Educational and Industry Perspectives in Food Engineering

By: Engr. Dr Chin Nyuk Ling, *M.I.E.M, P. Eng*

Food engineering sounds like a new field in Malaysia. Its concept, however, is not new as it arises from the much more established field of agriculture engineering years ago to cater to the needs of engineers majoring in food processing. As it is now, this programme is a good blend of courses between agricultural and chemical engineering, with a strong emphasis on food processing.

It requires mathematics as a foundation to explore various food operations, for example, heating, chilling, cooling, freezing, drying, mixing, boiling, frying, baking, steaming, blanching, pasteurising, sterilising, forming, evaporating, packaging, canning, *etc*, of food produce and products. In short, food engineering refers to the aspects of food processing and production. It includes, but is not limited to, the application of agricultural and chemical engineering principles to food materials. It is not food science and technology, and neither it is the genetic engineering of plants and animals (Anon., 2008).

Food Engineering Principles and Subjects

In food engineering, each processing operation can be described, understood and derived as an equation. This is done through general principles of engineering, namely, using mass and energy balances, heat, mass and momentum transfer. As food processing plants are often referred to as a bunch of tanks, pumps, pipes and conveyors, the understanding of food engineering requires fluid flow mechanics and material science. These general principles of engineering are delivered through elementary courses like heat and mass transfer, physical unit operations and systems, process equipment and plant designs, process control, modelling and instrumentation, and reaction kinetics. Other relevant components of food engineering include food chemistry, microbiology and management. Typical agricultural commodity processing such as rice, palm oil, rubber, cocoa and other crops are covered as electives.

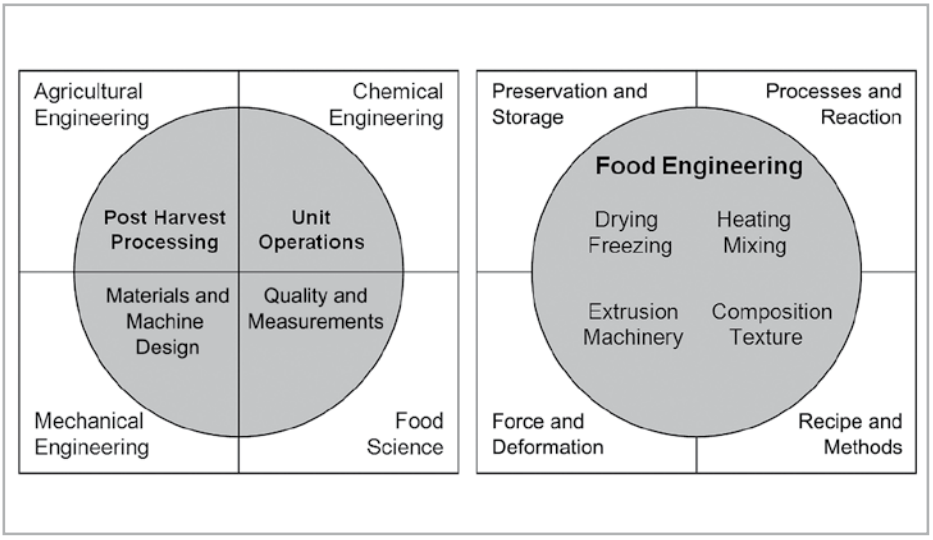
The level of understanding of food engineering principles and the ability to relate them to pertinent applications may come from general ideas and simple basic application to the ability to write and solve appropriate equations for specific circumstances. This is the difference between a food engineer and a food scientist. While scientists are primarily concerned with learning about things; engineers are problem solvers with the goal of creating solutions (Simpson, 2004). The engineers are expected to integrate analysis and science as a means to an end of producing something new within the constraint of time and money while considering other factors like health, safety and environment in their activity of engineering design.

Industrial Expectation

Food engineers help the food industry by studying food processing, the theory behind its operation and the available control parameters to achieve food products of consistent and high quality for the consumers. Among the food processing operations practised in the industry and served in the scope of food engineering studies are the classical unit operations such as the transport and storage of liquid and solid food; thermal processing *i.e.* heating, chilling and freezing of food; mass transfer of food; kinetic analysis and biochemical aspects of food; dehydration; liquid food concentration; non-thermal processing *i.e.* microwave and irradiation methods; extrusion; membrane separation processes; packaging; cleaning; and sanitation.

