

Flame retardants for engineering plastics

ACTILOX[®]

ACTILOX[®] B

Nabaltec



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Co-flame retardants for engineering plastics

The unique features of Nabaltec Boehmites offer a wide range of possibilities in demanding high temperature applications

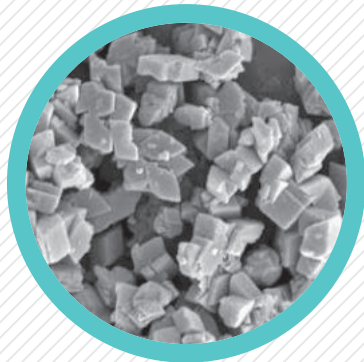
ACTILOX® and **ACTILOX® B** products are extremely pure, crystalline boehmites with a very low ATH residue (purity min. 99%). This guarantees an extraordinarily high temperature stability.

ACTILOX® and **ACTILOX® B** can be processed up to 340 °C. These products have a very good chemical resistance, especially a very high acid resistance.

Nomenclature and properties of aluminium hydroxide

ACTILOX® ACTILOX® B	Al(OH)₃
Chemical	Aluminium oxide hydroxide
Mineral	Boehmite
Common name	Aluminium monohydrate
Abbreviation	AOH
Loss on ignition	17 %
Density:	3.0 g/cm ³
Mohs hardness	3 - 4
pH	7 - 8

Product advantages of ACTILOX® / ACTILOX® B



- high thermal stability, processing up to 340 °C
- synergistic flame retarding effects
- high purity
- low electrolyte content
- high acid-resistance
- high thermal conductivity
- low Mohs hardness
- decomposition only slow up to approx. 400 °C
- excellent resin compatibility
- moderate alkalinity
- low water uptake
- scavenging of corrosive by-products
- high thermal capacity ($c_p = 1.54 \text{ J/gK}$ at 500 K (227 °C))

ACTILOX® / ACTILOX® B combine properties like inert chemical behaviour, good flow properties and low abrasion tendency and therefore act as a very effective co-flame retardant. **ACTILOX® / ACTILOX® B** functions together with many flame retardants commonly used for engineering plastics.

Especially in combination with phosphorous (PFR) and nitrogen based halogen free flame

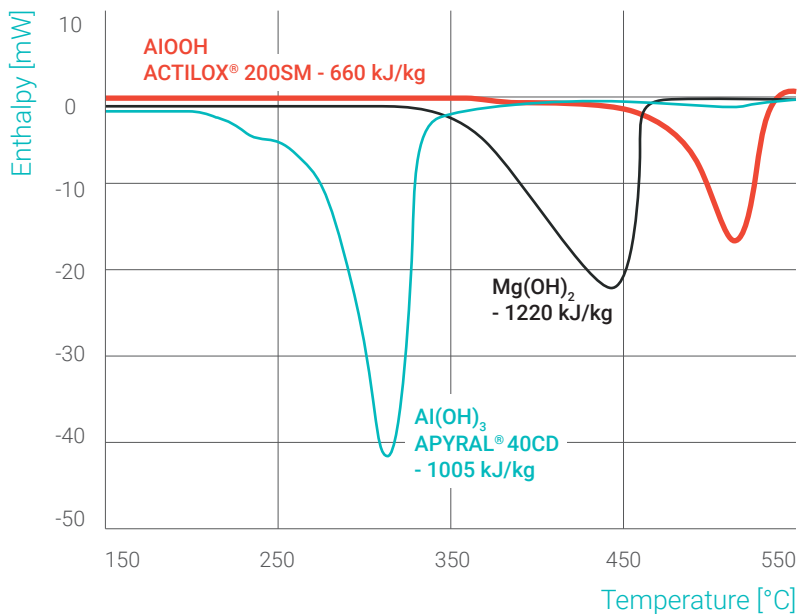
retardants (NFR) like diethylphosphinate aluminium salt (DEPAL) or melamine polyphosphate (MPP), **ACTILOX® / ACTILOX® B** can satisfy highest performance requirements.

Contrary to many other mineral flame retardants, Boehmite is advantageous for applications in high shear compounding or injection moulding processes.

The amphoteric character supports a scavenging of corrosive by-products, protecting machines,

tools and especially the polymer matrix from corrosion or degradation in melt flow processes.

