและดูแลอย่างเป็นระเบียบ	3 = พื้นที่ทั้งสองอยู่ในบริเวณเดียวกัน 2 = แยกพื้นที่ทั้งสองออกจากกันแต่ดูแลไม่เป็นระเบียบ/พื้นที่ทั้งสองอยู่ในบริเวณเดียวกันแต่ดูแลอย่างเป็นระเบียบ 1 = แยกทั้งสองพื้นที่ออกจากกันและดูแลอย่างเป็นระเบียบ	3						
7	มีการกำจัดสารเคมีที่เป็นของเสียด้วยการแยกจากของเสียอื่นและส่งให้บริษัท/หน่วยงานที่เกี่ยวข้องกำจัด	3 = นำกลับมาใช้ใหม่/ทิ้งปะปนกับของเสียอื่น 1 = ส่งให้หน่วยงานที่เกี่ยวข้อง/กำจัดตามวิธีการกำจัดบนฉลากของสารเคมี	3						

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PUBLICATION / PRESENTATION	This research was presented on the 13th Mahidol National Public Health Conference (Global Crisis and its Impact on Health: Public Health Challenge)