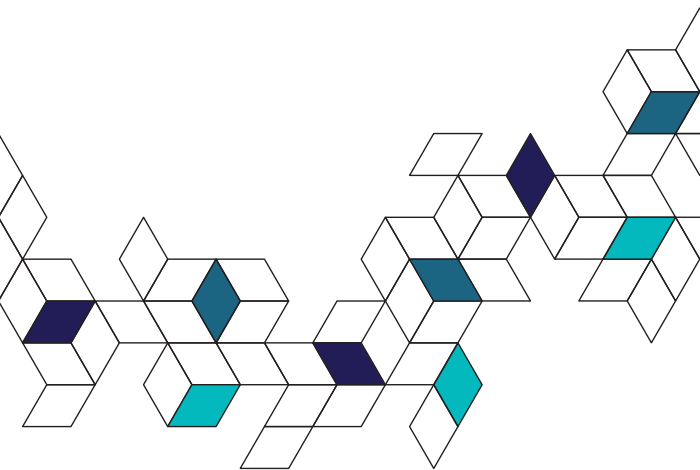
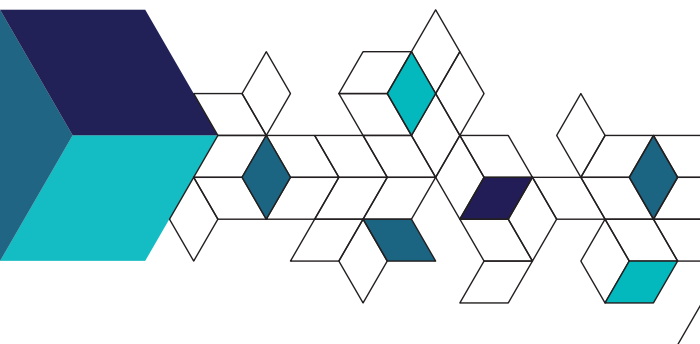


Products

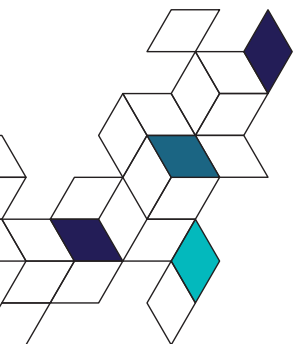


Nabaltec



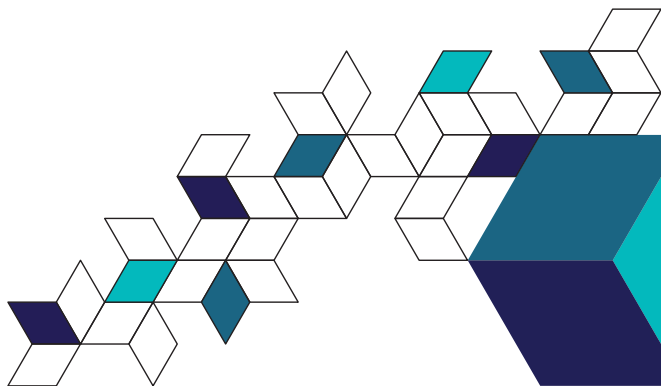


Nabaltec AG
Our **know-how**
for your **safety**



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Aluminium hydroxides
APYRAL®
Boehmites and additives
ACTILOX®

Aluminium hydroxide

Aluminium hydroxide, produced by the "BAYER-Process", is utilized by a number of different branches of industry.

NH 20

Main applications:		Production of <ul style="list-style-type: none"> • glass and ceramic products • aluminium fluoride, Cryolite and other aluminium salts • frits and pigments • molecular sieves • catalysts • refractory products • pigments
Average chemical analysis	Unit	
Al(OH) ₃	[%]	99.7
SiO ₂	[%]	0.02
Fe ₂ O ₃	[%]	0.02
Na ₂ O	[%]	0.2
Loss on ignition (105 – 1000 °C)	[%]	34.6
Moisture content (20 – 105 °C)	[%]	0.1
Properties		
Bulk density	[kg/m ³]	1000 – 2000
Specific density	[g/cm ³]	2.4
Crystal structure		Gibbsite

all values related to dried material

APYRAL®

APYRAL® with the chemical formula $\text{Al}(\text{OH})_3$, from Nabaltec is an environmentally friendly halogen free product which is used as a flame retardant filler in a wide variety of rubber and polymeric materials. During thermal decomposition **APYRAL®** does not generate toxic or corrosive gases. In addition, there is a distinct reduction in smoke density.

APYRAL® is effective in the crucial phase of the burning process before the outbreak of a fully developed fire.

APYRAL® – the flame retardant filler, offers these advantages:

- free of halogens
- environmentally friendly
- no development of toxic gases
- reduction of consequential damage
- clear reduction in smoke density
- cost effectiveness

Nabaltec offers a wide range of **APYRAL®** products to cover the different requirements of the plastics processing industry. The **APYRAL®** types produced by different production processes can be distinguished by their properties into the five groups below:

1. Standard products
2. Morphology modified products
3. Ground products
4. Viscosity optimized products
5. Fine precipitated products.

The quantity of **APYRAL®** added to the organic matrix depends on the required flame retardancy, the properties of the end products and the cost of the mixture. **APYRAL®** can replace other more expensive flame retardants. In addition, the amount of the usually more expensive polymer can be reduced and replaced by the cost effective filler **APYRAL®**. As a result, the total cost of the compound is generally reduced and is therefore more financially favourable.