Product Parameters	Unit	ACTILOX® 200SM	ACTILOX® B60	ACTILOX® B30
AlOOH	% min	99	99	99
Moisture	% max	0.6	0.2	0.2
Spec. surface area (BET)	m ² /g	17	5	3
D ₁₀	µm	0.2	0.6	1
D ₅₀	µm	0.35	1.2	2.3
D ₉₀	µm	0.6	2	5
Bulk density	kg/m ³	230	400	650
Oil absorption	ml/100g	36	28	25
Whiteness	% min	97	98	94
Spec. conductivity	µS/cm max	150	80	35



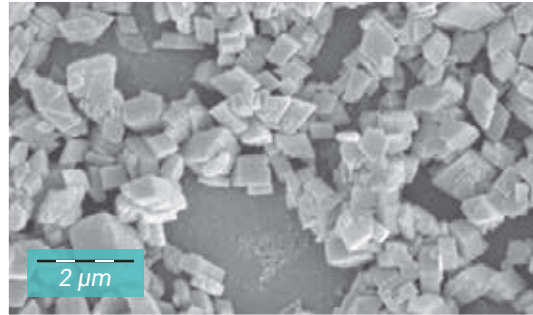
Processing behaviour

The advantageous compounding behavior is based on the special orthorhombic crystal structure of our **ACTILOX®** products.

This cubic like structure imparts very little frictional stress to polymers. Also chemical

induced degradation of polycondensates like polyamides and polyesters is extremely limited with **ACTILOX®** / **ACTILOX® B**. This is because these boehmites combine intrinsically moderate alkalinity with a very low moisture level achieved by Nabaltec's proprietary drying technology.

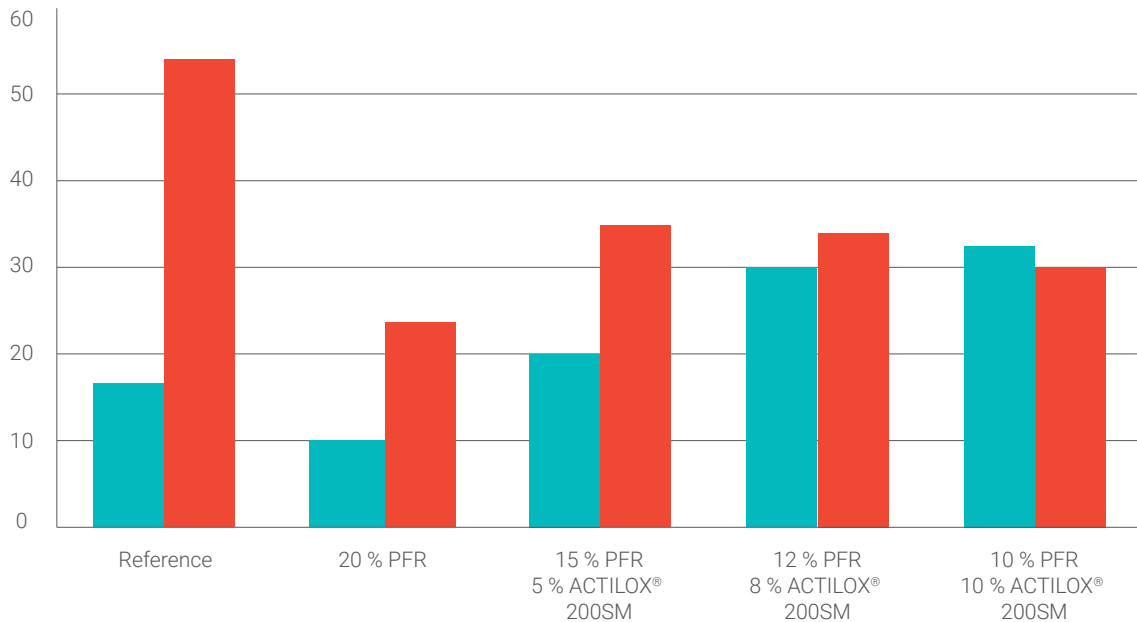
The diagram below displays melt volume rates (MVR) for poly(butyl-terephthalate) reinforced with 20 wt.-% glass fibres (PBT GF20) and nylon reinforced with 30 wt.-% glass fibres (PA66 GF30) containing different compositions of flame retardants. The formulations containing **ACTILOX®** show higher MVR than the flame retardant reference compounds not containing any boehmite. This MVR increase is not based on any polymer chain scission, as analysis has proven.



