Catalyst Development for on-Purpose Propylene - Looking Beyond Initial Activity

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With the present tendency for refineries to shift towards different types of feedstock, the supply of petrochemicals like ethylene, propylene and 1,3-butadiene typically taken for granted becomes less of a certainty. For this reason, on-purpose technologies for the production of these materials receive an increasing interest in both the academic and industrial environment.

This paper will highlight some of the common challenges in this field of research, and will focus on the on-purpose production of propylene. The key technology for production of propane is the dehydrogenation of propane, co-producing hydrogen. This process is operated at temperatures upward of 600°C and suffers from severe catalyst deactivation. To this end, steam can be added to the feed, which will to a certain extent mitigate the deactivation. Despite this addition, frequent catalyst regeneration is required to obtain acceptable catalyst life time.

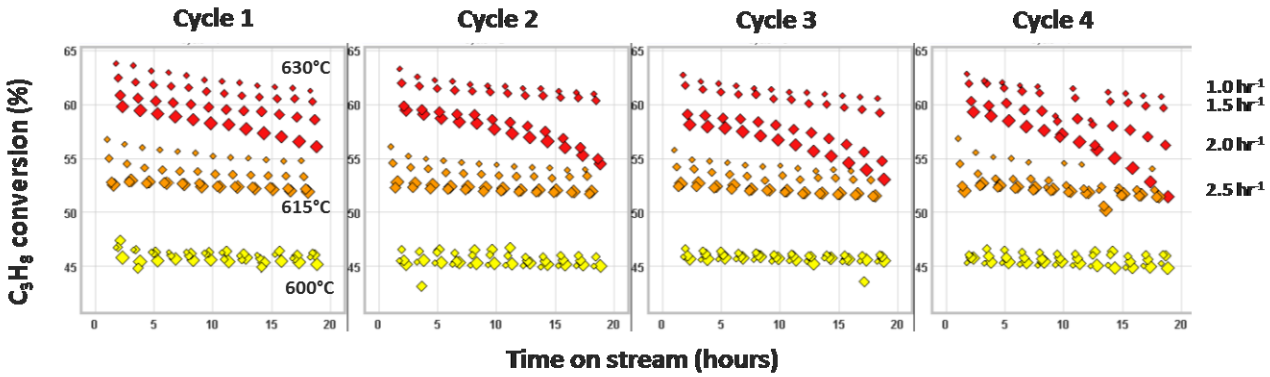

Figure 1 Four consecutive reaction cycles in the steam-assisted dehydrogenation of propane to propylene, using uniform catalyst regeneration procedure in between cycles.

This changes research strategy significantly. Beyond the need for assessment of catalyst performance under realistic conditions, it quickly becomes apparent that regeneration needs to be assessed as well. Figure 1 shows a typical experimental result, in which we can see that several cycles are required to demonstrate which reaction conditions are more appropriate in the long run. Obtaining this information is key to the successful identification of which is the "best" catalyst, beyond the usual considerations like activity and selectivity.

This paper will focus on experimental design strategies that can be used for this type of research, using a set of catalysts that results in a broad range of performance characteristics. Beyond test design and catalyst performance, some discussion is also provided on the design of the reactor used, and its consequences.

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