Henze Boron Nitride Products AG

Boron Nitride in Different Applications

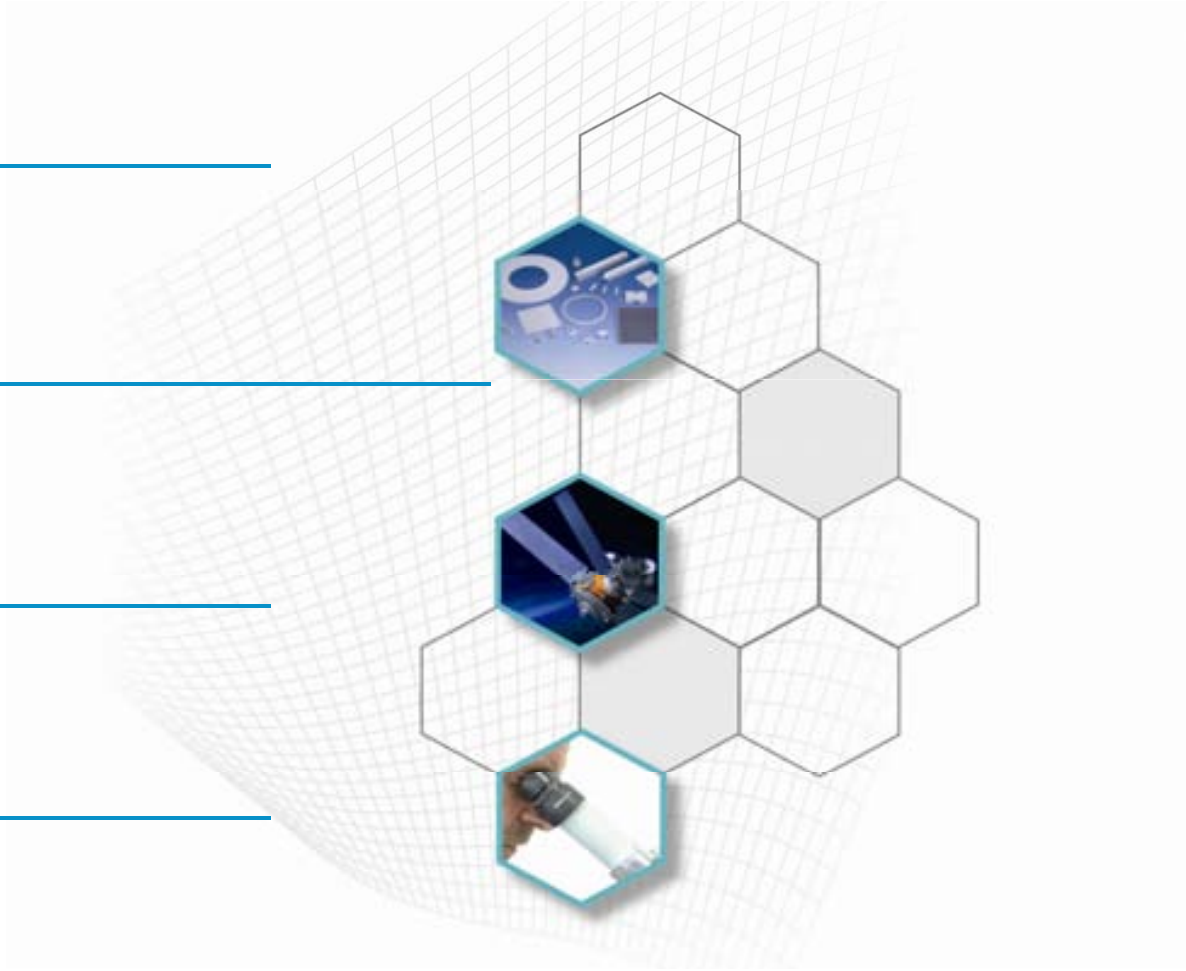
Agenda

Henze BNP AG

HeBoFill® and typical applications

HeBoSint® and typical applications

HeBoCoat® and typical applications



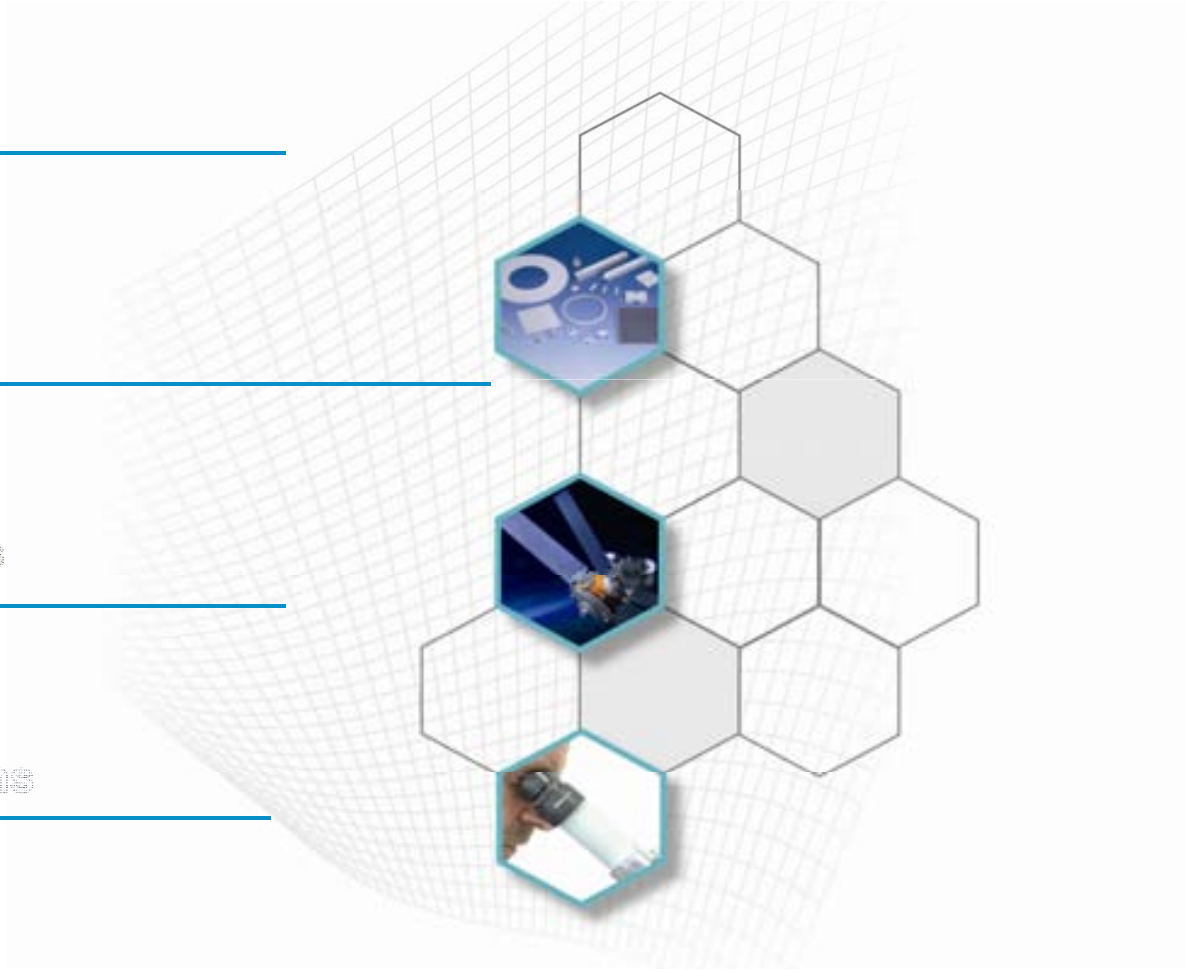
Henze
BORON NITRIDE PRODUCTS

Henze BNP AG

HeBoFill® and typical applications

HeBoSint® and typical applications

HeBoCoat® and typical applications

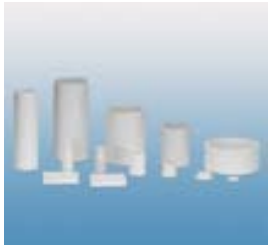


Henze BNP - company history

1993: Foundation by Peter Henze in Kempten (Germany), start with the sales of semi finished products of BN solid material on 9qm