SEM image of **ACTILOX® B60**

Composition of test compounds

	Reference		PFR		Synergistic combinations					
PBT	80	-	60	-	60	-	60	-	60	-
PA66	-	70	-	50	-	50	-	50	-	50
GF	20	30	20	30	20	30	20	30	20	30
PFR	-	-	20	20	15	15	12	12	10	10
ACTILOX® 200SM	-	-	-	-	5	5	8	8	10	10



■ MVR of PBT [cm³/10 min @ 250 °C / 2.16 kg] ■ MVR of PA [cm³/10 min @ 275 °C / 5 kg]

PFR = Exolit™ OP 1200; Exolit™ OP 1312



Flame retardancy performance

Flame retardancy performance

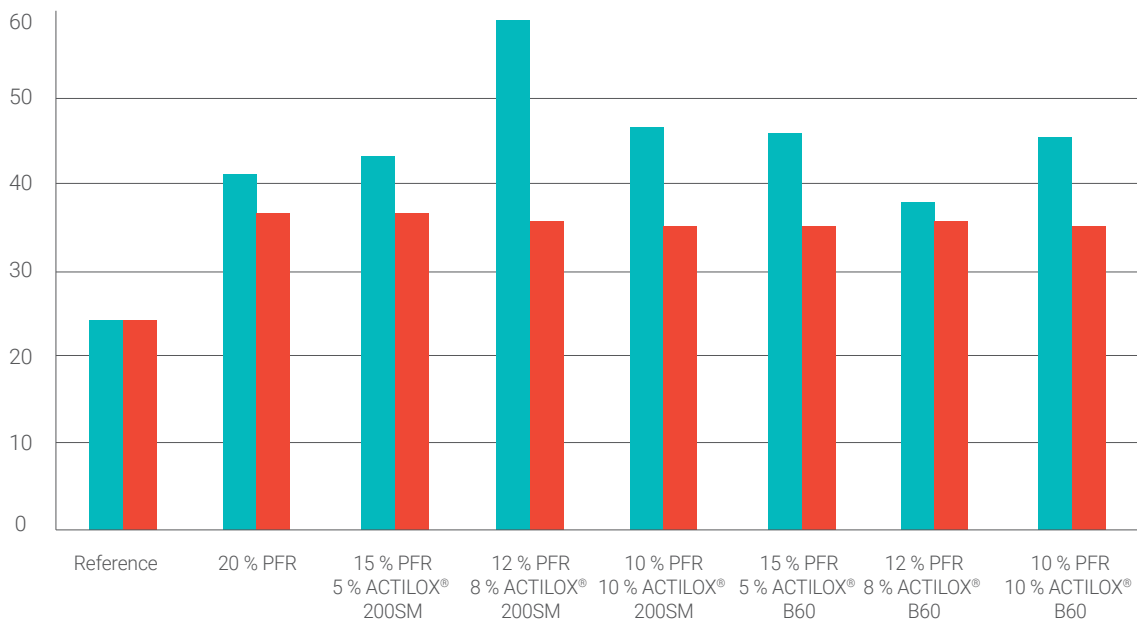
ACTILOX® / ACTILOX® B reveal the optimal synergistic performance in combination with commercially available halogen free flame retardants (HFFR) on a phosphorous (PFR) and nitrogen (NFR) base. A required UL 94 classification can be achieved in various formulations.

The usage of **ACTILOX® / ACTILOX® B** in such systems sets an optimal balance between heat re-

lease, char formation and generation of inert gases to extinguish flames most effectively.

Its ability to reduce smoke production is one further benefit of **ACTILOX® / ACTILOX® B**.

The diagram shows limiting oxygen index (LOI) as an indication for ignitability for the two compound series based on PBT GF20 and PA66 GF30 introduced before.



■ LOI of PBT GF20 [%O₂] ■ LOI of PA66 GF30 [%O₂]

PFR = Exolit™ OP 1200; Exolit™ OP 1312

The following tables display the corresponding UL94-V test results determined on 1.6 mm thick specimen (all have been prepared by injection moulding).

