

2.19 Developing a Chemical Engineering Course for Tanzania: Collaboration in Chemistry between the Universities of Dar es Salaam, Tanzania and Trondheim, Norway

T Førland and K S Førland
University of Trondheim, Norway

Cooperation between the University of Dar es Salaam (UDSM) and NTH (the Norwegian Institute of Technology, which forms a faculty of the University of Trondheim) in the field of chemistry began more than 20 years ago. We shall emphasise two issues at the Chemistry Department at UDSM that are common to many developing countries:

1. The need for education in chemical engineering.
2. The lack of textbooks in chemistry.

1. Development of Chemical Engineering at UDSM

There is both a great potential and a great need for creating a chemical industry based on local raw materials in Tanzania. The problem, however, was to find a proper strategy to start a course in chemical engineering. The simplest way was to start the course within the Chemistry Department as a supplement to the course in chemistry. In 1973 the Faculty of Science had been encouraged to start MSc programmes, particularly in applied fields. An MSc programme in chemical engineering fitted well into the university structure. The courses in chemical engineering could be based on a BSc in chemistry, with physics and mathematics. This would give the first graduates in chemical engineering within a few years.

Already at this stage an education program for future local teachers in chemical engineering was started. Well-educated Tanzanians should participate in the institution building as early as possible. They know the social conditions, the cultural traditions and the aspirations of the nation. Furthermore, Tanzanians should be involved in decisions such as how much emphasis there should be on basic knowledge and creativity, and how much on practical training and maintenance in the education. Financial support was provided by NORAD (Norwegian Agency for International Development) and consultancy assistance on the chemical engineering courses was obtained from SINTEF (The Foundation for Scientific and Industrial Research - see 2.6). It was realised from the beginning that in the long run there ought to be a Bachelor's course in chemical engineering to streamline the education for a larger group of students. The start as a MSc course on a smaller scale, however, gave useful experience with the new profession.

The MSc Course in Chemical Engineering

In 1974 two senior teachers from NTH-SINTEF were employed to plan the MSc course in chemical engineering. Planning involved theoretical courses, exercises and practicals. The preparations were carried out in Trondheim over a period of 6 months (half time employment). A laboratory of 30m² (about 300 square feet) was available in the Chemistry Department. Ten experiments were prepared covering different unit operations. The cost of the laboratory equipment was about £10,000 (1974). Local mechanical and electrical assistance was additional.

The capacity of the course was an intake of 8-10 students each year. Three Norwegian teachers were employed. The first intake was in October 1976. During the first months of studies, the students helped making laboratory equipment ready for use. The curriculum for the two year MSc course comprised:

Unit Operations I: Fluid/Particle Mechanics, Heat Transfer

Unit Operations II: Liquid/Gas and Liquid/Solid Mass Transfer.

Industrial Chemistry: Tanzanian Industry. Material and Heat Balances.

Chemical Reaction Engineering.

Process Control: Recording Instruments, Automatic Controllers.

Plant Design and Economics.

Masters Theses: A chemical plant based on Tanzanian raw materials was designed by a team of 2-3 students, examples being:

1. Ammonia from Songo-Songo Natural Gas.
2. Ethanol from Sugar Cane Molasses.
3. Sodium Alginate from Brown Marine Seaweed.
4. Salts from Lake Natron.
5. Yeast from Sugar Cane Molasses.
6. Purified Oil from Mafura Nuts.

Further Development

The Department of Chemical and Process Engineering (CPE) was established in the Faculty of Engineering in 1980. The basis was the chemical engineering course in the Chemistry Department (described above) and the process engineering course in the Department of Mechanical Engineering (started in 1978 with support from the Swiss Development Corporation). The MSc course based on the BSc in the Chemistry Department ended in 1982. By that time, 30 MSc (Chemical Engineering) degrees had been awarded.