Analysis	Unit	APYRAL® 1 – 55	APYRAL® 40 – 120
$\text{Al}(\text{OH})_3$	[%]	99.7	99.5
Fe_2O_3	[%]	0.01	0.01
SiO_2	[%]	0.01	0.01
Na_2O total	[%]	0.2	0.4
Loss on ignition (105 – 1000 °C)	[%]	34.6	
Specific density	[g/cm ³]	2.4	
Crystal structure		Gibbsite	

APYRAL® types

With its state-of-the-art production processes, Nabaltec AG offers ATH grades, where different characteristics concerning fineness, particle size, particle size distribution

and morphology are optimized for various processes in a wide range of applications. The following tables show characteristic values of the different **APYRAL®** products:

Product	Grain size D50*/** [μm]	Grain size D90*/** [μm]	Specific surface BET [m ² /g]	Bulk density [kg/m ³]	Moisture [%]
Standard product					
APYRAL® 1E	50*/60**	100*/120**	0.5	1000	0.05
Morphology modified					
APYRAL® 2E	25/28	50/58	0.5	950	0.1
Ground					
APYRAL® 8	15/20	30/45	1.3	750	0.1
APYRAL® 15	12/14	23/27	1.7	600	0.2
APYRAL® 16	16/21	44/52	1.8	750	0.1
APYRAL® 24	8/13	21/28	2.5	650	0.15
Viscosity optimized					
APYRAL® 20X	8/30	80/105	1.2	550	0.1
APYRAL® 30X	7/18	45/55	1.5	500	0.1
APYRAL® 22	12/19	40/50	2	600	0.15
APYRAL® 33	6/9	20/25	3	550	0.15
APYRAL® 44	8/10	19/25	2.3	500	0.2
APYRAL® 55	4/4	18/20	2.6	570	0.13
Fine precipitated					
APYRAL® 40CD	1.8	3.4	3.5	400	0.2
APYRAL® 60CD	1.0	2.3	6	300	0.3
APYRAL® 120E	0.9	3.7	11	200	0.5

* laser granulometer Cilas 1064

** laser granulometer Microtrac S 3500

APYRAL® applications

APYRAL® types can be used as a flame retardant filler in the following polymer materials:

- thermosets
- elastomers
- thermoplastics

Typical applications are:

- cable compounds
- technical rubber compounds
- pressed and cast plastic parts
- thermal insulation foams
- glass fiber reinforced plastics

	APYRAL®														
Application	1E	2E	8	15	16	24	20X	30X	22	33	44	55	40CD	60CD	120E
Carpet Beddings	•		•		•										
PUR-foams				•	•	•							•	•	
SMC			•		•		•	•	•	•			•	•	
BMC			•	•		•	•								
Pultrusion						•	•			•	•	•	•		
RTM						•	•	•	•	•	•	•	•		
Hand lay up			•		•	•	•	•	•	•		•			
Laminates			•		•	•				•	•	•	•	•	
Gelcoats												•	•	•	
Casting Resins	•	•	•	•	•		•	•	•	•	•	•	•		
Conveyer Belts			•		•								•	•	•
Cable Beddings			•	•	•										
Cable Insulations													•	•	
Cable Jacketings													•	•	•
Membranes, Tarpaulins			•	•							•	•	•	•	
Thermal Insulations													•	•	
Profiles, Pipes													•	•	
Insulators		•					•	•					•	•	
Dispersions	•	•	•	•		•							•	•	
Adhesives	•	•	•				•						•	•	
Coatings				•		•		•			•		•	•	•

APYRAL® manufactured by Naprotec LLC, USA

The table below shows the most important typical values of the **APYRAL®** grades manufactured at Naprotec LLC, TN, enabling the formulator to choose the right products for the desired application.

		Standard Grades APYRAL			
Analysis	Unit	410	413	414	418
Al(OH) ₃	%	99.6	99.6	99.6	99.6
Na ₂ O (water soluble)	%	0.05	0.04	0.03	0.04
Moisture (105 °C)	%	0.02	0.05	0.1	0.1
Median grain size (D ₅₀)*/**	µm	24*/37**	17/23	17/22	10/14
Sieve residue (> 45 µm / on 325 mesh)	%	36	17	6	0.25
Spec. surface area (BET)	m ² /g	1.0	1.3	1.1	1.6
Oil absorption***	ml/100g	18	19	19	20
Bulk density loose	g/cm ³	0.94	0.9	0.83	0.70
Bulk density packed		1.1	1.0	1.0	0.83
Tappi brightness (457 nm)	no unit	80	83	83	85

* laser granulometer Cilas 1064

** laser granulometer Microtrac S 3500

*** oleic acid

L [®]		Viscosity Optimized APYRAL [®]				
420	440	411 XLV	425 XLV	460 XLV	475 XLV	499 XLV
99.6	99.6	99.6	99.6	99.6	99.6	99.6
0.04	0.05	0.04	0.03	0.03	0.03	0.03
0.1	0.1	0.2	0.2	0.2	0.2	0.2
9/13	4.5/5.7	2.7/3.5	3/6	11/16	8/16	10/28
0.1	0.01	0.03	0.03	15	30	44
1.8	2.8	2.9	2.2	1.6	1.5	1.4
21	24	17	15	13	12	11
0.65 0.75	0.58 0.7	0.55 0.65	0.6 0.7	0.7 0.85	0.7 0.85	0.73 0.9
85	88	90	89	86	86	87

Suggested Naprotec products for common applications

The table gives a general indication which **APYRAL®** grades should be used in a specific application. Some **APYRAL®** types can be used in more than one application. In contrast some **APYRAL®**

types are especially tailored for special applications. To achieve the most optimal performance of the flame retarded compound system for each customer, the correct choice of **APYRAL®** for each application is important.

Application	APYRAL®	Standard Grades						Viscosity Optimized				
		410	413	414	418	420	440	411 XLV	425 XLV	460 XLV	475 XLV	499 XLV
Abrasives							•					
Adhesives		•		•	•	•				•	•	•
Bitumen Roofing						•						
Carpet Backing		•										
Cast Acrylic Sheeting				•					•			
Caulks & Sealants					•	•			•	•	•	
Ceramics				•		•						
Coatings / Inks / Paint					•	•	•	•	•	•		
Cured in Place Pipe (CIPP)						•		•	•			
FRP Applications												
• Contact Molding (hand lay up / spray up)			•	•	•	•			•	•	•	•
• Continuous Panels				•	•	•		•	•	•		
• Electrical Laminates				•		•	•	•	•	•		
• Filament Winding				•		•	•	•	•	•		
• Pultrusion			•	•	•	•		•	•	•		
• Resin Transfer Molding (RTM) / Infusion					•	•	•	•	•	•		
• SMC / BMC / TMC			•	•	•	•	•	•	•	•	•	•
Gap Fillers											•	•
Gel Coats							•	•	•			
Injection Molding						•	•	•	•			
Mine Belts					•	•			•			
Phenolic Molding				•		•			•		•	
Polyurethane Foam						•	•	•	•			
Potting & Encapsulating		•	•	•	•	•	•	•	•	•	•	•
Powder Coatings						•	•	•	•			
Preform			•	•	•	•			•	•	•	
Roof Coating												
(acrylic trowel on)					•	•	•	•	•	•		
Rubber						•		•	•			
Silicone Elastomers			•			•	•	•	•	•		
Tooling		•	•		•	•			•		•	•
Wall Coverings (PVC)							•	•	•			

APYRAL® HC

Optimized Flame Retardant Filler for Thermal Conductive Applications

Thermal conductive polymer compound are used as Thermal Interphase Materials (TIM). TIM are important in electronic applications and will become

essential for electromobility. Optimized **APYRAL® HC** fillers offer an easy toolbox for the majority of required thermal conductivity levels.