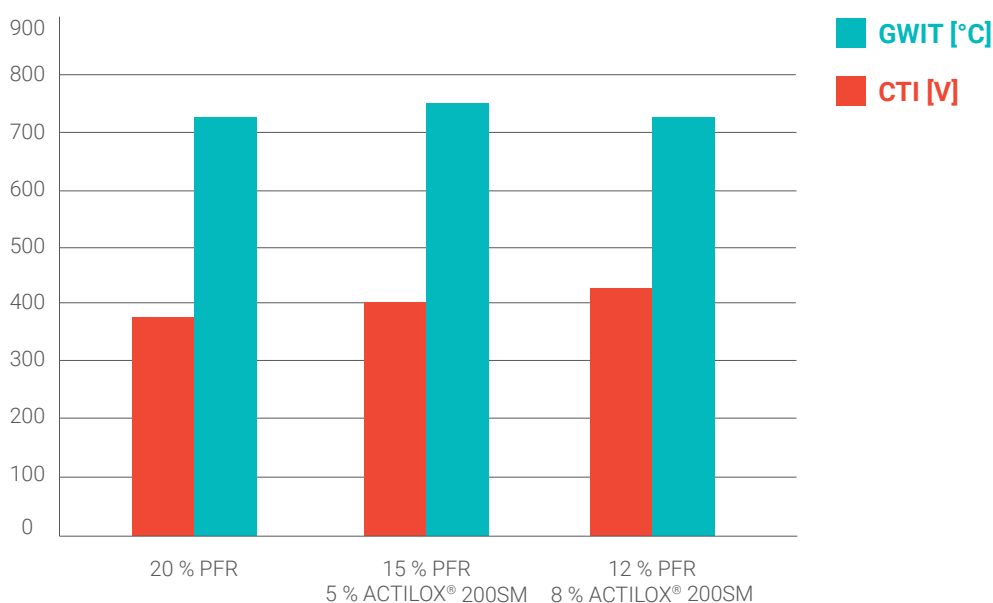
PA 66 GF30 PFR = Exolit™ OP 1312	
Ratio PFR / ACTILOX® 200SM	UL 94-V @ 1.6 mm
20 / 0	V0
15 / 5	V0
12 / 8	V0
10 / 10	V0

PBT GF20 PFR = Exolit™ OP 1200	
Ratio PFR / ACTILOX® 200SM	UL 94-V @ 1.6 mm
20 / 0	V0
15 / 5	V0
12 / 8	V0
10 / 10	V2

The glow wire test procedure indicates a very good performance of **ACTILOX® / ACTILOX® B** containing specimen produced by injection moulding. This is especially important for applications in connectors and switches.

The electrical insulation performance of such parts can be improved by the ability of **ACTILOX® / ACTILOX® B** to neutralize acidic by-products released by FR.

This effect is demonstrated by Comparative Tracking Index (CTI) measurements. CTI and Glow Wire Ignition Temperature (GWIT) for the different PBT GF20 formulations are plotted in the following diagram. Especially CTI can be increased when using **ACTILOX® 200SM** in combination with PFR.



PFR = Exolit™ OP 1200

ACTILOX® / ACTILOX® B reveals its excellent performance as flame retardant synergist also in halogenated flame retardant polymers. Halogenated flame retardants release acidic decomposition products during processing. Low molecular brominated flame retardant (BrFR) suffer from migration issues. Polymeric versions of BrFR reduce these migration issues. Antimony trioxide (ATO) is commonly used as a synergist to BrFR. ATO has some health and safety issues and promotes the formation of smoke in the case of a fire. In addition its high fluctuating price and limited availability makes ATO a candidate for substitution.

