

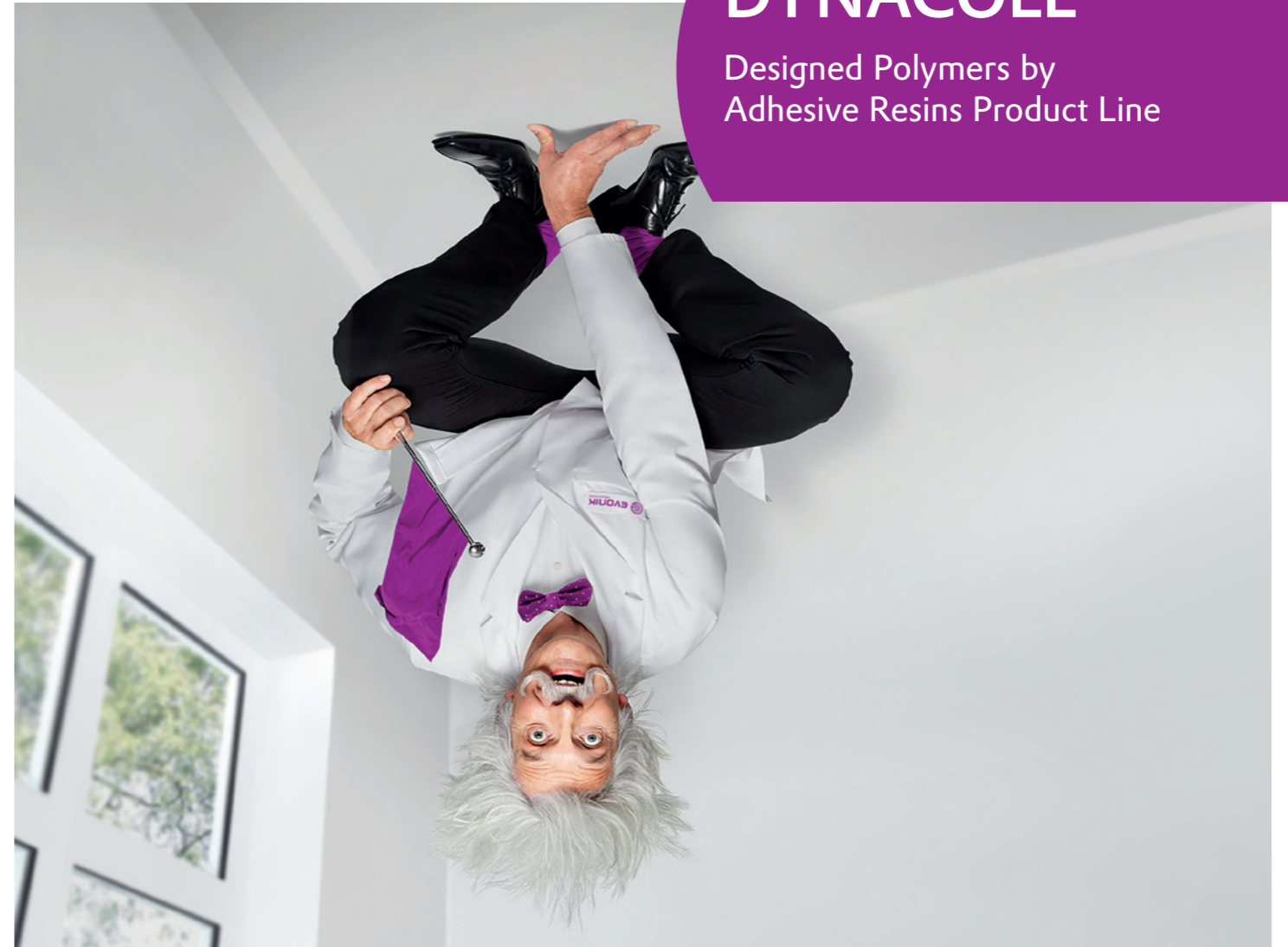
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**DYNACOLL®**

Designed Polymers by  
Adhesive Resins Product Line



**DYNACOLL®**



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**Evonik. Power to create.**

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# Welcome from the Adhesive Experts of Evonik

Discover our product portfolio designed for the Adhesives & Sealants Industry. Based on our different polymer backbone systems, we develop individual solutions according to your needs.

## Your benefits – our values

### Focus on customer orientation

We are a solution provider. Our mission is to create tailor-made solutions to ensure that every one of your projects is a success. That is why we are considered to be the first choice when it comes to solving your challenging tasks. Thanks to our global presence we can respond promptly and make your individual wishes come true.

### Perfectly targeted expertise

With our team of adhesive experts and our dedicated sales force, you can be assured that we offer a wealth of expertise. We do not only provide you with capabilities spanning from research and development through to logistics, but we can also offer you valuable market knowledge and in-depth technical expertise. That is why our know-how is spot-on, every time.

## Your markets – our focus

We offer custom-made Adhesive & Sealant solutions for a broad spectrum of industries. If you don't find your line of business here, just talk to us. Our team will gladly help you accomplish your project.

### Absolute reliability

Any good business partnership is based on reliability. There is nothing more valuable than knowing that your business partner will be there for you. We take this to heart and offer you excellent product quality, security of supply and our continuous drive to make your challenges our own – this way we help you overcome any obstacle along the way.

### Profiting from future orientation

Improving performance and efficiency can only be accomplished if you constantly stay ahead. That is why we identify future trends as early as possible, collaborating with you to develop innovative solutions. Our foresight is valued by customers and partners alike, because they know that we always keep an eye on the future to guarantee long lasting success.

- Automotive
- Electronics
- Construction
- Processing Aides
- Packaging
- Product Assembly

## Your solutions – our brands

### DYNACOLL®

Polyester-Polyols, Copolyesters, Polyacrylates

### VESTOPLAST®

Amorphous Poly-Alpha-Olefins

### VESTOWAX®

Fischer-Tropsch-Waxes

### POLYVEST®

Liquid Polybutadienes

### DEGALAN®

Methacrylate Binders for Heat Seal Lacquers

## Our Product Range

### DYNACOLL®

With our DYNACOLL® product range, we offer polyester-polyols, copolyesters and polyacrylates for your reactive and thermoplastic hot melts.

### VESTOPLAST®

### DEGALAN®

### POLYVEST®

### VESTOWAX®



# DYNACOLL® 7000

Designed Polymers for Adhesives & Sealants

## Polyester-Polyols

With its DYNACOLL® 7000 polyester-polyols Evonik offers tailor-made raw materials for one-component moisture-curable hotmelt adhesives and sealants (RHM). DYNACOLL® 7000 products are linear copolyesters with primary hydroxyl functionality and medium molecular weight.

Depending on their morphology the product range is divided into three basic groups:

- DYNACOLL® 7100 series** amorphous, solid
- DYNACOLL® 7200 series** liquid, pasty
- DYNACOLL® 7300 series** partially crystalline, solid

The product group is designed as a building block system, most DYNACOLL® 7000 polyester-polyols are compatible with each other. Partially incompatible but miscible systems are, however, necessary in many applications as well.

DYNACOLL® 7000 copolyesters are usually supplied in 25 or 30 kg and 190 or 200 kg steel drums. Liquid bulk deliveries are available on special request.