The 10th anniversary of CPE was celebrated with an international conference 'Chemical and Process Engineering for Development' in 1990. During the years 1983-1990, 240 candidates graduated with a Bachelor's Degree from CPE. It is now one of the two established departments of chemical engineering in Central, East and Southern Africa (the other one is in Ife, Nigeria), and it may accept students for education in chemical engineering from other countries. Those who are interested in the Tanzanian experience and the present courses given at CPE may address inquiries to:

The Head, Dr (Mrs) M R Halfani
Chemical and Process Engineering Department
University of Dar es Salaam
P O Box 35131
Dar es Salaam
Tanzania

Tel: + (255) 51-48601
Telex: 41561 UNIVIP TZ
Fax: + (255) 51-48274

Closely connected to CPE is the 'Institute of Product Innovation' (IPI), which will strengthen the link between CPE and Tanzanian industry. The new director of IPI is Dr C L C Migiro (previous head of CPE). His address is:

Institute of Product Innovation
University of Dar es Salaam
P O Box 35075
Dar es Salaam
Tanzania

Tel: + (255) 51-49192 ext 2989
Telex and fax: the same as CPE

2. Chemistry Texts for Developing Countries

The shortage of reading material, textbooks, journals, etc. is a problem in many developing countries. The lack of hard foreign currency and the high prices make texts from industrialised countries unaffordable. It will be a great help if quality textbooks could be published locally, minimising the expenditure of hard currency and reducing the price of textbooks. Such textbooks could be written by scientists from industrialised countries in cooperation with local staff, or by senior scientists in the developing countries. Aid organisations can encourage this by giving fellowships to textbook authors and economic support to cover the initial printing expenses.

An example of such activity is a textbook in thermodynamics for students of chemistry and chemical engineering at the University of Dar es Salaam (1). The first draft of the manuscript was written during a stay at UDSM. Local teachers in the field and other resource persons were consulted in the course of writing the draft. In the book, local examples are used in order to make the subject less abstract to the students and to motivate them. The theory in the book is closely connected to experiments in a previous textbook on practicals in physical chemistry (2). This book contains 22 experiments covering thermodynamics, electrochemistry and chemical reaction kinetics. A theoretical background is given for each experiment. A handbook for the staff was worked out to secure continuity in teaching them when staff turnover is rapid. Details about equipment and repair work are given in the handbook. NORAD contributed to the printing costs for the practicals book, so that it could be sold to the students for the cost of reprinting (£1 in 1980).

Since the shortage of reading material is a common problem to many developing countries, the distribution of cheap textbooks across country borders could help solve the problems in several countries. The Southern Africa Development Coordinating Conference (SADCC) has announced plans for establishing a SADCC University Press to publish textbooks for several countries. With economic assistance from industrialised countries, it could start on a small scale making available to several countries texts that have already been printed in one of them. After gathering experience, the activities could gradually be extended.

A well equipped library is invaluable for research. The publishers of periodicals and speciality textbooks could do a great service to the universities in developing countries by sending complimentary copies of their publications to university libraries.

References

1. Førland K S and Førland T: 'Chemical Thermodynamics', Chemistry Department, University of Dar es Salaam.
2. Førland T, Ndaalio G and Førland K S: 'Practicals in Physical Chemistry', Chemistry Department, University of Dar es Salaam, 1980.

The Authors

Professors Tormod and Katrine Seip Førland both graduated in chemistry from the University of Trondheim in Norway and, after 5 years in the USA, returned to Trondheim. They were appointed by NORAD (Norwegian Agency for International Development) to a 5-year teaching assignment in East Africa, which also led to the writing of a number of university textbooks for local use, and in 1991 were jointly awarded the Gunnerus medal of the Royal Norwegian Society for Sciences and Letters for their contributions to research and education in Tanzania. TF received a DSc (honoris causa) from the University of Dar es Salaam in 1990.

Department of Chemistry
NTH
University of Trondheim
N-7034 Trondheim
Norway

Tel: + (47) 7-594182 (TF) or 593997 (KSF)
Fax: + (47) 7-591676