Green Indicator

In the edition of the green indicator that you see before you on your screen, or indeed paper should you have printed it, we will have a closer look at a particular specialty chemicals niche. The niche is the chemicals used for producing tires, the rubber of course, but also the other components constituting a tire. In this month's CatScan-section we will have a look at the implications of emission control criteria when taking "precaution rather than aftertreatment" into account into the design of processes based on renewable feedstocks.

/ Christian Hulteberg

Renewable Tyres

With the recent news regarding Amyris cooperation with Michelin on using farnasene as a starting point for producing isoprene, a summary on the activities within renewable rubber in particular but also lift the perspective to include other components required for tire production. There are two pathways crystalizing with respect to synthetic rubber materializing, one over the already mentioned isoprene molecule and the other over isobutene.

The first path is, Amyris and Michelin aside, followed by Goodyear in cooperation with DuPont owned Genencore through a biotechnology-based approach. The same target molecule via a biotechnological process is also under development by GlycosBio, based on crude glycerin from the biodiesel business. The production in the GlycosBio process will also yield ethanol and acetone as side-products, so it is perhaps based on a modified ABE-strain. The traditional isoprene is a naphtha cracking residue which as such will be dependent on the oil price and has displayed fluctuating pricing over the last couple of years.

The second approach is in producing isobutene, which is pursued by Lanxess in cooperation with US based bio-isobutanol producer Gevo, Global bioenergies out of France and Genomatica. However, the rubber alone will not make a tire. Other crucial components in tire production include sulphur, stainless steel and carbon black, where sulphur is a cross-binding agent and carbon black is added for longevity and mechanical performance.

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Reducing By-products

There is one aspect of environmental catalysis that, in the author's opinion, isn't discussed or taught enough. There is a lot of discussion regarding the use of catalysts for abatement of various emission components such as VOC, NOx and chlorinated compounds. In some cases there is not much to do about the formation of these compounds, but in other cases there might be.

The optimization of existing catalysts and processes, including separation, for he desired output product therefore becomes important not only with respect to process economy but also with respect to emissions. It is therefore instrumental when considering a process optimization to first of all increase the yield and selectivity; and if possible make the catalyst "selective" to more benign side-products. Secondly, it is imperative that the side-products, if unavoidable, are used as feedstock in other processes. Thirdly, any waste created should to the extent possible be recycled and not deposited.

These criteria, when applied

Sulphur, being an elemental compound, is difficult to achieve from a renewable source. However, it may be possible to use recycled sulphur e.g. from flue gas or other waste-products and therefore lowering the requirement on virgin materials. The same is true for the stainless steel, if recycled energy and iron ore may be saved. In the case of carbon black however, being a carbon-based material, there should be ways of producing it from non-petroleum-based resources; recent developments also include the substitution of carbon black with silica to further lower the rolling resistance, maintaining the durability of the tire.

Another interesting challenge is in reducing the natural resources that go into making tyres when the cord is considered. The cord is made of nylon, rayon or polyester, where rayon which already is a natural, cellulose-based material may be the best way to move forward in this respect.

It is interesting to follow the drive for renewable materials in the rubber industry, keeping in mind that it all started with wood-based rubber, and seeing the business doing a full circle with respect to renewables. The question then is: how long before we see the first renewable tires on the road?

chemistry will therefore lead to some interesting challenges. Feedstocks based on renewable carbohydrates have one thing in common: they are all rich in oxygen. This means that when processing this type of feeds, it is inherent that a lot of water will be formed. This water is to be considered a side-product and should therefore be used and not treated as an effluent. If it is possible to recycle water within the process, that is an excellent application. Otherwise why not purify it and use it as drinking water; an application that definitely increase the demands on more selective catalysts and may perhaps only be realizable using low-temperature, enzyme based catalysis.

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