## Your benefits

Our building block system allows a precise formulation of reactive PUR hot melts with low application temperatures and high heat resistance. Basic effects on the RHM properties are:

### DYNACOLL® 7100 series

- shortens open time
- increases initial strength, melt viscosity and adhesion to polar substrates

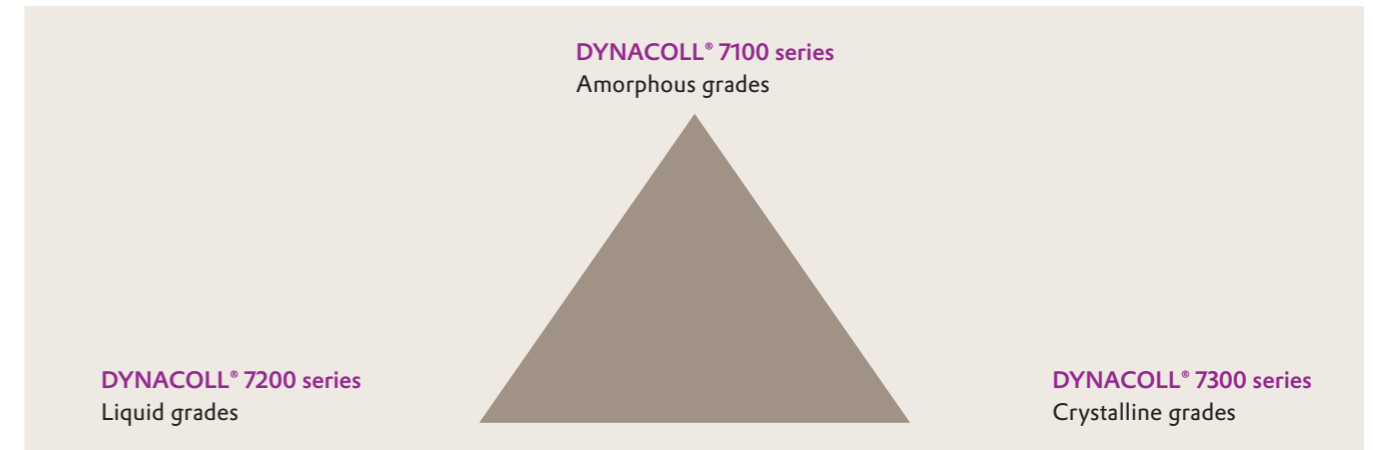
### DYNACOLL® 7200 series

- increases flexibility, open time and adhesion to non-polar substrates
- lowers melt viscosity

### DYNACOLL® 7300 series

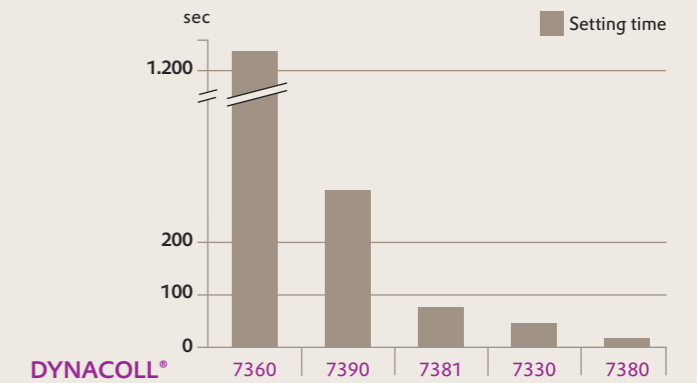
- shortens open time (depending on crystallinity) and lowers melt viscosity
- increases initial strength

## DYNACOLL® 7000 building block system allows a precise formulation of your RHM



### Example to adjust setting time

|                         |          |
|-------------------------|----------|
| DYNACOLL® 7150          | - 40 pbw |
| DYNACOLL® 7250          | - 30 pbw |
| DYNACOLL® 73XX          | - 30 pbw |
| 4,4' MDI [OH/NCO 1/2.2] |          |



### Influences of DYNACOLL® on RHM properties

| Series                   | 7100 | 7200 | 7300 |
|--------------------------|------|------|------|
| Open time / setting time | ↓    | ↑    | ↓↑   |
| Green strength           | ↑    | ↓    | ↑    |
| Viscosity                | ↑    | ↓    | ↓    |
| Flexibility              | ↓    | ↑    | ↓↑   |

# DYNACOLL® 7000

## Product Range DYNACOLL® 7000

| Grade              | Properties                                  |   |                             |                                      |                       |                               |
|--------------------|---|---|-----------------------------|--------------------------------------|-----------------------|-------------------------------|
|                    | Hydroxyl Number <sup>1)</sup><br>[mg KOH/g] | Acid Number <sup>1)</sup><br>[mg KOH/g] | Molecular Weight<br>[g/mol] | Glass Transition Temperature<br>[°C] | Melting Point<br>[°C] | Softening Point (R&B)<br>[°C] |
| <b>Amorphous</b>   |   |   |                             |                                      |                       |                               |
| 7110               | 50 - 60                                     | 8 - 12                                  | 2,000                       | 10                                   |                       | 55                            |
| 7111               | 27 - 34                                     | max. 4                                  | 3,500                       | 20                                   |                       | 64                            |
| 7130               | 31 - 39                                     | max. 2                                  | 3,000                       | 30                                   |                       | 79                            |
| 7131               | 31 - 39                                     | max. 2                                  | 3,000                       | 30                                   |                       | 78                            |
| 7140               | 18 - 24                                     | max. 2                                  | 5,500                       | 30                                   |                       | 87                            |
| 7150               | 38 - 46                                     | max. 2                                  | 2,600                       | 50                                   |                       | 95                            |
| <b>Liquid</b>      |   |   |                             |                                      |                       |                               |
| 7210               | 27 - 34                                     | max. 2                                  | 3,500                       | -15                                  |                       |                               |
| 7230               | 27 - 34                                     | max. 2                                  | 3,500                       | -30                                  |                       |                               |
| 7231               | 27 - 34                                     | max. 2                                  | 3,500                       | -30                                  |                       |                               |
| 7250               | 18 - 24                                     | max. 2                                  | 5,500                       | -50                                  |                       |                               |
| 7255               | 27 - 34                                     | max. 2                                  | 3,500                       | -60                                  | 32                    | 40                            |
| <b>Crystalline</b> |   |   |                             |                                      |                       |                               |
| 7362               | 47 - 54                                     | max. 2                                  | 2,000                       | -60                                  | 53                    | 60                            |
| 7360               | 27 - 34                                     | max. 2                                  | 3,500                       | -60                                  | 55                    | 63                            |
| 7363               | 18 - 24                                     | max. 2                                  | 5,500                       | -60                                  | 56                    | 63                            |
| 7365               | 14 - 20                                     | max. 2                                  | 6,500                       | -60                                  | 57                    | 63                            |
| 7361               | 10 - 16                                     | max. 2                                  | 8,500                       | -60                                  | 57                    | 65                            |
| 7381               | 27 - 34                                     | max. 2                                  | 3,500                       |                                      | 65                    | 73                            |
| 7380               | 27 - 34                                     | max. 2                                  | 3,500                       |                                      | 70                    | 77                            |
| 7330               | 27 - 34                                     | max. 2                                  | 3,500                       |                                      | 85                    | 90                            |
| 7320               | 27 - 34                                     | max. 3                                  | 3,500                       | -20                                  |                       | 92                            |
| 7340               | 27 - 34                                     | max. 2                                  | 3,500                       | -40                                  | 96                    | 102                           |
| 7331               | 27 - 34                                     | max. 2                                  | 3,500                       | -30                                  | 110                   | 115                           |
| 7390               | 27 - 34                                     | max. 3                                  | 3,500                       | -30                                  | 115                   | 118                           |
| 7321               | 27 - 34                                     | max. 2                                  | 3,500                       | -25                                  | 123                   | 126                           |

<sup>1)</sup> Hydroxyl Number and Acid Number represent delivery specifications

## Product Range DYNACOLL® 7000

| Density at 23 °C<br>[kg/dm <sup>3</sup> ] | Flash Point<br>[°C] | Melt Viscosity<br>[Pa s]  |                            | Grade              |
|---|---------------------|---------------------------|----------------------------|--------------------|
|   |                     | 80 °C<br>[Parallel plate] | 130 °C<br>[Parallel plate] |                    |
| 1.08                                      | >300                |                           | 1                          | 7110 <sup>1)</sup> |
| 1.23                                      | >300                |                           | 3                          | 7111               |
| 1.17                                      | >300                |                           | 10                         | 7130               |
| 1.23                                      | >300                |                           | 10                         | 7131               |
| 1.21                                      | >300                |                           | 50                         | 7140               |
| 1.26                                      | >300                |                           | 50                         | 7150               |
| 1.29                                      | >200                | 11                        |                            | 7210               |
| 1.17                                      | >200                | 10                        |                            | 7230               |
| 1.21                                      | >200                | 8                         |                            | 7231               |
| 1.15                                      | >200                | 5                         |                            | 7250               |
| 1.11                                      | >200                | 2                         |                            | 7255               |
| 1.15                                      | >200                | 0.5                       |                            | 7362               |
| 1.16                                      | >300                | 2                         |                            | 7360               |
| 1.16                                      | >300                | 5                         |                            | 7363               |
| 1.16                                      | >300                | 10                        |                            | 7365               |
| 1.16                                      | >300                | 15                        |                            | 7361               |
| 1.16                                      | >300                | 2                         |                            | 7381               |
| 1.10                                      | >300                | 2                         |                            | 7380               |
| 1.17                                      | >300                |                           | 0.3                        | 7330               |
| 1.23                                      | >300                |                           | 4                          | 7320               |
| 1.19                                      | >300                |                           | 1                          | 7340               |
| 1.19                                      | >300                |                           | 2                          | 7331               |
| 1.29                                      | >300                |                           | 0.7                        | 7390               |
| 1.20                                      | >300                |                           | 3                          | 7321               |

# DYNACOLL® 7000

## Preparation of Reactive Hot Melts

The product of the reaction between DYNACOLL® 7000 polyesters and an excess of diisocyanates is a reactive hot melt (RHM). The reaction occurs in the melt. For characterization of the RHM data in this brochure the preparation was carried out under the following constant laboratory conditions.