1998: Henze rents 120 qm in the cometa building for start-up companies. Setup of a warehouse to storefinished products for just in time delivery.

1998: Fist turning machine was installed, start with the machining of finished BN solid parts



2002:Henze was DIN 9001:2008 certified the first time.

2003: Setup of an international sales structure.

2004: Start with the R&D and manufacturing of HeBoCoat®- and HeBoFill®- products

2011:Step by step expansion up to 1.300qm is finished.

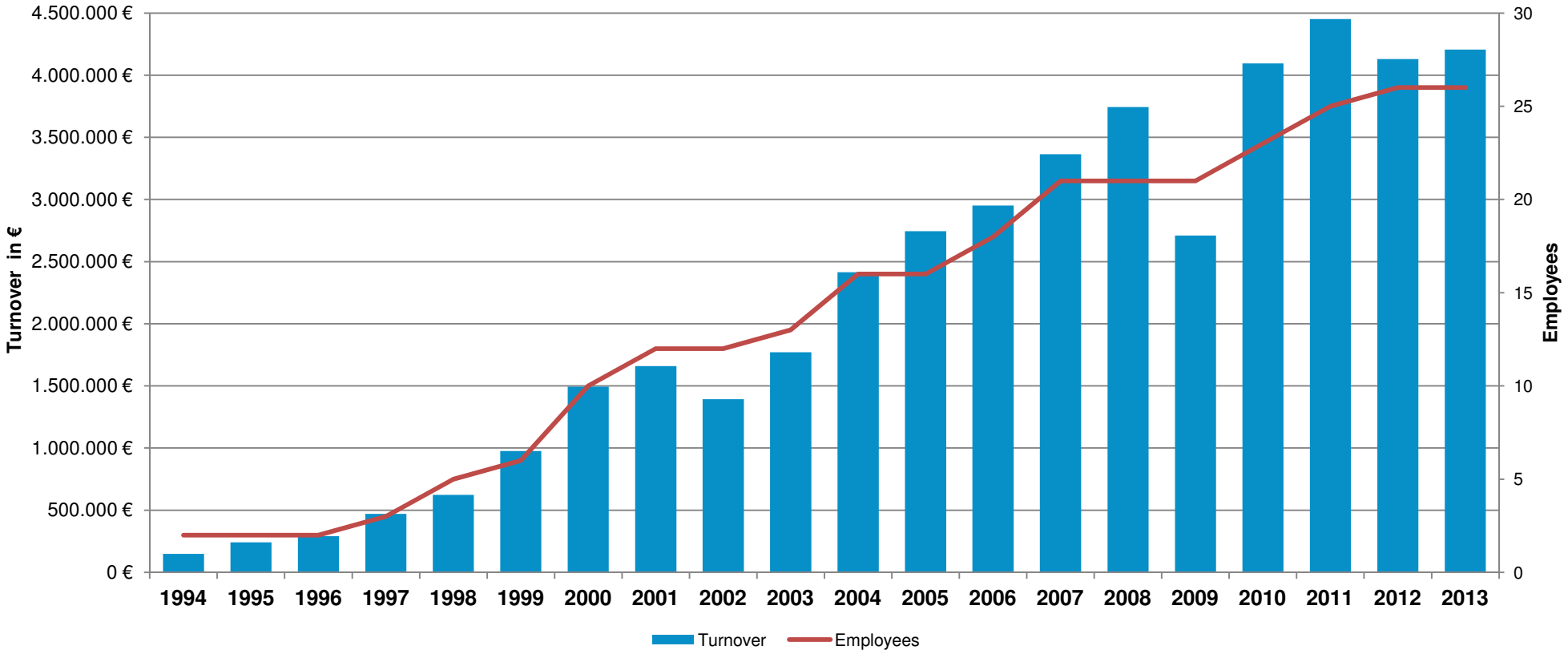
2012: The sons of Peter Henze, Matthias and Christoph Henze, join the managing board

