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Green Indicator

In this issue of the Green Indicator, we will have a closer look at the characteristics that differ renewable from traditional feedstocks for the chemical and petrochemical industry. We will discuss the use of catalysts in this environment and perhaps also suggest some solutions in this space. We will also have a look at serendipity in chemical engineering discovery and press the point of an open mind to innovation, not only as researcher but also in a management position.

/ Christian Hulteberg

Serendipity in Chemical Engineering Discovery

With the advent of a new discipline within the area of chemical engineering: renewable-based chemicals and fuels, it is of uttermost importance that we keep our eyes open for alternative discoveries. The amount of resources that has been invested in the field over the last 10 years has been substantial and it will continue to be an area into which funds are funneled; especially with decisions to not only reduce the emission of greenhouse gases, but also to reduce the electricity produced via nuclear energy.

The examples of serendipitous discovery are legion within the history of chemical engineering, post-it notes, velcro and cellophane just to mention a few. However, I'd like to use the example of the Phillips Petroleum company. In the early 1950-ies two researchers, J. Paul Hogan and Roberl L. Banks, in the Phillips laboratories were setting up experiments for oligomerization of ethylene and propylene to low-molecular-weight hydrocarbons, feeding propylene along with propane as a carrier gas through a packed catalyst bed. The original catalyst (NiO) was modified to contain chromia and the resulting product was crystalline polypropane.

The same afternoon, the two gentlemen wrote up the patent idea and signed it and filed to the company management. The history could have ended there, but since the atmosphere was one of allowing innovation (and the economic prospect of the discovery significant) full support was given from management for re-gearing the research to plastics as opposed to gasoline production. The development of the chromia-based catalyst also resulted in a new polyethane product and with less than six years from the discovery, Phillips was launching into the plastics business; quite different from its initial oil-company profile. With some aid of the hula hoop, Phillips managed to make their HDPE Marlex® into a successful product.

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CatScan

New Feedstock, New Catalysts

When working with alternative feedstocks, be it oleo-chemical or lignocellulose based, there are interesting challenges to address. The alternative feedstocks are higher in such elements as oxygen, sulphur and alkaline/alkaline earth metals. This creates an issue with hydrogen requirement, the same way heavier crudes and tougher sulphur requirements today puts pressure on existing refineries with respect to hydrogen consumption. In the case of oxygen, this can be as high as 25% which implies a significant hydrogen requirement unless alternative means of reducing the oxygen can be implemented e.g. gasification.

Sulphur is also a component to consider, especially with the lignocellulose-based feeds. The sulphur levels are however not very high, but high enough to cause problems e.g. with copper-based and nickel-based catalysts. Unfortunately, the sulphur levels are not always high enough for allowing for sour-type catalysts as there is a transformation from a sulphide to an oxide form. This is an area where work is well spent, investigating and discovering catalysts for e.g. water-gas shift or fuel synthesis that is active in low

In summary, it is important that the people researching the use of alternative, renewable materials as a feedstock for the fuels and petrochemical industries keep their eyes open to unexpected phenomena. However, it is just as important that the management of these researchers have the ability to identify these discovery and make the best of this type of unexpected results.

environments, either by stabilizing the sulphide phase, or by being active in both the sulphide and oxide phase.

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