

## THE MANY BENEFITS OF A LOWER BAKING TEMPERATURE

# Energy-Efficient Powder Coatings

There are a number of factors in favour of using energy-efficient powder coatings, including a lower baking temperature, possible improvements in quality and plant capacity and a broader range of applications. A number of different energy-efficient powder coating systems are now available. Their properties, benefits and limitations are described in this article.

Many users of powder coatings would like to be able to reduce the curing temperatures of their systems in order to cut their oil or gas consumption. Coating manufacturer FreiLacke has coined the term energy-efficient powder coatings to describe this type of product, which offers other benefits besides the simple reduction in temperature.

### Identifying new applications

Lowering the curing temperature in the oven results in direct savings of oil or gas. In addition, it increases the productivity of the coating plant, where the curing oven frequently acts as a bottleneck. Enlarging the oven is often not possible because of a lack of space. However, at the specified temperatures the conveyor speed can be increased and the oven throughput time reduced.

The use of energy-efficient powder coatings also allows a wider range of

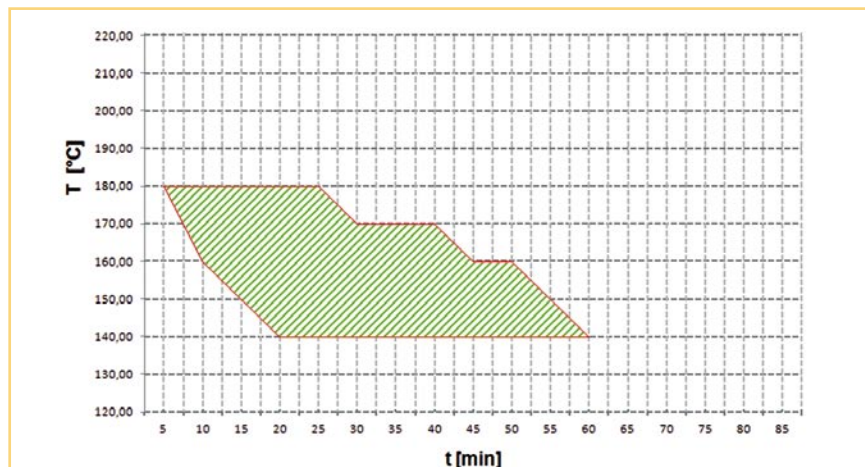


Figure 1: Curing window for an energy-efficient polyester powder coating

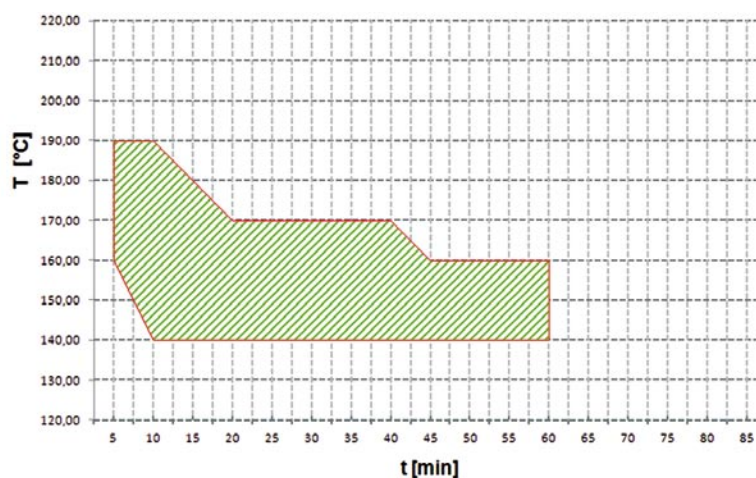
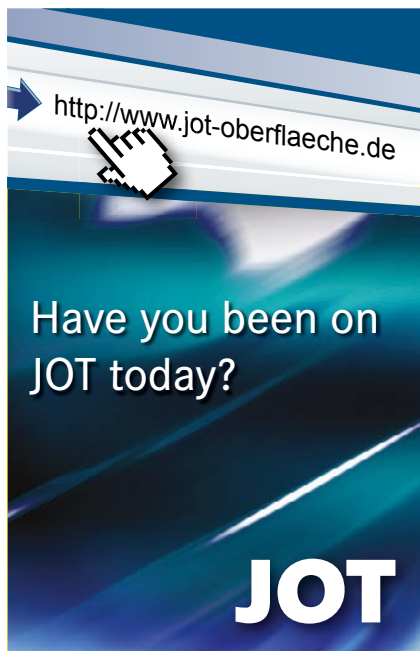