The polyester melt was evacuated in a flask, regardless of the actual (normally low) water content of the DYNACOLL® 7000 products, in a vacuum of less than 10 mbar for 45 minutes at 130°C. The polyesters are then reacted in an inert gas atmosphere (dried nitrogen or carbon dioxide) with the calculated amount of diisocyanate at 130°C.

The reaction is complete when the theoretical free isocyanate content is obtained. After 45 minutes the melt was degassed until it is free of bubbles. The reactive hot melt was then filled into containers and stored under exclusion of moisture and light. Under production conditions, the reaction times should be individually adapted to the adhesive formulations. Drying is determined by the water content of all the components of the formulation, and is generally recommended in order to prevent side reactions.

The following data should be determined for quality control: isocyanate content, melt viscosity, melting point or softening point (R&B), open time, and setting time. Calculation of initial weight of diisocyanate:

### Calculation:

$$\text{Weight of diisocyanate} = \frac{(WPES1 \cdot OH1 + WPESn \cdot OHn) \cdot EW \cdot R}{56110}$$

WPES1 = initial weight of polyester 1  
 OH1 = hydroxyl number of polyester 1  
 WPESn = initial weight of polyester n  
 OHn = hydroxyl number of polyester n  
 EW = equivalent weight of the diisocyanate used  
 R = ratio of isocyanate to hydroxyl groups

## Benefits of Reactive Hot Melt adhesives based on DYNACOLL® 7000

- Excellent stability of viscosity and color in processing
- Exceptionally good adhesion to a variety of substrates
- Solutions for a wide range of applications in various industries and fields such as the automotive, packaging, textile industries and wood processing, as well as for book-binding applications and sandwich bonding
- Suitable for standard hot melt equipment such as rollers and spray, screen, and melt print applicators.

## Reactive Hot Melt Data

Reaction products of DYNACOLL® with 4,4'-diphenylmethane diisocyanates (MDI) as a ratio of OH : NCO = 1 : 2.2

| Grade              | Properties                 |               |                  |                          |                         | Melt Viscosity                 |
|--------------------|----------------------------|---------------|------------------|--------------------------|-------------------------|--------------------------------|
|                    | Softening Point (R&B) [°C] | Open Time [s] | Setting Time [s] | Tensile Strength [N/mm²] | Elongation at Break [%] | 130 °C [Parallel plate] [Pa s] |
| <b>Amorphous</b>   |                            |               |                  |                          |                         |                                |
| 7110               | 64                         | 10            | 1                |                          | brittle                 | 3                              |
| 7111               | 71                         | 6             | 1                |                          | brittle                 | 13                             |
| 7130               | 88                         | 1             | 1                |                          | brittle                 | 45                             |
| 7131               | 88                         | 1             | 1                |                          | brittle                 | 50                             |
| 7140               | 102                        | 1             | < 1              |                          | brittle                 | 700                            |
| 7150               | 105                        | < 1           | < 1              |                          | brittle                 | 400                            |
| <b>Liquid</b>      |                            |               |                  |                          |                         |                                |
| 7210               | 45                         | several hours | several hours    | 15                       | 800                     | 5                              |
| 7230               |                            | several hours | several hours    | 15                       | 900                     | 9                              |
| 7231               |                            | several hours | several hours    | 15                       | 900                     | 8                              |
| 7250               |                            | several hours | several hours    | 15                       | 1,500                   | 9                              |
| 7255               | 40                         | several hours | several hours    | 30                       | 1,100                   | 5                              |
| <b>Crystalline</b> |                            |               |                  |                          |                         |                                |
| 7362               | 55                         | 130           | 35               | 25                       | 500                     | 2                              |
| 7360               | 59                         | 80            | 15               | 25                       | 500                     | 4                              |
| 7363               | 61                         | 50            | 15               | 25                       | 500                     | 11                             |
| 7365               | 63                         | 50            | 15               | 20                       | 550                     | 18                             |
| 7361               | 63                         | 50            | 10               | 20                       | 550                     | 30                             |
| 7381               | 67                         | 35            | 3                | 20                       | 80                      | 5                              |
| 7380               | 73                         | 20            | 1                | 20                       | 20                      | 5                              |
| 7330               | 85                         | 35            | 3                | 25                       | 15                      | 3                              |
| 7320               | 87                         | 40            | 35               | 35                       | 600                     | 48                             |
| 7340               | 97                         | 120           | 60               | 30                       | 700                     | 12                             |
| 7331               | 110                        | 90            | 30               | 30                       | 500                     | 20                             |
| 7390               | 118                        | 20            | 10               | 30                       | 10                      | 4                              |
| 7321               | 123                        | 40            | 15               | 35                       | 400                     | 30                             |

# DYNACOLL® 7000

## Compatibility of DYNACOLL® 7000

| Grade | 7110 | 7111 | 7130 | 7131 | 7140 | 7150 | 7210 | 7230 | 7231 | 7250 | 7255 | 7320 | 7321* | 7330 | 7331 | 7340 | 7360 | 7361 | 7365 | 7380 | 7381 | 7390 |   |
|-------|------|------|------|------|------|------|------|------|------|------|------|------|-------|------|------|------|------|------|------|------|------|------|---|
| 7110  |      | +    | +    | +    | ■    | +    | +    | +    | +    | +    | +    | +    | +     | ■    | ■    | ●    | +    | +    | +    | +    | ●    | ●    | + |
| 7111  | +    |      | +    | +    | ■    | ■    | +    | +    | +    | +    | +    | +    | +     | ■    | ■    | ■    | +    | +    | +    | +    | -    | -    | + |
| 7130  | +    | +    |      | +    | +    | +    | +    | +    | +    | +    | +    | +    | +     | +    | ●    | +    | +    | ●    | ●    | ●    | ●    | ●    | + |
| 7131  | +    | +    | +    |      | +    | +    | +    | +    | +    | +    | +    | +    | +     | +    | +    | +    | +    | +    | +    | +    | ■    | +    | + |
| 7140  | -    | -    | +    | +    |      | +    | ●    | +    | +    | ■    | -    | +    | +     | ■    | +    | +    | ●    | ■    | ■    | ●    | ●    | ■    |   |
| 7150  | ●    | ■    | +    | +    | +    |      | +    | +    | +    | +    | +    | ●    | +     | ■    | +    | +    | +    | +    | +    | +    | ■    | ■    | ■ |
| 7210  | +    | +    | +    | +    | -    | +    |      | +    | ●    | +    | ■    | +    | ■     | ■    | ●    | +    | ●    | ■    | ■    | ●    | ●    | ●    | ● |
| 7230  | +    | +    | +    | +    | +    | +    | +    |      | +    | +    | +    | +    | +     | +    | +    | +    | +    | +    | +    | +    | ●    | ●    | + |
| 7231  | +    | +    | +    | +    | +    | +    | +    | +    |      | +    | +    | +    | +     | +    | ●    | +    | +    | +    | +    | +    | ●    | ●    | + |
| 7250  | +    | +    | +    | +    | -    | +    | +    | +    | +    |      | +    | +    | +     | ■    | +    | ■    | ●    | +    | +    | +    | ■    | +    | + |
| 7255  | +    | +    | +    | +    | -    | +    | -    | +    | +    | +    |      | +    | +     | +    | +    | +    | +    | +    | +    | +    | -    | +    | - |
| 7320  | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    | +    |      | +     | -    | +    | +    | +    | +    | -    | -    | ●    | ■    | ■ |
| 7321* | -    | -    | +    | +    | +    | +    | +    | +    | -    | +    | +    | +    |       | +    | +    | +    | +    | +    | +    | +    | +    | +    | ■ |
| 7330  | +    | -    | +    | +    | -    | +    | -    | +    | -    | +    | +    | +    | +     |      | +    | +    | +    | +    | +    | +    | +    | +    | ■ |
| 7331  | -    | -    | +    | +    | +    | +    | -    | +    | +    | -    | +    | +    | +     | +    |      | +    | +    | ●    | ●    | -    | +    | +    | ■ |
| 7340  | -    | -    | +    | +    | +    | +    | +    | +    | -    | +    | +    | +    | +     | +    | +    |      | +    | +    | +    | ●    | +    | +    | ■ |
| 7360  | +    | +    | +    | +    | +    | +    | -    | +    | +    | +    | +    | +    | +     | +    | +    | +    |      | +    | +    | +    | ■    | +    | + |
| 7361  | +    | +    | +    | +    | -    | +    | -    | +    | +    | +    | +    | +    | +     | +    | +    | +    | +    |      | +    | +    | +    | +    | - |
| 7365  | +    | +    | +    | +    | -    | +    | -    | +    | +    | +    | +    | +    | +     | +    | +    | +    | +    | +    |      | +    | +    | +    | ■ |
| 7380  | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    | -    | -     | +    | -    | -    | +    | +    | +    |      | +    | +    | ■ |
| 7381  | -    | -    | -    | -    | -    | -    | -    | -    | -    | +    | -    | +    | +     | +    | +    | +    | +    | +    | +    | +    |      | +    | - |
| 7390  | +    | +    | -    | +    | ■    | -    | -    | +    | +    | +    | -    | -    | ■     | -    | ■    | ■    | -    | -    | -    | -    | -    | -    | - |

