Vistas for Reaction Engineering in the Chemical Processing Industries.

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The production of fuels and chemicals from crude oil and coal was first established more than a century ago, leading some to believe it is an area where major improvements in plant performance have been exhausted. In this presentation, we take the opposite view, showing how recent developments in chemical reaction engineering (CRE) have yielded remarkable technology improvements – and why this is likely to continue.

The paper describes how macro trends such as price volatility, the rise of unconventional oil, tighter environmental standards, and water shortages are driving more urgent demand for new technology solutions and value creation through CRE.

We'll discuss the importance of moving from the empirical to the fundamental. An example from fluid catalytic cracking (FCC) will show how the transition from a superficial feed, reaction and reactor description to a more fundamental model impacted gasoline yield, leading to improved regenerator schemes, and finally to the precise prediction of propylene yield. In another example, we'll show similar progress in the production of aromatics from naphtha, where new zeolitic materials have brought step-changes in activity and selectivity.

One of most dynamic areas in chemical processing is hydroprocessing. Today, refiners are being asked to process new feed stocks – such as Fischer-Tropsch waxes and shale-derived material -- and bring bio-based feeds up to spec so they can join the mainstream fuel distribution network. At the same time, customers are looking for ways to process higher boiling 'bottom of the barrel' material. We'll show how advances in the fundamental understanding of catalyst function, feedstock characterization and model representations -- all core elements of CRE -- have had a remarkable impact in these challenges.

Finally, we'll look at the future of the processing industries. This includes the advent of ionic liquids as catalysts and separation agents, the extensive use of molecule management to trace key components through the plant, and the application of CRE principles to water treatment in bio-reactors to achieve the ultimate vision of zero-discharge from chemical processing.