The importance of the teaching of case studies of industrial accidents in the disaster management education

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Abstract. The course acquaints students with knowledge of industrial safety. More specifically, incidents over the last decades relevant to industrial safety are covered. Finally, students are introduced to the possibilities of interventions and the importance of drills. More specifically, the effects of dangerous materials, the possibilities to reduce these effects and the instruments of response are covered. Finally, students are introduced to the possibilities of identification of dangerous materials. There are being taught more subjects related to chemistry on the National University of Public Service. The aim of this is to provide the special ability of those, who come out from the education. These subjects are connected to each other and built on each other and in this way they qualify the students for the skills they will use in the course of their later work. Although the chemistry-related subjects (for example case studies of industrial accidents) are not the most liked ones under the students, with some educational method their fear can be decreased. The aim of this article is to explain the lecture method in the disaster management education. The following aim of this article is to introduce an example of case studies of industrial accidents, and thus point out the importance of the subject.
Key Words: disaster management education, chemical safety, chemical decontamination, case studies of industrial safety.

Introduction. Modern life without chemicals is unthinkable; substances are part of our daily lives, whether in paints, insect sprays, mobile phones, kitchen appliances, pills or beauty products, to name a few of the millions of things and products safety in the use of chemicals has become the theme of a great deal of public concern and legislative activity. Present-day engineering exercises and domestic lifestyles depend on the use of a wide range of compounds (ECHA 2016).

Some deadly chemical accident in the past 40 years are listed below:

- 1 June 1974, cyclohexane leak at Nypro Chemical Plant in UK's Flixborough caused a detonation which killed 28 workers, injured 36 and cost the company 36 million pounds sterling (ECHA 2016);

- 3 November 1995, a blast in Río Tercero, Argentina, rocked a munitions factory killing seven people and wounding over 300 (ECHA 2016);

- 21 September 2001, the detonation in a storage warehouse in which 300 tonne of ammonium-nitrate pellets were stored for recycling at Atofina's Grande Paroisse fertiliser plant in Toulouse in southwest France killed 30 people and injured 200 more (ECHA 2016);

- 11 May 2004, the explosion at Stockline Plastics' factory in the Maryhill district of Glasgow, UK, claimed nine lives and caused injuries to over 40 people (ECHA 2016);

- 25 February 2012, at least 21 people died and about 28,000 were displaced after a chemical plant explosion in Baiyun region of Guiyang, capital of Southwest China's Guizhou Province. The blast led to a large spill of combustible liquids, such as toluene. The pillar of fire stood at 100 meters, witnesses said (FAO 2011);

- 17-18 April 2013, an explosion at the fertilizer plant in the area of West in Texas, USA, killed between 5 and 15 and wounded some 200 people. Many homes, a local school and an elderly care house were torn down by the shock wave (EEB 2006).

There are being taught more subjects related to case study (like accident report) on the National University of Public Service. The aim of this is to confirm the special knowledge of those, who come out from the education. These subjects are connected to each other and built on each other and in this way they prepare the students for the knowledges they will use in the course of their later job. While the chemistry-connected subjects are not the most liked ones under the students, with some educational technique their fear can be decreased (ACS 2007).

In this article – mainly by working up the relating literature and laws – I would like to give a brief survey from the authority's tasks, regarding the dangerous plants. In addition – based on the experiences of my educational work on the National University of Public Service since 2012 – I would like to reveal the importance of the teaching of subjects related to chemistry, namely the subjects, which present the possible effects of hazardous materials and dangerous technologies and the possibilities of prevention (ECHA 2010). Furthermore I would like to briefly show the teaching method I use, and which I managed to bring closer these not very liked subjects to the students with (ECHA, 2016).

It is not allowed to store incompatible chemicals in close proximity to each other (Table 1). Some rules for storing chemicals safely are enlisted in Table 2.

The purpose of the activity: chemical segregation:

- Store acids in a dedicated acid cabinet. Nitric acid should be stored alone unless the cabinet provides a single compartment for nitric acid storage.
- Store highly toxic compounds in a dedicated, lockable poison cabinet that has been labeled with a highly visible sign.
- Stock water sensitive chemicals in a water-tight cabinet in a cool and dry location segregated from all other substances in the laboratory.
- Store volatile and odoriferous chemicals in a ventilated cabinet.
- Collection flammables in an approved flammable liquid storage cabinet (refer to section titled Suggested Shelf Storage Pattern).

