# Project ChempharmVET

# IO6 – final report

## Country-specific training programs / curricula for process operators in the chemical and pharmaceutical industries

## Exemple of Slovenia, Portugal, Slovakia and Norway



This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

# Table of content





**This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.**

# Country-specific training programmes/curricula for process operator in the chemical and pharmaceutical industries

## Introduction

The aim of intellectual output 6 in the ChemPharmVET project was to collect and report on the new country-specific training programmes/curricula for process operator in the chemical and pharmaceutical industries that were developed, based on the European competence matrix. If necessary, the country specific training programmes, collected in the ChemPharmVET project, can be adjusted and adapted according to country specific circumstances in collaboration with relevant representatives of the chemical and pharmaceutical industries.

Firstly, the European model curricula was translated into the national languages, than each country prepared their own programme, taking into account definition of aims, objectives and tasks as follows:

- Elaboration of contents and practical parts, possible schedule;
- List of necessary material and technical capacity;
- Description of required teaching staff and its professional qualification;
- Access criteria for apprentices/students;
- Calculation of necessary finances (for preparing accreditation of the programmes).

In this report, four country specific training programs for process operator at NQF level 4 will be presented, these are examples of Slovenian (1), Portuguese (2), Slovakian and Norwegian (3) training programs.

1. Slovenian case is based on the training programme for unemployed upper secondary school graduates possessing general/generic competencies and can, through the training, obtain professional/vocational competencies to find employment in the chemical and pharmaceutical industries. The program is called **Operational Technologist in the Chemical and Pharmaceutical Industries (POT-KE)** and could, by our assessment, be easily adapted to other countries.

2. In Portugal, the European curricula for process operator was presented to education representatives and obtained very positive feedback. Even though there was no such national standard, similar elements can be found in different national qualification, such as the example of the **Industrial Chemical Technician**, which will be presented in this report.

3. In Slovakia there is a very similar training programme to the European curricula for process operator, called **Chemist –Operator**, education lasts for four years and is presented below in the case of Slovakia.

4. In the Norwegian case the curriculum for **chemical processing VG3** will be presented.



**This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.**

# 1. Slovenia

In 2015, Slovenia prepared and implemented the training programme Operational Technologist in the Chemical and Pharmaceutical Industries (Slovenian abbreviation: POT-KE).

## 1.1 Definition of aims, objectives and tasks

**Aims:**

- Help young unemployed individuals possessing general/generic competencies obtain professional/vocational competencies so as to find employment in the chemical and pharmaceutical industries, which suffer from a shortage of suitably qualified staff.

The chemical sector of Slovenia represents the manufacturing of chemical raw materials and diverse chemicals, the manufacturing of pharmaceutical agents and preparations and the manufacturing of plastic and rubber products. It is one of the most important industries. It is occasionally facing a shortage in suitably technically competent staff at SQF levels 4 and 5 (NQF, level 4).

**Objectives:**

- Train young unemployed upper secondary school graduates to find employment in the chemical and pharmaceutical industries (SQF, level 5).
- Elaborate an appropriate training programme so as to complement competencies needed by the chemical or pharmaceutical industry.

The labour market recorded a large number of young unemployed upper secondary school graduates (SQF, level 5). They acquired generic, mostly theoretical competencies during their full-time education, but they lack specific professional and practical knowledge (in chemical technology) required for the position of the operational technologist in the chemical industry, and they also lack knowledge of health and environmental protection, which is particularly important for the chemical or pharmaceutical industry.

**Tasks:**

- Together with the pharmaceutical industry, the Competence Centre of Chemical Industries at the Association of Chemical Industries of Slovenia elaborated the Operational Chemical Technologist training programme.
- The programme was conducted at the Secondary School of Chemistry in Ljubljana, and in four chemical and pharmaceutical companies.
- Following completion of the programme, the Association of Chemical Industries of Slovenia organised job interviews between employers and students who successfully completed training.

Within the framework of the proposed programme, unemployed upper secondary school graduates update, upgrade and complement their knowledge and skills. In this way, they boost their employability chances in the chemical, but also in other processing sectors.



**This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.**

## 1.2 Key competencies/knowledge/skills/aptitudes gained by participants after the completion of the programme

- Theoretical and practical knowledge from the contents of the chemistry syllabus for general upper secondary schools linked to the knowledge of technology and chemistry from the chemical technician syllabus (level 5 of complexity).
- Learning about chemical safety, response to accidents by taking key first aid measures, environmental chemistry and sustainable development principles as essential for health and environmental protection and for the implementation of European sustainable development principles.
- Some basic communication skills needed for good interpersonal relations and successful teamwork in the production, insight into ethics and values.
- Practical insight into the course of technological processes in several chemical companies, with emphasis on meeting quality standards and health and environment protection standards on the job, and learning about different areas and working methods of operational technologist in the chemical industry.

## 1.3 Elaboration of contents and practical parts, possible schedule

Pharmaceutical industry experts, the Association of Chemical Industries of Slovenia and teachers were involved in the preparation of contents. The teachers of the Secondary School of Chemistry in Ljubljana also participated in the elaboration of the school curriculum and practical laboratory part.

