



**A REPORT OF THE
INTERNATIONAL UNION OF PURE AND
APPLIED CHEMISTRY SAFETY
TRAINING PROGRAMME**

HELD BETWEEN

3 FEBRUARY AND 15 FEBRUARY, 2013

AT

**DOW BENELUX BV,
TERNEUZEN, THE NETHERLANDS**

UNDER THE SUPERVISION OF

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INTRODUCTION

In fulfillment of part of the duties of the Committee on Chemistry and Industries (COCI) of the International Union of Pure and Applied Chemistry (IUPAC), the Dow Benelux BV in conjunction with COCI organized an IUPAC Safety Training Programme at Terneuzen, The Netherlands between 3 and 15 February, 2013 for John Mumbo from Kenya and I. Generally the objective of the IUPAC Safety Training Programme is to provide opportunity for safety experts from developing countries to learn about safety and environmental protective measures by visiting and working in plants of IUPAC Company Associates in the industrialized world. This is meant to promote interactions between developed countries and the developing world and to disseminate state-of-the-art knowledge on safety and environmental protection in chemical production.

Having been offered the opportunity to participate in the IUPAC Safety Training Programme in February, 2002, it was not possible to utilise the opportunity when invited to the BP Chemicals Technology Centre in Naperville, Illinois, USA and the acrylonitrile production plant in Lima, Ohio, USA in 2003 due to the short notice given compared to the time required to process a US Visa. Similar opportunities given in 2004 to visit Mitsui Chemical Company sites in Japan, AstraZeneca in the UK in 2005 and Mitsui Chemical again in 2007 could not be taken up because of tight schedule of work. Therefore the invitation to visit Dow Chemical Industries Benelux BV, Terneuzen, The Netherlands came with much aspirations and expectations. These aspirations and expectation were undoubtedly met as the report below shows.

SUMMARY OF THE TOPICS COVERED

The safety training started just before entering the Dow site, immediately after passing the security guards, we were made to watch and listen to safety instructions on a computer system and thereafter answered fifteen very tactical questions. The answers to the questions required one to have paid close attention to details while listening to the safety instructions. It was as if one is being taught that safety practices require ones 100% attention. The first session was on the overview of IUPAC safety programme and introduction to the Dow Benelux BV site. After this a tour of the analytical services department was made and two books on Chemical Laboratory safety were given to each of the trainees. The organogram of the company and the various duties performed by various plants were also discussed. The Responsible Care Leader took us through the safety record of the company and explained how they have been able to attain and maintain the record. For the purpose of clarity and avoidance of repetition of facts the topic covered are classified under the various sub-topics below.

Trainings on personal safety

Lessons covered on personal safety include Behaviour Based Performance (BBP), Meet Behaviour Expectation (MBE), the ABC of behaviour, that is, Antecedence-Behaviour-Consequence and the Balance of Consequence (BOC). The lessons made it clear that having safety practices as behaviour is much better than having it as instructions or rules.

Influencer Model and Reason Model, and their use in enhancing safety were examined. Work Performance Analysis (WPA) was extensively discussed.

Management of safety

It has been reported that most incidences of casualties/personal injuries often occur with contract staff. We therefore learn about Contractor Safety Policy and Contractor Safety Checklist. Other topics covered are Environment, Health and safety (EH&S) policy and organization, EH&S Risk Management, EH&S awareness, EH&S Project Plan, EH&S Inspection, Incidence Registration and Investigation, EH&S Audit (Internal and External) and Company Health Services. Effect of language on safety was also discussed.

Management of EH&S delivery is another topic that was extensively discussed. The sub-topics under this include Research and Development (R&D) sample shipping process, Loss Prevention Principle, Document Management, Management of Change (MOC), Risk and Exposure Hazard, Qualitative Exposure Assessment (QEA), Compliance task tool and Ergonomics processes.

Operating Discipline Management System was discussed using the Dow company system as example. Dow's Environment, Health and Safety Responsible Care commitment is to drive cases of incidences to zero. This is also expressed as 'Make the Commitment, Zero Accidents, Zero Injuries, Zero Excuses'. Community Awareness and Outreach, Product Stewardship, Security, Process Safety, Emergency Preparedness and Response were discussed as essential parts of safety management.

