

## Implementing a chemical and hazardous waste management system in higher education and research

### Database information

**Country:** Poland

**Available language:** Polish

The **sector covered** in this case study is research and science at universities

**Task covered:** handling chemicals in laboratories, handling chemical waste

**Worker groups covered (vulnerable groups):** young workers

The **purpose of the good practice example** is ensuring safe working practices and raising awareness of the importance of sound waste management

**Target groups:** students, workers, employers, researchers.

## 1 Organisation involved

Department of Chemistry, Gdańsk University of Technology.

## 2 Description of the case

### 2.1 Introduction

The Gdańsk University of Technology wanted to improve chemical safety for its employees and students by aligning procedures with current legal norms and adapting them to the requirements of the European Union (EU). The Department of Chemistry conducts studies in the fields of biotechnology, chemistry, building chemistry, biomedical and materials engineering, materials conservation and degradation, corrosion, chemical technology and environmental protection. This educational programme is complemented by studies conducted in English in the fields of environmental protection and management, and green technologies and monitoring.

The main goal of this initiative was to introduce a comprehensive system for the management of hazardous substances and preparations and hazardous waste at Gdańsk University (Figure 1), in cooperation with other universities in Poland.

The starting phase was in 2000-2002, when 25 chemistry departments in Polish universities implemented two projects related to this subject. In 2004, a nationwide agreement was signed between the 25 departments to update procedures for the management of hazardous substances and preparations, and to introduce a comprehensive system for managing hazardous waste, including chemical waste.

Based on the experience gained from the abovementioned projects, the SYGOS (Chemical and Hazardous Waste Management System in Higher Education and Research) programme was implemented.

Figure 1: Entrance to the historic building of the Department of Chemistry at the Gdańsk University of Technology



## 2.2 Aims

- To develop procedures and instructions conforming to modern standards for the management of chemicals and waste.
- To optimise the management of chemical reagents (chemical substances used for education, scientific research, analysis and testing), including in terms of what is purchased and used.
- To implement a comprehensive computerised chemical reagents register, as part of the optimisation of chemical reagents management.
- To build a new storage area for chemical reagents.
- To organise properly equipped and properly secured waste disposal storage.
- To implement a labelling programme.
- To design a modern and regularly refreshed training programme on safe work in laboratories and handling of reagents and waste for employees and students.

## 2.3 What was done and how

The SYGOS system originated before the accession of Poland to the EU. Improvements and standardised procedures were introduced both legally (further amendments to the legislation, alignment of national regulations with those of the EU, reform of institutions responsible for environmental protection, promotion of the best available technology in environmental protection) and technically (construction of more modern waste disposal or recovery installations).

The inspiration behind and coordinator of the SYGOS programme was Professor Jan Zawadiak, of the Department of Chemistry at the Silesian Technical University in Gliwice. In 2007, 28 Polish university departments contributed to and participated in this programme.

In 2013, a central hazardous waste depot was built with financial support from the EU. This depot serves all organisational units at Gdańsk University (Figure 2). The central depot is designed to store very diverse types of chemicals. Floors are made from suitable chemical-resistant materials. Doors and walls are of a fire resistance suitable for this type of facility. Furthermore, ventilation systems, fire and other alarm systems, and fixed extinguishing systems have been installed.

Waste is transferred to the central depot at regular intervals; there, it is categorised, sorted, properly packed and prepared for safe transport to an authorised recipient. All types of waste produced at the university are transferred under specific waste codes to such an authorised recipient, for recycling or disposal.

Hazardous waste collection points managed by designated staff members have been established in the basic organisational units of Gdańsk University. Hazardous waste is collected selectively from the various departments of the university and then transferred to the Department of Chemistry.

The hazardous waste collected includes:

- inks and toners for printers;
- batteries;
- electrical waste;
- inorganic liquids containing dangerous substances;
- chlorinated and non-halogenated solvents;
- waste containing potentially infectious biological material;
- mercury waste;
- filters from the ventilation system;
- radioactive waste.

**Figure 2: The central depot for chemical reagents and hazardous waste at the Gdańsk University of Technology**



Specific methods for neutralising selected groups of organic compounds have been developed and implemented. A heavy metal waste compaction plant has been set up in student laboratories. In 2017, in addition, the management of technical gases was rationalised and the radioactive waste depot at Gdańsk University eliminated.

During the development of the SYGOS programme at Gdańsk University, an urban hazardous waste incineration plant was put into operation, to which Gdańsk University directly transfers biological and chemical waste.

A proposal for the disposal of inorganic non-volatile chemicals arising during laboratory and research activities has been made. Furthermore, Gdańsk University has implemented a segregation system for separating recyclables from municipal waste that goes beyond national legal regulations. That is, in addition to municipal selective waste collection, a separate collection system for non-hazardous waste has been introduced at Gdańsk University. The following waste materials are collected:

- dry mixed fraction;
- wet fraction (biodegradable materials);
- glass;
- plastics (crushers that reduce the volume of waste have been installed);
- metals;
- waste paper.

