Report on IUPAC-UNESCO-UNIDO safety and environmental training

at

MITSUI Chemicals, Inc., Japan

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By

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Sponsor/Host

IUPAC-UNESCO-UNIDO and .MITSUI Chemicals, Inc. (MCI), Japan.

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Introduction:

In an attempt to make life more comfortable and meaningful by man, there has been increased chemical production and consumption all over the World. These materials apart from having negative impact on environment after their useful life, they also create one form of hazard to man and environment during different stages of production and or consumption. The developed countries are making legislations and laws that stipulate various safety and health related requirement of all the parties involved; and introduction of various sophisticated safety measure covering operational, health and environmental aspect in close interaction with the government and the public. The developing countries are lagging behind in this crusade.

Realizing the importance of safety education, guidelines, legislation and implementation, the International Union of Pure and Applied Chemistry (IUPAC), the United Nations Educational, Scientific and Cultural Organization (UNESCO) and United Nations International Development Organization (UNIDO), have come together to develop a joint training program for safety and environmental protection. This program provides opportunities for safety experts around the World to learn about safety and environmental protection measures by visiting and working with IUPAC's Associate company's facilities. I was privileged to be accepted by Mitsui Chemicals Inc (MCI) Japan as one of the trainee for the year 2004.

Environment & Safety Management Training (ESM).

The training program was divided into two sections: namely:

A. Orientation and general work tour; and

B. Environmental & Safety Management training.

A.I Orientation and general work tour:

This gave me opportunity to know about Mitsui Chemicals Inc. (MCI), its corporate activities, different Work locations, and Research & Development center. Mitsui Chemicals Inc MCI Japan, one of the World strongest Petrochemical Industries, which has continuously utilized chemistry boundless potentials in providing technologies, innovations and creations of materials to man and at the same time keeping in harmony with the global environment. MCI has its tentacles spread all over the World with head office in Shiodome

City Center, Tokyo, Japan.

On arrival, the management of MCI at the head office in Tokyo received us. In attendance were Dr. Yukihiko Suematsu, GM, Polymer biz Development Division, MCI and Coordinator, Committee on Chemistry and Industry, Japan; Mr. Akira Shimada and Mr. Osamu Usui, GM and AGM Environmental Safety and Quality Div Respectively. We were later briefed about the training, living custom in Japan and the details of ESM training.

II. Works tour: Among the works visited are: Ichihara works, Iwakuni-Ohtake works and MCI Sodegaura Research and Development Center.

i. Ichihara works: Ichihara works is located at the strategic position at the seashore in Ichihara City, Chiba Prefecture, and the center of the Keiyo industrial zone consisting of petrochemical complexes. This works utilizes naphtha sourced from both domestic sources and importation. The works consists of highly productive large-scale production plants of polyethylene, polypropylene, phenol etc. These are used in production of different products such as and house holds, packaging and containers, housing and construction materials, medical and health care, sports, agricultural products, automobiles, electrical appliances and electronics, etc.

ii. Iwakuni-Ohtake works: Iwakuni-Ohtake works are located at the boundaries of Hiroshima and Yamagushi prefecture separated by Oze River. The two works, linked together by MCI material delivery bridge, consists of highly productive large-scale production plants for low molecular weight polyethylene, purified terephthalic acid, polyethylene terephthalic resin, Mitsui catalyst and other related products.

iii. MCI Sodegaura Research and Development Center:

Sodengaura Research & Development Center is located on 300,000 square meters of land full of greenery, which added to the comfort of the environment. The center is actively engaged in generating new products and technologies aimed at realizing an ever more comfortable human life. There are well over 1000 researchers and engineers at the R&D center. The center consists of seven different laboratories namely polyolefin, catalysis science, material science, functional chemicals, process technology and electrical /engineered materials laboratory.