Analysis	Unit	APYRAL® HC 500	APYRAL® HC 600	APYRAL® HC 700	APYRAL® HC 800
Al(OH) ₃	%	99.5	99.5	99.5	99.5
Na ₂ O (water soluble)	%	0.02	0.02	0.02	0.02
Moisture	%	0.1	0.1	0.15	0.15
D ₁₀ ^{*/**}	µm	0.9*/1.0**	0.9/1.3	1.0/1.5	0.9/1.0
D ₅₀ ^{*/**}	µm	12/30	10/20	13/20	4/5
D ₉₀ ^{*/**}	µm	85/110	45/66	45/55	19/23
Sieve residue (> 45 µm)	%	40	20	10	0.1
Spec. surface area (BET)	m ² /g	1.3	1.5	1.8	2.5
Oil absorption	ml/100g	11	12	13	16
Specific conductivity	µS/cm	50	50	50	50
Bulk density	kg/m ³	650	600	600	550
Thermal decomposition from	°C	220	220	220	220

* laser granulometer Cilas 1064

** laser granulometer Microtrac S 3500

Boehmite: **APYRAL® AOH** and **ACTILOX® B / SM**

Based on a highly sophisticated process, Nabaltec is producing an aluminium oxide hydroxide (AlOOH), which has been introduced to the market under the trade names **APYRAL® AOH**, **ACTILOX® B** and **ACTILOX® SM**.

The excellent processing properties are a consequence of the special almost cubic structure of our Boehmite particles. As a result of this property, a good dispersion is readily achieved during processing of highly filled plastic compounds and in both water- and solvent-borne dispersions.

The high purity of **APYRAL® AOH**, **ACTILOX® B** and **ACTILOX® SM** allows it to be used in electrically insulated components and electronics. Since they exhibit a very high temperature resistance, up to 340 °C, they can also be used in temperature demanding applications. Above this temperature a slow degradation occurs under water release. Used as a halogen free mineral co-flame retardant, our Boehmites can partially substitute organic phosphorous flame retardants and contribute to significant cost savings in the compounds. This can be utilized in thermoplastic and thermoset compounds.

The difference between **ACTILOX® B** and **APYRAL® AOH** is characterized mainly by a even higher purity level of **APYRAL® AOH** which is necessary for PCB and Lithium-Ion Batteries Separator (LIBS) applications but not for polymer applications, e.g. engineering plastics, epoxides, etc.

For Lithium-Ion batteries

Boehmite in separator film and electrode edge coating convinces by conveying high level of component reliability. This filler reduces the risk of short-circuiting in LIBS to a minimum and this in turn increases safety for the consumer.

For engineering plastics

In combination with phosphorous and nitrogen containing flame retardants. Boehmites have proven their high efficiency. They promote processing in extrusion or injection mold processes which improves the output rate or reduces cycle times of a production. Furthermore, the usage of Boehmite as inert flame retardants may actively reduce interfering acidic by-products of the flame retardants, stabilizing the polymer matrix positively.

Average chemical analysis	Unit	APYRAL® AOH
AlOOH-content	[%]	99
Fe ₂ O ₃	[%]	0.02
SiO ₂	[%]	0.01
Na ₂ O	[%]	< 0.1
Loss on ignition (105 – 1000 °C)	[%]	17

Physical properties	Unit	APYRAL® AOH 30	APYRAL® AOH 60	APYRAL® AOH 70	ACTILOX® 200SM
D ₅₀ *	[µm]	2.2	0.7	0.5	0.3
BET	[m ² /g]	3.2	5	7.5	18
Oil absorption	[ml/100g]	28	30	31	36

Surface treated functional fillers

Based on aluminium hydroxide (**APYRAL®**) as well as the Boehmite grades (**APYRAL® AOH** and **ACTILOX® B / SM**), Nabaltec offers a wide range of surface treated products. Extreme product requirements, such as improved tracking resistance, reduced water uptake due to an increased hydrophobic content or an improved processing

behavior are realized via special surface treatment. Specific applications in liquid resin processes or in engineering plastics generate great benefits from surface treated grades. The typical nomenclature of our products applies with the suffix of the surface coating functionality (see table below).

APYRAL® grade	Treatment / Function	Polymers
AS1	amino	EP, EVA, EVM, PA6, PA66, PBT, PUR, PVC
VS / VS1	vinyl	EPDM, LSR, PE, PMA, PMMA, PP, PVC, SIR, SR, UP
H / HC / HS1	hydrophobic	LSR, PUR, SM, SIR, TPU, PVC, PE, PP
P / PC	polar	EP, PUR, UP
T1	PVC thermal stabilisation	PVC
On request	others	

* laser granulometer Microtrac S 3500

ACTILOX® PA

Based on functional fillers Nabaltec develops solid formulations to be used as process aids in diverse polymer processes.

ACTILOX® PA is a mineral based masterbatch containing silicone compounds as active components.

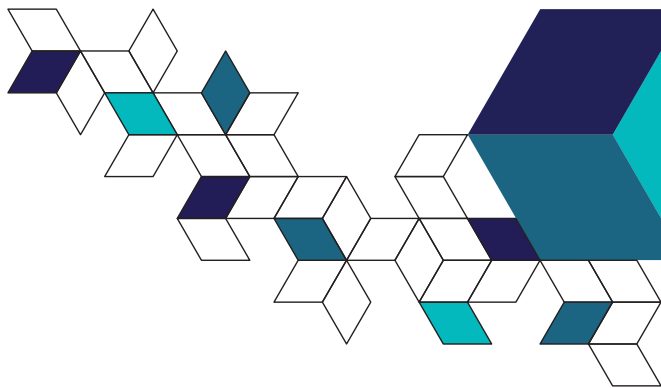
ACTILOX® PA-14 is used as a process aid for highly filled mineral flame retardant compounds, like HFFR cablecompounds. Positive effects are 30 % increase in line speed and an extremely reduced die drooling (die lip built up).