2013: Change of the legal structure from GmbH to AG

2014: Move into the new own building with 2500qm

1993 2000 2005 2010

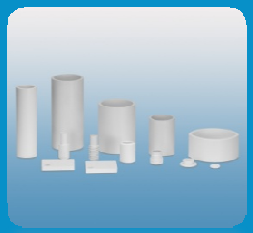
Henze BNP - Turnover and Employees



At one glace

BN-Powder HeBoFill®

Sintered Parts
HeBoSint®



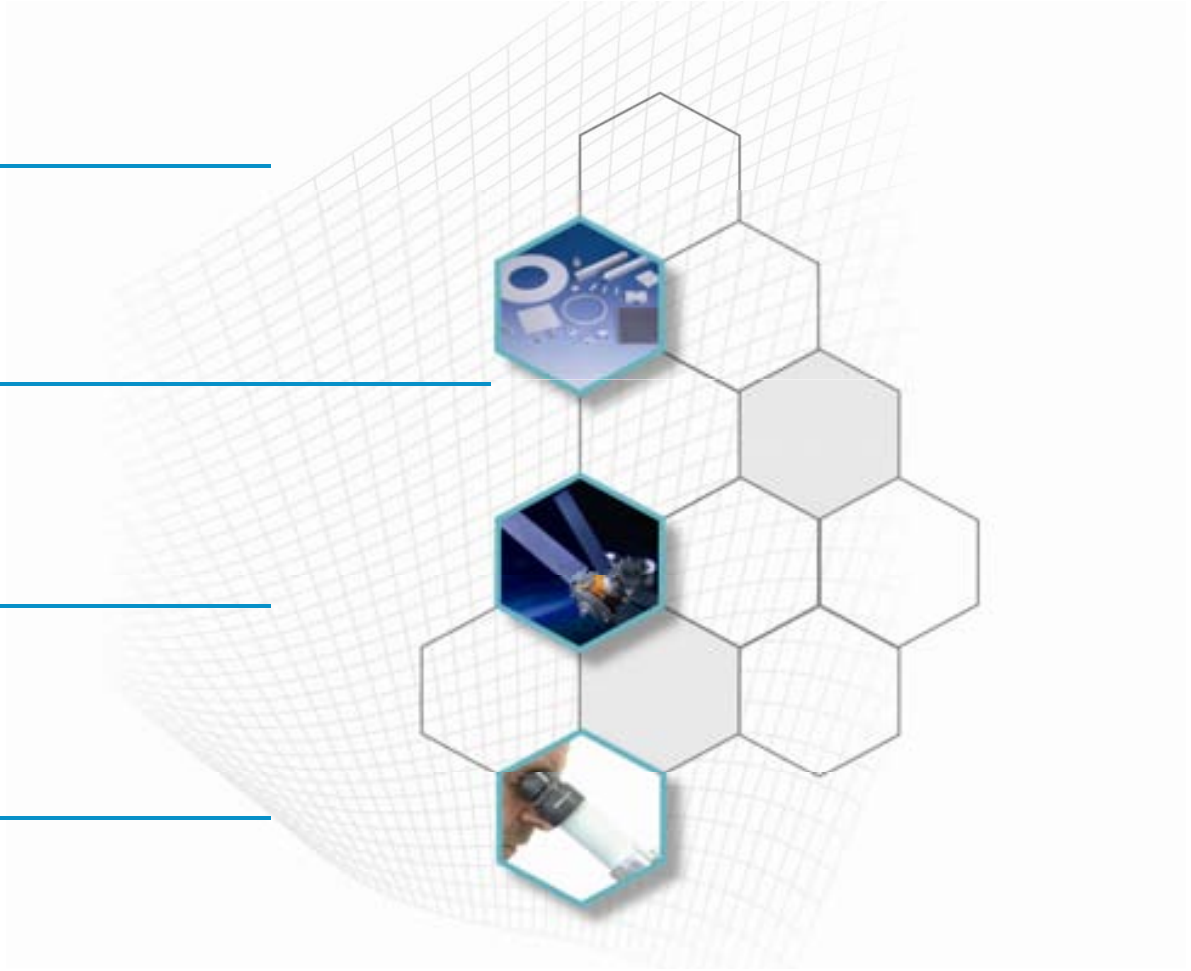
Suspensions and
Sprays HeBoCoat®

Henze BNP AG

HeBoFill® and typical applications

HeBoSint® and typical applications

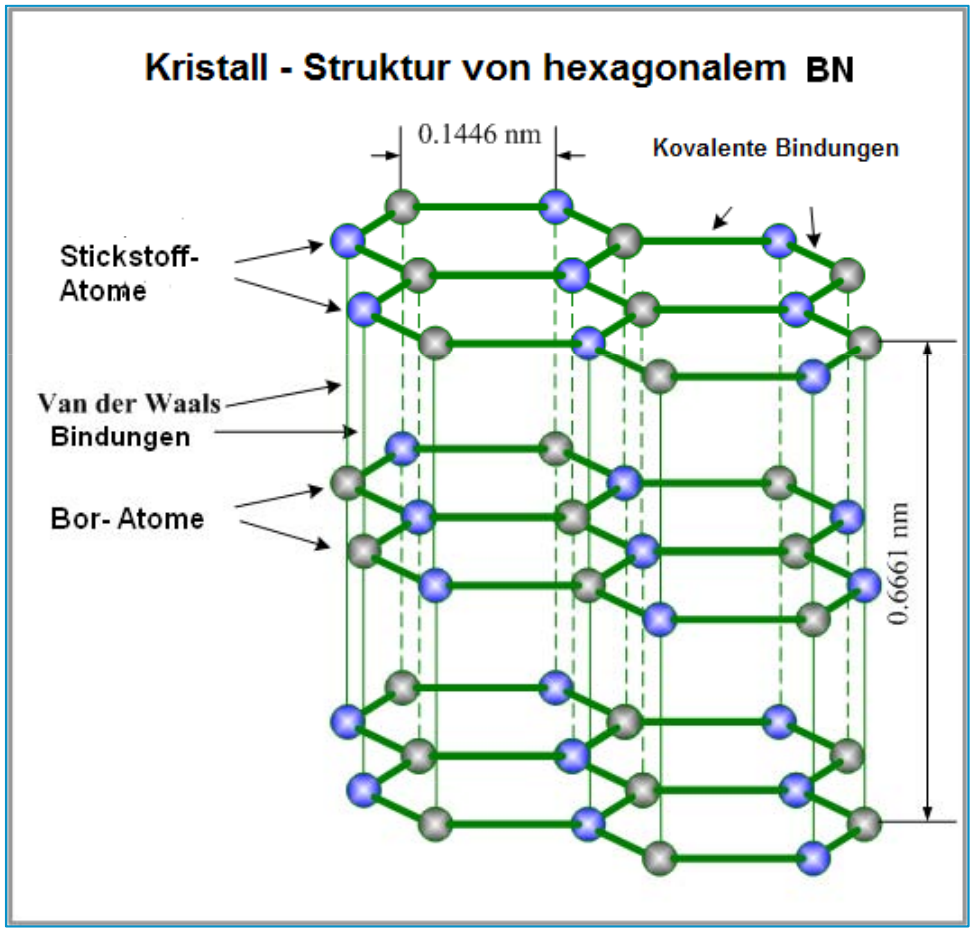
HeBoCoat® and typical applications

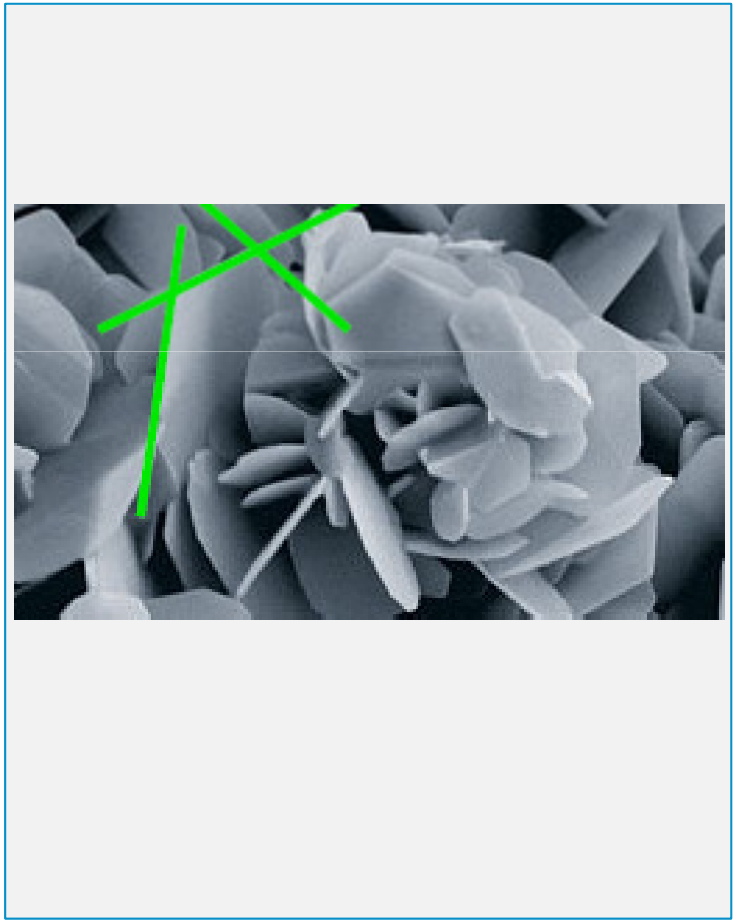


What is Boron Nitride?

- Boron Nitrogen compound: Boron [B] + Nitrogen [N] = BN
- Powder
- Does not exist in the nature
- Synthetic process - man made
- It is the basis for our HeBoSint®- and HeBoCoat®- Products

Cristal Structure of [B + N]





HeBoFill® Typical Boron Nitride Powders

HeBoFill®-Type	82	110	482	501
Colour	white	white	white	white
Purity (B+N)	> 94.0 %	> 98.5 %	> 98,5 %	> 98.5 %
Oxigen in total	< 3.0 %	< 1,5 %	< 0,5 %	< 0.5 %
Boron oxide	< 2.0 %	< 0,1 %	< 0,1 %	< 0,1 %
Carbon	n.a.	< 0,1 %	< 0,1 %	< 0,1 %
Spec. surface area	9 m^2/g	15 m^2/g	6,0 m^2/g	< 1 m^2/g
Particle size (D_{50})	7,0 µm	3,0 µm	40,0 µm	45,0 µm

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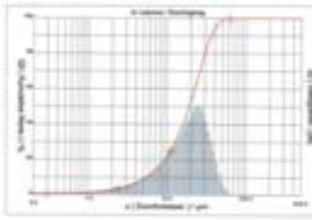
HeBoFill® Typical grades

- **HeBoFill® 82**
  - Is especially developed as a lubricant and release agent in the aluminium extrusion industry.