It was observed that, in all MCI works visited, there is a well-established information and communication system. Every guest is made to obey and follow all the safety procedure put in place. Also, we were made to watch the video clips of every works department visited before proceeding on works tour.

Orientation / sightseeing at Hiroshima.

In order to fully prepare us for the training, we are conducted round the City of Iwakuni on arrival at Hiroshima/Iwakuni. The second day of the orientation and all the weekends during the training were completely used for tourism tagged ***sight seeing course***. Among the places visited were: Miyajima, a place of historic and cultural assets which was full of beauty of nature; and Hiroshima peace memorial museum. The peace memorial museum is full of collections and displayed belongings left by the victims, photos and other materials that convey the horror of that event supplemented by exhibits that described Hiroshima before and after the bombing. The message stressed by photographs and video recordings is the complete elimination of all nuclear weapons and full realization of genuine peaceful and friendly international community. Other places visited include Kintai bridge, Iwakuni Castle, Kikko park, Hondori shopping area and several other places.

B Environment & Safety Management Training (ESM). .

The training at MCI covered the under listed outlined areas:

1. ESM check list-
   Completion of check list.
   Checklist for Safety & Health activities audit.
2. ESM in works-
   Safety and environmental
3. ESM activities
   Basic thought on prevention of accidents
   Thinking cause while accident occurred
   Material Safety Data Sheet (MSDS
   What to be done in case there is accident
   Danger Prediction and finger pointing

Hazard and Operability studies (HAZOP).
Hazard due to static electricity.
Human error.
Accident investigation technique
Occupational accidents and injuries
Taking action when occupational injuries occurred
Action flow when occupational injuries occurred.
Environmental Management.

1. ESM check list-

i. Check list: This check list (annexure 1) consist of six different subjects to be managed. The subjects are made of 6Ms namely Management, Man, Method, Material, Machine and Media. These subjects are further divided into items with a total of 24 different classifications from A-W; and the check items with a total of 172 questions.

ii. Checklist for Safety & Health activities audit.

Proper auditing of individual check items in the checklist enables us to dig out our companies weakness areas on the environmental & safety management. The checklists were completed, assessed, evaluated and each of us (the trainees) was provided with various measures on how to improve on my establishments ESM level.

2. ESM in works: the environmental safety management in works was studied with purpose of proper administration and management system as relate to safety and environment. Safety and environment administration manual of MCI and A guide to safety and health management published by Japan international training cooperation organization were used as guide. A good safety and environmental manual (S & E) is expected to have a well defined:

i. Safety & Environmental policy,
ii. Management plans as relate to: effect assessment, compliance with laws and regulations, work target and implementation targets and the system to execute the management plan.

iii. Administration and implementation as relate to organization and responsibility, education/training and qualification, document control, procedure for management of routine works and procedure for emergency action.

iv Assessment and corrective actions as relate to verification, monitoring/measurement, nonconformity and corrective/preventive action, S&E records, and internal auditing of S & E.

v. A good S & E manual must make provision for review of safety & health management.

It is therefore essential for every organization to establish its own Environmental Health and Safety (EHS) yearly plan. EHS yearly plan consists of basically, safety mission, safety policy and goal for that particular year, the performance of the previous year, and important yearly subjects (including measures, responsibility, dead line and results). Each trainee prepare and presented EHS yearly plan using four level of thought developed by Dupont (i.e. belief, principle, concept and design) with the application of PDCA system (plan, do, check and action) for our organizational use.

3. ESM activities

Basic thought on prevention of accidents.

The causes of accidents can be broadly divided into five, namely management, Safety control, human, unsafe behavior and unsafe state were well discussed. Prevention of accident therefore required an effective way of controlling these factors. Each of these causes was treated in detail.

1. Management caused (Top ware): it is the responsibility of the management to put in place a reliable safety policy, good leadership, job control, human relation and good moral.

2. Safety control caused (Soft ware) these involves the use of standard, rules, on job and off job training, work control (instruction) and equipment control.