Figure 2: Curing window for an energy-efficient, coarse textured hybrid powder coating

parts to be processed. In the case of parts of a similar type, for example with very thin or very thick walls, the lower peak temperature needed for powder coatings of this kind significantly reduces the risk of discolouration.

The lower temperatures also open up new applications for the powder coating

process. Substrates such as wood products (MDF) or plastic can be coated without problems. Metal substrates which, for functional reasons, cannot be exposed to high temperatures or complete assemblies which also have restrictions on their peak temperature can be coated using these systems.



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Gloss	85-95 GE	85-95 GE
Cross-cut in accordance with ISO 2409	Gt 0	Gt 0
Impact resistance in accordance with DIN EN ISO 6272-1	80 kg cm (front)	80 kg cm (front)
Cupping test in accordance with ISO 1520	6 mm	> 6 mm
<b>Chemical resistance</b> in accordance with DIN EN ISO 2812-2	2 h / room temperature	2 h / room temperature
Hydraulic oil, caustic soda 20%, engine oil, diesel	no change	no change
<b>UV resistance</b>		
UVB 313 test in accordance with DIN EN ISO 11507 process 1A	after 328 h residual gloss 65% test with red coating	after 328 h residual gloss 65% test with red coating
<b>Corrosion resistance</b>		
Salt spray test in accordance with DIN EN ISO 9227 NSS	after 504 h	after 504 h
Delamination from cut edge	7-9 mm	3-5 mm
Condensation water test in accordance with DIN EN ISO 6270-2 CH	after 504 h	after 504 h
Surface blistering	0 (S0)	0 (S0)
Delamination from cut edge	0 mm	0 mm
Surface corrosion	Ri 0	Ri 0
Cross-cut	Gt 0	Gt 0
<i>Note: Test carried out on iron-phosphated steel with a chrome-free passivation</i>		

Table 1: Properties of an energy-efficient powder coating cured at 140°C and 160°C

<b>Automobile</b>	Accessories and bolt-on parts
<b>Mechanical engineering</b>	Motors, gearboxes, cleaning equipment, pumps, tanks and containers, gas bottles, fire extinguishers, sports equipment, household appliances
<b>Job coaters</b>	Facades
<b>Functional furniture and storage technology</b>	Workshop fittings, lockers, metal walls, safes, shelving, shop fittings, shopping trolleys, control cabinets, computer housings, junction boxes
<b>Vehicle construction</b>	Construction vehicles, commercial vehicles, trains and trams, aerospace applications, agricultural machinery, garden machinery, mobile homes and portable cabins
<b>Construction and sanitary</b>	Building components, such as doors, frames, fences, grilles, post boxes, air conditioning systems, radiators

Table 2: Applications for an energy-efficient polyester powder coating grouped by industry