Additionally **ACTILOX® PA-14** improves flame retardance and water absorption.

ACTILOX® PA-B2 is a flame retardant booster in combination with aluminium hydroxide (**APYRAL®**) which at the same time improves the compound processability. **ACTILOX® PA-B2** helps to significantly decrease the pressure build-up during compounding and extrusion while not deteriorating other compound properties.

Analysis	Unit	ACTILOX® PA-14	ACTILOX® PA-B2
Density	g/cm ³	1.43	2.0
Bulk density	kg/m ³	600	610
Appearance	–	White powder	White powder

Calcined aluminas
NABALOX®
Ceramic bodies
GRANALOX®



NABALOX®

Nabaltec produces calcined aluminium oxides for a wide variety of applications especially for the refractory and ceramic industry. Raw material is aluminium oxide. After further calcining refining continues. The raw material has been carefully chosen by quality control of a number of important parameters:

- chemical purity
- grain size distribution
- crystallite size
- crystal structure

The calcination process determines the α -Al₂O₃ content, structure, size and morphology of the primary crystallites. The required product properties are optimized and refined by grinding, air separation, sieving, granulation and shaping.

This provides **NABALOX®** aluminium oxides with a number of advantages:

- low sintering temperature
- wide sintering range
- flexible processing
- high sintered densities
- optimized flow properties
- optimized packing density

NABALOX® aluminium oxides allow the high requirements of our customers to be attained, namely:

- high wear and impact resistance
- excellent dielectric properties insulation
- high mechanical strength
- excellent high temperature properties
- dimensional accuracy
- optimized chemical resistance
- low water demand
- high thermal shock resistance
- long durability in kiln applications

Calcined aluminas

Applications:

- chemical industry
- glass industry
- corundum
- refractory industry
- household ceramics
- wear-resistant ceramics
- electrical ceramics
- engineering ceramics

Analysis	Unit	NO 104 RA	NO 105	NO 105 RA	NO 105-71 RA
Al ₂ O ₃ ¹⁾	[%]	99.8	99.6	99.8	99.8
SiO ₂	[%]	0.02	0.02	0.02	0.02
Na ₂ O total	[%]	0.1	0.3	0.1	0.1

Fe ₂ O ₃	[%]	0.02	0.02	0.02	0.02
Specific surface area (BET)	[m ² /g]	4	0.6	0.7	0.5
α-Al ₂ O ₃ -content	[%]	95	98	98	98
D ₅₀ [*]	[μm]	80	80	80	80
Primary crystal size	[μm]	0.5	2	2	3

1) material preheated at 1100 °C

* laser granulometer Microtrac S 3500

Hard calcined, ground aluminas

Applications:

- refractory industry
- wear-resistant ceramics

Analysis	Unit	NO 115-71	NO 115 G	NO 115-25	NO 115 TC	NO 125 TC
Al ₂ O ₃ ¹⁾	[%]	99.6	99.6	99.6	99.6	99.8
SiO ₂	[%]	0.02	0.02	0.02	0.02	0.02
Na ₂ O total	[%]	0.3	0.3	0.3	0.3	0.1
Fe ₂ O ₃	[%]	0.02	0.02	0.02	0.02	0.02
Specific surface area (BET)	[m ² /g]	0.8	0.9	0.9	1.0	1.0
α-Al ₂ O ₃ -content	[%]	98	98	98	98	98
D ₅₀ [*]	[μm]	8	7	7	6	6
Primary crystal size	[μm]	3	2	2	2	2

Ceramic properties²⁾

Specific density	[g/cm ³]	3.9	3.9	3.9	3.9	3.9
Green density ³⁾	[g/cm ³]	2.27	2.33	2.30	2.31	2.29
Sintered density	[g/cm ³]	3.10 ⁴⁾	3.44 ⁴⁾	3.41 ⁴⁾	3.51 ⁴⁾	3.66 ⁴⁾
Sintering temperature	[°C]	1750	1750	1750	1750	1750
Isotropic linear shrinkage	[%]	11	13	13	14	15

1) material preheated at 1100 °C,

2) typical values,

3) pressing moisture 4 %, pressing strength 100 MPa uniax.,

4) for sinter tests 0.1 % MgO is added

* laser granulometer Microtrac S 3500

Hard calcined, ground aluminas

Applications:

- refractory industry
- engineering ceramics

Analysis	Unit	NO 135	NO 315	NO 325
Al ₂ O ₃ ¹⁾	[%]	99.6	99.6	99.8
SiO ₂	[%]	0.03	0.03	0.03
Na ₂ O total	[%]	0.3	0.3	0.1
Fe ₂ O ₃	[%]	0.02	0.02	0.02
Specific surface area (BET)	[m ² /g]	0.8	1.5	1.5
α-Al ₂ O ₃ -content	[%]	98	98	98
D ₅₀ [*]	[μm]	6	4	4
Primary crystal size	[μm]	3	2	2

Ceramic properties²⁾

Green density ³⁾	[g/cm ³]	2.33	2.37	2.34
Sintered density	[g/cm ³]	3.10 ⁴⁾	3.54 ⁴⁾	3.74 ⁴⁾
Sintering temperature	[°C]	1750	1750	1750
Isotropic linear shrinkage	[%]	9	14	16

1) material preheated at 1100 °C,

2) typical values,

3) pressing moisture 4 %, pressing strength 100 MPa uniax.,

4) for sinter tests 0.1 % MgO is added

* laser granulometer Microtrac S 3500

Soft calcined, ground aluminas

Applications:

- refractory industry
- engineering ceramics

Analysis	Unit	NO 265	NO 113	NO 313
Al ₂ O ₃ ¹⁾	[%]	99.6	99.6	99.6
SiO ₂	[%]	0.03	0.03	0.03
Na ₂ O total	[%]	0.3	0.3	0.3
Fe ₂ O ₃	[%]	0.02	0.02	0.02
Specific surface area (BET)	[m ² /g]	9	9	10
α-Al ₂ O ₃ -content	[%]	> 70	70 – 90	70 – 90
D ₅₀ [*]	[µm]	13	11	5
Primary crystal size	[µm]	< 0.5	< 0.5	< 0.5

