Bio-based PUR hot melt formulations thanks to DYNACOLL® *Terra*

As a market leader in polyester polyols for reactive PUR hot melts, which are successfully marketed under the trademark DYNACOLL® 7000 for decades, Evonik is the first company to bring a modular system of bio-based polyester polyols to market maturity. These polyols are not just a “green” version of the petrochemical polyols but also expand the range of properties of the existing product range.

At a time when the importance of resource efficiency is growing, the researchers in the Coating & Adhesive Resins Business Line have made it their mission to expand the range of polyester polyols containing hydroxyl groups, which were always based exclusively on petrochemical raw materials, with a new range of types made from bio-based polyols. To avoid limiting the options of adhesive formulators, the task was to develop a complete building block system of amorphous, liquid and crystalline polyester polyols. Additionally, these polyols should contain a proportion of bio-based monomers as large as possible.

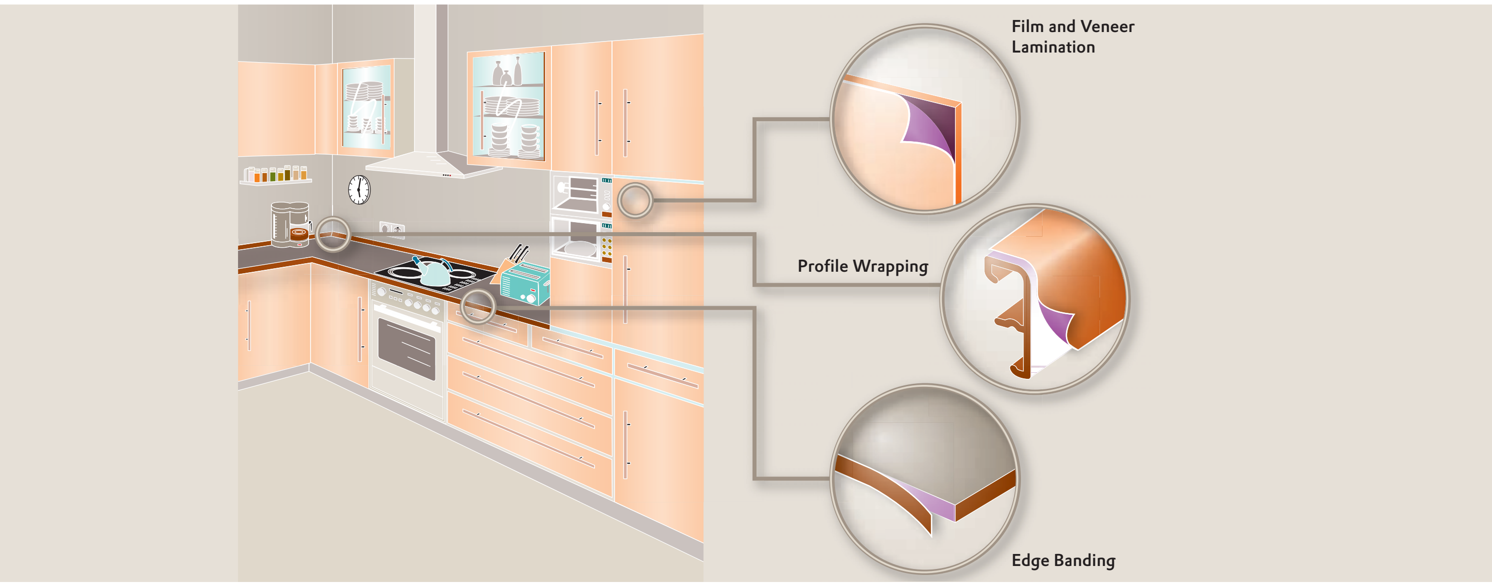
After two years of intensive research and development, a range of nine medium-molecular polyester polyols can be introduced to the market under its brand DYNACOLL® *Terra*, which boast a >30–100 percent share of renewable raw materials (cf. Figure 1)

Like the petrochemically based types, a modular system is made up of amorphous, liquid and crystalline types that, with their range of viscosities, melting points and glass-transition temperatures, largely define the properties of the formulated PUR hot melt, including open time, initial strength and setting time. The newly developed polyester polyols ▸▸▸

