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PB 170 - PB 250 - PB 400 - PB 600 / DM 1x

Epoxy foam

The two-component foaming epoxy systems PB enable the production of low density epoxy foams, ranging from 170 to 600 kg/m^3 depending on the selected grade. Designed for robustness and ease to use, these systems feature a convenient 2/1 volumetric mixing ratio and deliver excellent density uniformity. With the two hardener option offering different reactivity profiles, the system offers flexibility to optimize curing time according to the thickness of the application.

		PB 170 - PB 250 - PB 400 - PB 600	
		DM 12	**DM 13**
Reactivity		Slow	Fast
Mixing ratio	By volume	2 / 1	
Expanded density (kg/m^3)		170 to 600	
Expansion ratio		1.9 to 6.6	
Compression			
Modulus	N/mm²	85 - 340	80 - 335
Yield strength	N/mm²	2 - 25	3 - 27
Offset compression yield	%	3.35 - 11.8	4.9 - 14.2
T_g2 (°C)		93	89

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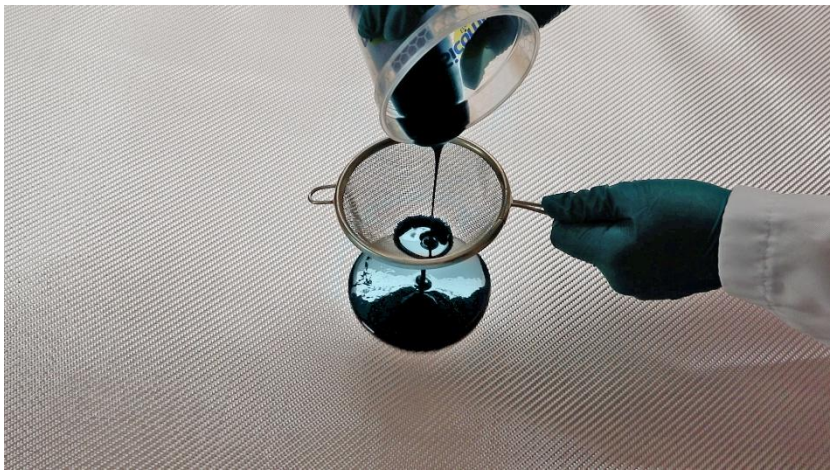
Recommendations for use

Homogenize the resin using a propeller agitator before use. Be sure to scrape the sides and bottom of the bucket. When mixing the two components, air is incorporated. These bubbles can be largely removed by passing the mixture through a stainless steel sieve with a mesh size of 1 to 2 mm.

The foam expansion is much faster than its polymerization. Mixing and spraying or casting operations must therefore be carried out quickly.



Industrial equipment

For optimal results, the use of a low-pressure mixing and dosing system equipped with a static mixer is recommended.

Exotherm

The polymerization reaction is exothermic. Excessive heat release can compromise the homogeneity of the cellular structure as well as the final mechanical properties of the expanded foam.

Casting tests were conducted at 20 °C in cylindrical containers with a diameter of 33 cm to determine the maximum casting and expansion thicknesses that ensure optimal quality of the final product (see table below).

The values obtained are provided for guidance only. It is strongly recommended to perform preliminary tests under actual production conditions to validate the process parameters. Indeed, the specific conditions of each application can significantly influence the reaction kinetics and heat dissipation.

The main factors affecting the exothermic reaction are as follows:

- Thermal conductivity of the mold
- Mold configuration (closed or open)
- Temperature of the materials and ambient temperature
- Geometry, thickness, volume, and mass of the casting

Temperature : 20 °C		Maximum casting thickness (cm)*	Ratio d'expansion	Maximum expanded thickness (cm)*
PB 170	DM 12	1.8 ± 0.2	6.6 ± 0.7	12 ± 1.2
	DM 13	0.8 ± 0.1		5 ± 0.5
PB 250	DM 12	1.8 ± 0.2	4.5 ± 0.5	8 ± 0.8
	DM 13	0.9 ± 0.1		4 ± 0.4
PB 400	DM 12	1.8 ± 0.2	2.8 ± 0.2	5 ± 0.5
	DM 13	1.1 ± 0.1		3 ± 0.3
PB 600	DM 12	2.1 ± 0.2	1.9 ± 0.2	4 ± 0.4
	DM 13	1.6 ± 0.1		3 ± 0.3

*Under the test conditions described.

Demolding

If a demolding step is necessary, it is recommended to apply a post curing cycle (once the resin is totally hard) for at least 4 hours at 40 °C. This step ensures the dimensional stability of the part.

Thermal conductivity

Material	Density (kg/m^3)	λ at 20 °C (W/m.K)
Copper	8 960	385
Steel	7 850	45 - 60
Concrete	2 300	1.4 - 1.8
Wood	500 - 700	0.12 - 0.20
PB 170 – PB 600	170 - 600	0.06 - 0.16
Expanded polystyrene	10 - 40	0.03 - 0.05
Air	1.2	0.025

Security & Safety

Immediately after mixing resin and hardener, a foaming reaction occurs and dihydrogen (H_2) is released.