3. Human caused (human ware 1) this has to do with the knowledge, skill, carelessness, human error, anxiety, misuse of protective gear and equipments, fatigue of the manpower involved in production etc.

4. Unsafe state caused (human ware 2): this are basically the work behavior, work position and posture, approach to danger and lack of cooperation between workers.

5. Unsafe state (hard wears) these concern basically the state of equipments, tools, protective gear, working condition and working methods.

Each of these causes, safety control method and counter measures were discussed. Also, principles of safety control, human error, conscious level of cerebrum in relation to different consciousness, physiological state, and various ways of preventing human error were also discussed.

Thinking cause while accident occurred. When accident occurred there is need to investigate the cause of the accident and the measures to be taken in preventing such future occurrence. The two lines of thinking cause is presented in figure 1. Although, the first route (which utilized penalty) is regarded as old fashion which must be discouraged. There should be feed back to prevent future occurrence.

See figure 1

Videotapes of some accidents recoded on delivery people and meter readers were watched. The hazards were all listed, grouped and countermeasures were also discussed. The hazards identified and counter measures were discussed. Other videotapes watched were accident caused by sulphuric acid, steam, and other chemicals.

What should be done to prevent accidents caused by burns and chemical spray:

1. Correct knowledge about the chemical.

Use instruction manual and Material Safety Data Sheet, check the name, label and handling instructions carefully.

ii. Follow the safe working methods- work procedure.

Hold meeting when using new procedure, ensure there is no residual pressure or liquids before starting, after work and during maintenance.

iii. Check safety location before, during and after works.

iv. Use appropriate and correct protective gear.

v. Run regular emergency drills.

Material Safety Data Sheet *(MSDS)* is a document containing essential information on chemical products including transportation, handling, storage and emergency actions from the supplier/manufacture to the recipient of the product. MSDS, written in a simple and clear language, consist of 16 major items, which includes; 1. chemical product and company identification, 2. composition/information on ingredients, 3. Hazard identification (potential health effects, inhalation, ingestion, skin contact, eye contact and carcinogenity.), 4. First aid measures in case of inhalation, ingestion, skin contact or eye contact, 5. Fire fighting measures- flash point, auto ignition temperature, and flammability limit; extinguishing media, etc 6.accidental release measure, 7. Handling and storage, 8. Exposure controls/personal protection, 9 physical and chemical properties, 10. Stability and reactivity, 11.Toxicological information, 12. Ecological information, 13. Disposal consideration 14. Transportation information, 15 regulatory information and 16 others.

I realized that most of the accidents and injuries witnessed /experienced in our laboratories in Nigeria occurred due to lack of such information**.** Only information numbers 1, 5, 9, 10 are usually provided by our chemical supplier.

What to be done in case there is accident.

The procedure to be followed was also studied. This includes, shout to the neighbors to draw attention, call ambulance immediately, find way of rescuing the wounded, avoid giving non professional treatment, learn how to operate emergency check, preserving the site of an accident until the end of investigation, reporting the fact and several others were discussed.

Danger Prediction and finger pointing.

Danger prediction is a method of digging out the possible dangers that may likely occur during an operation while finger pointing is the confirmation of the predicted danger. Danger prediction requires a sharp, sensitivity, high concentration and high level of willingness.

Hazard predictions make workers to be sensitive to danger that exist. Pointing and calling is necessary to concentrate harder at the key danger point in the work process. Danger prediction and finger point calls involves;

1. Discussion and dig out all the danger factors that are hidden in the existing condition.
2. List all the dangers and selection of one or two most important dangerous items or risk point.
3.Chosen an appropriate guide words to be used.
4. Practice finger pointing call at the danger spot.

Each of us was drilled using different practical examples relating to our jobs. The danger was first identified, then took a good posture and stare at the object to be checked. Then raised the right hand (pointing) and finally call (using short words agreed on like "temperature ok").