- **HeBoFill® 110**
  - Is a pure boron nitriede powder with good crystallinity and a wide grain size to the boron nitride typical properties like high temperature stability, high thermal conductivity, very good lubricating and releasing effects as well as its good electrical insulation, it is suitable for a variety of advanced applications.

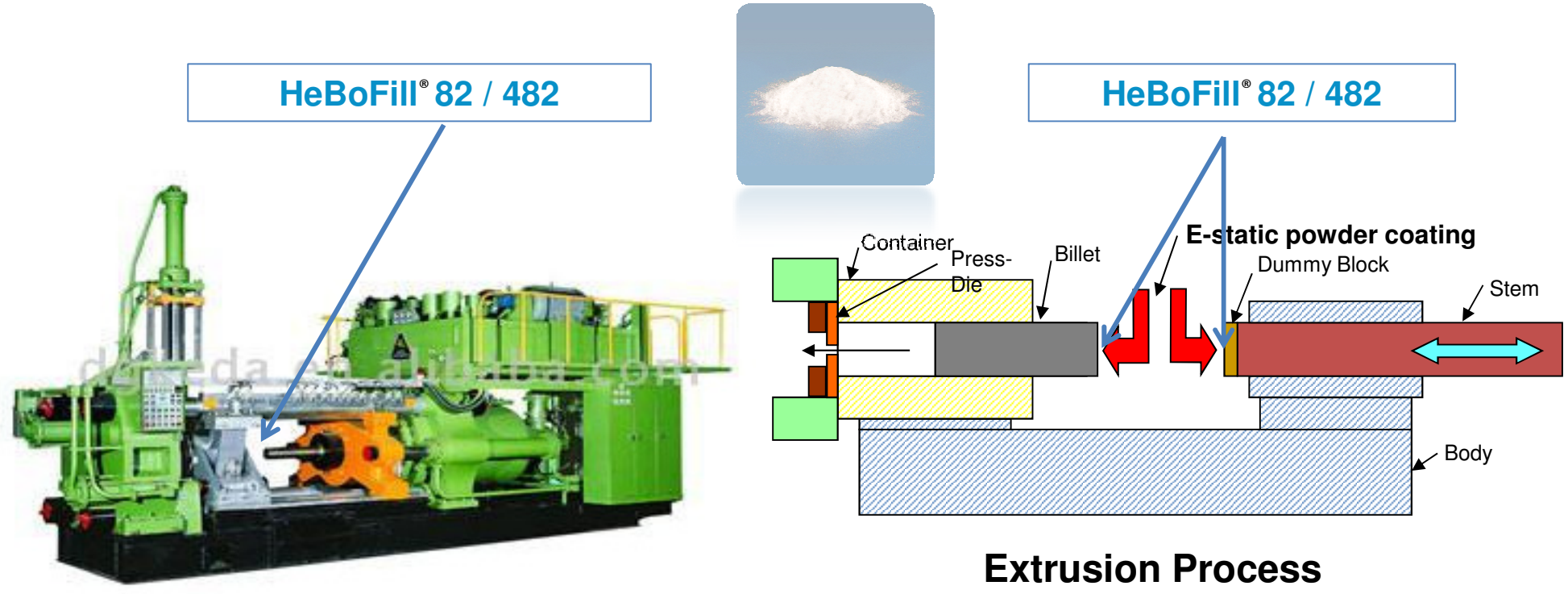
- **HeBoFill® 482**
  - Is a very high purity boron nitride powder with agglomerated structure. Due to its structure it shows a good flowability and meets therefore the requirements for most filling and transportation processes.

- **HeBoFill® 501**
  - Has a very high purity and a well crystallized single platelet structure with crystals of 40 µm. Due to the high purity and the large crystals it is particularly suitable as filler for plastic compounds in thermal management applications to increase thermal conductivity.



