European Federation of Chemical Engineers (EFCE)
Working Party Education (WPE)

Biochemical Engineers Education

Summary of the study completed by the WPE in October 1996

Areas studied:
1. Biotechnical Processes and Product Characteristics
2. Industrial Sectors that look for biotechnological processes
3. The role of the Biochemical Engineer in industry

The Process that the WPE used to complete the study:
1. Experts in the field were contacted to provide advice and help, notably European Federation of Biotechnology, Prof. Street (Teesside University) and Prof. Goma (INSA Toulouse).
2. BEMET European network, dealing with biotechnology evolution and education in the EU, and EBEN (European Biochemical Engineering Network) were analysed.
3. The subject was studied and discussed at EFCE – WPE meetings in London, Firenze & Toulouse.

Conclusions relating to Chemical Engineering Education:
1. All young chemical engineers should be given the opportunity to gain an understanding of microbiology and enzymology, with extra teaching about specific chemical engineering techniques used in biotechnology as listed in A below. (About 80 hours of lecture/tutorials/practical work should provide sufficient to enable them to work with specialists in the field. Some students may follow a more intensive option 200-300hours to answer locally identified needs.)
2. A progressive development of dual education is needed to meet certified needs to give students both Biological and Chemical Engineering scientific knowledge and to develop well integrated competency in these two fields (See B).

A. Biotechnological Courses in a classical chemical engineering curriculum:
- Microbiology and enzymology rudiments
- Characteristics of biological products and fermentation media
- Kinetics of biological reactions and bio-reactor engineering
- Specific methods of separation and final purification
- Practical scaling up of a biochemical process
- Specific regulation: GMP – FDA approval – Production licence, etc.
- Contamination risk: sanitisation, clean process areas

B. Proposal for curriculum in Biological Sciences and Technology
(Aiming to provide a coordinated Bio-Chemical Engineering Education)
- Biology elements:
  - Cell biology
  - Microbiology
  - Molecular genetics
  - Biochemistry
  - Microbial physiology
  - Enzymology
- Biochemical Engineering courses:
  - Bioreaction engineering
  - Downstream processing
  - Genetic engineering
  - Fermentation technology (Equipment, aeration, cleaning in place, etc)
- Advanced modules
  - Scaling up and layout of bioprocesses
  - Specific downstream methods for recovery and purification
  - Complex media – Rheological elements
  - Biosensors – Process Control – Mathematical modelling – Optimisation
  - Bioconversion processes
  - Biological processes and environment – Contamination risks
  - Food biotechnology
  - Biological processes used in water treatment
  - Cell culture engineering
  - Regulation – GMP
  - Economic aspects, energy saving in biotechnology