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HIGH PERFORMANCE ENABLED BY NATURE

New polyurethane crosslinker with significant bio-based content. By Gesa Behnken, Andreas Hecking, Berta Vega Sánchez.

Seventy percent of the carbon content of a new hardener for polyurethane coatings and adhesives is provided by biomass. The bio-based crosslinking agent matches the high performance and quality level of conventional petrochemical-based isocyanates, even meeting the very high demands of the automotive industry.

The ecological compatibility of products is becoming a critical factor for businesses that want to defend their position and grow in the market, because consumers are increasingly deciding in favour of sustainable goods and making sure they incorporate renewable materials. Environmental labels help them to identify relevant products more effectively. Examples include the "Vincotte OK Biobased", "DIN CERTCO Biobased" and "USDA Certified Biobased Product" labels.

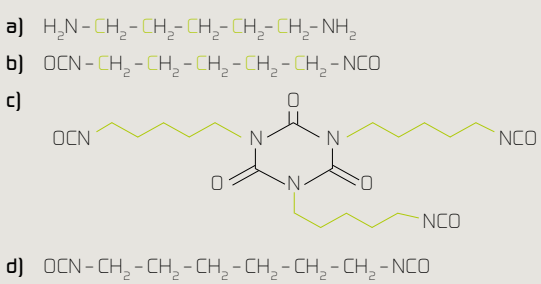
A number of U.S. states are supporting this trend. For example, the "BioPreferred" programme from the U.S. Department of Agriculture (USDA) compels public institutions to buy the material with the highest proportion of renewable raw materials for purchases over 10,000 US dollars [1].

In striving to fulfil these consumer demands, brand owners are in search of bio-based sustainable materials. This applies to the automotive industry, but also to others including the Ikea furniture stores and the Coca-Cola Company, which developed the "plant bottle" made partially from plants [2].

COATINGS INDUSTRY COMMITS TO 'GREEN PRODUCT' TREND

The coatings and adhesives industry has recognised this trend towards eco-friendly products, too. "Sustainability has become a key part of the growth and marketing strategies of a number of coating

Figure 1: Structural formulas of (a) Pentamethylene diamine (PDA), (b) Pentamethylene diisocyanate (PDI), (c) PDI trimer and (d) Hexamethylene diisocyanate (HDI); the carbon atoms from biomass are shown in green.



RESULTS AT A GLANCE

→ A new bio-based, high-performance hardener for polyurethane (PU) coatings and adhesives was developed. It is the first product of a new platform based on pentamethylene diisocyanate (PDI). Five of the seven carbon atoms in the material are bio-based.

→ Tests have shown that the bio-based hardener can create coatings that are just as weather-, chemical- and scratch-resistant and easy to apply as conventional coatings made exclusively with petrochemical inputs. The innovative hardener can offer greater freedom in formulation and faster drying.

→ Good results have been obtained in tests of automotive OEM and refinish formulations, anticorrosive and wood coatings. Chemical modification of the hardener allows an even wider range of PU systems to be crosslinked.

The right starting materials can make a key contribution to meeting sustainability demands in the coatings and adhesives industry. Covestro (formerly Bayer MaterialScience) has launched a new high-performance hardener made from renewable raw materials. It is the perfect reaction partner to the bio-based polyols already used in polyurethane coatings and adhesives. Now these coatings can be formulated almost entirely from bio-based components.
At the 8th International Conference on Bio-based Materials in April in Cologne, Germany, the new hardener was honoured with the Bio-based Material of the Year 2015 innovation award [6]. With this new hardener, users and manufacturers in various industries can position themselves as pioneers of more sustainable materials.

PRODUCTION SHOWS GREATLY REDUCED CO_2 FOOTPRINT

The new hardener "Desmodur eco N 7300" is a trimer of pentamethylene diisocyanate (PDI) (*Figures 1b*, *1c*). PDI is manufactured from pentamethylene diamine (PDA) using innovative gas-phase technology which consumes significantly less energy and solvent than conventional processes.
The PDA suppliers use biotechnology – specifically fermentation – to manufacture PDA (*Figure 1a*) from biomass. PDI is therefore synthesised in just two steps, as opposed to the four required for the petrochemical synthesis of the corresponding petrochemical substance hexamethylene diisocyanate (HDI, *Figure 1d*), a conventional diisocyanate raw material. The internal evaluation showed a significant double-digit improvement in percentage of the CO_2 footprint of bio-based PDI in comparison to HDI. The energy efficiency of PDI cradle-to-gate is significantly better.
PDA is produced from the starch of field corn (maize), which is cul-