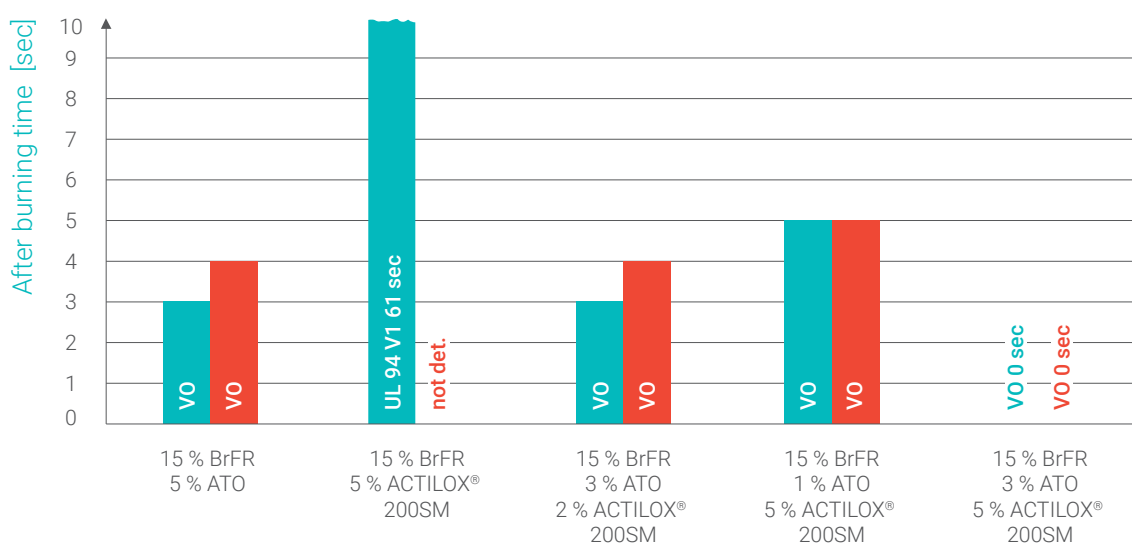
In the following two diagrams UL94-V and glow wire test results for a flame retardant system based on a polymeric brominated flame retardant

(brominated poly-styrene-co-butadiene) is displayed for PA66 GF30.

ACTILOX® 200SM cannot fully substitute antimony trioxide (ATO), as seen by the second formulation starting from the left. But 2 wt.-% of ATO based on the reference formulation (far right) can easily be substituted without any loss of performance. With increasing content of **ACTILOX® 200SM** and reduced ATO level the FR performance can be improved (increase of GWIT or reduction of after-burning time in UL94-V test).

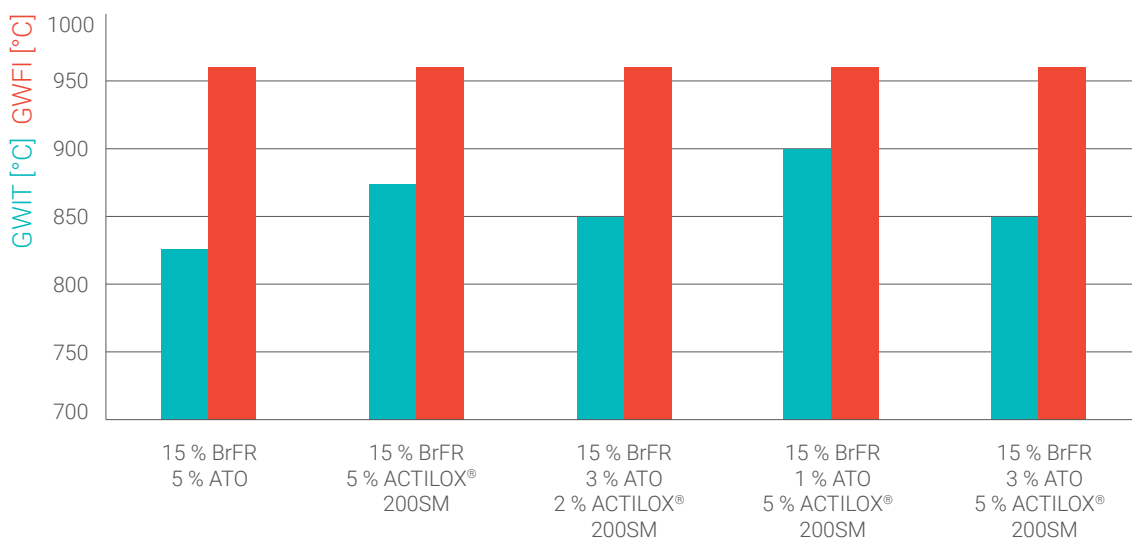
Composition of test compounds

	Reference	Synergistic combinations			
PA66	50	50	50	49	47
GF	30	30	30	30	30
BrFR	15	15	15	15	15
ATO	5	–	3	1	3
ACTILOX® 200SM	–	5	2	5	5



■ UL 94 V 1.6 mm ■ UL 94 V 0.8 mm

PA66 GF30; BrFR = Emerald Innovation™ 1000 (Lanxess)

