



# Experiential training of technicians

by J. du Plooy\* and R.N. Guest†

## Synopsis

Mintek has implemented a training scheme that provides students with the experiential training requirement for the National Diplomas in Chemical Engineering and Extraction Metallurgy. This note describes the main features of the scheme and the course content, and our view of future developments in this area.

## Introduction

In order to complete a National Diploma in Chemical Engineering or Extractive Metallurgy, students require 12 months' experiential training, in addition to four semesters of theory at a technikon. This experiential training equips the students with the skills and knowledge to enable them to be competitive in the job market.

In 1995 the Minerals Processing Division at Mintek became aware of a large number of students that complete their theoretical studies but have difficulty in obtaining accredited experiential training, owing to the shortage of companies that offer a programme acceptable by the technikons. This difficulty particularly affects students from disadvantaged groups. Mintek, in consultation with the various technikons, designed a well-organized training programme in minerals engineering, hydrometallurgy, and pyrometallurgy, and a selection process to identify suitable candidates for the scheme.

## Training principles

Every six months, four students are selected from technikons throughout the country to do their one-year experiential training at Mintek. Mintek specializes in the extraction of metals and minerals, and the practical work is primarily in that sphere. The nature of the work is varied, and the students gain experience in contract work undertaken for clients, as well as fundamental research.

The training is aimed at instilling the following skills:

- Psychomotor skills (how to physically do the job)
- Cognitive skills (knowledge and understanding of the various topics)
- Affective skills (attitudes and attributes of the student)
- Communication skills (verbal and written feedback and computer skills)

The programme is aimed at preparing the student for a production or a research atmosphere. Students are initially trained in the theory of the various unit operations. Use is made of both lecture notes drawn up by the training officer and of textbooks. Some of the technikons supply a logbook to their students, and this serves as a guideline.

## Assessment

Mintek staff act as mentors who continuously assess and guide the students' progress and liaise with the technikons, ensuring, for example, that the students are registered at their institutions for the experiential training period, and that Mintek refunds the costs incurred. Most technikons supply the students with a logbook in which to record their progress. Further feedback to the technikons is supplied by copies of the technical reports as part of their training. These reports are also useful in preparing references for the students to use in job applications.

Currently, the various technikons have different reporting requirements, but the programme endeavours to accommodate them all as far as the basics are concerned.

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Generally, reports sent to the technikon might cover the following topics:

- A technical report within the Mintek guidelines on a process with a simple mass balance depicting recoveries and grades of products. This report is an exercise in the collection, analysis, interpretation, and effective communication of data.
- An extensive mass and energy balance on a process.
- Power requirements for a pump in a specific system with the details of the system.

### Student selection

The initial selection of students is based on their performance in the theoretical semesters. The final selection is made after an interview. The candidates chosen are not necessarily those with the highest marks, and an indication of the ability to think practically is emphasised. To date, the students who have been selected have been top quality, and the programme has not had a single failure.

The course entails both lectures on the operation of equipment and practical hands-on experience. For the latter, the students are placed in a team under the guidance of an experienced engineer. The practical experience involves both bench-scale and pilot-plant investigations, the latter including shift work when possible.

The students also have the opportunity to develop their social skills by making use of Mintek's social and sporting facilities.

The following paragraphs describe the training scheme in more detail.

### Minerals processing

Three months are spent in the Minerals Processing Division. The first three weeks are spent discussing various unit operations. The students have to take an active role from the beginning in that they have to present certain modules to the rest of the class. The mentor clarifies misconceptions and presents the more difficult subjects. Each student is issued with a copy of *Mineral Processing Technology* (B.A. Wills), which is passed on to a junior student after 6 months have elapsed. Ten copies of the book *Mineral and Metal Extraction—An Overview* (L.C. Woollacott and R.H. Eric), which deals with Minerals Processing, Hydrometallurgy and Pyrometallurgy, are also available.

The students are taught to think through a project from start to finish, understanding how minerals are liberated and separated from the host rock. During this period they are introduced to computers, and taught how to present data and structure reports.

Mintek has the advantage of dealing with a wide variety of minerals, from gold and platinum to industrial minerals, coal and ferroalloy slags. The students, therefore, gain experience on a wide variety of unit operations treating many types of minerals. During this training they have the opportunity to learn to identify different minerals under the optical microscope. This is but one tool that they use to determine the efficiency of minerals-separating operations.