Safety equipment

Extensive discussions were held on the use of Personal Protective Equipment (PPE). This includes the various uses of the equipments, their usages, the various symbols indicating which PPE must be used and so on. Various types of safety alarm systems were discussed, including low oxygen alarm, attention alarm, evacuation alarm and all-safe alarm. The use of Sweep cards in case of evacuation was also discussed. The use of safety key point card and use of work-alone-system sensor were extensively discussed looking at both the merits and demerits. Many other

safety warning devices were discussed. The layout of some buildings and the safety gadgets in each of them were explored during a safety tour.

Compliance to EH&S regulations

Operation regulation for both the process and products were discussed. ISO 9000 (product standards-addresses only defaults), ISO 14000 (Environmental management system), ISO 18000 (Sustainable development) and ISO 50000 (Energy management) were explored as part of safety compliance. It is noted that the legislations are increasing and are becoming more and more tasking hence making compliance more complex. We examined the 6 σ (six sigma) project and how to translate various legislations (Dow , Dutch, European Union, United States and so on) into compliance. Compliance Management System and their deliverables/network, Compliance Projects, SWOT Analysis Compliance using Dow Terneuzen as example were discussed.

Emergency preparedness and response

The use of automated devices on site such as low oxygen level detection and work alone alarm systems were learnt. Locations, testing and operations of fire detectors (and alarms generally), shower and eye baths were also examined. The linkage between the security, fire department and EH&S were discussed. The schedule of duties of the Fire services men and their various weekly, monthly and quarterly drills were also discussed.

Hazardous materials

The management of laboratories, storage, transport and usage of hazardous materials and wastes were examined. The authenticity and use of Material Safety Data Sheet (MSDS) of hazardous material were discussed.

Process safety

The following topics that were discussed come under process safety. They are Process Risk Management, Layers of Protection (LoPA), Hazard Operability (HAZOP), WHAT IF Analysis, Loss Prevention Principles (LPP), Root Cause Incidence Analysis, Task Risk Analysis, Event and Action Tool, Master Task List, Daily Task List, Global Incidence Reporting Database (GIRD), Compliance Task, Moment of Change (MOC), Fire Explosion Incidence (FEI), Chemical Exposure Index (CEI), Emergency Response Planning Guideline (ERPG), Layer of

Protection Analysis (LoPA), Quantitative Risk Assessment (QRA), Prevention Principles, Periodic Reviews and Cardinal Roles.

Environmental Safety Management

The Environmental Technology Center of the Company is responsible for the environmental safety management. The various topics taught include Waste Management, Environmental Remediation, Method Developments, Pollution Prevention and Environmental Monitoring. The use of phytoremediation, bioremediation, wetland purification, strippers, oxidizers and carbon bed in environmental purification were discussed. Treatment of landfills and various contractual agreements on various environmental issues were given adequate coverage.

Reactive chemicals

Under process Safety, reactive chemicals were extensively discussed. Reactive Chemicals were defined, identified, classified and conditions that lead to their reactions were identified. Safe methods of storage and transport of reactive chemical, and Reactive Chemical Project Hazard Analysis (RCPHA) were also discussed.

Industrial hygiene Safety

This is a safety process that Anticipates, Recognises, Evaluates (prioritise, measure and advise) and Controls potential health hazards that may affect both the company's workers and costumers. Basic Industrial Hygiene Training were held on factors that affects health such as chemical (including Material Safety Data Sheet- MSDS and Research Sample Safety Data Sheet - RSSDS), radiations, sound, thermal stress, Ergonomic Risk Factors, lifting of heavy articles and Occupational Exposure Limits (OELs)

Business rotational programme

Discussions were held with two of the newly employed members of the Business Rotational Group (a three year programme which was aimed at producing leaders who will have general knowledge of the company by rotating to perform various tasks) on Project Sustainability especially as it affects Environment Health and Safety. Wastes to resource technology, Safety Audit, Environmental Audit, Safety of Plants were also discussed.