Table 1

Common incompatibles (Source: compiled by the author)

Industry material	*Incompatible with*
Ammonia, anhydrous	mercury, halogens, calcium, hypochlorite, hydrogen fluoride
Chlorine	ammonia, acetylene, butadiene, benzene, other petroleum fractions, hydrogen, sodium carbide, turpentine, finely divided powdered metals
Mercury	acetylene, ammonia, lithium
Nitric acid	acetic, chromic, and hydrocyanic acids, aniline, carbon, hydrogen sulfide, flammable material, readily nitrated substances
Sulfuric acid	chlorates, perchlorates,

Table 2

Classification of the hazards (Dobor & Szendi 2014; Dobor et al 2016)

Type of hazard	*Examples*
Physical: - excessive heat, noise or vibration exposure; - exposure to radiation from X-rays or lasers	- unwanted sound of 85 decibels or greater without hearing protection; - working in cold or hot areas where the body cannot easily maintain normal internal temperatures
Chemical: - solids, liquids or gases; - exposure to controlled, consumer, medical products, designated substances, etc.	- use of cleaning/laundry products in a client's home/office/workplace; - use of medical products to care for clients in the home; - care involving use of hazardous drugs
Biological - pathogenic organisms (blood-borne pathogens) capable of causing illness or disease; - bacteria, viruses, fungi (moulds, yeast), parasites, plants	- exposure to persons who may be ill or carriers of pathogenic organisms; - exposure to organisms from raw meats or from eating foods improperly prepared, cooked or stored; - exposure to the potential of any biological hazards as a result of close contact, personal care and/or interaction with people

The quick development of the chemical industry. Modern life would not be thinkable without the use of compounds. Plastics and other synthetic ingredients, including textile fibres and building materials, surround us and are part of our ordinary lives. Most customer products are derived from chemical production, from personal care and electronic products to detergents and do-it-yourself consumables. Agrochemicals help crops resist pests and illnesses and promote advanced yields. Pharmaceuticals are essential in human and animal health care. The list of functions is limitless (NEA, OECD 2005).

Chemical safety directive in Europe. European Directives have driven complete regulation in the EU member states. Supervisors need to be familiar with and recognise this legislation and how it relays to their factory so that they can produce and maintain a safe working atmosphere (EEB 2006). Therefore a leader in change does not warrant the safety of their workers through the proposal of safety events when handling chemicals, they can be held personally liable for failure to controller health and safety in the workplace. This means that the manager may have to pay a fine or even go to jail if convicted under the legislation (ACS 2007).

Safety rules for the chemical industry. Each employee should attest by signature that he or she has read and recognizes the safety rules. These rules must be strictly and impartially enforced. On the other hand, supervisors should encourage and extremely consider recommendations from the employees for developments in safety rules, practices, and tools. Safety meetings should be held with all employees at regular intervals (NIOSH, DHHS 2006).

The following are suggested as instructions for employee in all chemical factories (FAO 2011):

- urgently notify your manager if you are injured or experience a disease in the workplace;
- always know the hazards and physicochemical properties of the chemicals used (e.g., corrosiveness, flammability, reactivity, and toxicity). Read the label and the safety data sheet for each unskilled or really hazardous substance in the workplace;
- important to minimize exposure to hazardous chemicals, wear clothing that covers the torso, arms, and legs. Limit long hair and loose clothing. Wear shoes that completely cover the feet. Do not wear high-heeled shoes, open-toed shoes, sandals, or shoes made of woven material;
- every time wash your face, hands, and arms with soap and water before leaving the work area. This applies even if you have been wearing gloves (UNESCO 2010);
- at no time engage in horseplay, pranks, or other acts of mischief in chemical work areas;
- certainly not perform any work with hazardous substances when alone in the workstation;
- do not eat, drink, smoke, or apply cosmetics in work areas where laboratory or industrial chemicals are handled or stored;
- do not perform unofficial work, arrangements, or experiments with hazardous chemicals.

All over till the 1980s, countries began to improve environmental policies as a priority. These were national results and concentrated typically on combating local soil, air and water contamination by applying end-of-pipe technologies (WHO 2008).

Chemical safety rules, although they are strict, they need a more systematic approach. Firstly, information about the properties and potential effects of substances on human health and the environment was needed. At that time such data could only be obtained by carrying out exams. The toxicological tests in use were frequently studies performed using laboratory animals such as rats and fish. In addition, information was needed about acceptable chemical contact levels for workers and users (Schweickhardt 2014). The safety characteristics of new chemicals being introduced to the market were clearly a key issue that needed consideration and relevant policies. This decision nodded a policy adjustment from a respond way to prevent.

Novel technologies: different challenges. By changing matter at the atomic and molecular volume, nanotechnologies are generating new chemicals with different properties by using substances that are previously on the market. This is favourable for a vast range of applications, such as drugs, plastics, strong but lightweight materials and energy production (EEB 2006). In Table 3 it is summarized a chemical accident which took place a couple of years ago.

Table 3

A short guide to the chemical accident in Lithuania (ammonia spill) in 1989 (ARIA 2007)

Rupture of a cryogenic ammonia tank	
Local of accident	Jonova, Lithuania
Date of accidents	March 20th 1989
Injured people	7 deaths and 57 wounded (treatment lasting from 2 to 3 weeks)
Dangerous material released	ammonia
GHS/CLP hazard pictograms of ammonia	
Human and social consequences	The urban authorities, warned 25 minutes after the beginning of the accident, decided to evacuate the high risk areas as soon as the concentration of ammonia in the air exceeded 10 mg/m^3; 32 000 people were thus displaced.
Circumstances of the accident	The day of the accident, one of the liquefying turbo-compressors used for the relocation of the ammonia from the production unit to the cryogenic reservoir was halted for long term maintenance; the second turbo-compressor was halted for a repair occupation of short duration.
The measures taken	Major technological changes, for example: - continuous recording of the major variables involved in cryogenic storage, with duplication and recording in the control room; - storage capacity for ammonia limited to 80 % of the volume of the cylindrical part of the reservoir
The lessons learned	Repairs periods are always risky situations which demand increased vigilance, as do special situations or rare operations. A prior examination of the risks, proportional to the stakes, should be conducted and compensatory measures should be formally taken. Safety measures and equipment, such as emergency controls must be permanently accessible, even in degraded situations.