Typical Application of HeBoFill®

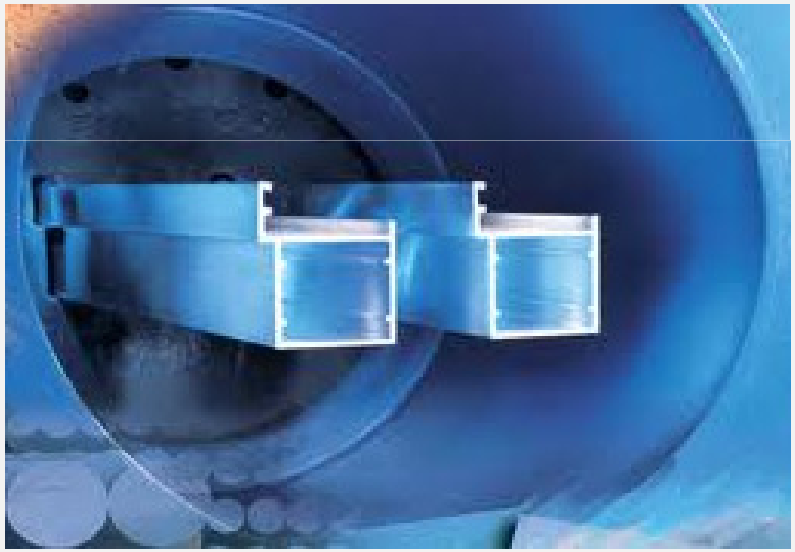
Aluminium Extrusion Process



Extrusion Process

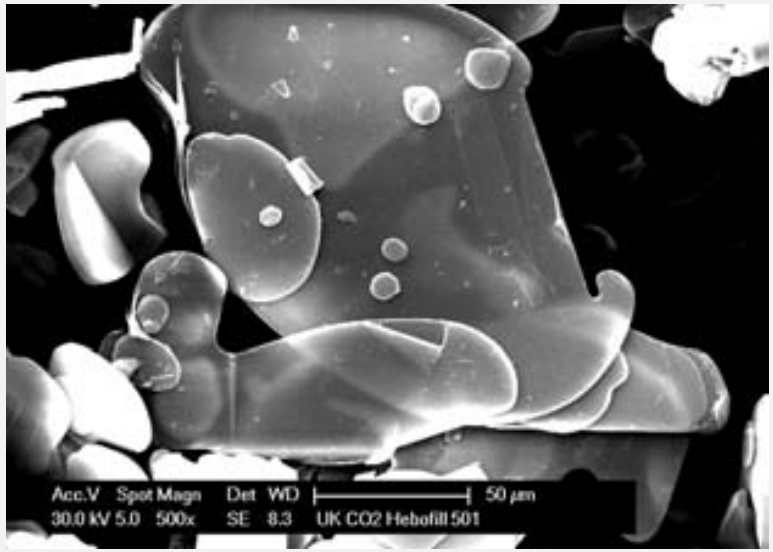
Typical Application in Aluminium Extrusion

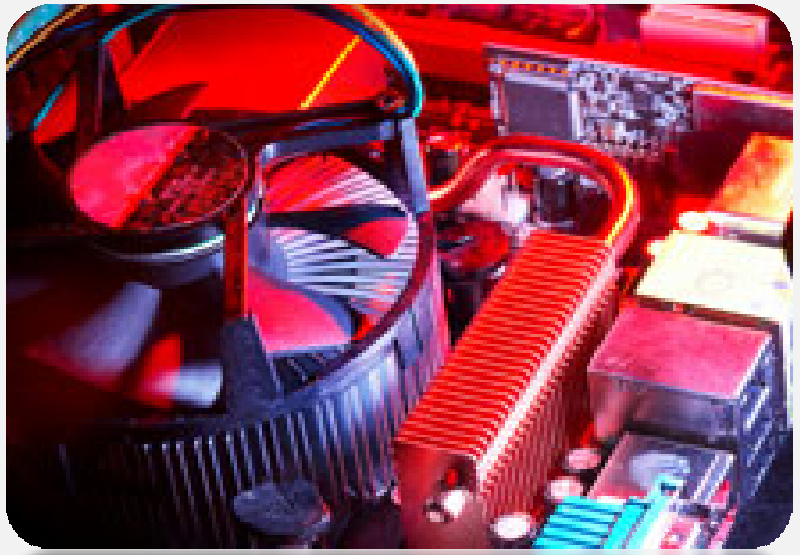
Aluminium billets and Extrusion profiles



Thermal Management

HeBoFill® improves the themal conductivity and maintains the electrical insulation





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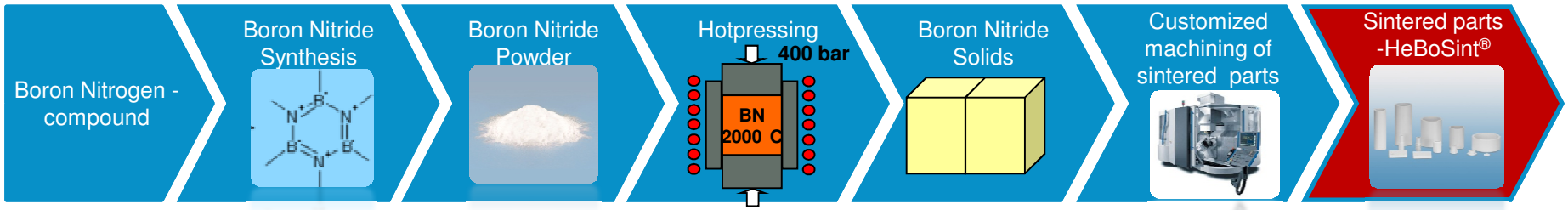
HeBoFill® and typical applications