**Content and hourly distribution of the training programme Operational Technologist in the Chemical/Pharmaceutical Industries (POTKE)**

The programme is not conducted within the school educational system.
**It consists of 272 hours, of which 180 hours of theoretical training and 92 hours of practical training.**

| **MODULES OF THE POT-Ke PROGRAMME:** | **Hours: theoreti-cal training** | **Hours: practical training** |
|---|---|---|
| [1]**Basic units and modules:** knowledge, skills and competencies included in the chemistry syllabus for upper secondary school and the chemistry technician programme | | |
| **I. Introductory presentation of the programme:** informing participants about the programme, working methods and conditions for successful completion and obtaining of a certificate of competence | 2 | |
| **II. Refresher unit (**selected chapters from the chemistry syllabus for upper secondary school):<br>- General and inorganic chemistry<br>- Physical chemistry<br>- Organic chemistry | 55 | 5 |

1 In Slovenia, both programmes are at SQF level 5. An upper secondary school programme has general education contents and most students continue their studies in higher and university programmes. The chemistry technician programme is part of vocational education and training. Following its completion, secondary school graduates are integrated into the labour market or they continue their studies at tertiary level.



**This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.**

| | | |
|---|---|---|
| - Chemical arithmetic | | |
| **III. Chemistry and technology unit (**selected chapter from the chemistry technician programme):<br>- Chemical technology<br>- Materials<br>- Management of chemical engineering processes and equipment<br>Note: Practical training will take place in a chemistry lab, which can at the same time accommodate a maximum of 17 students. | 75 | 45 |
| **Other units and modules:** knowledge, skills and competencies which are not included in the chemistry syllabus for upper secondary school and in the chemistry technician programme. | | |
| **IV. Chemical safety, response in case of an accident, environmental chemistry and sustainable development principles:**<br>- Chemical safety (protection of health and the environment from adverse effects of chemicals), response in case of an accident and first aid (note: module is mandatory prior to the beginning of lab exercises and on-site visit);<br>- Responsible management programme;<br>- Chemical processes as a result of human activity taking place in the environment and causing climate and other changes;<br>- EU guidelines and their implementation with emphasis on sustainable manufacturing and consumption in the chemical industries of Slovenia;<br>- Engineering and purification processes of waste materials prior to emissions into the environment<br>Note: Practical training will take place in the IT classroom. | 18 | 10 |
| **V. Communication for successful team work in the production, ethics and values** | | 4 |
| **VI. Training in a chemical company for technological work in the production:**<br>- Presentation of the entire company and the unit of the company where students will be involved;<br>- Presentation of key work processes, health and environment protection as well as quality systems;<br>- Inspection of key selected manufacturing or development operations.<br>Note: A mentor (technologist/researcher) is assigned to students for a visit. He/she will show students the key selected manufacturing or development operations in the company. | | 28 |
| **VII.** Support activities and examination | 35 | |



This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Forms of teaching/training:

- lectures within theoretical training and lectures with demonstrations in modules II and III;
- lab exercises in units II and III;
- lectures and teamwork in exercises in units IV and V;
- presentation and practical insight into production processes with the explanation in chemical companies in unit VI.

The programme lasts 2.5 - 3 months, runs 5 working days in a week on a continuous basis, in principle on average 6 teaching hours a day.

## 1.4 List of necessary material and technical capacity

We provided the following material and capacities for the training programme POT-KE:
Classrooms, IT classroom, chemistry lab with general and chemistry technology equipment;
Also, three chemical companies and one pharmaceutical company are visited so as to look into technology procedures and get to know work tasks; learning materials, medical examination and personal protective equipment for working in the lab.

Indicative (short) inventory of equipment and technical capabilities for practical training in the PoTKE programme:

**Analytical laboratory with standard equipment** and devices that are normally found in chemistry laboratories:
Basic equipment in the room:

- work-tops with ceramic or similar top plate
- sinks made of acid-resistant material and material resistant to other chemicals
- fume cupboard with adequate suction system
- cupboards for the storage of glassware, ironware as well as other “chemical containers” and devices
- at least one (usually more) special cupboard of metal for the storage of hazardous chemicals, equipped with suction
- laboratory dryer
- basic computer equipment

Other equipment:

- standard laboratory containers and devices (glassware, ironware, other “chemical containers” made of ceramics or plastics, volume measurement dosage devices….)
- analytical balances
- precision balances
- spectrophotometer
- potentiometer or pH-meter (automatic titrator)
- UV lamp used in the detection of TLC
- plate for chromatography (silica gel F 256 or $Al_2O_3$ F 256)

**Technology laboratory with standard equipment** and devices that are normally found in chemistry laboratories, basically the same as above.
Other equipment for technology exercises:


This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

- standard laboratory containers and devices (glassware, ironware, other “chemical containers” made of ceramics or plastics, volume measurement dosage devices….)
- precision balances
- analytical balances
- vacuum rotary evaporator with a vacuum pump
- heat exchanger (teaching apparatus)
- sieves for screening analysis
- laboratory ceramic mills
- filtration device (teaching apparatus)
- reverse osmosis equipment or laboratory ion exchanger for the preparation of purified water to be used in the laboratory
- laboratory rectification device (fractional distillation)
- laboratory or semi industrial agitators
- school low voltage source
- integral parts of laboratory device for zinc coating of sheet metal (wires, plugs and sockets, glass tray)

**Chemicals** (powders or crystalline substances – purity for school laboratory use: 99.5% to 99.8%):

- Salicylic acid
- Anhydrous citric acid
- $KMnO_{4(s)}$
- $NaOH_{(s)}$
- Concentrated HCl
- Concentrated $H_2SO_4$
- $H_3PO_4$
- bath for zinc coating
- EDTA
- Indicators for neutralisation titrations and for complexometric titration
- Chloroform
- Formic acid
- Methanol


This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

## 1.5 Description of required teaching staff and its professional qualification

- Unit I: representative of a responsible body with in-depth knowledge of chemical industry, training programme and method of execution;
- Units II and III: secondary school teacher of chemistry or specialised subjects in the area of chemistry;
- Unit IV:
  - chemistry teacher in secondary school programmes and a lecturer with a knowledge of environmental chemistry and sustainable development principles;
  - lecturer/instructor possessing specific knowledge and skills in the area of chemical safety, environment protection, health and safety at work and response to accidents;
  - first aid: medical expert;
- Unit V: lecturer/instructor with a knowledge of practical use of communication skills enabling adequate and efficient transfer of information among co-workers;
- Unit VI: expert with an adequate educational background, who comes from a chemical company and is employed in areas to be presented to students; such as Chemical Engineering University Graduate or Chemical Technology University Graduate or Pharmaceutical Engineering University Graduate (in a pharmaceutical company).
- **Unit VII: tutor –** one of lecturers who at the same time also have a broad understanding of all programme units.