Visual evaluation of the melt after storing 24 hours at 130 °C (\*at 140 °C):

+ = transparent    ■ = opaque    1:1 Mixtures of polyesters  
 ● = cloudy    - = phase separation    1:1 Mixtures of polyesters reacted with MDI (OH : NCO = 1 : 2.2)

## Analytical Methods

### Hydroxyl Number

Determination according to DIN 53 240-02.

Approx. 2 – 3 g of polyester are dissolved in dichloromethane or THF. The OH groups are esterified at RT with acetic anhydride, using 4-dimethyl-aminopyridine as catalyst. After hydrolysis of the unreacted anhydride, titration is carried out with 0.5 N methanolic KOH.

### Acid Number

Determination according to DIN EN ISO 2114.

Approx. 4 g of polyester are dissolved in 50 ml of tetrahydrofuran. Following addition of 50 ml of a mixture of equal parts by weight of tetrahydrofuran and ethanol, titration is carried out with methanolic or ethanolic KOH against phenolphthalein.

### Molecular Weight

The molecular weight is calculated based on the sum of hydroxyl number and acid number.

### Glass Transition Temperature

Determination according to DIN 53 765.

The glass transition temperature is determined as for the melting point.

### Melting Point

Determination according to DIN 53 765.

The melting point is determined using a DSC instrument. The sample and an empty reference crucible are heated at 20 °C/min. The melting point corresponds to the maximum of the melting peak. To ensure better reproducibility, it is customary to use the values from the second heating operation.

### Softening Point (Ring and Ball)

Determination according to DIN ISO 4625.

The sample is casted as a melt into a ring and the ring, following the solidification of the melt (or the recrystallization in the case of crystalline substances), is inserted into a test frame. The sample is stressed concentrically with a chrome-plated steel ball and the test frame is immersed in a bath of glycerol. The glycerol is heated at a rate of approximately 5 °C/min. The softening point (R&B) is the temperature of the glycerol bath at the time when the steel ball contacts the baseplate of the test frame.

### Density

Determination according to DIN 51 757.

### Flash Point

Determination according to ISO 2592.

### Open Time

Determination according to Evonik internal method.

The material is heated up to 130 °C and applied on paper as an approximately 0.5 mm thick film. Strips of open surface paper are pressed into the melt at certain intervals. After the adhesive film is tack-free the paper strips are removed. The open time is given by the time, when no fiber tear can be observed anymore.

### Setting Time

Determination according to Evonik internal method.

The setting time is given by the time it takes until two bonded wooden cubes can no longer be twisted against each other by hand.

### Melt Viscosity

Determination according to DIN EN ISO 3219, parallel plate method.

### Tensile Strength / Elongation at Break

Determination according to DIN 53 504.

Dumbbell specimens are punched out from a 0.5 mm thick moisture cured RHM film. Curing conditions are 7 days, 20 °C and 65 % rel. humidity. Elongation at break denotes the percentage increase in length of an original section of 10 mm marked on the bar of the dumbbell specimen, at the moment of break.

# DYNACOLL® Terra

Designed Polymers for Adhesives & Sealants

## Bio-based Polyester-Polyols

With its DYNACOLL® Terra product range Evonik offers polyester-polyols made from renewable raw materials.

These bio-based polyesters contain between >30 and 100 pbw of renewable monomers.

According to our DYNACOLL® 7000 product range a building block system of medium molecular weight copolyesters for moisture curing PUR hot melts was developed. It is divided in three basic groups:

**Amorphous Grades**

**Liquid Grades**

**Crystalline Grades**

DYNACOLL® Terra bio-based polyesters are usually supplied in 25 or 30 kg and 190 or 200 kg steel drums.

## Your benefits

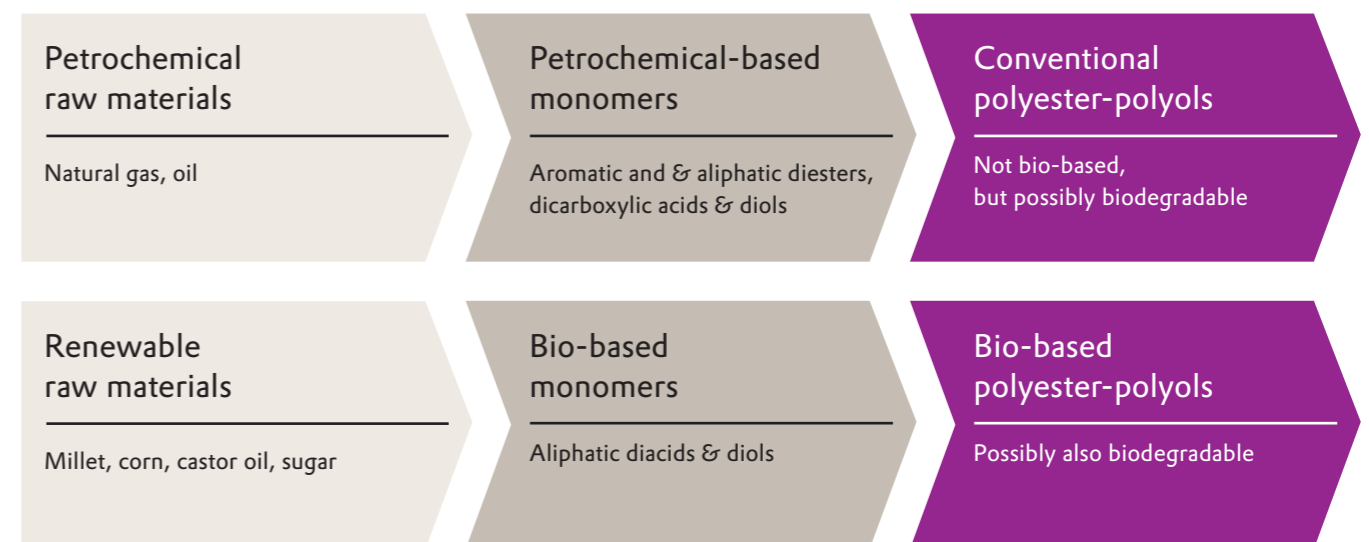
- Support of resource efficiency by using green components
- Modular combination of polyesters in RHM formulation possible
- Available grades exhibiting broad range of properties in formulations
- Well-balanced and versatile adhesion properties
- Implementation of new properties possible