The IT aspect of the SYGOS system consists of the following elements:

1. Introduction of the IChem computer program, enabling:
  - the creation of a database for chemical reagents storage at the departmental level;
  - the creation of a database of reagents and chemicals intended for liquidation, sale or exchange;
  - the use of a database of physicochemical properties of chemical reagents (about 10,000 items);
  - the use of a database of safety data sheets created from data supplied by the Merck and POCHchemical companies.
2. Introduction of the Etchem3 computer program for labelling chemicals, in accordance with current legal standards.

## 2.4 What was achieved?

The management of hazardous waste in Polish universities is gradually improving.

The implementation of the SYGOS programme at Gdańsk University, and in particular in the Department of Chemistry, has led to:

1. greater experience in dealing with chemicals and waste;
2. the fulfilment and anticipation of the legal requirements of Poland and the EU;
3. the development of a system for proper, modern collection and sorting of chemical waste, a selective collection system for other waste at Gdańsk University, and the integration of those systems with the municipal waste collection system;
4. the assessment of reagent stocks in individual departments and of technical conditions and equipment in the department's storage areas;
5. the removal of unsuitable reagents (more than 70 tonnes of hazardous substances have been disposed of);
6. the implementation of a computerised system for recording and labelling chemical substances used in laboratories (chemical reagents).

The SYGOS system is also in line with the department's learning and didactic goals, and it is a practical supplement to the educational activities of the department and the university as a whole. The initiative has contributed to achieving educational goals relating to environmental protection and student safety, and has helped in implementing safety standards in the laboratory and spreading the message in other, related activities.

## 2.5 Success factors and challenges

The SYGOS activities are part of the mission of Gdańsk University, and one of the key elements of providing quality education for the dynamic development of the knowledge economy and society. An important part of building a quality culture is care of the environment and health.

### 2.5.1 Success factors

- **Support from superiors**
- The introduction and functioning of the SYGOS system was and is supported (including financially) by the dean of the Department of Chemistry and the rector of Gdańsk University.
- A chemical safety specialist was appointed, who represents the dean of the Department of Chemistry and the rector of Gdańsk University as regards the management of chemical reagents and waste.
- A coordinator for the SYGOS system was appointed in the Department of Chemistry.

- **Cooperation with other universities and with the programme creator**

Gdańsk University participated in the introduction of the SYGOS programme from the beginning, when it was being developed by the Silesian Technical University. Yearly meetings were held at the Silesian Technical University to discuss the scope of the activities, procedures, organisational structures and proposed changes, and various solutions that could help in implementing the SYGOS programme. These meetings were the main platform through which universities from all over Poland could exchange experiences and offer each other training. In particular, the work done by the programme's founder, Professor Zawadiak, in reaching out to the authorities of individual universities was important. He raised awareness and encouraged non-chemists to seek solutions for these new issues.

The continuous exchange of experiences among universities is ongoing. It is very important, for example when designing a waste collection depot, to visit depots at other universities, to exchange experiences, and to discuss the advantages and disadvantages of solutions and approaches.

- **Involvement of employees**

The staff of the Department of Chemistry at all levels (lecturers, academics, laboratory staff and other technical staff) have been involved in the implementation and operation of the chemical management programme and waste system. The employees participate in the programme at various levels, tailored to their competences and the nature of their workplaces.

- **Involvement of students**

Students are constantly trained and supervised to ensure that they fulfil the requirements of the system, according to the nature of their activities (laboratory work, participation in scientific student circles, conducting independent research). Mentors are responsible for safety at work and training, in which students also actively participate.

Figure 3: Student laboratories — a combination of tradition and modernity



## 2.5.2 Challenges

- **High turnover of students and staff and a multicultural environment**

Work at the university is characterised by a high turnover of students and a high variability of tasks. Students and employees struggle with new challenges during their scientific work and may be exposed to constantly changing risks. This leads to various problems related to sharing of information, respect of procedures, and training.

Another challenge is the multicultural nature of the university: students, PhD students and scientists from all over the world study and work at Gdańsk University. Language barriers and cultural differences, as well as short-term stays at the institution, require more attention on the part of educational staff.

- **Variety and variability of used substances and preparations**

In didactic work, and especially in the field of chemistry, various substances and mixtures are used that are often hazardous to workers, students and the environment.

As knowledge and science progress, new properties of substances as well as new substances and mixtures are discovered.

Students, PhD students and employees of the Department of Chemistry synthesise new substances as part of their work. New innovative materials and methods may also entail new risks and require more attention when working in the laboratory.

All employees of the department are involved in ensuring safety and health at work. This is reflected by a low number of occupational accidents, improved health and safety conditions, and reduced workplace exposures to dangerous substances.

Picture 4: restored chemistry classroom dating from 1904



## 2.6 Transferability

The chemical and waste management system is transferable to chemistry departments at other universities. Several universities have already implemented the system.

## 2.7 Further information

Łukasz Katlewicz

Tel. (+48) 58 347 28 35

lukasz.katlewicz@pg.gda.pl

## 3 References and Resources

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