## 1.6 Access criteria for students

- Training programme participants have to pass an upper secondary school-leaving examination (*matura*).
- Expected basic traits of a student are as follows: interest in natural sciences, especially chemistry, inquisitiveness, self-initiative, openness and communication skills, sense of teamwork and orderliness, also willingness for possible future work or employment in the industry.
- Given the preselection of students by the Employment Service of Slovenia, it is possible to conduct a preliminary short basic chemistry test to make the final selection. Students are informed in advance about contents to be tested.

## 1.7 Cost estimates for preparation, accreditation and implementation of the programme

In total, the programme consists of 277 hours and in the case of full occupancy of classrooms and labs totals EUR 1654/person (including VAT).

## 1.8 Review of further activities in 2017/ 2018 dedicated to the training of staff for the chemical and pharmaceutical industries

Following the initiative of the pharmaceutical industry and its needs in manufacturing, we undertook partial correction of the programme POT-KE in 2017. Our initial purpose was to elaborate a training programme for two separate qualifications: Operator – Industrial Mechanic and Chemical Process Operator, but we later



**This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.**

decided to prepare a qualification within one programme at SQF level 4 of complexity (= EQF, level 4), enabling the simultaneous development of competencies in mechatronics and chemistry/pharmacy. The profile was named Operator in the Chemical and Pharmaceutical Industries.

In April 2018, we plan to start implementing the pilot programme Operator in the Chemical and Pharmaceutical Industries comprising **208 hours; 100 hours of theoretical training** and **108 hours of practical training, and additionally 14 hours** envisaged for contacts with a tutor and consultations. Substantive and practical modules have been defined; the matrix of knowledge and skills is currently under preparation. We also plan to include one-month training in the pharmaceutical industry, but we still do not know if this is possible in practice.

Access criteria for students are as follows: completed technical vocational training programme (SQF, level 4). Priority will be given to currently unemployed individuals with completed technical vocational programmes (level 4) and the already employed staff in the pharmaceutical industry so as to complement their competencies.

## 1.9 The presence of elements of the training programme Process Operator in the European Chemical and Pharmaceutical Industry in both similar training programmes in Slovenia.

Clarification:
SQF consist of 10 levels. SQF levels 4 and 5 correspond to EQF level 4. Education and competencies at these two levels in Slovenia differ.
The training programme Operational Technologist in the Chemical and Pharmaceutical Industries is placed at SQF level 5, while the training programme Operator in the Chemical and Pharmaceutical Industries is at SQF level 4.
As training does not take place in industrial production (apprenticeship is not envisaged), it is not possible to implement certain elements incorporated in CHEMPHARM, and therefore additional training on the job is also expected.

Number 4 or 5 in the table indicates which element of CHEMPHARM is included in these two training programmes. In case a certain element is covered in both programmes, contents at level 4 have a limited scope and a lower level of complexity.

| CHEMPHARM UNIT 1 Perform operational logistics | |
|---|---|
| Learning outcome | [2]Learning outcomes (LO) on the basis of two VET programmes at NQF level 4 or 5 and of Slovenian |

2 The first comparable VET programme in Slovenia was implemented as a pilot at SQF level 5 in 2015, another, which is currently planned, is at SQF level 4; it will probably be launched as a pilot in 2018.



**This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.**

| | Vocational Qualifications[3]<br>[4] * Y(es) – part of LO is at SQF level 4, part at 5;<br>x = no or Not at SQF level 4; EQF 4 =SQF 4 + 5 |
|---|---|
| 1.1 Preparation | Y |
| 1.1.1: Prerequisite: Foreign language | X 5 |
| 1.1.2: Prerequisite: Digital tools and software use | Y |
| 1.1.3: Production planning | X, 5 |
| 1.1.4: Logistics | X |
| 1.2: Execution | X, 5 |
| 1.2.1: Health and safety | Y |
| 1.2.2: Process control | X |
| 1.2.3: Products and packaging | X |
| 1.3: Monitoring | Y |
| 1.3.1: Quality standards and assessment | X 5 |
| 1.3.2: Compliance with requirements | Y |
| 1.3.3: Feedback and improvements | Y |

| UNIT 2 Conduct Processes | |
|---|---|
| Learning outcome | Learning outcomes (LO) of Slovenian Vocational Qualifications[5] and on the basis of two VET programmes at NQF level 4 or 5.<br>[6] * Y(es) – part of LO is at SQF level 4, part at 5; x = No or Not at SQF level 4; EQF 4 =SQF 4 + 5 |
| 2.1 Process preparation | Y |
| 2.1.1 Basic process understanding | Y |
| 2.1.1.1 Production process | Y |
| 2.1.1.2 Equipment | Y |
| 2.1.1.3 Equipment setup | Y |
| 2.1.2 Instrumentation and control | Y |
| 2.1.2.1 Calculation | X,6 |
| 2.1.2.2 Instrumentation diagrams | Y, |
| 2.1.2.3 Mode of operation | Y |
| 2.1.3 Equipment operation | X,5, |
| 1.3.1: Quality standards and assessment | X |
| 2.1.4 Software | Y |
| 2.1.5 Procedures | Y |
| 2.1.6 Contamination | Y |
| 2.1.7 Handling of raw material | Y – planned |
| 2.2 Handling of machinery in process | Y |