Ceramic properties²⁾

Green density ³⁾	[g/cm ³]	n. d. ⁵⁾	1.85	1.90
Sintered density	[g/cm ³]	n. d. ⁵⁾	3.48 ⁴⁾	3.60 ⁴⁾
Sintering temperature	[°C]	–	1750	1750
Isotropic linear shrinkage	[%]	n. d. ⁵⁾	20	21

1) material preheated at 1100 °C,

2) typical values,

3) pressing moisture 4 %, pressing strength 100 MPa uniax.,

4) for sinter tests 0.1 % MgO is added,

5) not determined

* laser granulometer Microtrac S 3500

(Super-) Reactive, monomodal aluminas

Applications:

- refractory industry
- wear-resistant ceramics

Analysis	Unit	NO 615-10	NO 625-10
Al ₂ O ₃ ¹⁾	[%]	99.6	99.8
SiO ₂	[%]	0.03	0.03
Na ₂ O total	[%]	0.3	0.1
MgO (doped)	[%]	–	–
Fe ₂ O ₃	[%]	0.02	0.02
Specific surface area (BET)	[m ² /g]	1.6	1.6
α-Al ₂ O ₃ -content	[%]	98	98
D ₅₀ *	[µm]	3.0	3.0
Primary crystal size	[µm]	2	2

Ceramic properties²⁾

Green density ³⁾	[g/cm ³]	2.37	2.39
Sintered density	[g/cm ³]	3.77 ⁴⁾	3.85 ⁴⁾
Sintering temperature	[°C]	1750	1750
Isotropic linear shrinkage	[%]	15	16

1) material preheated at 1100 °C,

2) typical values,

3) pressing moisture 4 %, pressing strength 100 MPa uniax.,

4) for sinter tests 0.1 % MgO is added,

5) not determined

* laser granulometer Microtrac S 3500

NO 715-10	NO 725-10	NO 613-10	NO 713-10 RF	NO 713-10	NO 713-10 MF
99.6	99.8	99.7	99.7	99.7	99.8
0.03	0.03	0.05	0.05	0.05	0.05
0.3	0.1	0.1	0.1	0.1	0.1
–	–	–	–	0.1	–
0.02	0.02	0.02	0.02	0.02	0.02
2	2	6	7	7	7
98	98	95	95	95	95
2.5	2.5	1	0.5	0.5	0.5
2	2	0.5	0.5	0.5	0.5

2.36	2.35	2.20	n. d. ⁵⁾	2.25	2.32
3.80 ⁴⁾	3.89 ⁴⁾	3.88	n. d. ⁵⁾	3.95	3.89
1750	1750	1600	–	1600	1600
15	17	18	n. d. ⁵⁾	18	17

Reactive, bimodal aluminas

Applications:

• refractory industry

Analysis	Unit	NO 615-30 ^{a)}	NO 625-30 ^{b)}
Al ₂ O ₃ ¹⁾	[%]	99.6	99.7
SiO ₂	[%]	0.05	0.05
Na ₂ O total	[%]	0.2	0.1
Fe ₂ O ₃	[%]	0.02	0.02
Specific surface area (BET)	[m ² /g]	3.5	3.5
α-Al ₂ O ₃ -content	[%]	96	96
D ₅₀ [*]	[μm]	2.3	2.3
Primary crystal size	[μm]	0.5/2	0.5/2

Ceramic properties²⁾

Green density ³⁾	[g/cm ³]	2.74	n. d. ⁴⁾
Sintered density	[g/cm ³]	3.92	n. d. ⁴⁾
Sintering temperature	[°C]	1725	–
Isotropic linear shrinkage	[%]	13	n. d. ⁴⁾

NABALOX® aluminas spray dried, free of binder

Chemical analysis	Unit	NO 9912 C	
Al ₂ O ₃ ¹⁾	[%]	92	
Na ₂ O	[%]	0.1	

Physical analysis

Primary crystal size	[μm]	2	
Median granulate size	[μm]	200	
Bulk density	[kg/m ³]	–	
Granulate-moisture	[%]	max. 0.5	

Processing characteristics²⁾

Sintering temperature	[°C]	1580	
Dwell time	[h]	2	
Sintered density	[g/cm ³]	3.70	
Isotropic linear shrinkage	[%]	–	

a) ceramic grade, b) refractory grade,

1) material preheated at 1100 °C, 2) typical values,

• wear-resistant ceramics

• high temperature ceramics

NO 625-31 ^{a)}	NO 530 ^{b)}	NO 645 ^{b)}	NO 652 ^{b)}	NO 660 ^{b)}
99.7	99.7	99.7	99.7	99.7
0.05	0.05	0.05	0.05	0.05
0.1	0.1	0.1	0.1	0.1
0.02	0.02	0.02	0.02	0.02
4.0	4.0	4.0	3.0	3.0
96	96	96	96	96
2.1	2.0	2.2	2.8	2.5
0.5/2	0.5/2	0.5/2	0.5/2	0.5/2
2.75	n. d.	n. d.	n. d.	n. d.
3.93	n. d.	n. d.	n. d.	n. d.
1725	–	–	–	–
12	n. d.	n. d.	n. d.	n. d.

NO 9622 C	NO 9915 C	NO 9922 C	NO 9980 C
96	99.7	99.7	99.8
0.1	0.1	0.1	0.1
2	0.5/2	< 1	< 1
200	170	190	100
–	–	–	–
max. 0.5	max. 0.5	max. 0.5	max. 0.5
1650	1720	1600	1600
1	2	1	2
3.80	3.88	3.92	3.93
–	–	–	–

3) pressing moisture 4 %, pressing strength 100 MPa uniax.,

4) not determined, * laser granulometer Microtrac S 3500

Polishing aluminas

The special qualities of **NABALOX®** aluminas are successfully used worldwide as polishing media. The **NABALOX®** polishing oxide range offers a broad spectrum of soft and hard calcined aluminas for the various areas of industrial surface finishing.

