

UniCat Colloquium

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Biochemical Engineering's Grand Adventure

Building on the recent revolution in molecular biology, enabling many bio-product innovations, biotechnology is in transition to bring the products to the market. A shift is required from natural sciences to engineering sciences with first conception of new, efficient large-scale bioprocess designs, followed by implementation of the most promising design in practice. An outline is presented of main challenges that the field of biochemical engineering is currently facing, in a context of major global sustainability trends. The critical stage is the conceptual design phase. Issues can best be addressed and overcome by adopting an attitude where one begins with the end in mind. This applies to three principal components: 1. the bioprocess value chain, where the product specifications and downstream purification schemes should be set before defining the upstream sections, 2. the time perspective, starting in the future assuming that feedstock and product-market combinations are already in place and then going back to today, and 3. the scale of operation, where the industrial operation sets the boundaries for all lab-scale research and development, and not vice versa. In this way, an ideal process is defined taking constraints from anticipated manufacturing into account. For illustration, three bioprocess design examples are provided, that show how new, ideal conceptual designs can be generated. These also make clear that the engineering sciences are undergoing a revolution, where bio-based approaches replace fossil routes, and gross simplification is replaced by highly detailed computational methods. For biochemical processes, lifeline modeling frameworks are highlighted as powerful means to reconcile the competing needs for high speed and high quality in biochemical engineering, both in the design and implementation stages, thereby enabling significant growth of the bio-based economy.

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