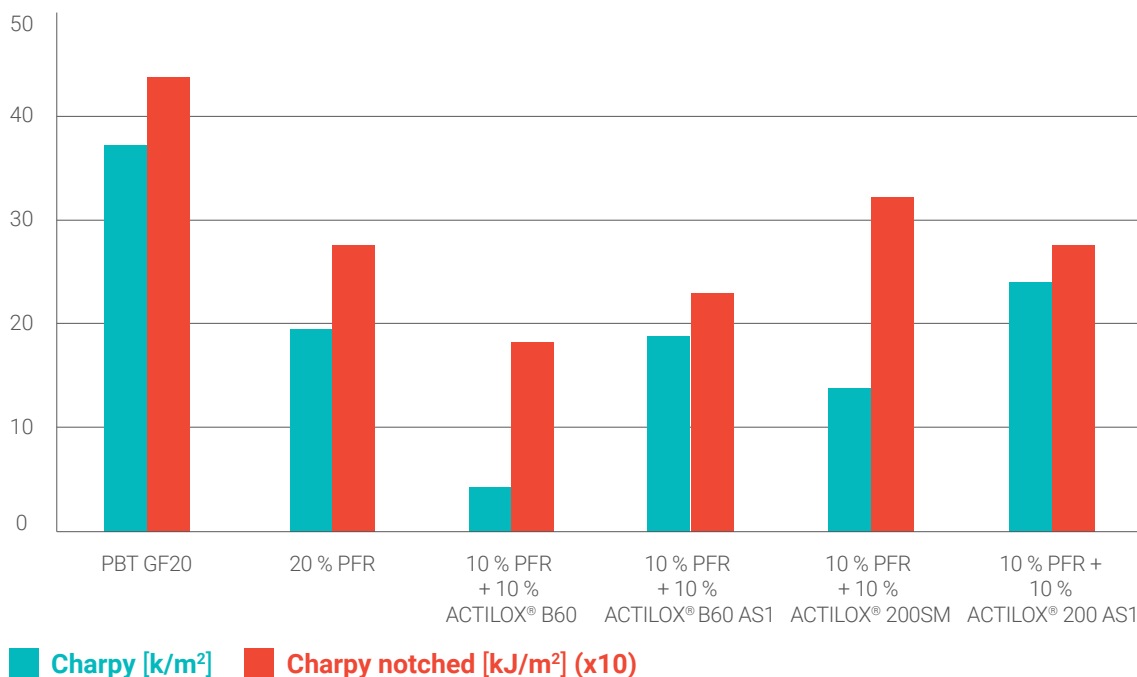


PA66 GF30; BrFR = Emerald Innovation™ 1000 (Lanxess)

Mechanical properties

Mechanical properties

Surface treated grades of ACTILOX® / ACTILOX® B



Composition of test compounds

	Reference	PFR	Synergistic combinations
PBT	80	60	60
GF	20	20	20
PFR	–	20	10
ACTILOX®	–	–	10

ACTILOX® / ACTILOX® B can be surface treated to achieve better homogenization in compounding processes and to improve mechanical compound performance. Additionally, water uptake can often be reduced when the surface of the filler is hydrophobized by organic coating.

Our know-how in surface treated **ACTILOX® / ACTILOX® B** grades help us to specially design

products to meet highest customer needs. Their different surface functionalizations range from highly hydrophobic (**ACTILOX® HS1**) via amino-group functionalized (**ACTILOX® AS1**) to vinyl- or epoxy-group functionalized (**ACTILOX® VS1** or **ACTILOX® ES1**).

In the diagram above the effect of aminosilane coating in PBT GF20 is demonstrated. Impact strength of the flame retardant combinations based on PFR with **ACTILOX® 200SM** and **ACTILOX® B60** and the aminosilane treated products **ACTILOX® 200 AS1** and **ACTILOX® B60 AS1** is shown.

As can be clearly seen in the chart, the surface treated products give significantly improved impact properties.

Service

for our customers

Technical service development / production

Nabaltec AG develops new products and refines innovative products in close cooperation with our customers and raw material suppliers.

Here we use our own lab facilities as well as our excellent contacts to external test institutes and laboratories to offer our customers a wide range of service to support them in formulation development and test procedures.

The successful implementation of this development and the intensive customer consultations enable Nabaltec AG an interaction with our customers in a cooperative, responsible and innovative manner. This culminates in the development of high performance products at the customer as well as in our facility.

Additionally, we have the capacity to fashion tailor made products for special customer requirements and their highly sophisticated and demanding markets.

Laboratory services

Our analysis centre is responsible for independent production control and quality offers laboratory services for customers intending to use our large analytical equipment.