The lecture method in the disaster management (for example prevention possibilities of chemical hazards) education. The calamities related to hazardous materials notably endanger human life and health, the material goods and the environment. The measures, of which aim is the reduction and the exclusion of impacts require, that the intervening force make the right decision considering the situations, and to this, it is very important to know the characteristics of the material causing the accident.

The different subjects of natural science and of chemistry, taught on the specialization work for this aim, are:

- applied natural science – applied chemistry;
- applied natural science – radiation protection;
- chemistry of toxic materials;
- dangerous technologies;
- averting of damages caused by hazardous materials;
- basics of industrial chemistry – facultative subject.

A study, made among the students during the first managements showed that they have chemistry-related knowledge of different levels. Therefore it is significant to spend time during the lessons to refresh the fundamental chemical knowledge,

respectively to present the features and impacts of the most numerous hazardous materials and compounds. The programs of the different chemistry-related subjects have to join each other and built on each other, so there is some overlap in the program of subjects.

Concerning the hazardous or dangerous substances, in legislation relating to chemical safety, any substance in gas, liquid or solid form that can cause harm, is referred to as a hazardous or dangerous substance. Sometimes a dangerous substance is only one of a product's ingredients and these are called preparations. Some examples of dangerous materials are given below:

- waste-fume from a soldering iron;
- carbon monoxide - from car exhausts;
- toxic – certain varnishes and paint removers;
- caustic – oven cleaner;
- harmful – xylene, which is used in printing inks
- irritant (Sensitiser) - hair dyes, bleach.

All industrial accidents are the lessons learned. Goal case studies designed to develop skills working in hazardous industries to keep the attention of even routine operations as well. There is a preferred way to perform all work with chemicals that can both decrease the probability of an accident to a minor level and minimize its consequences, should one happen. Risk reduction depends on safe work practices; the use of personal protective equipment; appropriate engineering controls; and, when promising, the substitution of a less hazardous chemical for a more hazardous one. The reactivity, flammability, corrosiveness, and toxicity of chemicals used will command the safeguards to be taken. Such evidence might well form an introductory section to all written procedures. Most countries already had systems in place to manage the safety of medicines and pesticides. This involved the industry which was introducing a new product, registering it and giving information which would allow the government to predict any possible connected risks. It seemed rational for countries to improve similar organisations to cover industrial chemicals (NEA, OECD, 2005).

By means of the knowledges it can be told, that chemistry and the related subjects (case study) are not the most liked ones, also that the students often have half-finished chemical knowledge. Thus it is important to have enough time to refresh the basic knowledge, so later the students will be able to get the more specific material easier (WHO, 2008). By preparing the presentations of the lessons it has to be considered that the material has to be perfect and the presentations have to be colourful and graphic to keep up the interest of the students. This can be achieved by organizing – in frame of different subjects – laboratory-practices or visits to different dangerous plants, moreover the educational films and documentaries showed connected to some parts of the subject-material also serve this purpose (UNESCO, 2010) (Table 4).

Table 4

Emergency procedure (Dobor & Szendi 2014; Dobor et al 2016)

Identify the location of all the exits in the laboratory and building.
Recognize the location of the emergency phone.
Know the location of and know how to operate the following:
Fire extinguishers
Alarm systems with pull stations
Fire blankets
Eye washes
First-aid kits
Deluge safety showers
In case of an emergency or accident, follow the established emergency plan as explained by the educator/manager/colleague and evacuate the building via the nearest exit.

Conclusions. Through the practises it can be told, that chemistry and the related subjects are not the most liked ones, furthermore that the students often have imperfect chemical knowledge. Therefore it is important to have adequate time to refresh the basic

knowledge, so later the learners will be able to attain the other specific material easier. By preparing the presentations of the programs it has to be considered that the material has to be clear and the presentations have to be colourful and graphic to keep up the interest of the students. This can be realized by organizing – in frame of different subjects – laboratory-practices or visits to different hazardous plants, furthermore the educational movies (and pictures) and documentaries showed connected to some parts of the subject-material also serve this purpose. Nearby these it is also very substantial to give the right support for students, who acquire the material more difficult or get along with practical tasks harder in order to close them up. Applying these educational methods it is imaginable that either the students get closer to chemistry- connected subjects, who prefer the humane ones, respectively who "were afraid" from chemistry until now, so either the show or the acquirement of knowledge can be made easier.

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