Methods used for the recovery of valuable minerals that are dealt with in depth include:

- sample preparation
- particle-size distribution determination and the meaning of results
- size classification of particles
- size reduction of particles with various crushers and mills
- froth flotation
- gravity separation of minerals using tables, spirals, jigs, and centrifugal separators
- determination of the Bond Work Index to determine energy requirements to reduce a particular ore in size
- simple mass balance using the two-product formula
- magnetic separation
- electrostatic separation
- technical report writing using a personal computer with standard software packages.

During the last two weeks of this three-month period, students prepare a technical report with the assistance of their mentor and submit this report to the technikon for approval. These reports are also reviewed by the heads of sections, and at times by the manager of the division. In addition to this report, a logbook provided by the technikon is completed at regular intervals.

### Hydrometallurgy

The three-month period in the Hydrometallurgy Division involves modules on the following topics:

- leaching fundamentals
- ion exchange
- solvent extraction
- electrowinning.

The students assist technicians and engineers with their tasks and are rotated between the various disciplines to ensure that they gain experience in all aspects of the division's activities.

### Pyrometallurgy

Typical practical experience gained during the three-month period in this Division covers the following:

- operation of a top-blown rotary converter (TBRC)
- operation of the 200 kVA arc furnace (DC)
- observation of the 300 kVA furnace (AC) in action
- calculation of power requirements for a pump in a cooling system
- the different methods of temperature determination used in industry
- the operation of an overhead crane
- an internal presentation on the commercial extraction of zinc
- a small project on the extraction of vanadium.

The last three-month period is spent in a division of the student's choice, unless workload in a specific division dictates otherwise.

### Other training activities

Mintek also has a training programme for semi-skilled operators at Mintek with the aim of giving them a better

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understanding of the various processes that they operate, and the ability to diagnose and rectify problems during the pilot-plant runs.

This training has been made available to outside companies on request. The training officer has visited mines and spent a few days assessing their laboratory staff in the operation of comminution and bench-scale flotation techniques.

By request, the practical part of a M.Tech degree can also be done at Mintek. During the first three months of 1998, a lecturer from Technikon Northern Transvaal carried out a project on evaluating various grades of ferrosilicon as media in a 20 t/h pilot DMS cyclone rig using 250 and 350 mm cyclones. The metallurgist concerned was able to obtain satisfactory data to complete his M. Tech, while Mintek gained experience in the field of DMS.

### Future of the programme

The training programme has been so successful that Mintek has taken on an extra training officer, who is also starting a B.Tech in Chemical Engineering. Because he speaks various African languages, he will be able to better understand some of the difficulties that black students face.

The programme has the potential to be expanded greatly, provided that support can be obtained from industry. There is an acute shortage of suitable training schemes, and industry would benefit by sending their technikon bursars to Mintek as part of their practical training.

This would ensure that newly-qualified technicians embark on their careers with practical experience of a wide variety of extractive-metallurgy operations and with good communications skills. ♦

## Quiz highlights careers in science and technology\*

The national final of Mintek's popular science quiz for high school students, Minquiz, has produced winning teams in three different cultural categories—English, Afrikaans and Regional.

The English category was won by a team from Greenside High (Gauteng South), while the Afrikaans leg was won by Menlopark Hoërskool (Gauteng North). The Regional category was won by a team from HF Tlou High School from the North West province.

Guest of honour at the quiz, Minister Lionel Mtshali of the Department of Arts, Culture, Science and Technology, in his speech said that the World Competitiveness Report of 1996, which evaluated different countries on the basis of knowledge generation, knowledge transfer, and application of knowledge, pointed to the fact that South Africa is losing its competitiveness, partly because of its weakness in developing skills in science and technology. However, the

Minister commented that his ministry is particularly excited about the Minquiz competition, as it targets the youth and seeks to make a lasting impression. 'South Africa possesses huge reserves of precious minerals that need to be exploited, but the country requires skills for extracting these minerals from complex ores, and developing processes so that value-added products are made available to the industrialized world. This is necessary for the creation of jobs and wealth', he said.