Site visits

The following visits were made apart from the two general site tours that were conducted.

Visit to Analytical services laboratory and chemical stores

Guided visit to Pilot plant and R&D laboratories

Guided visit to waste water treatment plant

Guided visit the plant laboratory.

Guided visit to the Phytoremediation sites

CSB Videos

A number of Chemical Safety Board (CSB) videos were watched online to exemplify the causes of incidences, how they can be managed and prevented.

LIST OF TRAINERS

The following experts took various aspects of the training

Responsible Care Leader/ Compliance Management Director

Training Coordinator

Master Black Belt, Diamond Value Chain Consultants Service Group

Technical Leader, Core Research and Development group

Environment, Health and Safety Leverage Services Specialist

Environment, Health and Safety delivery specialist

Environment, Safety and Security Department Leader

Environment, Health and Safety Analytical Support Expert

Industrial Hygiene & Ergonomics Expert

Environment, Health and Safety, Fireworks Expert

Operation regulation affairs Expert

Reactive Chemical & Safety Expert
Environment, Health and Safety Delivery Leader
Compliance Management System Leader
Compliance Project Leader
Compliance & Exp Leader
Environment, Health and Safety delivery technician
Process safety Expert
Biox Leader
EH&S, Business Rotational Programme 1
EH&S, Business Rotational Programme 2
Shared Production laboratory Manager

THE USE OF THE INFORMATION LEARNED IN UNIVERSITY OF IBADAN AND NIGERIA AT LARGE

Many of the safety procedures learnt in Dow Terneuzen are not available in my University, it is not that they are not known to be important but they have just not been put in place. Safety is a common song in Dow Terneuzen, every direction one looks into; one will see one safety sign/instruction or the other. It has therefore become very imperative to bring Environment, Health and Safety consciousness into my University. To some extent, the University has been very conscious of the need for a good environment and health management systems but the awareness of safety, especially chemical safety is very low.

Safety Campaign will be one of the immediate tasks that should be started immediately I return to Nigeria (This has already started as at the time of writing this report). The University has a unit that looks after and monitors the environment, the Physical Planning Unit; another unit that looks after the Health of her workers and students, the University Health Centre; the only unit that works on safety is the Security Unit that takes care of security of properties and fire services, there is no unit that takes care of laboratory safety. Since nine out of the thirteen faculties in the University are science-based, the University will be advised to set up a Unit to take care of Laboratory Safety (As at now, discussions are ongoing with the Director of Special Duties at the Vice Chancellor's Office). The University may eventually be advised to have an EH&S department like many other Universities in the developed countries.

The Department of Chemistry services all the departments in the science-based faculties. About one thousand five hundred first year students pass through the Department yearly. The Department will be advised to do the following:

To Establish a Laboratory Safety Committee to advise the Head of Department on safety process, monitor laboratory activities and recommend necessary safety procedure. (The Department has just set up a Departmental Laboratory Safety and Security Committee which I have been asked to chair).

To include a more detail safety instruction into year one practical course (CHE 195). (The department has agreed to do this but could not take effect this year because the course is about being completed. However, some Chemical Laboratory Safety videos clips have been collected for the training starting from next academic session).

To offer regular laboratory safety instructions to all students in Chemistry Department where change in orientation to safety process will be encouraged.

To paste necessary safety/hazard instructions in the various parts of the Department.

To resuscitate the alarm system that the Department used to have in the 1970s, when the influence of the University College London was still much on the Department.

To reorganise the Chemical Store for proper storage of chemicals (This has already started).

To procure pipette fillers for titration purposes. Before this time students fill pipettes by sucking with mouth. (The Head of Department has just purchased a large number of pipette filler for students' use).

To enforce the use of appropriate personal protective equipments.

To conduct regular inspection in the various laboratories (both teaching and research). This seldom happen unless there is a problem in any of the laboratories.

In addition to these recommendations to the Department of Chemistry effort will be made to see to it that the University General Studies Centre includes some essential EH&S training in their curriculum for non science-based students.