### New products and their properties

Energy-efficient polyester powder coating for exterior use

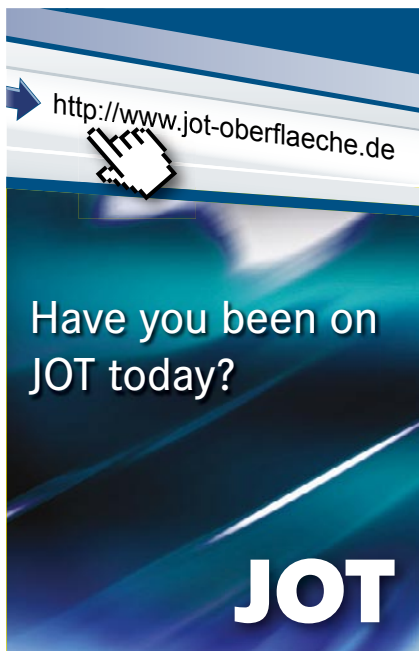
A polyester product which cures at a temperature of 140 °C is available for high-quality exterior applications, such as vehicles or architectural components. Reducing the baking temperature for products of this kind carries the risk that components with a low molecular weight will migrate to the surface of the coating and cause an unattractive milky film to form, a process referred to as blooming. However, polyester powder coatings are now available where blooming does not occur, Figure 1, Tables 1 and 2.

### Hybrid powder coating with a coarse satin-matt texture

Powder coatings have been developed especially to meet the requirements of the mechanical engineering industry with a typical coarse textured surface and a satin finish. The powder coatings begin curing after 10 minutes at 140 °C, Figure 2, Tables 3 and 4. When combined with a liquid paint with a high solid content, which has the same appearance, and also with a water-soluble paint, these powder coatings from FreiLacke form a complete system.

### The limitations of energy-efficient powder coatings

Frequent colour changes or changes between different types of powder coatings, for example at contract coating companies, result in the oven settings or the conveyor speed being constantly adjusted to suit the powder coating currently in use. This involves the risk of the system being operated with empty hangers. In addition, the oven must be set to precisely the required curing temperature for the powder coating. If the curing temperature is too low, the powder coating will not form a satisfactory film and the components will be rejected or will need to be reprocessed. From an energy perspective, constantly changing the temperature of the dryer is inefficient and



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Tests	Object temperatur 140 °C/10 min	Object temperatur 160 °C/10 min
Surface	coarse texture	coarse texture
Gloss	satin	satin
Cross-cut in accordance with ISO 2409	Gt 0	Gt 0
Impact resistance in accordance with DIN EN ISO 6272-1	100 kg cm (front) 30 kg cm (reverse)	100 kg cm (front) 60 kg cm (reverse)
<b>Chemical resistance</b> in accordance with DIN EN ISO 2812-2	1 h / room temperature	1 h / room temperature
Xylol	softening, discolouration, significant change in gloss	
Caustic soda 20 %	no change	no change
Sulphuric acid 10 %	no change	
Salzsäure 10 %	no change	
Mikrozid AF disinfectant	no change	
Nopredisan 135-1 disinfectant	softening, discolouration, reduction in gloss	
Hydraulic oil	no change	
Cutting oil	no change	
Engine oil	no change	no change
Brake fluid	slight softening, significant discolouration	
Diesel	no change	no change
High-octane petrol	no change	
FAM test fuel	softening, slight discolouration, change in gloss	
<b>Corrosion resistance</b>		
Salt spray test in accordance with DIN EN ISO 9227 NSS	after 504 h	after 504 h
Surface blistering	0 (S0)	0 (S0)
Delamination from cut edge	5-8 mm	3-6 mm
Surface corrosion	Ri 0	Ri 0
Edge corrosion	Ri 2	Ri 1
Condensation water test in accordance with DIN EN ISO 6270-2 CH	after 240 h	after 240 h
Surface blistering	0 (S0)	0 (S0)
Delamination from cut edge	0-1 mm	0-1 mm
Surface corrosion	Ri 0	Ri 0
Cross-cut	Gt 0	Gt 0

*Note: Test on clean, untreated steel sheet*

Table 3: Properties of an energy-efficient hybrid powder coating cured at 140°C and 160°C

<b>Mechanical engineering</b>	Machine tools, metalworking machines, textile machines, printing presses, woodworking machines, packaging machines, lifts and escalators, motors, gearboxes, cleaning equipment, pumps, tanks and containers.
<b>Functional furniture and storage technology</b>	Workshop fittings, lockers, safes, control cabinets, computer housings, junction boxes

Table 4: Applications for an energy-efficient hybrid powder coating grouped by industry

not cost-effective. In other words, it is not possible to make full use of the benefits of energy-efficient powder coatings.