## Product Range DYNACOLL® Terra

| Grade              | Properties               |                 |                  |                              |               |                       |                |
|--------------------|--------------------------|-----------------|------------------|------------------------------|---------------|-----------------------|----------------|
|                    | Proportion of Renewables | Hydroxyl Number | Molecular Weight | Glass Transition Temperature | Melting Point | Softening Point (R&B) | Melt Viscosity |
|                    | [%]                      | [mg KOH/g]      | [g/mol]          | [°C]                         | [°C]          | [°C]                  | [Pa s]         |
| <b>Amorphous</b>   |                          |                 |                  |                              |               |                       |                |
| EP 413.01          | > 30                     | 30              | 3,500            | 30                           |               | 85                    | 35 (130 °C)    |
| EP 413.02          | > 30                     | 30              | 3,500            | 30                           |               | 85                    | 32 (130 °C)    |
| EP 413.03          | > 35                     | 40              | 2,800            | 40                           |               | 90                    | 17 (130 °C)    |
| EP 413.04          | > 30                     | 50              | 2,200            | 50                           |               | 95                    | 15 (130 °C)    |
| <b>Liquid</b>      |                          |                 |                  |                              |               |                       |                |
| EP 424.01          | > 85                     | 30              | 3,500            | -40                          |               |                       | 4 (80 °C)      |
| EP 424.02          | > 75                     | 30              | 3,500            | -45                          |               |                       | 4 (80 °C)      |
| <b>Crystalline</b> |                          |                 |                  |                              |               |                       |                |
| EP 481.01          | 100                      | 30              | 3,500            | -45                          | 55            | 65                    | 2 (80 °C)      |
| EP 480.01          | 100                      | 30              | 3,500            | -20                          | 65            | 75                    | 2 (80 °C)      |
| EP 480.02          | > 60                     | 30              | 3,500            |                              | 70            | 80                    | 2 (80 °C)      |

Acid number < 2mg KOH/g

## Comparison of conventional and bio-based polyester polyols



# DYNACOLL® Terra

## Reactive Hot Melt Data

Reaction products of DYNACOLL® Terra with: 4,4' - MDI as a ratio of OH : NCO = 1 : 2.2

| Properties         |                            |               |                  |                                 |                                       |                         |
|--------------------|----------------------------|---------------|------------------|---------------------------------|---------------------------------------|-------------------------|
| Grade              | Softening Point (R&B) [°C] | Open Time [s] | Setting Time [s] | Melt Viscosity at 130 °C [Pa s] | Tensile Strength [N/mm <sup>2</sup> ] | Elongation at Break [%] |
| <b>Amorphous</b>   |                            |               |                  |                                 |                                       |                         |
| EP 413.01          | 102                        | 1             | 1                | 200                             |                                       | brittle                 |
| EP 413.02          | 103                        | 1             | 1                | 400                             |                                       | brittle                 |
| EP 413.03          | 100                        | 1             | <1               | 65                              |                                       | brittle                 |
| EP 413.04          | 100                        | <1            | <1               | 40                              |                                       | brittle                 |
| <b>Liquid</b>      |                            |               |                  |                                 |                                       |                         |
| EP 424.01          |                            |               |                  | 4                               | 10                                    | 1,300                   |
| EP 424.02          |                            |               |                  | 4                               | 15                                    | 1,300                   |
| <b>Crystalline</b> |                            |               |                  |                                 |                                       |                         |
| EP 481.01          | 60                         | 600           | 200              | 5                               | 22                                    | 500                     |
| EP 480.01          | 70                         | 100           | 15               | 5                               | 25                                    | 500                     |
| EP 480.02          | 75                         | 10            | 1                | 5                               | 22                                    | 200                     |

## Compatibility

| Grade     | EP 413.01 | EP 413.02 | EP 413.03 | EP 413.04 | EP 424.01 | EP 424.02 | EP 481.01 | EP 480.01 | EP 480.02 |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| EP 413.01 | ■         | ●         | +         | +         | ●         | ●         | ■         | ■         | ■         |
| EP 413.02 | ■         | ■         | ●         | ●         | ■         | -         | ■         | ■         | -         |
| EP 413.03 | +         | ■         | ■         | +         | -         | +         | +         | -         | ■         |
| EP 413.04 | +         | +         | +         | ■         | +         | +         | +         | +         | -         |
| EP 424.01 | -         | ■         | -         | +         | +         | +         | ●         | ●         | ●         |
| EP 424.02 | -         | -         | +         | +         | +         | +         | +         | ●         | -         |
| EP 481.01 | -         | ■         | +         | +         | +         | +         | +         | +         | +         |
| EP 480.01 | -         | ■         | -         | +         | -         | +         | +         | +         | +         |
| EP 480.02 | -         | -         | -         | -         | -         | -         | +         | +         | +         |

Visual evaluation of the melt after storing 24 hours at 130 °C

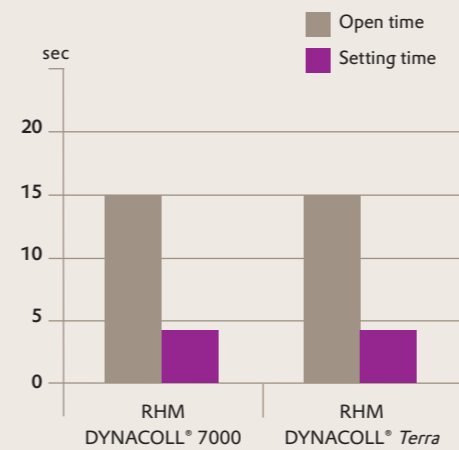
- + = transparent
- = opaque
- = cloudy
- = phase separation

1:1 Mixtures of polyesters  
1:1 Mixtures of polyesters reacted with MDI (OH : NCO = 1 : 2.2)

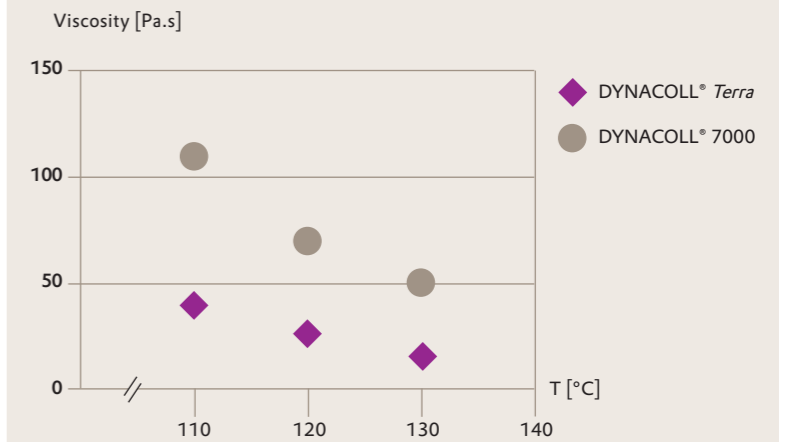
## Sustainable RHM & Implementation of new properties

### Guide formulation edge banding

35 ppw – DYNACOLL® Terra EP 413.04  
20 ppw – DYNACOLL® Terra EP 424.02  
10 ppw – DYNACOLL® Terra EP 480.01  
25 ppw – DYNACOLL® Terra EP 480.02  
10 ppw – DYNACOLL® S 1402  
& 4,4' MDI [OH/NCO 1/2.0]



Biobased RHM allows lower application temperature, e.g. for edge banding applications

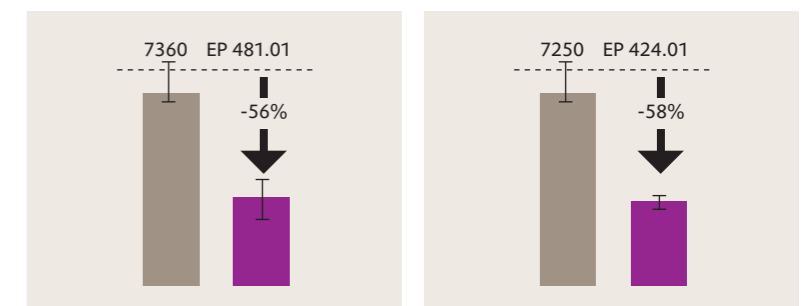
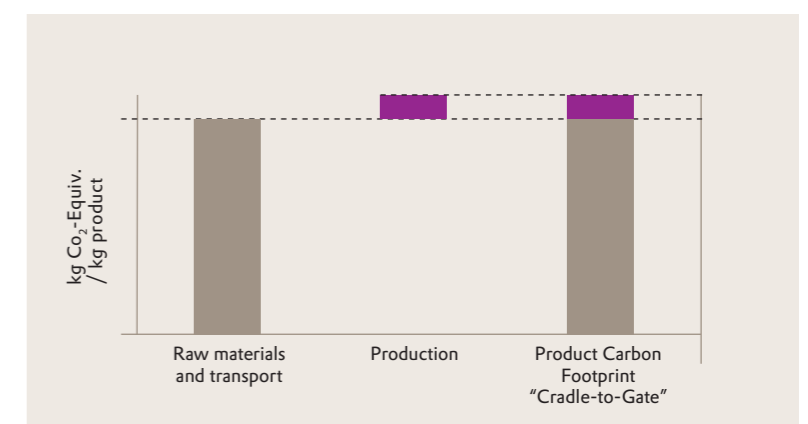


## Carbon footprint evaluation

The use of renewable resources helps to slow down the climate change because less greenhouse gases are released. A lower global warming potential (GWP) and thus a lower carbon footprint lead to a reduction in global warming.

