

Chemical anchors and mine bolts

Application data and cure data

Nouryon is the world's leading producer of organic peroxides for the curing of thermoset resins, coatings and specialty monomers. We're home to the best known brands in the thermoset market, examples include Butanox[®], Cadox[®], Perkadox[®] and Trigonox[®]. We also offer a range of auxiliary products, such as specialty promoters to meet your specific production requirements.

This application guide introduces you to our thermoset product portfolio and helps you find a suitable curing system for your specific application.

Applications

To fix screws and bolts in rocks, mine walls, bridges by using a body filler

Nouryon curing agents

- Perkadox GB-50XX
- Perkadox 33
- Perkadox 20S

Main products

Sausage mine bolts

- Thermoplastic tube filled with UP resin and filler containing 25 - 30% resin inside the sausage there is a compartment containing the BPO formulation
- UP resin is pre-accelerated with a tertiary amine and inhibitor having a shelf life of approx. 1 year at 30°C and a cure of 30 sec. to 30 min. at ambient temperatures

Glass tubes

- Large glass tube filled with UP resin and sand containing 25 - 35% resin inside this large glass tube there is a small glass tube filled with Perkadox GB-50X, Perkadox 33 or Perkadox 20S

Reason for our products

- High quality
- Good aftersales and technical service
- Safety research
- Worldwide distribution
- Customized application research: special formulated products for an optimal performance in this application

Reactivity figures

Perkadox GB-50X

Cure characteristics at 20°C of 3 phr Perkadox GB-50X + various amines

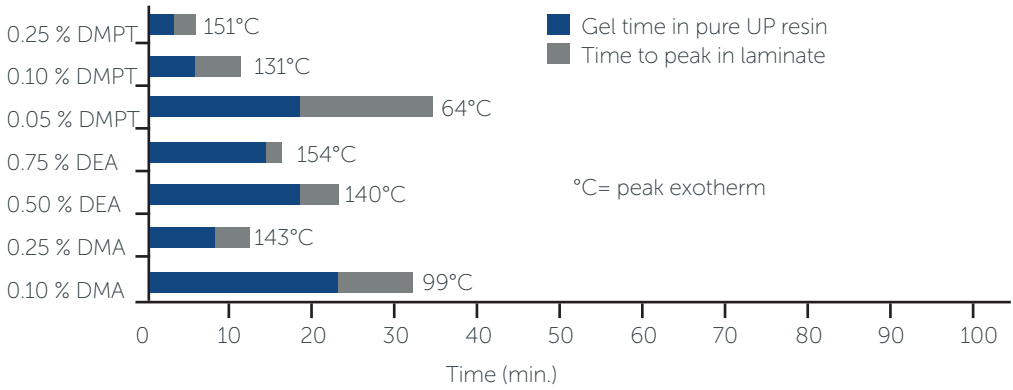
Gel time in 100 grams pure UP resin.

Time to peak exotherm and peak exotherm measured in 4 mm laminates.

DMA = Dimethylaniline-100%

DEA = Accelerator NL-64-100

DMPT = Accelerator NL-65-100



Cure data

Perkadox GB-50X

Perkadox GB-50X is a free flowing, fine, granular powder containing 50% dibenzoyl peroxide for the curing of unsaturated polyester and acrylic resins at ambient and elevated temperatures. At temperatures up to 80°C, Perkadox GB-50X should be used in combination with an aromatic tertiary amine accelerator. Above 80°C the use of an accelerator is not required.

Perkadox GB-50X is easy to handle, easy to disperse and dissolves very quickly in unsaturated polyester resins and acrylic resins. When in acrylic resins a very high degree of transparency of the cured part is required the special grade Perkadox GB-50XL is advised. The curing system Perkadox GB-50X/amine accelerator shows a very fast cure that is hardly influenced by humidity and fillers. Even at low temperatures a relatively good cure will be obtained. A disadvantage may be the yellow colour and poor light resistance of the molded product.