HeBoSint® and typical applications

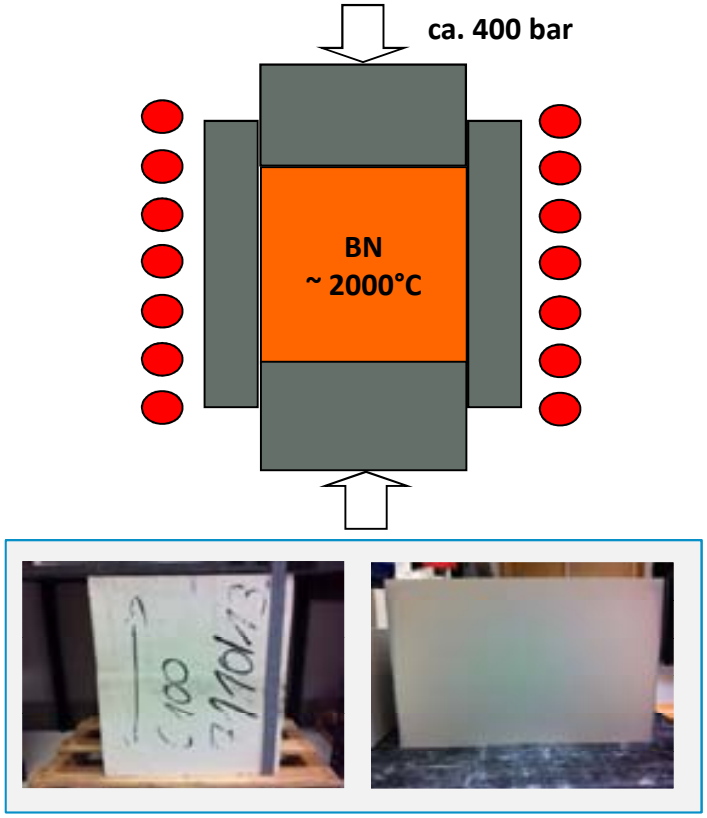
HeBoCoat® and typical applications

From BN Powder to HeBoSint®

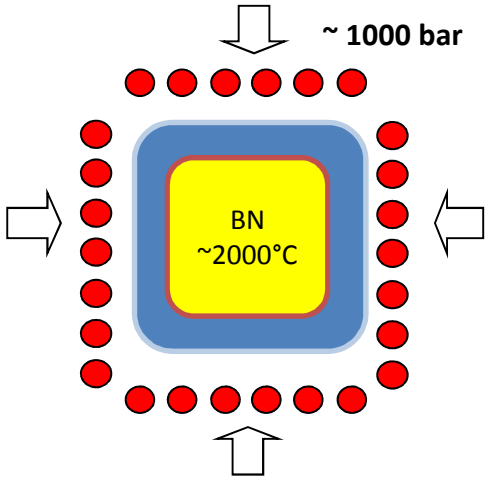


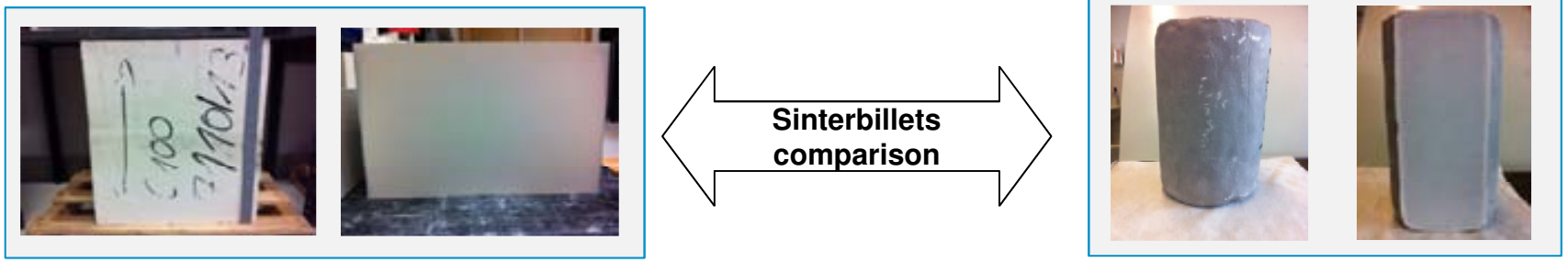
Different Sinter processes

Hot Pressing (HP)



Hot Isostatic Pressing (HIP)





HeBoSint® Overview BN Solids

HeBoSint®-Typ	P100		C100		D100		O120		O140		O740		O820	
Binder	none		Calcium Borate		none		none		Boric Oxide		Boric Oxide		none	
Composition	hBN		hBN		hBN		hBN+SiC+ZrO_2		hBN+SiC+ZrO_2		hBN+SiC+ZrO_2		hBN+SiO_2	
Typ. Density (g /cm³)	1,9		2,0		2,0		2,4		2,9				2,2	
Orientation dependence	Anisotropic		Anisotropic		Isotropic		Anisotropic		Anisotropic		Anisotropic		Anisotropic	
Thermal Properties														
Pressing direction	∥	⊥	∥	⊥	∥	⊥	∥	⊥	∥	⊥	∥	⊥	∥	⊥
Spec. Heat at 20°C (J/gK)	0,5		0,6		0,6		0,6		0,6		0,6		0,8	
Therm. Conductivity at 20°C (W/mK)	20	30	43	48	25		28	45	24	34	24	34	10	30
Therm. Expansion (10^{-6} / K) RT – 1500°C	0,5	1,0	3,0	4,0	3,0		3,0	4,5	4	8	4	6	0,2	3,0
Max. Use Temperature (°C) – Oxidizing Atmosphere – Inert Atmosphere – Vaccuum Atmosphere	~ 1000 ~ 2300 < 2300		~ 1000 ~ 1600 ~ 1600		~ 1000 ~ 2300 < 2300		~ 1000 ~ 1800 ~ 1800		~ 1000 ~ 1800 ~ 1800		~ 1000 ~ 1800 ~ 1800		~1000 ~ 1500 ~ 1500	
Electrical and Mechanical Properties														
Pressing direction	∥	⊥	∥	⊥	∥	⊥	∥	⊥	∥	⊥	∥	⊥	∥	⊥
Spec. Electr. Resistivity (Ohm cm)	> 10^{12}		> 10^{12}		> 10^{12}		> 10^{12}		> 10^{12}		> 10^{12}		> 10^{14}	
Bending Strength (MPa)	18	15	40	35	30		70	40	120	80	144	107	65	35
Young's Modulus (GPa)	14	11	30	25	23		35	20	45	30	71	50	85	75
Compressive strength (MPa)	27	22	60	52	45		140	60	240	120	280	160	130	50

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HeBoSint® sintered materials

HeBoSint® P

- High purity material for high temperature application

HeBoSint® C

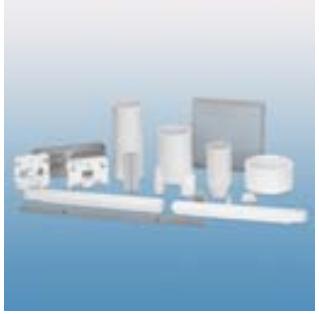
- Calcium borate bonded material, economic quality for various applications