The Industrial Training Unit of the University will also be advised to include some safety training into their orientation programme for students going on industrial training.

Lobby the National University Commission to ensure that universities in Nigeria follow appropriate safety procedures in their laboratories and also include the same in their curricula.

Efforts will be made to develop guideline for safety training so that other students and staff will be trained. This will be a type of train the trainer scheme. It is expected that this will be very effective.

Efforts will also be made to develop policy on general safety

AN ASSESSMENT OF DOW CHEMICAL ENVIRONMENT, HEALTH AND SAFETY PROGRAMME

At the beginning of the training Dr Al Ribes gave a number of question he would like us to use in assessing Dow Chemical Environmental Health and Safety programme. Below are some points that reflects my assessment:

1. Management System

The management system of EH&S is very good, it is a functional integrated system. It has a well defined management structure and the various duties are clearly delineated and each area headed by a capable personnel. Each assigned responsibility has its own feedback mechanism (both online and written). We noticed a number systems that have just been introduced, this shows that the system is dynamic and not static. It has been designed to cover all the sites and puts in to place checks and balances. Several automations in the system make human error a rare occurrence.

2. Management commitment and responsibilities

The commitment of Dow management to EH&S is high. The number of staff who are employed for safety related issues has increased over the years despite the fact the overall number of staff decreased. The commitment to zero incidence is high and this is clearly seen in the high level safety campaign that operates in the company. Accepting IUPAC and OPCW fellows for safety training is an indication of the high commitment the management has to safety. The responsibility of the management has made safety to be a way of life for most of the Dow employees in Terneuzen.

3. Employee involvement

It is apparent that both the management and the employees are actively involved in Dow's EH&S. They are talking about it, live it and training others. I did not at any point in time see any

member of staff not properly prepared, safety wise, for the task they perform. They are involved in various drills and alarm testing processed. There are rewards for best performance and penalties for defaulters.

4. Hazard recognition and remediation

Hazardous areas are clearly identified and labelled. A number of safety plans or precautions are often seen around such areas. The design to house (offices) most staff away from the plant production site is commendable because if there is any accident many of the staff will not be affected.

It was seen that Dow Terneuzen has been learning from accidents that occurred in other companies and have been putting preventive measures in place. The company also have a good reporting system within the local community. There is a strong network with local authorities, fire brigade and health workers in the host community.

The company has clearly identified areas on the site that have been previously contaminated and appropriate remediation technologies have been setup to clean up the area.

5. Training and education

A number of internal training programs are conducted regularly on EH&S. A number of the trainers have sent by Dow to undergo more specialised trainings on EH&S. The use of publicity materials, alarm systems and the weekly fire drills educates and updates staff training. The notice boards are full of educative information.

6. Documentation and tracking

The Company is connected to the intranet of the global Dow. This enhances the access to documents from other Dow sites and also makes it easy to upload information for others to see. Though we do not have access to the intranet backview but the home page interface shows a well designed documentation and tracking system. It is easy to track most events that has occurred in the company or another site of Dow . Incidences of accidents are well documented and can easily be retrieved.

ARRANGEMENTS OF THE SAFETY TRAINING PROGRAMME

The arrangements were generally very satisfactory. In spite of the freezing temperatures we were able to accomplish all our tasks and even introduced some other ones.

Hosts and trainers

The hosts are very hospitable and kind. They were able to understand our backgrounds and related to us as expected. They made us feel at home and were very punctual when appointments were fixed. It was really a great privilege having the company of Dr Al Ribes, Dr Carolyn Ribes and Dominique De Wispelaere.

Most of the trainers have worked in the industry for more than fifteen years; they have hands-on experience and adequate knowledge of the various aspects they taught. They were all enthusiasm about the training and it was therefore not difficult to pass on the knowledge to us. Most of them were able to communicate effectively in English language and in cases where there are deficiencies, the trainers made up it up by giving various demonstrations.