Considering the GWP of products measured in mass of CO<sub>2</sub> equivalents the "Cradle-to gate" carbon footprint is primarily influenced by raw materials. Therefore cooperations with suppliers are essential.

Carbon footprint assessments have been carried out for two example grades of DYNACOLL® Terra, in which the carbon footprint for the life cycle of the products was determined. The carbon footprint is reduced up to approximately 60% by using renewable resources compared to conventional petrochemical-based polyester polyols.



Data sources: Suppliers, GaBi database, CEFIC, own calculations



# DYNACOLL® AC

Designed Polymers for Adhesives & Sealants

## Polyacrylates

With its DYNACOLL® AC product range Evonik offers acrylics for one-component moisture curable hot melt adhesives.

Acrylics for adhesives are bead polymers made of methyl methacrylate and n-butyl methacrylate which are mainly used to modify reactive hot primarily for flat lamination applications.

Various DYNACOLL® AC grades with tailored glass transition temperature and molecular weight are available. They also differ according to their acid and hydroxyl functionality.

DYNACOLL® AC polyacrylates are supplied as beads in bags of 25 kg, big bags are possible on request.

## Your benefits

**DYNACOLL® AC provides outstanding quality and flow properties**

- Low particle size
- Easy handling
- Short dilution time

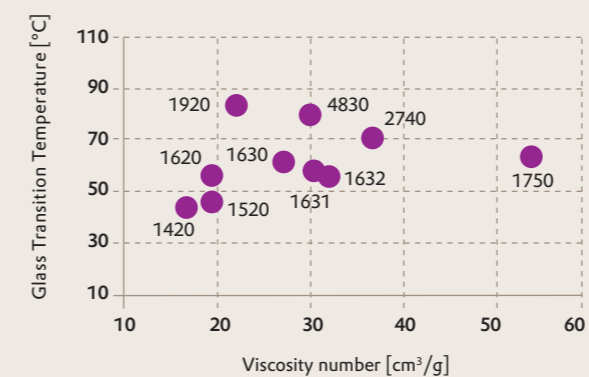
**DYNACOLL® AC modified reactive hot melts for flat lamination provide**

- Low viscosity
- Very long open time
- Aggressive tack
- High creep resistance directly after bonding

## Product Range DYNACOLL® AC

|                      | Properties                              |                                |                             |                           |                               |                               |                                     |
|----------------------|---|--------------------------------|-----------------------------|---------------------------|-------------------------------|-------------------------------|-------------------------------------|
|                      | Glass Transition Temperature Tg<br>[°C] | Molecular Weight Mw<br>[g/mol] | Viscosity Number<br>[cm³/g] | Acid Number<br>[mg KOH/g] | Hydroxyl Number<br>[mg KOH/g] | Softening Point (R&B)<br>[°C] | Melt Flow Rate 190 °C<br>[g/10 min] |
| <b>Bead Polymers</b> |   |                                |                             |                           |                               |                               |                                     |
| AC 1420              | 44                                      | 30,000                         | 16                          | 6                         |                               | 120                           | 1,000                               |
| AC 1520              | 48                                      | 35,000                         | 19                          | 8.5                       |                               | 135                           | 500                                 |
| AC 1631              | 57                                      | 60,000                         | 30                          | 9                         |                               | 150                           | 60                                  |
| AC 1620              | 56                                      | 35,000                         | 19                          | 8                         |                               | 140                           | 300                                 |
| AC 1630              | 60                                      | 55,000                         | 27                          | 8                         |                               | 150                           | 40                                  |
| AC 1632              | 55                                      | 65,000                         | 32                          | 3.5                       |                               | 145                           | 35                                  |
| AC 1750              | 65                                      | 140,000                        | 54                          | 4                         |                               | 190                           | 9                                   |
| AC 1920              | 85                                      | 37,000                         | 22                          | 6                         |                               | 160                           | 70                                  |
| AC 4830              | 82                                      | 60,000                         | 30                          |                           |                               | 175                           | 8                                   |
| AC 2740              | 70                                      | 80,000                         | 36                          |                           | 4                             | 170                           | 7                                   |

## Product Portfolio DYNACOLL® AC



## Analytical Methods

### Glass Transition Temperature

Determination according to ISO 11357-1.

### Molecular Weight

Determination according to DIN 55627-1.

Calibration standard polymethyl methacrylate (PMMA)

### Viscosity Number

Determination according to ISO 1628-1.

### Acid Number

Determination according to DIN EN ISO 2114.

### Hydroxyl Number

Determination according to DIN 53 240-02.

### Softening Point (Ring and Ball)

Determination according to DIN ISO 4625.

### Melt Flow Rate 190 °C

Determination according to DIN ISO 1133 (21.6 N).

# DYNACOLL® AC

## Acrylic Modified Reactive Hot Melts

Reactive hot melts for flat lamination applications are typically prepared by reacting polymer mixtures of DYNACOLL® AC polyacrylates, mainly crystalline DYNACOLL® 7000 polyester polyols and polypropylene glycol (PPG) with molecular weight 1000 or 2000 with excess diisocyanates like MDI (Diphenylmethane diisocyanates) at elevated temperatures under exclusion of moisture. It is recommended to dissolve DYNACOLL® AC in PPG under strong stirring first and then add DYNACOLL® polyesters into the molten mixture. After drying and homogenization the reaction with MDI can be carried out until the theoretical NCO-content is reached. After degassing the adhesive is filled in sealed containers. These reactive hot melts can be applied e.g. by roll coater.

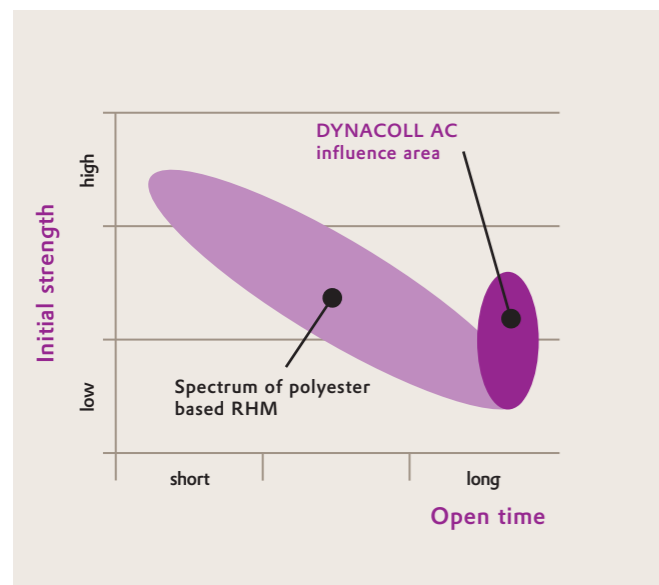
## Flat Lamination Applications

The flat lamination technology is widely used for multilayer sandwich constructions and surface lamination of lightweight materials with decorative films to give them a solid or more valuable appearance. Core materials are mainly made from MDF fiber-board, particle-chipboard or plywood, cardboard or plastic foams while typically plastic films, high gloss films, paper, HPL or veneers are used as surface layers.

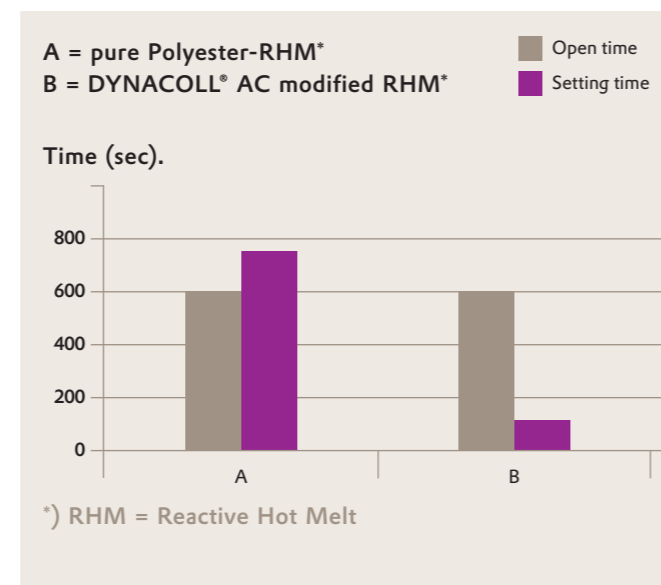
The adhesives need to provide low viscosity and long open times for sufficient wetting and long handling times for bonding large size panels. On the other hand, setting times should be short to allow fast production runs. Pure polyester polyol based RHM formulations with long open time often do also have long setting times and therefore do not provide sufficient initial strength. Instead, DYNACOLL® AC polyacrylates enable the formulation of moisture curing hot melts with long open times and high initial strength. Especially their high molecular weight leads to excellent creep resistance of the adhesive allowing to keep bonded parts in place without any further mechanical fixation.

