

Upgrading knowledge and skills in mineral processing through a lifelong learning program-prochaine

MARIA SINCHE GONZALEZ, DOC., DR., SENIOR LECTURER, MINERAL PROCESSING
SAIJA LUUKKANEN, PROF., HEAD OF OULU MINING SCHOOL
UNIVERSITY OF OULU

The intensive training program in mineral processing (PROCHaine) provides to professionals working in the mining and processing sector an excellent basis to enhance their skills in mineral processing and process modelling. The training program is built upon the latest expertise in the field and covers the mineral processing chain from ore mineralogy and bench scale testing to continuous mode process testing, process optimization in a state-of-the-art pilot plant and modelling and simulation using HSC Chemistry software. Each module includes important process-related aspects such as environmental effects and Occupational Health and Safety (OHS).

1. Background of the program

In the past decades, the competitiveness of European mining and mineral processing operations has been decreasing. A key contributing factor to this decrease is the deterioration of the grade of ores as well as the increasing complexity of ore mineralogy. However, current developments make it possible to profitably recover valuable components from low-grade sources including both mines and secondary sources such as tailings. Therefore, the competitiveness of mining and mineral processing firms in the Nordic and other European countries will potentially increase.

A key prerequisite for such an increase in European competitiveness is to enhance the competences of the mining and processing experts currently working in the sector. These professionals need to gain new knowledge and skills about mineralogy and processing of low grade sources as well as to develop new abilities to collaborate, to shape creative approaches for solving production problems, to use digital tools such as modelling and simulation and to take responsibility for the completed projects. These skills are required to continually design and redesign more complex mineral

processing operations – which also need to be run in even more resource effective ways.

One major challenge in designing effective mineral processing operations is the significant differences between laboratory scale tests and industrial scale process operations. These differences arise from the large variation that naturally occurs in ores/secondary sources. Such variety needs to be thoroughly considered in process design and implementation.

Accordingly, Prochaine supports lifelong learners to gain insight into overcoming such challenges by making use of novel pilot scale facilities and laboratory tests combined with modelling and simulation, in order to better illustrate the impact

Oulu Mining School (OMS) from the University of Oulu, Finland

Lulea University of Technology (LTU), Sweden

Geological Survey of Finland (GTK), Finland

Outotec, Finland

Schneider Electric, Finland

The education is based upon the expertise in:

- continuous mode concentrating plant facilities at Oulu Mining School and Geological Survey of Finland
- process mineralogy and bench scale testing at Luleå University of Technology
- process simulation software of Outotec
- control and automation of Schneider Electric

that variation (ore and conditions) has on the effectiveness of processes as well as the types of good practices that better optimize the processes.

2. The Prochaine Project

The educational project PROCHaine initiated in 2017 for upgrading the skills and knowledge in mineral processing.

PROCHaine is under the sponsorship of the European Institute of Innovation and Technology (EIT Raw Materials), a body of the European Union under the Horizon 2020, the EU Framework Program for Research & Innovation. The consortium of the project consists of academia, a research organization and technology providers:



3. Project objective and scope

The goal of this project is to develop an advanced level and practical training program in mineral processing. The objective is to ensure that mineral processing engineers working in the sector gain new knowledge and experiences on the factors affecting the process design and upscaling to better plan, implement and manage operations.

The target group of learners consists of professionals already working in the mining sector, who are keen to learn more about mineral processing and to gain an advanced level of knowledge and understanding about the theory and practical issues concerning

the laboratory tests, pilot and demonstration plants of ore beneficiation as well as about the influence of upscaling on the operations and economics of mineral processing plants. Therefore, after the program participants can contribute to more efficient and better-controlled processes considering the environment and personal safety.

The scope of the training program comprises of three individual training modules, each focusing on specific aspects of the beneficiation chain: ore characterization, process design in laboratory and pilot scale, and process optimization in pilot and industrial scale.

Use of modelling and simulation tools will be integrated to be a part of each module. In addition, environmental aspects and health and safety issues related to the process design are taken into account in each course, as shown in Figure 1.

The training modules are organized once a year and accept a maximum of 15 participants in each module (Figure 4). After the standard package has become constant and gained more publicity among the players in the field, it could be held more than once a year on a tailored basis.

4. Facilities and infrastructure

At Oulu Mining School, participants use the flotation laboratories and the small-scale continuous mode pilot plant of 20 - 70 kg per hour (Figure 2), which creates an excellent platform for developing eco-efficient process solutions for material treatment and for studying the upscaling of the processes.

The laboratories of LTU are equipped to develop mineral processing methods anywhere along the beneficiation chain from mineralogical analysis to different mineral separation methods and dealing with process waste.

GTK Mineral Processing (GTK Mintec) offers a unique platform for the development and testing of energy saving, low-environmental-impact crushing, grinding and concentration processes. The demonstration plant with a capacity of 500 to 5000 kg per hour of mineral treatment is used in the training. It contains not only a flotation circuit but also various beneficiation processes such as gravimetric separator, low and high intensity magnetic separator (LIMS, HIMS) and automatic control.