3 http://www.nrpslo.org/en/
4 Please note the explanation *
5 http://www.nrpslo.org/en/
6 Please note the explanation *



This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

| | |
|---|---|
| 2.2.1 Production process | X,6 |
| 2.2.1.1 Preparing production | X,6 |
| 2.2.1.2 Starting production | Y |
| 2.2.1.3 Closing down | X |
| 2.2.2 Production quality standards | Y |
| 2.2.2.1 Purification and contamination | |
| 2.2.2.2 Product characteristics and handling | Y,5 |
| 2.2.2.3 Product packing and storing | Y,6 |
| 2.2.2.4 Waste handling | Y |
| 2.2.3 Production modus variation | Y, 5,6 |
| 2.2.3.1 Identification of critical values | Y,6 |
| 2.2.3.2 Experimental setups | Y5,6 |
| 2.3 Control of the working process | Y |
| 2.3.1 Standards compliance | Y |
| 2.3.2 Safety | Y |
| 2.3.2.1 Risk management and mitigation | Y |
| 2.3.2.2 Handling of hazardous situations | Y |
| 2.3.3 Quality control | Y |
| 2.3.3.1 Sampling control | X,5 |
| 2.3.3.2 Measurements | X,5 |
| 2.3.3.3 Test series in process control | X,5 |
| 2.3.3.4 Quality analysis and reporting | X,5,6 |

* Not all of the described Learning Outcomes are part of job description of one person. In Slovenia, we have 3 profiles at different SQF/EQF levels, which are covered by those who are independent of the above mentioned knowledge and skills.
Based on our view on actual tasks and employment in the pharmaceutical industry, many elements of Learning Outcomes are too demanding for the Process Operator at SQF levels 4 and 5 = (EQF 4). 1.2.2 .; 1.2.3.; 1.3.2 .; 2.1.1 .; he/she does not lead a team in the production process and is not a supervisor or a team instructor. In the Slovenian National VET Profile, such competencies are described at the level of complexity 6. The profile is called the Operational Technologist in the Chemical Industry Manufacturing Process (confirmed at national level in 2017). They are also partly covered by the Operational Technologist at SQF level 5.

| UNIT 3 Participate in quality control | |
|---|---|
| Learning outcome | Learning outcomes (LO) of Slovenian Vocational Qualifications[7] and on the basis of two VET programmes at NQF level 4 or 5<br>[8] * Y(es) – part of LO is at SQF level 4, part at 5; x = No; or Not at SQF level 4 ; EQF 4 =SQF 4 + 5 |
| 3.1: Taking samples | Y |
| 3.1.1 Safety | Y |

7 http://www.nrpslo.org/en/
8 Please note the explanation *


This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

| | |
|---|---|
| 3.1.2: Methods of sampling | X,5,6 |
| 3.1.3: Implementation of sampling | X,5,6 |
| 3.1.2.1: Sampling and offloading of samples from equipment | Y |
| 3.1.2.2: Packaging, storing and transfer of samples | Y |
| 3.1.2.3: Documentation of samples | X,5 |
| 3.2: Sample analysis | X,5 |
| 3.2.1: Procedure and process | X,5 |
| 3.2.3: Result | X,5 |
| 3.3: Participating in quality control | X,5 |
| 3.3.1: Quality control | X,5 |
| 3.4: Feedback and fine-tuning | X,5,6 |

| UNIT 4 Participate in maintenance and repairs | |
|---|---|
| Learning outcome | Learning outcomes (LO) of Slovenian Vocational Qualifications[9] and on the basis of two VET programmes at NQF level 4 or 5 [10] * Y(es) – part of LO is at 4 SQF level 4, part at 5; x = No; or Not at SQF level 4 ; EQF 4 =SQF 4 + 5 |
| 4.1. Operating permit (required to start working on the site) | |
| 4.1.1: Safety precautions in maintenance | Y |
| 4.1.2: Maintenance preparation | Y |
| 4.2. Lock out and tag out of installation | Y,5,6 |
| 4.3. Maintenance and repair | Y, 5.6. |
| 4.3.1: Specific conditions | Y,5 |
| 4.3.2 Feedback and improvements | Y,5,6 |

9 http://www.nrpslo.org/en/

10 Please note the explanation *



This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

# 2. Portugal

## 2.1 Portuguese Education and Training System (E&T)

The Portuguese Education and Training System (E&T) is under the overall responsibility of the central government. The main entities involved in the E&T system in Portugal are described above:

- The Ministério da Educação e Ciência (MEC - Ministry of Education and Science) is traditionally responsible for the educational sector (pre-primary education, basic education, secondary education, school based training and higher education).
- Ministério da Solidariedade, Emprego e Segurança Social (MSESS - Ministry of Solidarity, Employment and Social Security), particularly the Instituto para o Emprego e Formação Profissional (IEFP - Institute for Employment and Training), is traditionally responsible for training - CVET, apprenticeship and Active Labour Market Policies (ALMPs).
- The two Ministries share the responsibility for Agência Nacional para a Qualificação e o Ensino Profissional (ANQEP - National Agency for Qualification and VET).

Overall responsibility for the E&T services lies with central departments of both Ministries that are the key bodies in implementing policy. Non-higher education regional authorities and VET regional authorities (respectively, under the coordination of the MEC and MSESS) are responsible for the implementation of policies at local level.