A multitude of **NABALOX®** types are used for the production of polishing pastes and emulsions for almost any material group, such as metal, stone, plastic, car paint, semiconductors, special glasses and many others.

The agglomerates and primary crystals of the aluminas have a direct influence on the quality of the surfaces to be finished and will be determined by the following parameters:

The primary crystal size,

or the primary grain, is the body which directly causes material abrasion during polishing. This size will determine the dimension and type of the material abrasion and is thus primarily responsible for the achievable surface quality. Small primary crystals cause minor surface roughness with only minor material abrasion and therefore induce a high surface quality. With large primary crystals, the surface

roughness and material abrasion will be correspondingly higher.

The secondary grain

represents a cluster (agglomerate) of primary crystals. During the polishing process the secondary grain will be destroyed by mechanical action, leading to the release of primary crystals of several hundred nanometers to μm size.

Therefore the polishing process begins and a defined abrasion rate will be induced. The initial abrasion rate is reduced by the decomposition of the agglomerate and a polishing action begins, which is decisive for the final surface quality. Apart from the grain size, the structure of the grain cluster will also decisively influence the oil absorption value.

The grain size distribution

reflects the distribution of the different grain size classes (fractions), relative to the secondary grains. By tailoring the production process it is possible to manufacture a broad spectrum of different polishing types which are adjusted to the various finishing problems of a wide variety of materials. The following tables are intended to provide an overview of the available qualities.

Typical chemical analysis	[%]
Al_2O_3	> 99
SiO_2	0.04
Fe_2O_3	0.03

	Abrasive ³⁾	D50 [μm] ⁴⁾	D90 [μm] ⁴⁾	BET [m ² /g] ⁵⁾	Oil absorption [%] ⁶⁾
Very hard calcined aluminas					
α-Al₂O₃¹⁾ : 98 % Primary crystal size²⁾: 3 μm, platelets					
NO 205-71	*****	60	110	0.6	35
NO 230	****	20	70	0.7	20
NO 115-71	***	8	40	0.8	17
NO 235	**	6	20	0.8	15
Hard calcined aluminas					
α-Al₂O₃¹⁾ : 98 % Primary crystal size²⁾: 2 μm					
NO 205 G	****	80	130	0.7	35
NO 255	***	65	110	0.8	35
NO 255 F	***	60	100	0.8	35
NO 250	**	55	90	0.8	30
NO 225	**	15	40	0.8	25
NO 275	**	8	30	0.8	20
NO 295	**	7	25	0.9	20
NO 215 G	**	7	30	0.9	17
Soft calcined aluminas					
α-Al₂O₃¹⁾ : > 70 % Primary crystal size²⁾: < 0.5 μm					
NO 202 II	***	80	130	8	45
NO 265	**	13	50	9	30
NO 212	**	12	45	10	25
NO 313	*	5	30	10	25
Very soft calcined aluminas					
α-Al₂O₃¹⁾ : < 5 % Primary crystal size²⁾: < 0.05 μm					
NO 201	***	80	130	75	55
NO 221-40	**	40	80	75	50
NO 221-30	*	30	60	75	50

1) XRD, 2) SEM, 3) comparative polishing test, 4) laser granulometer Microtrac 3500 S, 5) DIN ISO 9277, 6) DIN EN ISO 787 part 5

Soft calcined, fine ground aluminas

As a result of a systematic development of its production processes Nabaltec can offer a completely new group of soft calcined aluminas with unique properties. The new generation of soft calcined aluminas of the trademark **NABALOX®** is characterized by

- *constant* high specific surface area, up to 75 m²/g
- narrow grain distribution with low coarse fraction
- a low batch to batch variation concerning grain size and purity
- a low tendency to agglomeration and thus improved dispersibility compared to conventional ground aluminas.

Refractories

Due to their typical primary crystal size of 0.2 µm and below, the soft calcined aluminas of **NABALOX®** are an ideal viscosity adjusting agent for gunning mixes and mouldable materials. It is therefore possible to achieve the desired consistency without organic plasticisers or clay minerals which guarantees a high refractoriness.

Glazes

Because of its high reactivity and constant grain size, **NABALOX®** soft calcined aluminas are the ideal Al₂O₃ carrier for high-quality glazes and stains.

Ceramic inks

The defined fine grain size distribution of **NABALOX®** soft calcined aluminas allows them to be used for digital printing with ceramic inks, without the need of further refinement steps.

Polishing media

Low agglomeration, narrow particle size distribution and constant oil absorption are the properties of **NABALOX®** soft calcined aluminas. These characteristics guarantee outstanding results in applications, such as suspensions and pastes.

Technical ceramics

Because of its high specific surface area **NABALOX®** soft calcined aluminas are ideally suited for the manufacture of catalyst supports and filtration media with high porosity and a low shrinkage tolerance.

Soft calcined, fine ground aluminas

	D50 ³⁾ [μm]	D90 ³⁾ [μm]	BET ⁴⁾ [m ² /g]	Oil ⁵⁾ absorption [%]
Very soft calcined γ-aluminas				
α-Al₂O₃¹⁾ : < 5 % Primary crystal size²⁾: < 0.05 μm, Na₂O < 0.3 %				
NO 681	1.9	3	75	40
Soft calcined aluminas				
α-Al₂O₃¹⁾ : > 70 % Primary crystal size²⁾: < 0.5 μm, Na₂O < 0.3 %				
NO 183	27	75	10	30
NO 183 F	18	55	10	30
NO 283	11	35	10	30
NO 283 F	5	18	10	30
NO 383	4	15	10	30
NO 683	1.5	3	11	26
Soft calcined, low soda aluminas				
α-Al₂O₃¹⁾ : 95 %, Primary crystal size²⁾: 0.5 μm, Na₂O < 0.1 %				
NO 684	1.5	3	6	20

1) XRD, 2) SEM, 3) laser granulometer Microtrac S 3500,

4) DIN ISO 9277, 5) DIN EN ISO 787 part 5

GRANALOX® ceramic bodies

Based on its own alumina range, Nabaltec produces high Al_2O_3 -containing bodies in accordance with the standards C 786, C 795 and C 799 of IEC 672-1 with 92 - 99.8 % Al_2O_3 . These ready-formulated raw materials are ready for pressing and can be formed directly into ceramic parts via uniaxial or cold isostatic pressing.