1 kg of mix may release up to several liters of H_2 at 22 °C.

H_2 has no toxicological effect and no known ecological impact. Nevertheless, as it is a very flammable gas, ensure adequate ventilation to prevent localized accumulation. Work far from all sources of sparks and open flames.

Ensure that packages are properly closed to prevent contamination or reaction of resin with acids, bases or strong oxidizers that may cause the undesired release of H_2.

Caution when opening resin: slight internal overpressure may be present. In some cases, bubbles may appear on the surface of the resin. This phenomenon has no impact on the performance or appearance of the final product.

Resins

		PB 170	PB 250	PB 400	PB 600
Aspect and color		White liquid			
Viscosity (mPa.s)	20 °C	15 000	22 000	22 000	32 000
	25 °C	8 000	12 000	12 000	16 000
	30 °C	4 500	7 500	7 000	10 000
Density (kg/L)	20 °C	1.18	1.19	1.19	1.25
Shelf life	23 °C	12 months			

Hardeners

		DM 12	DM 13
Reactivity		Slow	Fast
Aspect et color		Colorless liquid	Orange liquid
Gardner color		< 2	< 12
Viscosity (mPa.s)	20 °C	475	645
	25 °C	310	425
	30 °C	210	295
Density (kg/L)	20 °C	0.99	1.01
Biobased carbon content (%)		0	27*
Shelf life	23 °C	24 months	12 months

*Calculated value

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Mixtures PB 170 - PB 250 - PB 400 - PB 600 / DM 1x

		PB 170		PB 250	
		DM 12	DM 13	DM 12	DM 13
Mixing ratio	By weight	100 / 43		100 / 42	
	By volume	2 / 1		2 / 1	
Initial viscosity (mPa.s)	20 °C	5 000	4 700	5 800	7 300
	30 °C	2 100	2 900	2 800	4 900
Gel time (1 mm)	20 °C	21 h 15	8 h 00	19 h 30	8 h 00
	30 °C	11 h 30	4 h 30	11 h 00	4 h 30
Expanded density (kg/m³)	20 °C	170 ± 20		250 ± 25	
Expansion ratio	20 °C	6.6 ± 0.7		4.5 ± 0.5	

		PB 400		PB 600	
		DM 12	DM 13	DM 12	DM 13
Mixing ratio	By weight	100 / 42		100 / 39	
	By volume	2 / 1		2 /1	
Initial viscosity (mPa.s)	20 °C	6 300	6 500	9 300	8 400
	30 °C	3 500	4 000	3 800	4 400
Gel time (1 mm)	20 °C	21 h 30	7 h 30	17 h 15	6 h 45
	30 °C	10 h 30	4 h 00	9 h 45	4 h 00
Expanded density (kg/m³)	20 °C	400 ± 30		600 ± 40	
Expansion ratio	20 °C	2.8 ± 0.2		1.9 ± 0.2	

Post-curing

The mechanical properties on an epoxy system can be optimized through the implementation of a post-curing cycle. The Sicomin laboratory uses predefined cycles to create technical data sheets and facilitate the comparison of different systems. These experimental cycles can be adapted to the specific target application, taking into account the following parameters:

- Selected epoxy system (T_g2)
- Available heating methods
- Dimensions and sampling of the piece
- Nature of the tooling (thermal conductivity of the material)

Many system can provide good mechanical properties after curing at room temperature (>18 °C) for 24 to 48 hours before demolding. However, mechanical properties improve rapidly with a slightly higher temperature, around 40 °C, for several hours.

Epoxy systems with high T_g and slow hardeners imperatively require post-curing at higher temperature. The post-curing can start immediately after the exothermic peak, but it can also begin later, after the assembly of different components and before finishing operations. If the nature of the models and tooling is not suitable for high temperatures, we recommend carrying out the initial steps up to a maximum admissible temperature, then, after cooling and demolding, continuing the cycle with suitable former.

For a conventional epoxy system, we recommend a step-by-step cycle of 20 °C each for a duration of 4 hours.

Example for an epoxy system with a T_g2 of 100 °C:

4 h at 40 °C + 4 h at 60 °C + 4 h at 80 °C + cooling at room temperature before demolding.

There are many epoxy systems with short, high temperature curing cycles that do not fit into this post-curing scheme (pultrusion, hot press, pre-preg). For these systems, the initial curing achieves maximum mechanical performance without post-curing.

We invite you to contact our technical department for any questions on this subject.

Mechanical properties on cast resin (10 mm thickness)

		PB 170			
		DM 12		DM 13	
Post-curing cycle*		24 h 40 °C	16 h 60 °C	24 h 40 °C	16 h 60 °C
Density	kg/m³	168	176	179	174
Tensile					
Modulus	N/mm²	150	140	165	145
Maximum strength	N/mm²	2	2	2	2
Elongation at max. strength	%	1.6	1.8	1.6	1.7
Flexion					
Modulus	N/mm²	150	135	130	130
Maximum strength	N/mm²	3	3	3	3
Elongation at max. strength	%	2.4	2.8	2.3	2.8
Shear					
Breaking strength	N/mm²	1.3	1.4	1.4	1.4
Compression					
Modulus	N/mm²	85	88	85	80
Yield strength	N/mm²	2	2	3	3
Offset compression yield	%	3.5	4.2	7.4	4.9
Glass transition					
T_g1	°C	64	78	68	81
T_g2	°C		88		85

*These post-curing cycles are applied after a 24 hour ambient temperature hardening period, allowing to surpass gel point and the exothemic peak.