We also watched slides and photographs of several finger-pointing activities. The trainees were also provided with some photograph to use and predict the dangers expected and the possible counter measures discussed.

Hazard and Operability studies (HAZOP).

HAZOP, coined out of the words **haz**ard and **op**erability study, a technique developed by ICI in United Kingdom to estimate plant hazard degree. Hazard and Operability studies can therefore be defined as the application of a formal systematic critical examination to the process and engineering intention of new or existing facilities to assess the hazard potential of mal-operation or mal-function of individual items of equipment and their consequential effect on the facility as a whole. HAZOP requires a team of experienced people, usually those concern with the daily operation of the plant and engineers concern with the design of the plant. Such team makes use of guidewords to generate several numbers of questions, which gives information on what the equipment is expected to do.

Basic procedure of HAZOP studies.

The basic procedure involved in HAZOP studies is listed below in a systematic order starting with selection of object line and equipment till the final stage of results utilization.

Step 1: Selection of object line and equipment.
Step 2: Application of the guidewords.
Step 3: Assortment of guidewords and process parameter (assumption of deviations)
Step4: Research of the first cause (research of the second causes except equipment)
Step5: Study of the results and affection to the system.

Step6: Studying that existing safety counter measures (detection, prevention and protective equipments).
Step7: Studying additional countermeasures and extraction of separate study items.
Step8: Record of above studied results.
Step9: Utilization of the results.

The position of Safety evaluation technique in HAZOP study.
Practical examples of chemical production plants were studied and the position of safety evaluation right from plant basic design to official run were studied and summarized in figure 2.

See attached figure 2.

Hazard due to static electricity.
The detailed study of static electricity was carried out. Different kind of electrostatic charge like (friction, peeling flowage, stirring blow off, drooping collision, crushing etc). Typical examples and the principle of generation were studied. The marginal electric shock generated by human body and the degree of shock was discussed. Also different types of hazard and failures caused by static electricity were divided into three (namely a, explosion and fire; b electric shock; and c. production failure), were studied.

***Safety measure for static electricity*:**
The general safety measures such as earthen, use of dual safety system, wearing appropriate gear, use of manual and training were discussed. The other safety measures discussed are;

i. Prevention: a. Removal and isolation of ignition source, and b.removal of air and oxygen
ii. Safety during production: Handling of flammable materials in enclosed space; b. ventilation system for the explosive synthesis gas; and c. replacement and ceiling of flammable materials by inert gas.
iii. Control (action taken in case of accident): stoppage of deliveries and blocking flammable materials and b. power exhausts and forced cooling of flammable materials.

Examples of static electricity accidents and hazards.

Slides and photographs of accidents and hazards caused by static electricity were displayed. The detailed analyses of causes, extent of damage and counter measure to preventing future occurrence were discussed.

Human error.

Accidents sometimes occur due to human error. In order to understand how to prevent such human error, different types of human error, conscious level of cerebrum in relation to different state of consciousness, conscious action and psychological state were studied. The reliability and various ways of preventing accident caused by human error were discussed.

Accident investigation technique

A close look at a statistical triangle (Figure 3) summaries the possible ways of preventing human error by creating obstacle layers. This obstacle layer prevents the error from getting across. The indicator on the left hand side shows the extent of damage, which can be related to the extended cost or negative impact on the organization.

See figure 3 attached.

Occupational accidents and injuries: Usually, under normal operation that is situation without problem where all laws, technical guide lines, internal rules, work plans, work order, operation standards and common practices are applied, the operation usually come to an end successfully. Deviation from normal situation usually results in accidents and or injuries depending on the level of deviation as shown in figure 4**..**

See figure 4 attached.

Taking action when occupational injuries occur: the action taken when deviation from normal occurs depends on the level/gravity of deviation as indicated in the figure 4 above.

1. Deviation due to unusual state. This is the lowest level of deviation and the actions taken are: contact, report, confirm and taking actions.