Therefore, DYNACOLL® AC modified RHM provide new opportunities for flat lamination applications.

Initial strength – influence of DYNACOLL® AC



Lab results – setting time comparison



## Flat Lamination

### Enhance properties of your RHM with DYNACOLL® AC

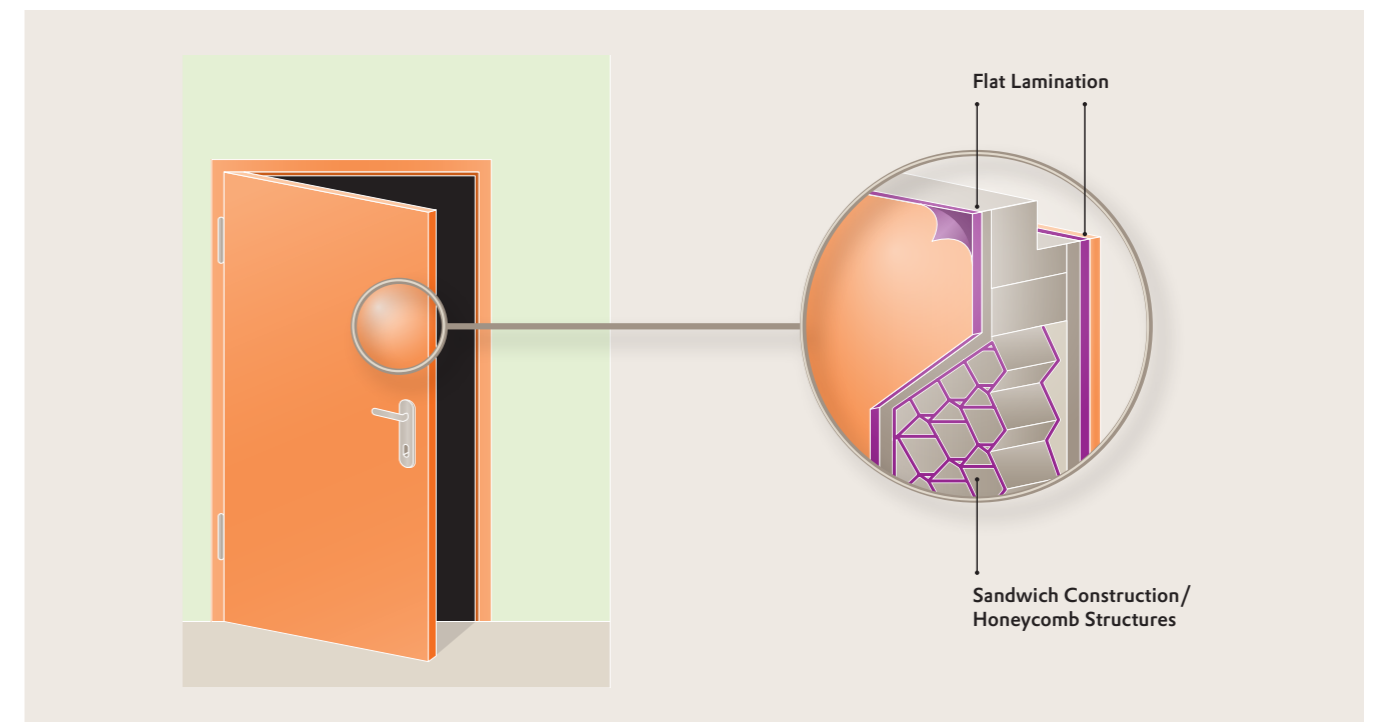
DYNACOLL® AC modified reactive hot melts are the first choice for flat lamination purposes.

Typical areas of application are:

- **Sandwich composites**  
of aluminium, FRP panels, foam or wood-based substrates  
e. g. for recreational vehicals
- **Honeycomb structures**  
e.g. for door manufacturing
- **Foil laminated particleboard**  
e.g. for furniture
- **Medium density fiberboard panels**  
e.g. for furniture

## Bonding of panels or sandwich composites require

- **Long open time**  
Large assembly parts need long handling times
- **High initial strength**  
Bonding without further mechanical fixation saves time
- **Short setting time**  
Cost-efficient production runs need short cycle times



# DYNACOLL® S

Designed Polymers for Adhesives & Sealants

## Copolyesters

With its DYNACOLL® S product range Evonik offers thermoplastic copolyesters of high molecular weight for use in thermoplastic hot melt and solvent based adhesives. The product range includes amorphous as well as crystalline grades of different melting points and various degrees of crystallinity or hardness.

The crystalline grades are distinguished particularly by high adhesive strength as well as good resistance to chemicals and solvents. For solvent based applications the amorphous grades are recommended; these have good solubility in non-chlorinated and excellent adhesion to a wide range of substrates.

### Applications

|                                 | Crystalline Grades |        |        |        |        |        |        | Amorphous Grades |        |        |        |
|---------------------------------|--------------------|--------|--------|--------|--------|--------|--------|------------------|--------|--------|--------|
|                                 | S 243              | S 1272 | S 1252 | S 1218 | S 1227 | S 1402 | S 1401 | S EP 1408        | S 1606 | S 1611 | S 1426 |
| <b>Textile Industry</b>         |                    |        |        |        |        |        |        |                  |        |        |        |
| Hot Melts                       |                    | •      | •      | •      | •      |        |        |                  |        |        |        |
| Adhesive film                   |                    | •      | •      | •      | •      | •      | •      |                  |        |        |        |
| Adhesive web and net            |                    | •      | •      | •      | •      |        |        |                  |        |        |        |
| <b>Profile Wrapping</b>         |                    |        |        |        |        |        |        |                  |        |        |        |
| PVC Window frames               |                    |        |        |        |        | •      | •      | •                |        |        |        |
| Metal / Plastics bonding        |                    |        |        |        |        |        | •      | •                |        | •      | •      |
| Metal primer                    |                    |        |        |        |        |        |        |                  | •      | •      |        |
| <b>Electronic Industry</b>      |                    |        |        |        |        |        |        |                  |        |        |        |
| Solvent based adhesives         |                    |        |        |        |        |        | •      | •                | •      |        | •      |
| Hot Melt adhesives              |                    |        |        |        | •      |        | •      | •                |        |        |        |
| <b>Automotive Industry</b>      |                    |        |        |        |        |        |        |                  |        |        |        |
| Interior textile lamination     |                    | •      |        |        | •      |        |        |                  |        |        |        |
| Decorative film lamination      |                    | •      | •      | •      | •      |        | •      |                  |        |        |        |
| <b>Packaging Industry</b>       |                    |        |        |        |        |        |        |                  |        |        |        |
| Flexible packaging              |                    |        |        |        |        |        | •      | •                | •      | •      |        |
| <b>Polymer Modification</b>     |                    |        |        |        |        |        |        |                  |        |        |        |
| Additive for Reactive Hot Melts |                    |        |        |        |        | •      | •      |                  |        |        |        |
| Masterbatches                   | •                  |        |        |        |        |        |        |                  |        |        |        |