For curing at ambient temperature the following amine accelerators are available to adjust the gel time and speed of cure of the cure system based on Perkadox GB-50X:

- Accelerator NL-65-100 (N,N-Dimethyl p toluidine) for short gel times
- Accelerator NL-64-100 (N,N-Diethyl aniline) for long gel times

Dosing

Depending on working conditions, the following peroxide and accelerator dosage levels are recommended:

Perkadox GB-50X

2 - 5 phr *

Amine accelerator

0.05 - 0.5 phr

*(parts per hundred resin)

Cure characteristics

In a **high** reactive standard orthophthalic polyester resin the following application characteristics were determined.

GELTIME CLEAR RESIN AT 20°C (GELNORM)

UP resin	100	100	100	100	100
Perkadox GB-50X	3.0	3.0	3.0	3.0	3.0
Accelerator NL-64-100	0.1	0.5			
Accelerator NL-65-100			0.0	0.1	0.4
Gel time (minutes)	160	20	20	5	1

Cure of 1 mm pure resin layer at 20°C

The speed of cure is expressed as the time to reach a Persoz hardness of respectively 30, 60 and 120 s.

	Persoz	30	60	120	s
3 phr Perkadox GB-50X + 0.1 phr Accelerator NL-64-100			0.5	1	h
3 phr Perkadox GB-50X + 0.05 phr Accelerator NL-65-100	1		2.5	14	h
3 phr Perkadox GB-50X + 0.1 phr Accelerator NL-65-100				0.5	h

Cure of 4 mm laminates at 20°C

4 mm laminates have been made with 450 g/m² glass chopped strand mat. The glass content in the laminates is 30% (w/w).

The following parameters were determined:

- Time temperature curve
- Speed of cure expressed as the time to achieve a Barcol hardness (934-1) of 0-5 and 25-30 respectively.
- Residual styrene content after 24h at 20°C and a subsequent postcure of 8h at 80°C.

	GEL TIME (min.)	TIME TO PEAK (min.)	PEAK EXOTHERM (°C)	
	3 phr Perkadox GB-50X + 0.5 phr Accelerator NL-64-100	21	26	140
3 phr Perkadox GB-50X + 0.05 phr Accelerator NL-65-100	28	35	64	
	BARCOL		RESIDUAL STYRENE	
	0-5 (h)	25-30 (h)	24 h 20°C (%)	+8 h 80°C (%)
3 phr Perkadox GB-50X + 0.5 phr Accelerator NL-64-100		<1	2.9	2.1
3 phr Perkadox GB-50X + 0.05 phr Accelerator NL-65-100	1	8.5	6.6	0.8

Perkadox 33

For some special applications it is desirable to use a dry benzoyl peroxide powder as a catalyst. For these cases the benzoyl peroxide formulation Perkadox 33 was introduced, which is a mixture of benzoyl peroxide and filler. Perkadox 33 can be handled very easily and without risk. It contains no plasticizer and is lower concentrated than the usual benzoyl peroxide formulations, which makes dosing easier.

One of the most important applications for Perkadox 33 is as a catalyst for putties based on unsaturated polyester resins. A putty containing an accelerated polyester resin and Perkadox 33 cures rapidly so that after a short time the surface can be sanded and polished.

The putty is made of two components, viz.:

- a) A powder consisting of a mixture of filler with pigment and Perkadox 33 as a catalyst.
- b) A liquid component consisting of polyester resin and N,N-Dimethylaniline or NL-65-100, or alternatively, a polyester resin with a built-in amine accelerator.

When the putty has to be applied component a) and b) are mixed.

The manufacturer of these putties should take care that the powder contains Perkadox 33 and the liquid component the Accelerator, in such amounts that after mixing the two components there is enough time to apply the putty. A good formulation proved to be:

Component a

- 5-10% Perkadox 33, calculated on the resin
- Filler, as much as desired
- Pigment

Component b

- Resin
- 0.05-0.15% N,N-Dimethylaniline

In component a) the last two components not only have a considerable influence on the properties of the putty, but also on the stability of the catalyst and the cure speed.

Some fillers and pigments cause a decomposition of the benzoyl peroxide so that no cure is obtained.