2.Deviation due to occupational accident: all the action in steps 1 above followed by emergency shut down and evacuation.
3. Deviation due to occupational injuries: all the action in step 2 above, emergency action including first aid treatment, rescue operation for the victims, occupational injury investigation and prevention of future occurrence. It must be noted that, even if we have "near-miss" without injury, this same action in case three still applies.

Action flow when occupational injuries occur

When occupational accident and injuries occurred, there is need to analyses such occurrence. The steps to be followed in case occupational injury occurred is presented in the flow chart(Figure 5):

See figure 5 attached

Environmental Management.

We are also introduced to environmental study with case reference to Iwakuni-ohtake water treatment sludge. Any organization with a good environmental management team is expected to strictly obeyed the under listed items.

1 Observe regulations and agreements regarding environmental preservation, security and disaster, preservation, and labour safety and health.
2 promote latest technologies and effective use of limited, valuable resources to prevent environmental pollution and labor accidents.
3. Improve the management system, performance and continually making periodical revision.
4.Inform all employees of the environmental policy and promote activities for complying with any changes.
5.Strive to live in harmony with the region through outside activities and public relation activities related to the environmental preservation, security and disaster prevention, and labor safety and health.

It is in compliance to this policy, that MCI, having one of the most advanced plants in terms of production and environmental safety, ensures proper treatment of all their

industrial wastewater before discharging outwards.

As part of our training, wastewater treatment facility was used as case study. Basically, the wastewater from plants contains oily substances (hydrocarbon). The wastewater is sent to water processing facilities tank after treatment followed by oil separator to withdraw the oily part. The separated wastewater is then neutralized to adjust the pH, aerated and biologically treated with bacteria in an activated sludge-processing chamber. The sludge is dewatered (precipitation) and the resulting clean water is then re-used and the excess discharged into the seawater while the waste (solid) is sent to incinerator. The resulting product from incinerator is put into efficient use.

The treated water is sampled with automated sampler or sensor monitor, then analyze and the various parameters recorded. Periodic manual sampling and laboratory analysis is also use as counter measures. The various parameter of the final treated water must comply with recommended specification before emptied into the river water.

The separated oil from wastewater treatment is sent and re-used by the power generation boilers furnaces and waste incinerator. This separated oil is used as fuel in these facilities (Utility). Sometimes, this fuel is complemented with low-level heavy oils in case of insufficiency. A low NO_X burner is always used. Automatic Oxygen, NO_X and other gaseous monitor as well as monitor screen and scrubbers are used at all times in ensuring that the equipments are operating in optimal condition.

Usually, the main sources of noise and vibration in petrochemical and related companies are mainly compressor, blowers and extruders. It was observed that the noise level was very low, which may not have any significant effect on the people residing in the area. The following measures are implemented to reduce the effects;

1. Machinery was installed far from residential housing as allowed by design; 2. Most of the instruments installations were low-noise, low-vibration type; 3. Installation of storehouses near the boundaries; 4. Use of soundproof walls and; 5. Regular evaluation and monitoring.

Conclusion: This training has really exposed me to greater commitment on environmental safety and management right from test-tube and flask (laboratory level) through pilot plant level to production plants and safety of life. I am satisfied with the

training and I will share my experience with my colleagues both in Nigeria and India. Environment & Safety Management training will be included as one of the activities during industrial training attachments regularly given to the undergraduates and graduates in Nigeria, while on attachment in my Institute (Rubber Research Institute of Nigeria). The attachment programme is a link between my Institute and Rubber related / Polymer Industries, Universities/Polytechnics/Colleges of Science & Technology in Nigeria. I will share my experience as regard ESM at the meetings of professional organization like Chemical Society of Nigeria, Material Society of Nigeria, Polymer Institute of Nigeria etc) in which I belong to. These organizations can easily make acceptable suggestion to various level of Government in my Country.

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