The objective of reducing the curing temperature of energy-efficient powder coatings to a minimum also carries the risk that a minor problem with the dryer will result in significant quality problems and therefore the parts will require reprocessing.

The closer the oven temperature is to the permissible lower limit, the nearer the property profile of the powder coating comes to its limits. Energy-efficient powder coatings are less resistant to underbaking than coatings which cure at a standard temperature of 180°C or 200°C. This has a disproportionately damaging effect on their corrosion protection and mechanical properties.

The resins and curing agents used play a decisive role in the formulation of energy-efficient powder coatings. The amount of these coatings currently produced is significantly less than conventional powder coatings, which means that they are more expensive.

### Improving quality

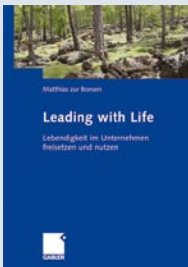
A number of energy-efficient epoxy, hybrid and polyester powder coating systems are available for a wide range of applications and requirements. These systems are ideally suited to production processes where components spend a longer period in a cooler oven or where a faster conveyor speed is possible. Before selecting and using an energy-efficient powder coating, it is important to identify the range of parts to be coated, the requirements the coating must meet and whether the oven has direct or indirect gas heating. In many cases powder coatings can be applied in a more energy-efficient way and also bring improvements in quality. —

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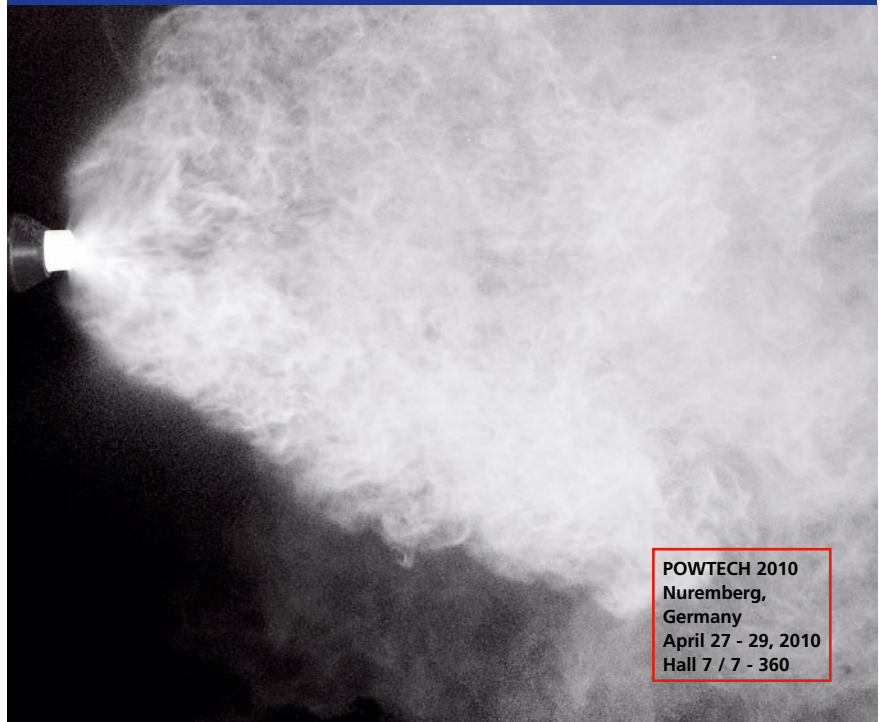
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