Experiments of Perkadox 33 together with fillers gave the following results:

FILLER	INFLUENCE ON STABILITY
caborundum	no influence
gypsum	no influence
mica	no influence
wood flour	no influence
chalk	no influence
quartz flour	no influence
pumice powder	no influence
talc, pure	no influence
aluminum powder	weak influence

asbestine, pure	weak influence
infusorial earth, kieselguhr (pure)	weak influence
lithopone	weak influence
microdol	weak influence
iron oxide, red	weak influence
iron powder	weak influence
slate powder	weak to moderate influence
titanium dioxide (rutile)	weak to moderate influence
graphite	strong influence
china clay	strong influence
bentone 34	very strong influence
carbon black	very strong influence

It is clear that the latter two substances are not suitable for this purpose. We would like to point out that these details only refer to the products which we have investigated. Similar products from other sources may behave differently, so that we recommend carrying out some tests in individual cases.

When the filler is added just before use the influence of the filler on the cure speed of the putty is slight, as the inhibiting effect appears only after a certain time of storage. China clay, however, gives an immediate inhibition. Most pigments more or less accelerate the cure.

When applying these putties the following rules should be observed:

- The base must be completely dry.
- The base must be well cleaned and free of grease.
- When using Perkadox 33 the temperature during application must be higher than 15°C.
- Storage of the putty components must be at a cool dark place (see data sheet).

Perkadox 20S

For some special applications it is desirable to use a dry benzoyl peroxide powder as a catalyst. For these cases the benzoyl peroxide formulation Perkadox 20S was introduced, which is a mixture of benzoyl peroxide and filler. Perkadox 20S can be handled very easily and without risk. It contains no plasticizer and is lower concentrated than the usual benzoyl peroxide formulations, which makes dosing easier.

One of the most important applications for Perkadox 20S is as a catalyst for putties based on unsaturated polyester resins. A putty containing an accelerated polyester resin and Perkadox 20S cures rapidly so that after a short time the surface can be sanded and polished.

The putty is made of two components, viz.:

- a) a powder consisting of a mixture of filler with pigment and Perkadox 20S as a catalyst.
- b) a liquid component consisting of polyester resin and N,N-Dimethylaniline or NL-65-100, or alternatively, a polyester resin with a built-in amine accelerator.

When the putty has to be applied component a and b are mixed.

The manufacturer of these putties should take care that the powder contains Perkadox 20S and the liquid component the Accelerator, in such amounts that after mixing the two components there is enough time to apply the putty. A good formulation has proved to be:

Component a

- 8-17% Perkadox 20S, calculated on the resin
- filler, as much as wanted
- pigment

Component b

- resin
- 0.05-0.15% N,N-Dimethylaniline

In component a) the last two components not only have a considerable influence on the properties of the putty, but also on the stability of the catalyst and the cure speed.

Some fillers and pigments cause a decomposition of the benzoyl peroxide so that no cure is obtained.

Experiments of Perkadox 20S together with fillers gave the following results:

FILLER	INFLUENCE ON STABILITY
caborundum	no influence
gypsum	no influence
mica	no influence
wood flour	no influence
chalk	no influence
quartz flour	no influence
pumice powder	no influence
talc, pure	no influence
aluminum powder	weak influence

asbestine, pure	weak influence
infusorial earth, kieselguhr (pure)	weak influence
lithopone	weak influence
microdol	weak influence
iron oxide, red	weak influence
iron powder	weak influence
slate powder	weak to moderate influence
titanium dioxide (rutile)	weak to moderate influence
graphite	strong influence
china clay	strong influence
bentone 34	very strong influence
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When the filler is added just before use the influence of the filler on the cure speed of the putty is slight, as the inhibiting effect appears only after a certain time of storage. China clay, however, gives an immediate inhibition. Most pigments more or less accelerate the cure.

When applying these putties the following rules should be observed:

- the base must be completely dry.
- the base must be well cleaned and free of grease.
- when using Perkadox 20S the temperature during application must be higher than 15°C.
- storage of the putty components must be at a cool dark place (see data sheet).

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Additional information

Product Data Sheets (PDS) and Safety Data Sheets (SDS) for our polymerization initiators are available at www.nouryon.com

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Nouryon

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