Conceptual design of chemical devices and functional products

By

HO, Elliot Ngou-Tin

Date: 20 September 2018 (Thursday)
Time: 10:00
Venue: Room 3598 (Lifts 27-28)

Examination Committee:
Prof. David HUI, Chairman
Prof. Henry Hei Ning LAM, Supervisor
Prof. Ka Ming NG, Co-supervisor
Prof. Richard LAKERVELD

Abstract
Manufacturing has been the core to promote economic development and social progress since industrial revolution. Chemical industry had emphasized on chemical manufacturing process design. Starting from cost minimization, manufacturing has been evolving to consider more factors including consumer preferences. Hence, chemical product design is starting to receive increased attention. Consumer preferences and needs are dynamic and everchanging, therefore a systematic procedure to guide the product design can reduce unnecessary trials and shorten the time to market. Consumer-centred chemical products can be classified into four classes, which are molecular products, formulated products, functional products and chemical devices. There are extensive studies on the design of these products but often focused on a specific product. Design frameworks had been offered but limited to molecular and formulated products. As a result, conceptual design frameworks for chemical devices and functional products are proposed based on the study of numerous products. The systematic procedures start by defining the functions and specifying the technical requirement, followed by design and evaluation of product concepts, and lastly the mass production process is designed. Chemical devices are regarded as a simplified chemical plant, the design procedures also include selecting unit operations and designing the operating conditions by modeling. Domestic dehumidifier and air purifier are examples used to illustrate the framework. Functional products are built with materials of specific structures. Manufacturing processes that are unconventional to chemical engineers are often required to generate the desired structures. Knowledge of these unconventional processing techniques are scattered, thus a classification is proposed to aid the process selection. Surface addition processes are studied as the example. All in all, chemical product design is still in development and this thesis had progressed it by providing guidance to engineers to design any of the four classes of products.