### Product Range DYNACOLL® S

|  | Crystalline Grades |        |                   |        |        |                  |                  | Amorphous Grades |        |        |        |
|--|--------------------|--------|-------------------|--------|--------|------------------|------------------|------------------|--------|--------|--------|
|  | S 243              | S 1272 | S 1252            | S 1218 | S 1227 | S 1402           | S 1401           | S EP 1408        | S 1606 | S 1611 | S 1426 |
| <b>Properties</b>                      |                    |        |                   |        |        |                  |                  |                  |        |        |        |
| Softening Point [°C]                   | 195                | 140    | 135               | 130    | 115    | 100              | 97               | 90               | 155    | 130    | 140    |
| Melting Point [°C]                     | 195                | 128    | 120 <sup>1)</sup> | 115    | 100    | 90 <sup>1)</sup> | 85 <sup>1)</sup> | 80 <sup>1)</sup> |        |        |        |
| Glass Transition Temp. [°C]            | 35                 | 0      | 20                | 15     | 10     | -10              | -25              | -30              | 65     | 50     | 35     |
| Hydroxyl Number [mg KOH/g]             |                    |        |                   |        |        | 5                | 6                | 4                | 4      | 4      | 4      |
| Acid Number [mg KOH/g]                 |                    |        |                   |        |        | 3                | 2                | 2                | 2      | 2      | 2      |
| Viscosity Number [cm <sup>3</sup> /g]  | 68                 | 84     | 94                | 80     | 80     | 78               | 80               | 85               | 62     | 61     | 90     |
| Shore D Hardness                       | 79                 | 53     | 64                | 63     | 63     | 27               | 19               | 17               | 80     | 79     | 78     |
| Open Time [s]                          | 5                  | 10     | 5                 | 20     | 5      | 15               | 15               | 50               | 15     | 10     | 20     |
| Tensile Strength [N/mm <sup>2</sup> ]  | 40                 | 25     | 20                | 20     | 15     | 10               | 5                | 2                | 60     | 20     | 50     |
| Elongation at Break [%]                | 7                  | 400    | 450               | 300    | 350    | 400              | 500              | 300              | 5      | 3      | 5      |
| <b>Melt Flow Rate (MFR) [g/10 min]</b> |                    |        |                   |        |        |                  |                  |                  |        |        |        |
| 160 °C                                 |                    | 30     | 10                | 30     | 35     | 100              | 110              | 130              |        |        |        |
| 180 °C                                 |                    | 60     | 20                | 60     | 90     | 220              | 190              | 250              | 10     | 50     | 15     |
| 200 °C                                 | 130                | 120    | 45                | 110    | 150    | 360              | 290              | 400              | 30     | 100    | 30     |
| 220 °C                                 | 240                | 250    | 75                | 210    | 240    |                  |                  |                  | 60     | 190    | 60     |
| <b>Melt Viscosity [Pa s]</b>           |                    |        |                   |        |        |                  |                  |                  |        |        |        |
| 160 °C                                 |                    | 330    | 900               | 300    | 240    | 80               | 80               | 55               |        |        |        |
| 180 °C                                 |                    | 140    | 360               | 150    | 120    | 50               | 40               | 30               |        |        |        |
| 200 °C                                 |                    | 65     | 180               | 80     | 60     | 30               | 25               | 15               | 150    | 70     | 270    |
| 220 °C                                 | 50                 |        |                   |        |        | 10               | 15               | 5                | 90     | 15     |        |
| <b>Solubility</b>                      |                    |        |                   |        |        |                  |                  |                  |        |        |        |
| Methylene chloride                     | -                  | +      | +                 | +      | +      | +                | +                | +                | +      | +      | +      |
| Trichloroethylene                      | -                  | -      | -                 | •      | •      | +                | +                | +                | +      | +      | +      |
| Ethyl acetate                          | -                  | -      | -                 | -      | -      | -                | •                | +                | +      | +      | +      |
| MEK (methylethyl ketone)               | -                  | -      | -                 | -      | -      | -                | •                | +                | +      | +      | +      |
| Toluene                                | -                  | -      | -                 | -      | -      | •                | +                | +                | -      | +      | +      |
| Dioxolane (Dioxacyclopentan)           | -                  | -      | -                 | -      | -      | +                | +                | +                | +      | +      | +      |

1) optical method  
+ = > 10% (soluble)  
• = < 10% (slightly insoluble)  
- = < 1% (virtually insoluble)

# DYNACOLL® S

## Analytical Methods

### Softening Point (Ring and Ball)

Determination according to DIN ISO 4625.

### Melting Point

The melting point is determined by DSC according to DIN 53765 or an optical method (Mettler FP 82).

### Glass Transition Temperature

Determination according to DIN 53 765.

### Hydroxyl Number

Determination according to DIN 53 240-02.

### Acid Number

Determination according to DIN EN ISO 2114.

### Shore D Hardness

Determination in accordance with DIN 53 505.

All values refer to crystallized products.

### Viscosity Number

Determination according to DIN 53 728.

0.5 g of the test substance are dissolved in 100 ml of a mixture of 50 % by weight phenol and 50 % by weight 1,2-dichlorobenzene. The viscosity of the solution and the solvent is determined by the Ubbelohde method. The viscosity number J is determined using the formula:

$$J = \left[ \frac{t_1}{t_2} - 1 \right] \times \frac{1}{c}$$

$t_1$  = flow time of solution [s]

$t_2$  = flow time of solvent [s]

c = concentration of test substance [g/cm<sup>3</sup>]

### Open Time

Determination according to Evonik internal method.

The open time is defined as the time between the application of the adhesive and the start of recrystallization – or in case of amorphous products until the surface becomes tack-free.

### Tensile Strength / Elongation at Break

Determination in accordance with DIN EN ISO 527-1/3.

It is determined on standard dumbbell-shaped specimens. The elongation at break denotes the percentage increase in length of an original section of 10 mm marked on the bar of the dumbbell specimen, at the moment of rupture.

### Melt Flow Rate (MFR)

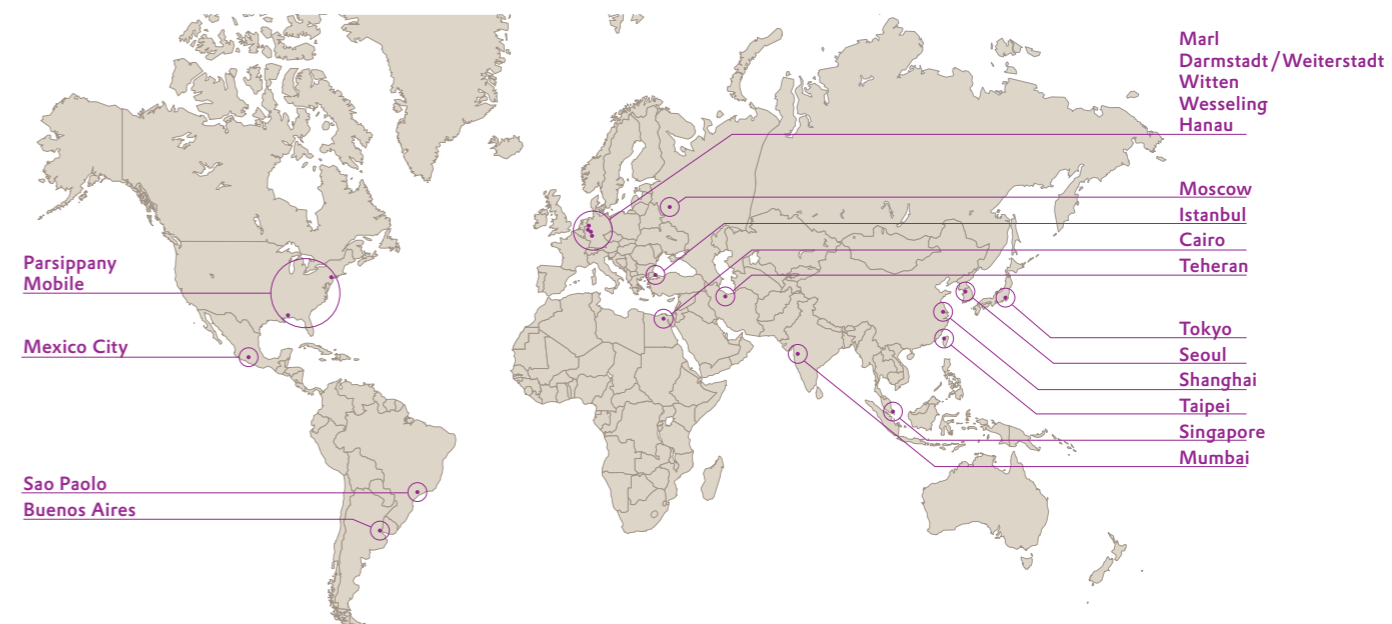
Determination according to DIN ISO 1133.

Approx. 10 g of the test sample are placed in a temperature-conditioned metal cylinder. Via a cylindrical die, a force of 21.6 N acts on the melted sample. The weight of sample flowing through the standardized nozzle within a measured time is used to calculate the MFR. The MFR is expressed as the weight of sample extruded in 10 minutes.

### Melt Viscosity

Determination according to DIN EN ISO 3219, parallel plate method.

## Designed Polymers: Discover our global network



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