With this excellent equipment we are able to execute analytic tests in the area of inorganic solids, trace elements and water quality.

The certification in accordance with DIN EN ISO 17025 confirms the high service standards of our lab.

We will gladly inform you about our capabilities.

Nabaltec

product portfolio

NABALOX®

Aluminium oxides, for the production of ceramic, refractory and polishing products

APYRAL® AOH

Boehmite, as flame retardant filler and functional filler

NABACAST®

Hydraulic, cement-free binder, based on α -alumina

ACTILOX®

Boehmite, as flame retardant filler and catalyst carrier

APYRAL®

Aluminium hydroxides, as flame retardant and functional filler

GRANALOX®

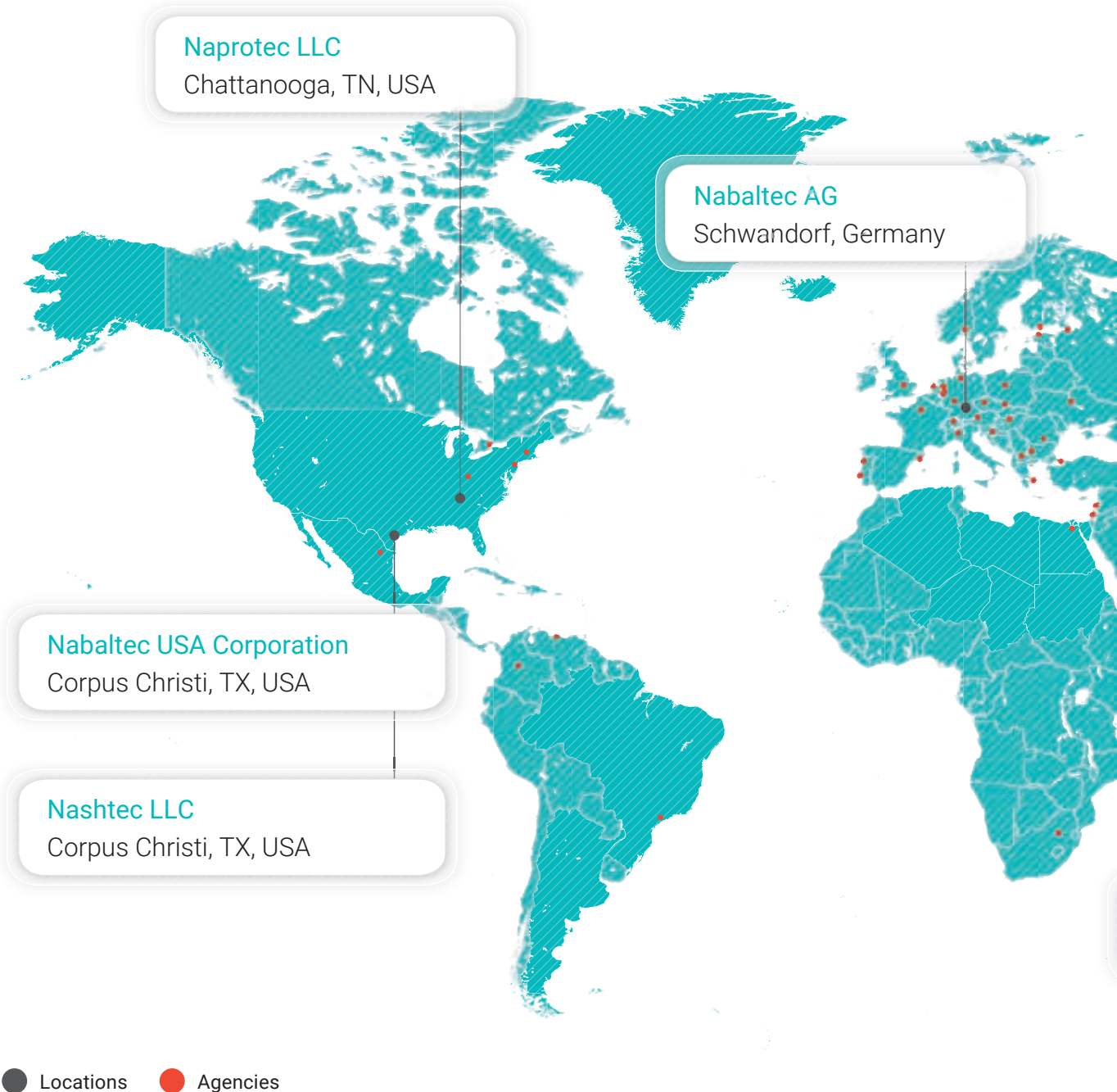
Ceramic bodies, for the production of engineering ceramics