**The main stakeholders for VET are:**

a) internal stakeholders: ANQEP and IEFP, schools and IEFP training centers, certified VET providers, learners, teachers/trainers, as well as,
b) external stakeholders: social partners, including confederations of both employers' associations and trade unions that participate in the VET advisory bodies.
c) Higher education (universities and polytechnic institutes) are autonomous institutions.

At each level of the E&T system a number of advisory bodies, including social partners, deliver technical views and recommendations, i.e.:

(a) Conselho Nacional de Educação (National Education Council) covering the whole spectrum of E&T;
(b) Conselho das Escolas (Schools Council) specifically focused on basic and secondary education;
(c) Conselho Coordenador do Ensino Superior (Coordinating Council for Higher Education)

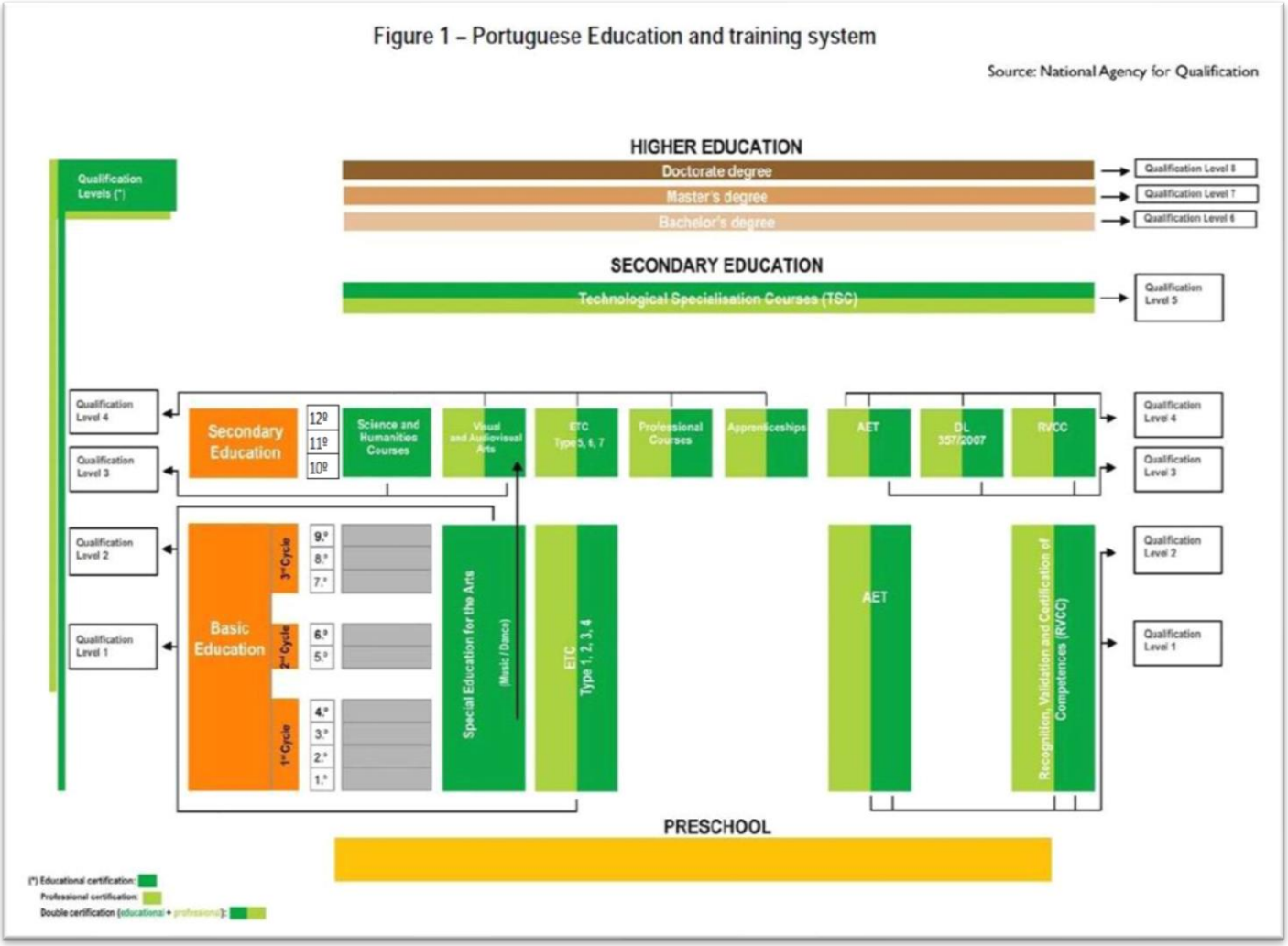
The Figure 1 shows the structure of the Portuguese E&T system, the current organisation for the provision of E&T from pre-school to higher education.



This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Figure 1 – Portuguese Education and training system

Source: National Agency for Qualification




As illustrate in the figure above, the Portuguese E&T system has the following levels:

- Pre-primary education
- Compulsory education: basic and secondary levels (EQF level 1 to level 3)
- VET programmes at secondary level (EQF level 4)
- Post-secondary non tertiary education (EQF level 5)
- Higher education: universities and polytechnics (EQF level 6 to 8)

### 2.1.2 Portuguese Education and Training Provision - General Features:

Since 2000 there is a process for bridging the traditional gap between education and training. In 2007, the Sistema Nacional de Qualificações (SNQ - National System of Qualifications) was developed**.** It constitutes a milestone in the development of the E&T system and an attempt to get aligned with the EU policies. The SNQ framework is based on a structured relationship between VET within the educational system and VET in the labour market. It establishes common objectives and instruments, which have been developed over the years and complementary tools to sustain the implementation of the policy. These are reference frameworks used to help policy developers, learners, teachers/trainers, employers and society at large in understanding how the system functions and, more importantly, its benefits. Instruments to support SNQ implementation were developed, namely the:

- National Qualifications Framework (QNQ),
- National Qualifications Catalogue(CNQ),
- Mechanism for the recognition, validation and certification of competences (RVCC) and the



**This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.**

- Individual competences portfolio. SNQ sets the main policy objectives that represent main drivers of the reforms affecting VET provision

### 2.1.1 Vocational Educational and Training (VET): objectives and main features

The training offered by courses leading to a qualification can be **vocational courses** (secondary-level training that last for three academic years and leads to Level 3 vocational qualification and a diploma in secondary education), courses under **the apprenticeship system** (initial alternance training, intended for young people – between 15 and 25 – and that leads to Level 2 vocational qualification and a certificate of completion of Cycle 3 of basic education, or a Level 3 vocational qualification and a certificate of completion of secondary education) and **education and training courses** (intended for people aged 15 or over who left or are in risk of leaving the regular education system and for young people who have completed 12 years in school and wish to acquire a vocational qualification; lead to an academic certificate equivalent to year 9 or 12 of school and a Level 2 or 3). Other courses include specialised art courses and technology courses (that leads to a diploma of secondary education and a level 3 vocational certificate).
Concerning the post-secondary vocational education and training the main offer are Specialized Technology Courses that provide a non-tertiary vocational education and training (and leads to a diploma of specialised technology and a Level 4 vocational certificate).

## 2.2 Country-specific training programs for process operators in the chemical and pharmaceutical industries – The Portuguese qualification standard - Industrial Chemical Technician

The previous information briefly described the Portuguese E&T system, which comprises different programmes of education and training, since the basic to the tertiary levels. The qualification presented is part of the IVET programmes, included in the Specialized Technology Courses that provide a non-tertiary vocational education and training, in this case of level 4.
The European training curricula for the "**Process Operator in the European Chemical and Pharmaceutical Industry**" was presented to some education representatives from VET centres in the chemical sector. The feedback to the Curricula was very positive, since there is no national standard in the National Qualification Catalogue in Portugal, for the Operator in Chemical and Pharmaceutical Industry, and despite some elements can be found in some existing national qualifications, as is the case of the Industrial Chemical Technician, the Chempharm Curricula covers more learning outcomes and tasks, specifically in the pharmaceutical industry part.
The existing training curricula in Portugal for the Industrial Chemical Technician will be presented below.

### 2.2.1 The Industrial Chemical Technician

The VET programme for the Industrial Chemical Technician is organized in three parts:
- General and Scientific (around 1500 hours)
- Technological and Expertise (1225 hours)
- Internship in workplace (600 hours/840 hours in a company, industry or other)

After the internship period, trainees may be employed in the companies where they performed the on-the-job training; The main employers for this qualification are private laboratories, researcher centres, hospitals, pharmaceutics and industries.


This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Below is presented the profile and learning units for the Industrial Chemical Technician.

## Industrial Chemistry Technician Profile (Technological and Expertise part)
**(Level IV EQF/NQF)**

### Definition

The Process Operator in a chemical plant supervises and operates a production process equipment requiring a specific procedure in respect of health and safety, quality and environmental protection. For this the operator uses a great variety of monitoring and operating equipment, ranging from simple equipment to a central control room with integrated measuring and regulating functions for the supervision and control of the production process.

### General description

*Detect and resolve problems related with the conduction of start, stop and driving operations of production processes of an industrial unit, taking into account the qualitative and quantitative technical analysis, the chemical processes and the chemical technology unit operations and processes and measurement and control instruments, respecting the safety, hygiene and health requirements at work and of environmental protection.*

### Main tasks

1. **Collaborate in the preservation and control of the structures and industrial equipment functionality.**

   1.1 Analyse different kinds of technical information related with the production process, including data provided by measurement and control instruments, drawings, maps, charts and technical instructions regarding equipment and process development; 1. Identify and characterize the various processes and industrial technologies and regulation methods for chemical industry.
   1.2. Measuring and control technology and technical processes variables and equipment in order to detect problems that arise in production;
   1.3. Collect and prepare substances and products samples to be analysed;
   1.4. Perform simple physicochemical analysis, interpret the results and process it;
   1.5. Reporting, making the necessary calculations and recording in tables and graphs the data relating to control operations of the tests performed;
   1.6. Detect non-conformities of products and the production process and diagnose the respective causes;
   1.7. Propose corrective and preventive actions of non-conformities and assist in their implementation;
   1.8. Participate in start, stop and driving operations of production processes and equipment in accordance with the rules and established procedures.

2. **Collaborate on the improvement of the production processes aiming to achieve a greater equipment efficiency, taking into account the materials degradation factors and the prevention and control techniques.**

   2.1. Establish the regulating equipment parameters appropriate to the product and process;
   2.2. Participate in the definition of the most appropriate control process to the industrial unit;
   2.3. Participate in the selection of equipment and instruments to be used in the process.

3. **Collaborate in the definition and implementation of safety, hygiene and health standards and environmental protection applied to chemical industry.**

4. **Develop reports and control documents related with the performed activity.**

### Skills (How to)

1. Identify and characterize the various processes and industrial technologies and regulation methods for chemical industry.



This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

2. Identify and characterize the different starting operations and control of a manufacturing circuit or section and the respective equipment.
3. Use the planning and organization work techniques.
4. Interpret drawings, schemes and other technical specifications on the production technologies, raw materials and products.
5. Use the tools and metrology techniques.
6. Using sampling techniques.
7. Identify and use different laboratory materials and equipment.
8. Using the execution techniques of the laboratory work basic operations.
9. Using the techniques of quantitative and qualitative analysis of samples.
10. Interpret the results of analyses.
11. Diagnosing defects in the manufacturing process, deficiencies in equipment and deviations in production.
12. Using the techniques of driving and regulating equipment.
13. Equipment monetization techniques.
14. Set parameters for regulating equipment according to their characteristics and product manufacturing.
15. Apply quality control techniques.
16. Apply the technical procedures for prevention of occupational hazards in the workplace.
17. Apply the safety, hygiene and health and environmental protection relating to professional activity.
18. Use the technical documentation regarding the registration of the activity.