Mechanical tests are carried out on samples of pure cast resin, without prior degassing, between steel plates.

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		PB 250			
		DM 12		DM 13	
Post-curing cycle*		24 h 40 °C	16 h 60 °C	24 h 40 °C	16 h 60 °C
Density	kg/m³	248	239	266	264
Tensile					
Modulus	N/mm²	275	280	295	285
Maximum strength	N/mm²	4	4	4	4
Elongation at max. strength	%	2.0	2.1	2.0	2.1
Flexion					
Modulus	N/mm²	250	250	245	235
Maximum strength	N/mm²	6	6	6	6
Elongation at max. strength	%	3.1	3.2	3.3	3.8
Shear					
Breaking strength	N/mm²	2.7	3.0	2.8	2.9
Compression					
Modulus	N/mm²	150	145	145	135
Yield strength	N/mm²	4	5	5	5
Offset compression yield	%	4.9	6.6	7.8	9.1
Glass transition					
T_g1	°C	64	80	67	82
T_g2	°C		88		87

*These post-curing cycles are applied after a 24 hour ambient temperature hardening period, allowing to surpass gel point and the exothemic peak.

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		PB 400			
		DM 12		DM 13	
Post-curing cycle*		24 h 40 °C	16 h 60 °C	24 h 40 °C	16 h 60 °C
Density	kg/m³	395	388	399	397
Tensile					
Modulus	N/mm²	495	460	500	480
Maximum strength	N/mm²	6	7	7	7
Elongation at max. strength	%	1.6	2.1	2.3	1.9
Flexion					
Modulus	N/mm²	515	470	485	485
Maximum strength	N/mm²	12	13	13	14
Elongation at max. strength	%	2.9	3.7	3.8	3.8
Shear					
Breaking strength	N/mm²	5.9	6.2	6.1	6.5
Compression					
Modulus	N/mm²	250	235	235	235
Yield strength	N/mm²	11	11	11	12
Offset compression yield	%	7.7	9.9	9.3	10.0
Glass transition					
T_g1	°C	63	77	65	80
T_g2	°C		88		87

*These post-curing cycles are applied after a 24 hour ambient temperature hardening period, allowing to surpass gel point and the exothemic peak.

Mechanical tests are carried out on samples of pure cast resin, without prior degassing, between steel plates.

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		PB 600			
		DM 12		DM 13	
Post-curing cycle*		24 h 40 °C	16 h 60 °C	24 h 40 °C	16 h 60 °C
Density	kg/m³	594	599	593	620
Tensile					
Modulus	N/mm²	1 050	1 050	1 050	1 000
Maximum strength	N/mm²	11	11	11	12
Elongation at max. strength	%	1.2	1.2	1.2	1.4
Flexion					
Modulus	N/mm²	1 100	1 000	1 050	985
Maximum strength	N/mm²	20	19	21	19
Elongation at max. strength	%	2.0	2.0	2.2	2.1
Shear					
Breaking strength	N/mm²	10.2	10.1	11.7	11.6
Compression					
Modulus	N/mm²	340	325	335	330
Yield strength	N/mm²	25	25	25	27
Offset compression yield	%	11.4	11.8	12.1	14.2
Glass transition					
T_g1	°C	65	80	69	81
T_g2	°C		93		89

*These post-curing cycles are applied after a 24 hour ambient temperature hardening period, allowing to surpass gel point and the exothemic peak.

Mechanical tests are carried out on samples of pure cast resin, without prior degassing, between steel plates.

Measurements are carried out following norms:

Physical properties

Gardner color	*NF EN ISO 4630*
Viscosity	*NF EN ISO 3219 - Rheometer, geometry cone/plate 50 mm - 2 ° at 10 s^{-1}*
Liquid density	*ISO 2811-1 - Pycnometer*
Powder density	*NF EN ISO 1183-3 – Helium pycnometer*
Foam density	*NF EN ISO 845*
Biobased carbon content	*ASTM D68166-16 – Some values are theoretically calculated*

Reactivity

Gel time	*Time sweep G' = G''- Rheometer, geometry plate/plate 50 mm*
Pot life	*Mean time to reach 50 °C or limit time for use*

Thermal properties

Glass transition	*NF EN ISO 11357-2 - Ramp from -5 to 180 °C at 20 °C/min* *T_g onset : 1^{er} pass* *T_g onset max. : 2^{nd} pass*

Mechanical properties

Tensile	*ISO 527-2*
Flexion	*ISO178*
Compression	*ISO 604 ou NF EN ISO 844 (foams)*
Charpy impact strength	*NF EN ISO 179-1*
Shear	*ASTM D732-17 (Punch tool)*
Toughness	*ISO 13586:2000*

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