Figure 1

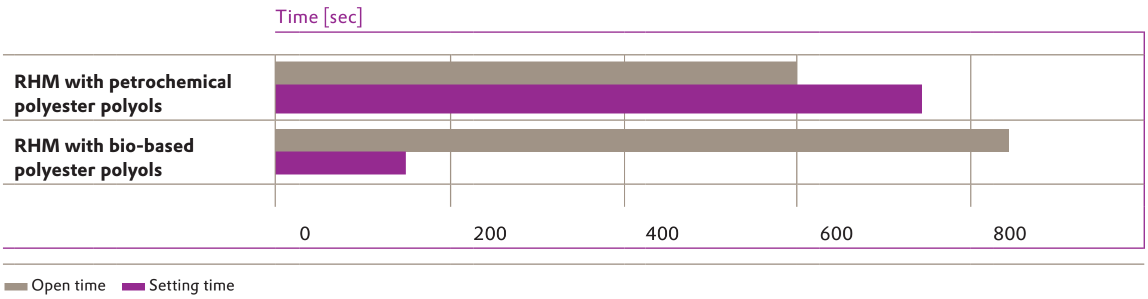
		Properties	Renewables content [%]	Softening point (R&B) [°C]	OH Value [KOH/g]	Melt viscosity [Pa s]
DYNACOLL® *Terra*	**Amorphous types**	EP 413.01	> 30	85	30	35 (130°C)
		EP 413.02	> 30	85	30	32 (130°C)
		EP 413.03	> 35	90	40	17 (130°C)
		EP 413.04	> 30	95	50	15 (130°C)
	Liquid types	EP 424.01	> 85	-	30	4 (80°C)
		EP 424.02	> 75	-	30	4 (80°C)
	Crystalline types	EP 481.01	100	65	30	2 (80°C)
		EP 480.01	100	75	30	3 (80°C)
		EP 480.02	> 60	80	30	2 (80°C)

Acid number <2 mg KOH/g



Typical applications for reactive hot melts in a kitchen

Figure 2



Flat lamination with a reactive hot melt (RHM) made of petrochemical- and bio-based polyester polyols. The latter displays a longer open time—important for this application—and a shortened setting time

▸▸▸ were combined in model formulations in a variety of mixing ratios, and the physical and adhesive properties of the reactive hot melts underwent application-oriented testing. It became clear that the bio-based formulations not only can produce reactive hot melts with properties comparable to petorchemically based ones, but that they can even produce improved products.

A good example is a reactive hot melt for flat lamination. Here, long open times with high initial strength are desirable (cf. Figure 2). Having a comparably long open time, the setting time of the bio-based type was significantly shortened compared to conventional formulations.

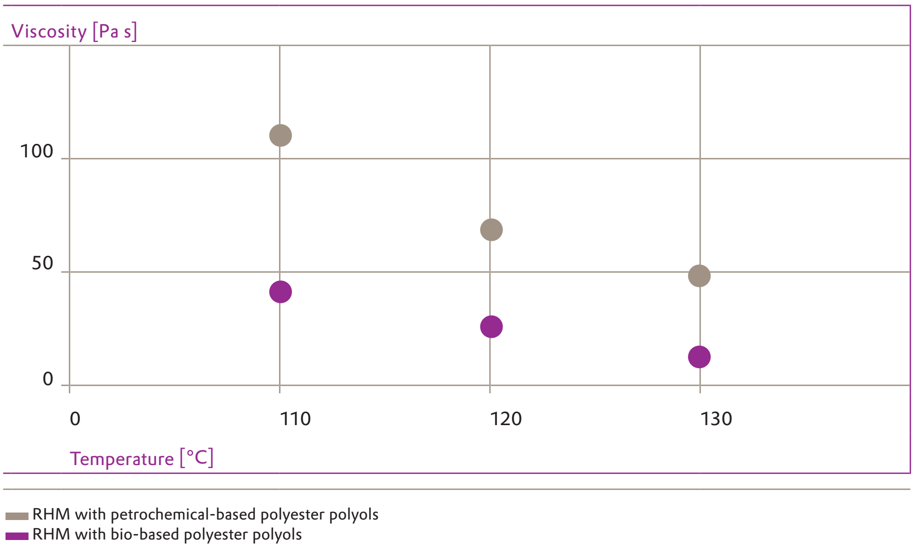
The newly developed types also expanded the formulation spectrum for reactive hot melts with rapid setting time. Fast-setting reactive hot melts, which are used in applications like edge banding, require a highly crystalline content in the formulation, which can often result in incompatibility with amorphous polyols. Thanks to a newly identified bio-based monomer, scientists have now developed amorphous types that show improved compatibility and also have lower viscosities at high glass-transition temperatures (cf. Figure 3). These viscosities are even lower than the previous standard. In the case of edge banding, application temperatures can be lowered while retaining the same properties.

In addition to the middle-molecular bio-based modular system, an initial polyester based on sustainable raw materials was also developed in the high-molecular range. This polyester shows an organic content of approximately 60% and will be used in the production of adhesive films.

On the technical end, no appreciable modifications of existing plants are needed for production of the bio-based products, since the syntheses are comparable with those of petrochemically based ones. Evonik can therefore scale the production of bio-based products at short notice—and, for the first time, adhesive formulators can offer their customers reactive hot melts based on renewable resources.

Contact: Gabriele Brenner
gabriele.brenner@evonik.com

Figure 3



Reactive hot melts (RHM) with bio-based polyester polyols have lower viscosities than those with petrochemical-based polyester polyols. This allows edge banding at lower application temperatures, for example.