**Learning Units:**

1. Laboratory work basics 25
2. Environment, Safety and Health at Work concepts basic 25
3. Safety, hygiene and health in the laboratory 25
4. Unit operations 50
5. Metrology basics 25
6. Chemical calculation 25
7. Volumetric base acid 50
8. Precipitation volumes 25
9. Volumetric complexation 25
10. Volumetric redox 50
11. Hydrocarbons 25
12. Functional groups and reactions of organic compounds 50
13. Biomolecules 25
14. Enzymology 25
15. Photosynthesis and Respiration 25
16. Chemical industry - introduction 25
17. Unit operations in the industry 25
18. Static and dynamic fluid 25
19. Movement of solid particles in a fluid 25
20. Treatment of solid 25
21. Heat transfer 25
22. Mass transfer 25
23. Chemical reactors mixing and stirring 25
24. Environmental Management 50
25. Quality 50
26. Fluid transfer and gas compression 25
27. Generators and heat exchangers 25
28. Industrial turbines 25
29. Start distillation columns and equipment stop 25
30. Electrotecnics 25
31. Pressures and levels 25
32. Temperatures 25
33. Flow rates and valve 25
34. Industrial regulation 25
35. Metals 50
36. Alloys and special materials 25



**This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.**

37. Behaviour of materials 50
38. Protection materials 25
39. Industrial painting 25

## Necessary materials and technical capacity

Chemistry lab with all the related equipment – for the practical part; normal classrooms equipped with computers - for the theoretical part

## Description of required teaching staff and its professional qualification

Professional vocational trainers/teachers with a higher degree level in chemistry or related subjects and also the pedagogical training for teachers /trainers.

## Access criteria for apprenticeships

Since this course is a Specialized Technology Courses that provide a non-tertiary vocational education and training, leading to a Level 4 vocational certificate, the access criteria for the apprentice is to have at least the level 2 of qualification completed. The learners should also be unemployed and not engaged in any training offer to enter access the course.

## Calculation of necessary finances

This programmes are co-financed by the Portuguese Government, specifically through the IEFP (Institute for Employment and Training)



**This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.**

# 3. Slovakia

## 3.1 Definition of aims and objectives, tasks

The goal of education is a graduate who can work in chemical production as well as in food and pharmaceutical production. He knows the principles of technological operations, knows how to manage them and can influence them during the production process.
He is able to handle operations under operational and laboratory conditions, is able to measure and control the parameters of chemical and biotechnological processes and perform other activities that form the basis of his professionalism. The graduate is able to control the setting of the technological parameters in the relevant parts of the production process, he can control the automation elements of the machines and production lines. Additional, he is capable of identifying equipment failures and providing synergy in maintenance processes. He is able to identify deviations in the quality of raw materials and products and to provide synergy in the quality management process as well.
Chemist-operator works in a team, actively communicates and participates in the organization and management of the workplace. He is constantly learning, finding, classifying and processing information about his specialization. At the same time, he is able to apply modern methods, technology and style of work, logical thinking, autonomy, responsibility and initiative.
Currently, the programme **Chemist – Operator** (identification number **2860 K**) is providing education in this direction in Slovakia. The education lasts for four years.
Of the total of 4224 lessons, 1920 lessons is general education, 640 lessons is the theoretical education, 576 hours is the practical training. The remaining 1088 available hours, the school can use to enhance the teaching of subjects as needed.

## 3.2 Elaboration of contents and practical parts, possible Schedule

**Theoretical part of education – knowledge:**

- Define basic concepts and laws of general, inorganic and organic chemistry, use chemical names and symbols

- Describe the composition of homogeneous and heterogeneous mixtures, perform related calculations

- Identify the importance and inclusion of the most important technological operations in chemical production

- Describe the function of the most important types of machinery and equipment in chemical production and its parts

- Identify the physical parameters used to regulate chemical production processes, express them using physical quantities and make the necessary calculations

- Identify the safety parameters of the required range of chemicals in terms of their importance for use in chemical production

- Identify technologically significant qualitative indicators of raw materials, intermediates and chemical products and the principles of their measurement

- Define the principles of technological discipline, safe and hygienic work in the conditions of the chemical production process

- Know the fundamentals of the economy and business in a specific field

- Define the principles of health and work environment protection, and environmental protection



This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Classical and specialized vocational schoolrooms are used for theoretical education.

## 3.3 Practical part of education - skills:

- Recognize the function of the technological devices used in the particular process

- Reads and interprets technical and technological documentation

- Work with the materials, chemicals, tools, devices and machines safely. Use personal protective equipment

- Follow the instructions and set up and operate machines, devices and some technological equipment in the particular industry

- Carry out routine operations with the control elements of the manufacturing plant

- Read and check the key parameters of the process, insert necessary records into the operating software Set and check the measuring instruments

- Takes samples of materials, prepares them for analysis, performs relevant analyzes and evaluates obtained results

- Carry out measurement of physicochemical parameters in basic technological operations using manual and instrumentation methods

- Carry out the evaluation of qualitative parameters of raw materials and products using basic physicochemical methods

- Express the measured values in SI units, make calculations for other frequently used technical units
- Recognize uncomplicated failures of devices and their resources. Provide assistance to a dedicated maintenance team

- Identify product errors, analyse causes and suggest improvements

- Document the work of chemical plant (or parts thereof). Read and interpret records properly

- Obey the principles of occupational health, work environment, environmental protection

Practical training for younger pupils is performed in laboratories, in higher classes at workplaces in the production process (plants, workshops, laboratories).