Outotec provides the training in modelling and simulation using HSC Chemistry software. Simulations from basic to advanced level are carried out by participants using the information collected during

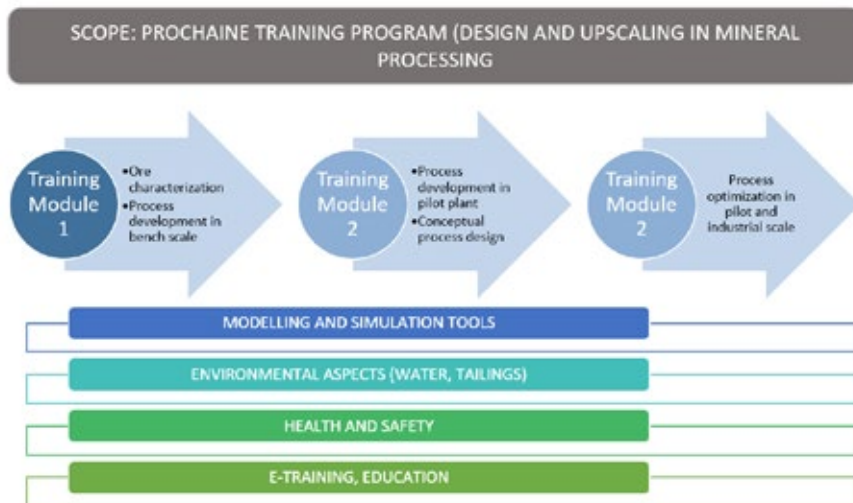


Figure 1. Scope of lifelong learning program PROCHAINE



Figure 2. OMS Pilot plant



Figure 3. Participants in the first PROCHaine course

the tests in laboratory scale and in pilot and demonstration plant.

Schneider Electric provides the training in control and automation, testing the software and instrumentation available in the pilot plant to manage the energy and process.

5. Impact

Various stakeholders in Europe, e.g., in the Nordic countries must sustain and develop the competitiveness of mineral processing companies.

Mining and mineral processing professionals need to gain competences in new mineral processing approaches to be able to run effective operations with low grade ores and tailings.

The persons participating in the lifelong learning program will benefit from the theoretical lectures and hands-on practice in state-of-the-art facilities. Those professionals will enhance their personal workplace position and their companies will as well gain from the more capacitated personnel.

Individuals are welcome to apply and companies are welcome to contact us to arrange a tailored package.

6. Participation and satisfaction

The first PROCHaine course consisting of three modules and intensive six weeks of lectures and practice concluded satisfac-

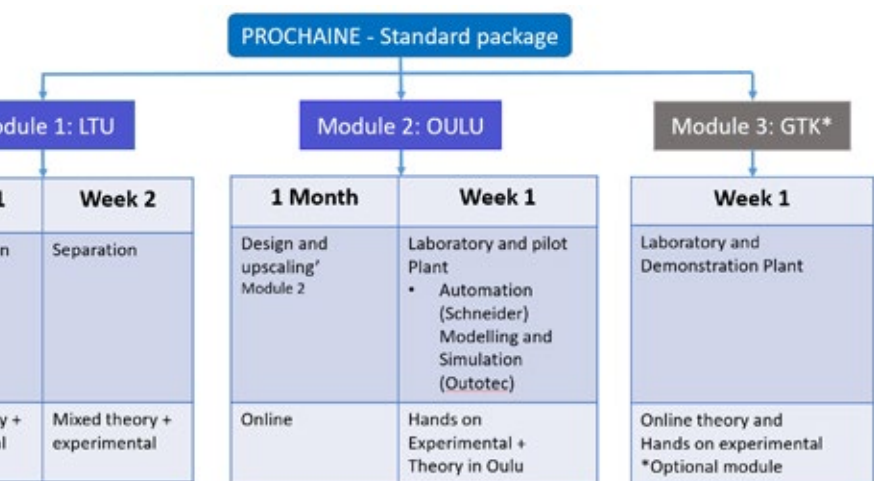


Figure 4. PROCHaine - Standard training package

torily with participation of five companies: Boliden, Nordkalk, Outotec, Yara and Metso and 14 participants with a background in mineral processing, mineralogy and environment (Figure 3).

From the feedback of participants, their satisfaction on achieving their learning outcomes was higher than 95%.

7. Structure of training courses

One of the problems with working professionals aiming for continuous development is the time needed for attending face-to-face. Based on the experiences obtained while developing first Prochaine, the next program will have an improved structure and schedule. Module1 will last two weeks in LTU and module 2 in OMS takes one

month of theory online and one week in laboratory and pilot plant. Module 3 of one week in the GTK demonstration plant is an optional choice for participants.

8. Acknowledgments

The authors acknowledge the financial support received for the PROCHaine project (2017-2019) from the European Institute of Innovation and Technology (EIT RawMaterials), a body of the European Union under the Horizon 2020, the EU Framework Program for Research and Innovation. Cordial thanks also to PROCHaine partners and lecturers of the program.

Information: www.prochaine.eu