In food engineering, the modelling and simulation of the above mentioned operations play a vital role for the prediction, control and optimisation of the processes. Rao (2004) identified the attributes that are required for being successful food engineers in the industry as having competencies in:

a) basic technical competency in the area of engineering sciences with a special emphasis on food,
b) the application of technical competency in real world problems,
c) the ability to work as a team,



The concept of food engineering from four significant fields (left) and its contents, with food as the subject and element (right)

(To be continued on page 16)

d) the competencies in the area of project management, and
e) understanding how to combine engineering principles with sound business analysis.

International Food Engineering Programmes

Food engineering programmes are available internationally. A community of food engineers under the auspices of the Institute of Food Technologists have created a website to provide resources in food engineering to students, practising engineers, researchers and university lecturers. Within the United States, there are many universities which offer food engineering as a specialisation or major in undergraduate programmes such as the biological, biosystem or agricultural engineering.

In the United Kingdom, food engineering is mostly found in the chemical engineering or food science and technology departments. Food engineering is mostly available within a school or another department in most countries (Singh, 2008). In countries like Brazil, Mexico, Sweden, Switzerland, Ireland, Turkey, China, India, Japan and Thailand, food engineering can be found established as an independent department in a university. In Malaysia, the Process and Food Engineering Department in Universiti Putra Malaysia is the pioneer and the only department which offers standalone degrees in food engineering at the moment.

Teaching Food Engineering as a Standalone Degree

The teaching of food engineering as a degree option or area of specialisation rather than as a standalone degree or discipline limits the breadth and depth of coverage on food engineering although this approach has been built around the essential academic elements of an engineering programme. In the US, food engineering is included as a single required course of all biological or agricultural engineering students or offered as a series of elective design courses (Marks *et al.*, 2004).

By offering food engineering as a standalone programme, students are able to learn and quantify the biological aspects and constraints of food materials in process design, particularly in the engineering context. In order to differentiate these graduates in the market place, it is important for the curriculum to emphasise the integration of food or biology with engineering. The mixture of engineering with food or biology is the distinguishing feature that makes food engineering unique among the engineering disciplines and provides the additional dimension of an understanding of life sciences (Simpson, 2004).

The integration of engineering, physical and biological sciences as the background of a food engineering programme thus requires staffs from multidiscipline to produce graduate food engineers with a strong background in basic engineering and biological sciences, who understand the scope and range of problems encountered in food industries, and have the ability to synthesis einformation for application in design and problem solving.

Opportunities in Food Engineering

In recent decades, food engineering has been a very important field due to the vast and changing demands of consumers whose awareness of quality and nutritional food put pressure on the food industries to produce products which are of high quality yet economical. Food is certainly important to us for survival, keeping us healthy and providing energy for our daily life. There are always new and seemingly healthier products coming into the market and more local industries are turning to the international market each year.

Today's life has become more 'busy' and more people are relying on ready-to-serve and processed food. In spite of extensive research effort and development, there are still considerable difficulties involved in converting many fundamental ideas into practice. Studies on food engineering principles from different perspectives and their application in analysing, predicting and designing a food process are opportunities of advancement in food engineering.

Examples of recent technologies developed for food processing are the high pressure processing, pulsed electric fields processing, non-thermal processing using osmo-dehydration, processing using the fields from the electromagnetic spectrum at various frequencies from radio, microwave and infrared, to irradiation techniques using gamma rays, X-rays and high energy electron beams. Food engineers can also work closely with the industry to design new processes where food undergoes minimal processing using hybrid and combinations of methods from conventional processes with new technologies. This definitely promises a real market-driven challenge to both the industry as well as academic food researchers. ■

REFERENCES

[1] Anonymous. (2008). Food Engineering. http://en.wikipedia.org/wiki/Food_engineering. Accessed date: 15 September 2008.

[2] Rao, V.N.M. (2004). Industry expectations for engineering competency. 2004 IFT Annual Meeting, 12-16 July 2004, Las Vegas, NV.

[3] Marks, B.P., Steffe, J.F. and Dolan, K.D. (2004). Teaching food engineering as an application area in biological and agricultural engineering. 2004 IFT Annual Meeting, 12-16 July 2004, Las Vegas, NV.

[4] Simpson, R.J. (2004). Teaching food engineering as a standalone degree. 2004 IFT Annual Meeting, 12-16 July 2004, Las Vegas, NV.

[5] Singh, R.P. (2008). International Food Engineering Programs. www.ift.org/divisions/food_eng/education/international.htm. Accessed date: 11 September 2008.