Hotel

The Hotel accommodation at Hampshire Hotel, a four star hotel, was very good. The rooms were very neat and the workers there were also very nice to us. The major problem we had at the hotel was the time it take to bring dinner after making orders, this is however typical for most Dutch hotel. It was a really "slow Dutch meal –with a snail diagram". It generally took close to 60 minutes before meals were ready except for breakfast which is instant. The other minor problem at the hotel was that we had only two hours access to the Internet and a maximum of four connections within the two hours. This was however not a big issue because we spent most of our time at the Dow site where we had unlimited access to the internet and phone.

Travel

I personally had problems with travels (Visa) but it was neither due to faults from IUPAC nor Dow. My University Protocol Officer failed in his responsibilities hence the training dates had to be shifted. I appreciate IUPAC and Dow Benelux BV for bearing with me and for the kind gesture.

Sightseeing

Saturday and Sunday were used for sightseeing. On Saturday, we visited one of the villages around Terneuzen to watch their yearly carnivals. It was an exciting scene. I would confess that I have never witness a carnival of such magnitude in a village. The attires were very beautiful, the 'toys' were magnificent and the organization was fantastic. What a nice experience!

A visit way paid to Brugge, one the UNESCO cultural heritage centres. It is interesting to note that the whole town has been identified as such. It is an old town surrounded by waters and

having very old houses. The whole town was full of tourist. The town's main stake is simply tourism.

Lunch at work

The planning and the execution of the training were fantastic. We went for lunch on each of the days with different members of the training team; this afforded us the opportunity to have deeper interactions with each of them. Sometimes when serious issues are discussed over meal, they easily get resolved and leave indelible marks in the heart of the discussants.

SURPRISES

I am surprised at the level treatment given to the company's waste water before being discharged into the sea. It is very impressive

Laboratories and industrial companies have their respective associated offensive smells in Nigeria. I am surprised that there were no offensive smells, spills, noise and solid waste dispersions on the company's site

A number of contamination issues that a typical Nigerian will take for granted are given serious attention. The Onsite remediation (especially phytoremediation) technologies put in place are impressive.

RECOMMENDATIONS

The training at Dow Benelux BV, Terneuzen was very good. The management, trainers and training coordinators did their best. However, a number of things could be done in better way.

It will be very good if future IUPAC Safety Trainings are conducted in summer or a time when the weather conditions will not be a distraction. This I know is strongly subject to the host company's programmes.

Local holidays, festival periods and other events that can have influence on trainers' availability should also be taking into consideration when planning for the programme (I acknowledge the fact that my schedule altered the initial plans).

It will be very good if the time table or schedule of training is sent much earlier to participants before arrival at the host company.

On the first day of the training, Carolyn Ribes gave us two books on Chemical Laboratory safety which turns out to be very good guide for safety procedures in a university laboratory environment¹. It also gives the idea that COCI can develop a standard curriculum for IUPAC Safety Training Programme and subsequently can get experts from all over the world to write on the various topics. This book or manual can therefore be given to safety experts before the training. This will help to standardise the Safety training programme. This manual can also help IUPAC Safety Training fellows to train others in their communities. Eventually the IUPAC safety training may be seen like a train the trainers scheme.

The way safety campaign has been handled is great. Seeing virtually all members of staff putting on a safety logo badge in addition to their identity card is great.

CONCLUSIONS

“Safety first“ seems to be the slang of Dow Terneuzen Management instead of profit as it would be expected of a business organisation. The objectives and my expectations of the training were met; we have learned more about safety and environmental protective measures. We had useful interactions and exposures. New knowledge was acquired on safety and environmental protection in chemical production.

The training has given me a reorientation; I left Dow Benelux BV Terneuzen being conscious of safety in everything I do, see or discuss. Will I say, I have been EH&S brainwashed.

I want to say a big thank you to COCI of IUPAC and Dow Benelux BV Terneuzen for the opportunity given to me to take part in this safety training. It's impact will remain indelible.

Thank you.

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¹ Chemical Laboratory Safety and Security: A Guide to Prudent Chemical Management, US National Academies, <http://dels.nas.edu/global/bcst/Chemical-Management>