The quality of the raw materials is of key importance for all properties of the final ceramic parts. As an alumina producer, Nabaltec can control and guarantee constant physical and chemical properties of the material (grain distribution, primary crystallite size, bulk density, specific surface, grinding behaviour and reactivity).

Nabaltec's ceramic bodies are produced under rigid quality control of green and sintered density, shrinkage, porosity, loss on ignition and granulate size. The properties of the $\alpha\text{-Al}_2\text{O}_3$ (corundum) are tailored to the application areas in which the material is used such as wear resistance, high temperature stability, good electrical insulation, thermal conductivity and corrosion resistance.

Ceramic bodies with 92 % Al_2O_3 predominate in wear resistance applications. Low electrical conductivity and dielectric loss together with good mechanical properties and thermal conductivity are obtained from ceramic bodies NM 96.

The highest demands of bending strength, thermal shock resistance, resistance to acid and alkaline attack, abrasion and wear resistance are met by the grades of NM 99.

As a special service, Nabaltec offers its customers the supply of material with individual binder compositions.

The ceramic bodies free of binder can be used by an addition of approx. 20 % water for slip casting or by addition of suitable plasticizers for other moulding technologies (e.g. extrusion, injection moulding, tapecasting).

Ceramic body	Fields of application
NM 92	wear resistant ceramics, standard machinery parts
NM 96	electrical insulating and polishable machinery parts, chemical resistant ceramics, ballistic protection
NM 98	machinery parts, ballistic protection
NM 99	engineering ceramics

Ceramic bodies, ready for pressing

(ready formulated raw-materials for production of high-grade aluminium oxide ceramics)

Chemical analysis	Unit	NM 9212 E	NM 9212 F	NM 9212 G	
Al ₂ O ₃	[%]	92	92	92	
Na ₂ O	[%]	0.1	0.1	0.1	

Physical analysis

Primary crystal size	[µm]	2	2	2	
Median granulate size	[µm]	200	100	190	
Bulk density	[kg/m ³]	1280	1220	1270	
Granulate-moisture	[%]	0.4	0.3	0.4	
Loss on ignition ¹⁾	[%]	6.0	6.6	6.7	

Processing characteristics²⁾

Sintering temperature	[°C]	1580	1580	1580	
Dwell time	[h]	2	2	2	
Sintered density	[g/cm ³]	3.70	3.70	3.70	
Isotropic linear shrinkage	[%]	14.6	15.3	14.9	

1) RT – maximum sintering temperature,

2) pressing strength 100 MPa, for NM 9922 I 180 MPa

	NM 9510 F	NM 9620	NM 9620 F	NM 9622	NM 9622 FS	NM 9622 W	NM 9634 F
	95	96	96	96	96	96	96
	0.1	0.1	0.1	0.1	0.1	0.1	0.1

	2	2	2	2	2	2	2
	100	200	100	200	100	200	100
	1260	1250	1250	1280	1220	1280	1280
	0.2	0.1	0.3	0.3	0.3	0.3	0.3
	5.6	3.8	4.0	4.1	4.8	3.6	3.7

	1620	1620	1620	1650	1650	1650	1620
	1	1	1	1	1	1	1
	3.72	3.71	3.74	3.80	3.79	3.79	3.80
	14.8	14.8	13.5	14.5	15.0	14.7	14.0

Ceramic bodies, ready for pressing

(ready formulated raw-materials for production of high-grade aluminium oxide ceramics)

Chemical analysis	Unit	NM 9816	
Al ₂ O ₃	[%]	98	
Na ₂ O	[%]	0.1	

Physical analysis

Primary crystal size	[µm]	2	
Median granulate size	[µm]	200	
Bulk density	[kg/m ³]	1290	
Granulate-moisture	[%]	0.4	
Loss on ignition ¹⁾	[%]	4.4	

Processing characteristics²⁾

Sintering temperature	[°C]	1650	
Dwell time	[h]	2	
Sintered density	[g/cm ³]	3.85	
Isotropic linear shrinkage	[%]	14.7	

1) RT – maximum sintering temperature,
2) pressing strength 100 MPa, for NM 9922 I 180 MPa

	NM 9922	NM 9922 I	NM 9970 F	NM 9980 F	NM 9991 F
	99.7	99.7	99.7	99.8	99.8
	0.1	0.1	0.1	0.1	0.1

	< 1	< 1	< 1	< 1	< 1
	190	70	100	100	100
	1200	1150	1160	1100	1090
	0.5	0.3	0.3	0.3	0.4
	3.1	4.2	3.6	3.8	4.2

	1600	1600	1600	1600	1600
	2	2	2	2	2
	3.92	3.90	3.92	3.93	3.95
	17.2	16.8	16.7	20.2	19.4

Nabaltec

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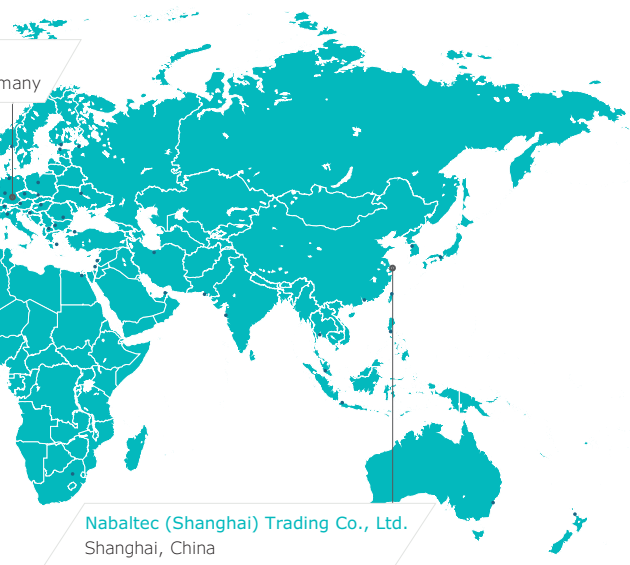
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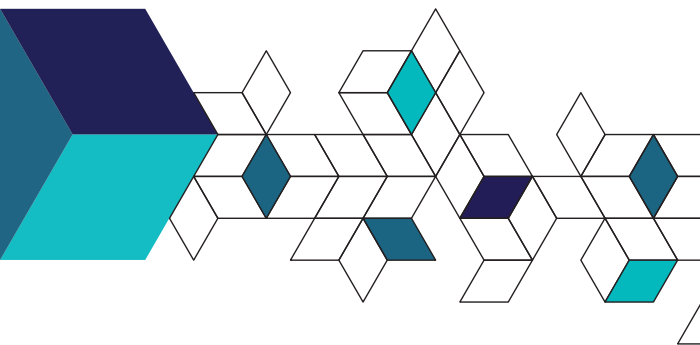