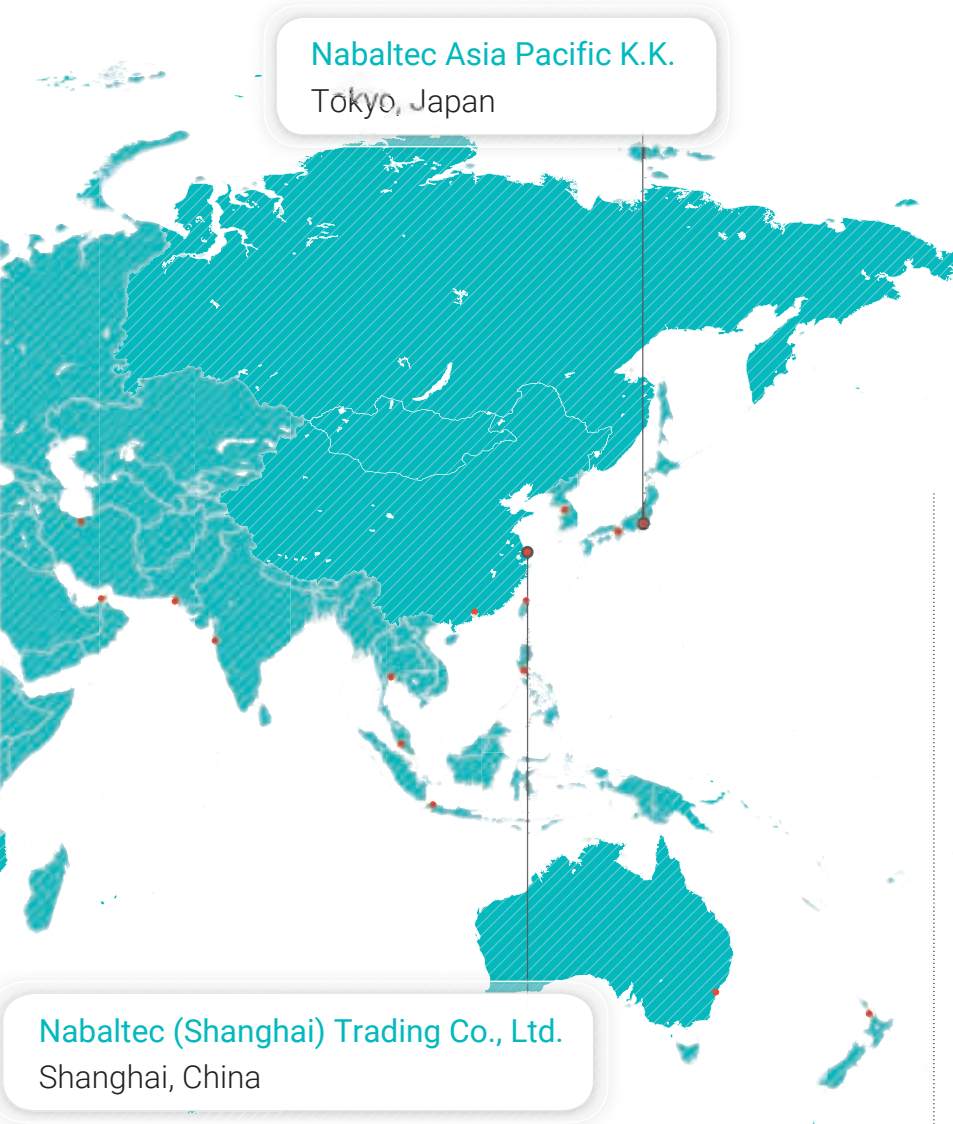
SYMULOX®

Synthetic sintered Mullite, for the production of e.g. refractory products

Nabaltec worldwide

Visit us at our website www.nabaltec.de where you will find the latest company updates and recent versions of all available certificates free for download as PDF-documents.





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All data listed in this brochure are reference values and subject to production tolerance. These values are exclusive to the product description and no guarantee is placed on the properties. It remains the responsibility of the users to test the suitability of the product for their application.

02 / 2020