## 3.4 Description of required teaching staff and its professional qualification

For a class with 17 pupils:
- two teachers are required to provide theoretical teaching (master or engineering university education)

- three masters of vocational education (bachelor degree and practice) provide teaching in practical training.

## 3.5 Access criteria for apprentices/students

**Educational requirements**: Lower secondary general education and fulfillment of the conditions of the admission procedure.
**Health requirements**: Applicants may be admitted to the relevant study departments, whose health status has been assessed and confirmed by the doctor. In the event of a change in the applicant's ability to work, a medical assessment of medical fitness is required.



**This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.**

# 4. Norway

## 4.1 Definition of aims and objectives, tasks

### Structure

Chemical processing consists of three main subject areas. The main subject areas complement each other, and should be viewed in relation to one another.

### Overview of the main subject areas:

| Year level | Main subject areas | | |
|---|---|---|---|
| Vg3 / In-service training at a training establishment | Production and maintenance | Product and product flow | Documentation and quality |

### Main subject areas

**Production and maintenance**

The main subject area covers the use of processing equipment and processing data in operational and emergency situations. Interaction with colleagues and other professional groups is also included in the main subject area. Furthermore, the subject covers maintenance of processing plants and equipment and how to prepare for working with the system. Working according to current rules and regulations is a central theme of the subject.

**Product and product flow**

The main subject area covers production flow from raw materials to finished product. Furthermore, the subject covers the how the business organises its value creation. Results from assessments and reports are included in the main subject area. Environment, health and safety are central themes of this subject.

**Documentation and quality**

The main subject area covers calculations and the use of drawings, images, schedules, instructions, procedures and standards. The main subject area also includes discussion skills. Furthermore, the subject covers registration procedures and non-conformance reporting.

**Basic skills**

Basic skills are integrated into the competence aims for this course in areas where they contribute to the development of and are a part of the basic subject competence. In Chemical processing, basic skills are understood as follows:

Being able to express oneself orally and in writing in Chemical processing involves describing work tasks. It also involves risk assessment and preparing non-conformance reports. It also deals with communicating with colleagues and other collaborators regarding questions related to the profession.

Being able to read in Chemical processing involves understanding and following work descriptions, instruction manuals, procedures and standards.

Numeracy in Chemical processing involves calculating pressure, temperature, mixture proportions and other processing parameters. It also involves adjusting and regulating the processing plant, taking measurements and completing registrations according to drawings, schedules and standards for product quality.

Digital literacy in Chemical processing involves using digital tools to search for information, communication, coordination activities and planning of work tasks. Furthermore, it involves the use of digital control and monitoring systems.



This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

**Competence aims**

**Production and maintenance**

The aims of the training are to enable the apprentice to:

- plan, execute and assess work in line with instructions, procedures and existing regulations
- use technical flow charts
- give an account of operational aspects of the unit and appurtenant processing equipment
- start, operate and stop production units and processes
- optimise production with help from measurements and analyses
- monitor, analyse and troubleshoot with help from tools, equipment and own judgement
- solve operational and maintenance tasks with an interdisciplinary team
- prepare the processing equipment for maintenance
- carry out systematic preventive maintenance on the equipment
- prepare the processing equipment for start-up
- follow run-down and emergency stop procedures
- use measuring, controlling and regulating equipment, and give an account of how these work
- use control and monitoring systems
- implement measures according to warnings and emergency procedures

**Product and product flow**

The aims of the training are to enable the apprentice to

- use data sheets and documentation based on routines for environment, health and safety and quality control
- give an account of the company's value chain from raw material to product
- discuss and elaborate on factors that influence profitability of production
- give an account of what happens chemically, biologically and physically during unit operation and processes
- give an account of the company's organisation, distinctive characteristics and role in a local, national and international context
- perform operational analyses and evaluate the analyses against the specifications

**Documentation and quality**

The aims of the training are to enable the apprentice to

- use drawings, schedules, images, instructions, procedures and standards at work
- report using oral and written skills in Norwegian and English using digital tools
- register and report on deviations



This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

- document work according to instructions, procedures and existing regulations
- give an account of the company's affect on the environment and the consequences this has for operations and deviations
- perform work according to ethical guidelines for the trade
- discuss and elaborate on problem-solving and optimising production in Norwegian and English with colleagues and other professional groups

## 4.2 Elaboration of contents and practical parts, possible schedule

The companies are free to use the training hours. There may be challenges with shift work and turnarounds. Particularly within offshore training places, where the candidate works for 14 days and is free for 4 weeks.

## 4.3 List of necessary material and technical capacity

The companies themselves decide on their own process equipment and training equipment. Is a process enterprise approved as a training company, its equipment and technical facilities are also approved by the local training office as OK.

## 4.4 Description of required teaching staff and its professional qualification

The training officer in the company must at least have a certificate of vocabulary within the vocabulary he teaches. Work experience within the trade certificate is a prerequisite. Doesn't the company have business professionals this are compensated with higher education by the training director. Such as a master or bachelor degree in chemistry, laboratory subjects, food science or process chemistry.

## 4.5 Access criteria for apprentices/students

Access to the VG3 chemistry process (EQF level 4) can be done in two ways:

- Completed and passed the VG2 chemistry process. Done in school.
- 5 years relevant work in the subject within a company that is approved for the training of chemistry process. Then take an exam corresponding to the theoretical competence that is in the VG3 curriculum.


This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.