

CHEMICAL AND BIOLOGICAL ENGINEERING DEPARTMENT SEMINAR SERIES

From ethanol and butanol fermentations to cell- and tissue-culture ... and back to biofuels, 100 years of bioreactor design and the birth of a discipline

Presented by: Eleftherios Terry Papoutsakis, Department of Chemical Engineering & the Delaware Biotechnology Institute, University of Delaware

Time: Wednesday, April 29; 3:15 – 4:30 pm

Location: Perlstein Hall Auditorium

Abstract

Ethanol fermentations were established industrial process in late 19th and early 20th century prior to the formal genesis of biochemical engineering and bioprocess engineering. Biochemical engineering had its genesis in the mid 1940s in resolving the bottleneck for the development of large-scale, oxygenated, deep-tank fermentations for antibiotic production. This effort and the classical now work by Elmer Gaden and co-workers, and, separately, by R. H. Wilhelm and his Merck co-workers constitute the foundation of biochemical engineering as a distinct discipline. The late 1950s and 1960s brought to fore a wealth of new challenges and ideas with the concepts of bioreactors for immobilized enzymes and cells for biotransformations and whole-cell biocatalysis, in addition to the concept of computer-controlled fermentors. The 1970s brought fresh ideas on bioreactor design (including the various air-lift designs, many of which are now widely used), and numerous bioreactor-operation policies and their optimization including the now widely employed concept of fed-batch fermentations. The 1980s were marked by the realization that the design of bioreactors for growing animal cells (whether on microcarriers or in free suspension) was a new major challenge that required fresh analysis and new mixing concepts and scale up. This challenge was met with tremendous success leading to the growth of the now dominant animal-cell biotechnology for the production of protein therapeutics. This was followed by more specialized challenges at smaller scales to develop bioreactors for tissue engineering applications, and scaled-down technologies for the development of small or microbioreactors for parallel or high-throughput bioprocessing. Now, as we face the urgency to develop sustainable technologies for the production of chemicals and biofuels from renewable resources, there is a fresh set of challenges for efficient bioreactors and processes to meet perhaps the most diverse set of needs and applications.