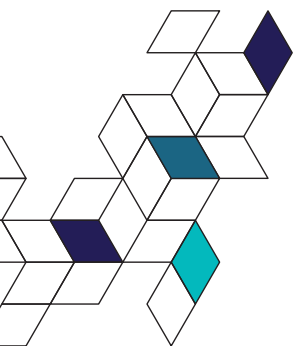
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Technical Service

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Quality control

Our quality control department is equipped with state-of-the-art analytical devices.

Moisture content (at 105 °C) of fillers	DIN EN ISO 787-2
Loss on ignition (105 – 1000 °C)	ISO 806
Bulk density	DIN EN ISO 23145-2
Angle of repose	ISO 902
Oil absorption value	DIN EN ISO 787-5
Sieve analysis by testing sieves	DIN 66165-2
Whiteness	DIN 53145-1
Colorimetry	DIN EN ISO 11664-4
pH-value	DIN EN ISO 787-9
Specific conductivity	DIN EN ISO 787-14
Chemical composition	DIN EN 725-1
Specific surface area	DIN ISO 9277
Specific density*	DIN EN 993-1
Water absorption, open porosity*	DIN EN 993-1
Grain size distribution	ISO 13320 / ISO 22412

Laser diffraction

Dynamic light scattering

X-ray diffraction (XRD)

Scanning electron microscopy (SEM)

Plasma emission spectroscopy (ICP-OES)

Energy dispersive X-ray analysis (EDX)

** measured on bulk samples (mullite, ceramic bodies)*

Sieve size information

DIN-Meshes per		Sieve aperture per		USA standard	Tyler	British standard	AFNOR	DIN-Meshes per		Sieve aperture per		USA standard	Tyler	British standard	AFNOR
cm	cm²	µm	Inch	Mesh	Mod.	cm	cm²	µm	Inch	Mesh	Mod.	cm	cm²	µm	Inch
		1		(12500)											
(5000)		2.5	.0001	(5000)						589	.0232		28		
(1000)		5	.0002	(2500)						590	.0232	30			
(500)		10	.0004	(1250)						599	.0236			25	
(250)	(60000)	20	.0008	625				10	100	600	.0236				
		37	.0014	400						630	.0248				29
		40	.0016							699	.0275			22	
		43	.0017		325	17				701	.0276		24		
130	(16900)	44	.0017	325						710	.0280	25			
		50	.0020			18	8	64		750	.0295				
120	(14400)	53	.0021	270	270	300				800	.0315				30
100	10000	60	.0023							833	.0328		20		
		61	.0024		250					840	.0331	20			
		62	.0024	230						853	.0036			18	
		63	.0025			19				991	.0390		16		
		66	.0026			240	6	36		1000	.0394	18			31
		74	.0029	200	200					1003	.0395			16	
80	6400	75	.0029							1168	.0460		14		
		76	.0030			200				1190	.0469	16			
		80	.0032				20	5	25	1200	.0472				
		88	.0035	170						1204	.0474			14	
		89	.0035		170	170				1250	.0492				32
70	4900	90	.0036							1397	.0550		12		
60	3600	100	.0039				21			1405	.0553			12	
		104	.0041		150	150				1410	.0555	14			
		105	.0041	140			4	16		1500	.0590				
50	2500	120	.0047							1600	.0630				33
		124	.0049		115	120				1651	.0650		10		
		125	.0049	120			22			1676	.0660			10	
		147	.0058		100					1680	.0661	12			
		149	.0059	100						1981	.0780		9		
40	1600	150	.0059				3	9		2000	.0787	10			34
		152	.0060			100				2057	.0810			8	
		160	.0063				23			2362	.0930		8		
		175	.0069		80					2380	.0937	8			
		177	.0070	80						2411	.0949			7	
		178	.0070			85	2.4	6		2500	.0985				35
30	900	200	.0079				24			2794	.1100		7		
		208	.0082		65					2812	.1107			6	
		210	.0083	70						2830	.1110		7		
		211	.0083			72	2	4		3000	.1180				
		246	.0097		60					3150	.1240				36
24	576	250	.0098	60			25			3327	.1310		6		
		251	.0099			60				3380	.1320	6			
		295	.0116		48	52				3962	.1560		5		
		297	.0117	50			1.5			4000	.1570	5			37
20	400	300	.0118							4699	.1850		4		
		315	.0123				26			4760	.1870	4			
		350	.0138	45			1.2	1.5		5000	.1970				38
		351	.0138		42					5613	.2210		3.5		
		353	.0139			44				5660	.2230	3.5			
16	256	400	.0158				27	1	1	6000	.2300				
		417	.0164		35					6300	.2480				39
		420	.0165	40						6680	.2630			3	
(14)	(196)	422	.0166			36				6730	.2650	3			
		495	.0195		32					7925	.3120		2.5		
12	144	500	.0197	35		30	28			8000	.3150	2.5			40

Location

certified

The high standard of Nabaltec AG management systems which we set up at our facility in Schwandorf is regularly certified by the TÜV committee.

Schwandorf

- ISO 9001 (Quality Management System)
- ISO 14001 (Environmental Management System)
- ISO 45001 (Occupational health and safety management system)
- ISO 50001 (Energy Management System)

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.

Conversion table

Metric unit	Physical category	Conversion factor (approx.)	US unit
°C	temperature	$\times 1.8 + 32$	°F
kg	weight	$\times 2.21$	lb (pounds)
to (metric)	weight	$\times 1.1$	tn. sh. (short ton)
l	volume	$\times 0.264$	gal
m ²	area	$\times 10.76$	ft ²
mm	length	see table p. 41	mesh
µm	length	see table p. 41	mesh
kW/h	energy	$\times 3412.13$	BTU/h

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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.