White paper

Advances in bio-based polyurethanes for automotive interior coatings

By Michael Costello, Director of Sustainability at Stahl

In Automotive, the importance of a sustainability agenda is paramount. Think of electric cars and vehicles that are more fuel-efficient. With these kinds of innovations the industry is working hard to cut down on greenhouse gas emissions from cars.

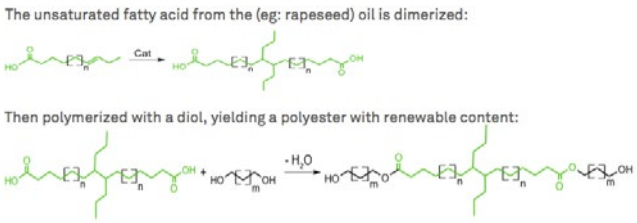
As a highly specialized chemicals company and the expert in car interiors materials and surfaces, Stahl is at the forefront of these developments. Yet, there are more ways to approach environmental responsibility and Stahl is pro-actively working on improvements to stay ahead of the competition. Without letting the other developments slip under the radar, we are working towards solutions to further reduce the environmental footprint in the automotive industry.

One such development is the advancement in bio-based polyurethanes. Until recently, coatings technology for finishing automotive leather and synthetic surfaces was largely based on petroleum feedstock chemicals, like ethylene and propylene. But recent advances in biotechnology have allowed a new class of polymers to be developed. Made from renewable raw materials, these bio-based aqueous polyurethanes can also demonstrate superior film performance to their fossil fuel-based predecessors. Obviously, this is good news for Automotive regarding sustainability. Whether used for car seats, steering wheels, dashboards, door trims or consoles, polyurethane-based finishes - for both leather and synthetics - can be found everywhere in a car.

The reduction of VOC's and the need for more durable coatings, especially in the automotive industry, has meant that water-based polyurethanes have become the standard for high-performance leather finishing. Polyurethane films are both durable and flexible and they protect the leather from staining, abrasive damage and the long term effects of weathering. Furthermore, they provide the characteristic touch, surface appearance and durability. Polyurethane dispersions are also known as water-based polyurethanes.

The main chemical building blocks for the manufacturing of polyurethane dispersions are isocyanates and polyols. In recent years, thanks to advances in the biotech industry, polyols have been developed with plant-based (renewable) resources instead of petroleum-based raw materials. In this case the oils are extracted from plants and transformed into polyols - the unsaturated fatty acid from the oil is dimerized then polymerized with a diol to produce the polyol, in this case a polyester diol (graph 1).

Graph 1: Schematic representation of the synthesis of a bio-based polyester polyol based on vegetable oil

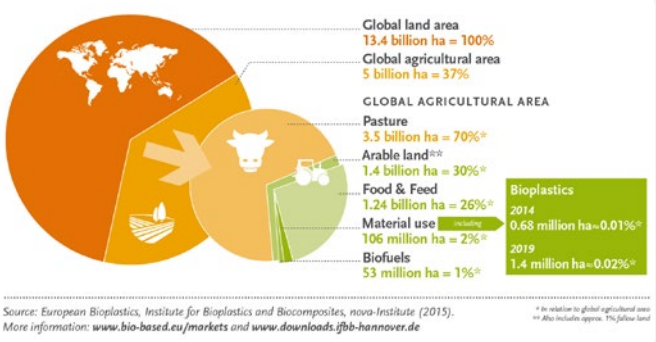


Many different plant oils can be used to make these bio-polyols, like canola (rapeseed), soy, palm or linseed. Some advantages of using renewable oils versus fossil fuel-based materials are:

- Plants can be re-grown, avoiding depletion of the earth's crust
- Wide availability of the plant resources in all regions
- Lower carbon footprint vs extraction and transport of fossil fuels
- Some plant oils are already being used in animal feedstuffs and biodiesel (eg: rapeseed)

A question that sometimes arises about renewable resources for industrial applications is land-use. As graph 2 illustrates, the land use required for biopolyols, which itself is a subsegment of bioplastics, is a tiny portion of the total land use for materials.

Graph 2: Land use for bioplastics 2014 and 2019



Recent advances in biotechnology have made it possible to formulate high performance polyurethanes using polyols derived from plant-based oils. This innovation has implications for all the touch points in our cars: the door panels, seats, steering wheel, gear shift, instrument panel, middle console etc. all use polyurethane based coatings. As these coatings are derived from renewable resources rather than petroleum-based materials, this represents a significant environmental advantage in itself, but since these new polyols also provide higher durability and performance to the car interior, we can consider this to be a turning point in the industry.

After extensive testing, the conclusion is that polyurethane films made with the latest bio-based polyester technology are more resilient to hydrolysis than previously studied bio-based polyesters. Indeed, the properties come close to the level of polycarbonate-based polyurethanes, which are considered to be the gold standard for automotive finishing.

An added advantage of this innovative bio-based technology is the environmental gain made in the first stages of manufacturing, since the amount of co-solvent required can be significantly reduced by using biobased polyols.

The biocontent level achieved in polyurethanes of this type can range between 10 - 60%, depending on the final product design, and is typically 35% in the pure PUD. Given that only a few years ago we were observing lower performance with a lower biocontent, it is only a matter of time before higher biocontent polyurethanes can be developed with even higher performance. All good news for the industry.

Global leader in innovation

Being the global market and innovations leader in its field, Stahl works hand in hand with all renowned OEMs. As an example of our progressive approach, we joined forces with Rinspeed, to create the Rinspeed Σtos concept car, which was launched in January 2016. This 'driverless car' is our view on a futuristic and sustainable car interior and boasts eye-catching technologies such as glow-in-the-dark for leather. Other innovations that are particularly interesting for car interiors are:

- **Stahl EasyWhite Tan™.** Our innovative chrome free tanning technology has strong green credentials regarding the use of water, energy and chemicals. Leather tanned with Stahl EasyWhite Tan™ is of high-quality, soft and smooth and offers unique advantages for pale and vibrant colors in leather for car interiors. Furthermore, it enables the production of leather that is thinner and lighter than ever before.
- **PolyMatte® and Green PolyMatte®.** Smooth finishing technology that is matt in itself. Compatible with water-based, polyurethane coatings, provides a luxurious feel to the finished article. Green PolyMatte® is based on rapeseed oil.
- **Proviera® - Probiotics for Leather™.** A 100% biodegradable and 100% natural biotech alternative to existing chemicals and processing techniques for the beaming stage. This probiotic formulation enables the production of high-quality leather, while significantly reducing the effluent load.
- **STAHL EVO.** Next generation of polyurethane-coatings for synthetics for finishes, pre-skin, base and adhesive layers. This new technology supports brands, manufacturers and OEMs in their ambitions towards Zero Discharge of Hazardous Chemicals (ZDHC) in the supply chain.

Contact details

Visit **www.stahl.com** for more information about Stahl's sustainable solutions for Automotive. For questions regarding this technical article, please contact: Michael Costello, Director of Sustainability at Stahl via **michael.costello@stahl.com**.

If it can be imagined, it can be created.