Minquiz '98 was funded by the Department of Arts, Culture, Science and Technology, sponsored by Amplats, Iscor and TrustBank, and supported by MiningTek and the Council for Geoscience. ♦

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## South African rock mechanic wins most prestigious award in the field of rock mechanics

Arno Daehnke, of CSIR: Mining Technology, was recently awarded the Rocha Medal for the world's best Ph.D. in 1997, in the areas of rock mechanics and rock engineering, by the International Society of Rock Mechanics (ISRM). The award is the most prestigious of its kind in the field of rock mechanics and this is the second time in the past decade that a CSIR: Mining Technology colleague has received the award.

As part of the award Arno receives a Bronze medal, a cash prize and an invitation to deliver a plenary address at

the ISRM Congress in Paris next year. Arno's Ph.D. was on the Stress Wave and Fracture Propagation in Rock.

Arno is presently a Project Manager in the Rock Engineering programme at Miningtek. He previously studied at the University of Cape Town, where he was awarded a B.Sc. in Mechanical Engineering, and later a Master of Science in Engineering. His Ph.D. was awarded by the Vienna University of Technology and was supervised by Prof. P. Rossmannith and Dr J. Napier. He has six journal and 12 conference papers to his credit. ♦

# Humboldt/South African research awards

## Call for nominations for 1999\*

### Nomination and selection procedures

Nominations are invited for the Humboldt/South African Research Award to internationally renowned German scholars in the fields of the sciences (natural and social), humanities, mathematics, medicine, engineering and agriculture in recognition of their achievements in research, for promoting research co-operation between South Africa and Germany and contributing to research capacity building in South Africa. Only full or associate professors, or scholars of equivalent standing outside universities, may be nominated for this research award. The nominee's academic achievements must be internationally recognized through, for example, proven success in research work, positive responses by peers to the nominee's published work and by other previous distinctions.

Nominations must be made by leading researchers in South Africa. The nominating South African scholar is required to guarantee that sufficient material and equipment are available for the research work envisaged by the award winner during his/her stay in South Africa or that, particularly in the case of studies in the humanities, access to archives or libraries is assured.

In addition to a formal nomination the following documents are required in English:

- ▶ a tabulated curriculum vitae including full postal address, telephone and telefax numbers (and e-mail address, if available)
- ▶ a list of publications, patents and copies of some of the most important recent research outputs
- ▶ a detailed recommendation by the nominator regarding the nominee's academic qualification, including his/her agreement to act as host
- ▶ the requested agreement by the host institution stipulated below
- ▶ at least three reviewers (researchers of high standing) and their complete addresses who can be approached by the Foundation for Research Development (FRD) to evaluate the nomination
- ▶ a short proposal of the studies the researcher wishes to pursue in the host country including an indication of the envisaged date of commencement and duration of the project in South Africa
- ▶ the name of other South African research institutes the proposed award winner may want to visit.

Nominations must be submitted via the executive head (or his or her designate) of the institution to which the nominator is attached. Nominations which are not supported by the executive head should please also be forwarded to

the FRD with a note to this effect. Prospective host institutions must ensure that the necessary research infrastructure is available for nominees to undertake the envisaged research programme.

Nominations can be submitted to the FRD, P.O. Box 2600, Pretoria, 0001 (Attention: Mrs R. Robertson at any time of the year. Those received by 31 October of every year will be processed and considered at the meeting of the Humboldt/South African Research Awards' Panel during February/March of every year. Those received after the above date of 31 October will stand over to the next year for processing.

### Conditions of the award

A German researcher receiving the Humboldt/South African Research Award will participate in a co-operative research programme of his/her own choice with researchers at research institutions, universities or technikons in South Africa for a period of time which should be at least four months but which should not exceed twelve months. The research stay may, however, be split into several periods. Awardees will be assisted by the nominator and the FRD to include features relating to research capacity building in his/her research programme while engaged in research in South Africa and in developing contacts with research colleagues at historically black institutions.

The FRD has no objections to the guest researcher taking over teaching assignments, if he/she so wishes.

### Endowments

The value of the Humboldt/South African Research Award ranges from R40 000 to R120 000 depending on the length of stay. A return ticket (business class) will be made available once to the award winner for the flight between his/her permanent residence abroad and the South African host city. The same travel benefits will apply to the spouse and children (under 21 years of age) of the award winner provided they stay with the award winner for at least three months. An additional grant will be made to contribute towards costs incurred for medical and accident insurance as well as accommodation. Hosts are expected to make all the necessary preparations for the award winner's research activities and to ensure that he/she receives assistance in settling in. ♦

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