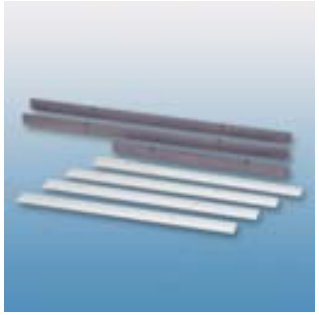
HeBoSint® D

- Hot isostatic pressed material, isotropic, without any binder, high purity

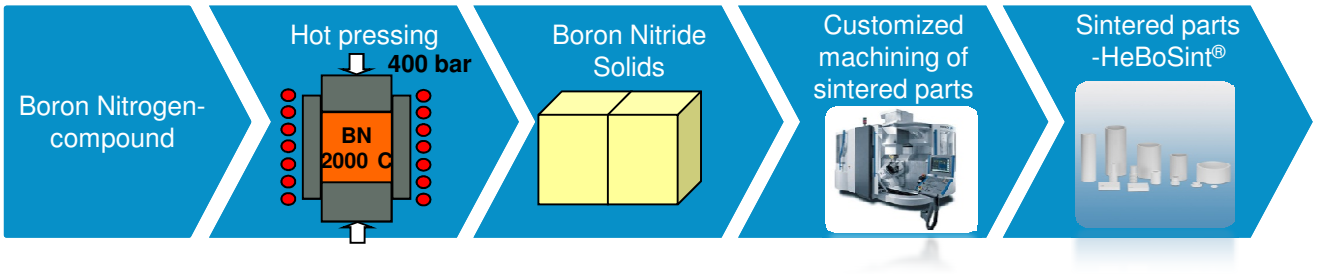
HeBoSint® O

- Hot pressed composite material (BN + ZrO2) with higher wear resistance and hardness
- Hot pressed composite material (BN + SiO2) with higher strength and high electrically insulation



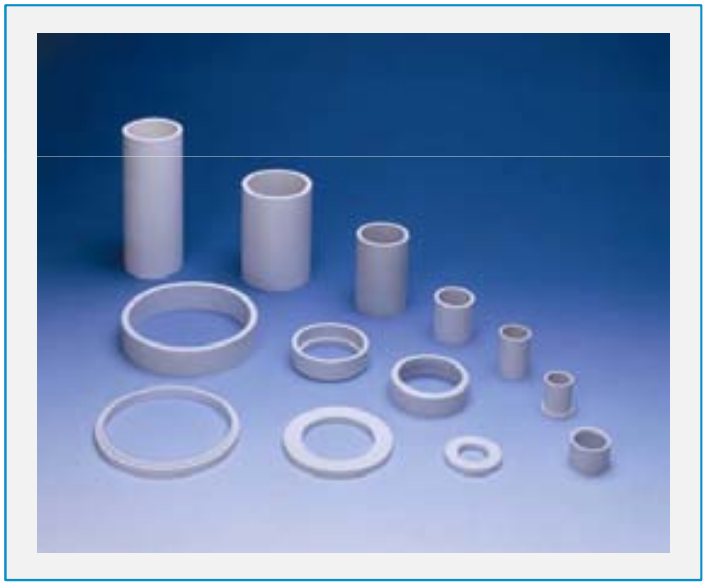


Typical Properties of HeBoSint®

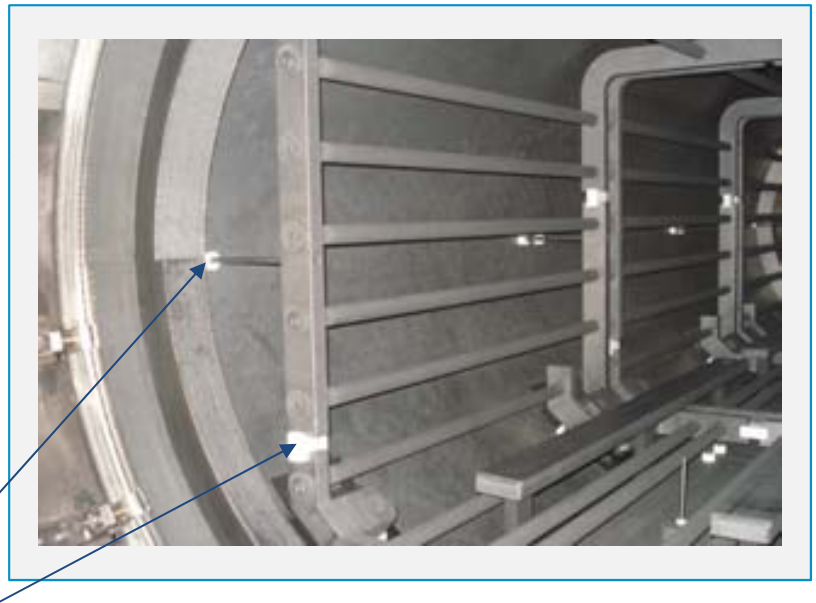


- Very high temperature stability up to 2.300 C.
- Chemical stability
- Not wetted by aluminum and most other molten metals
- Electrically insulating
- Highly thermal conductivity
- Physiologically “safe to use”

Typical applications of HeBoSint® in high temperature furnaces



HENZE BNP AG
Insulators for high temperatur furnaces



Graphical material on the authority of PVA TePla AG

HeBoSint®

Typical application in PVD ARC

Examples

- HeBoSint® frame

Application

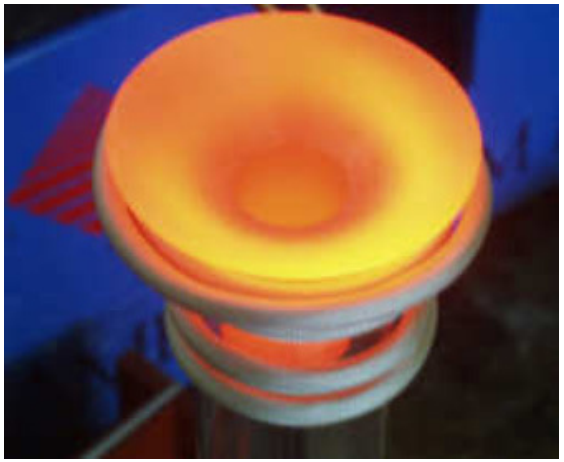
- PVD ARC equipment

Typical application in smelting installations

Example

- HeBoSint® crucibles

Application



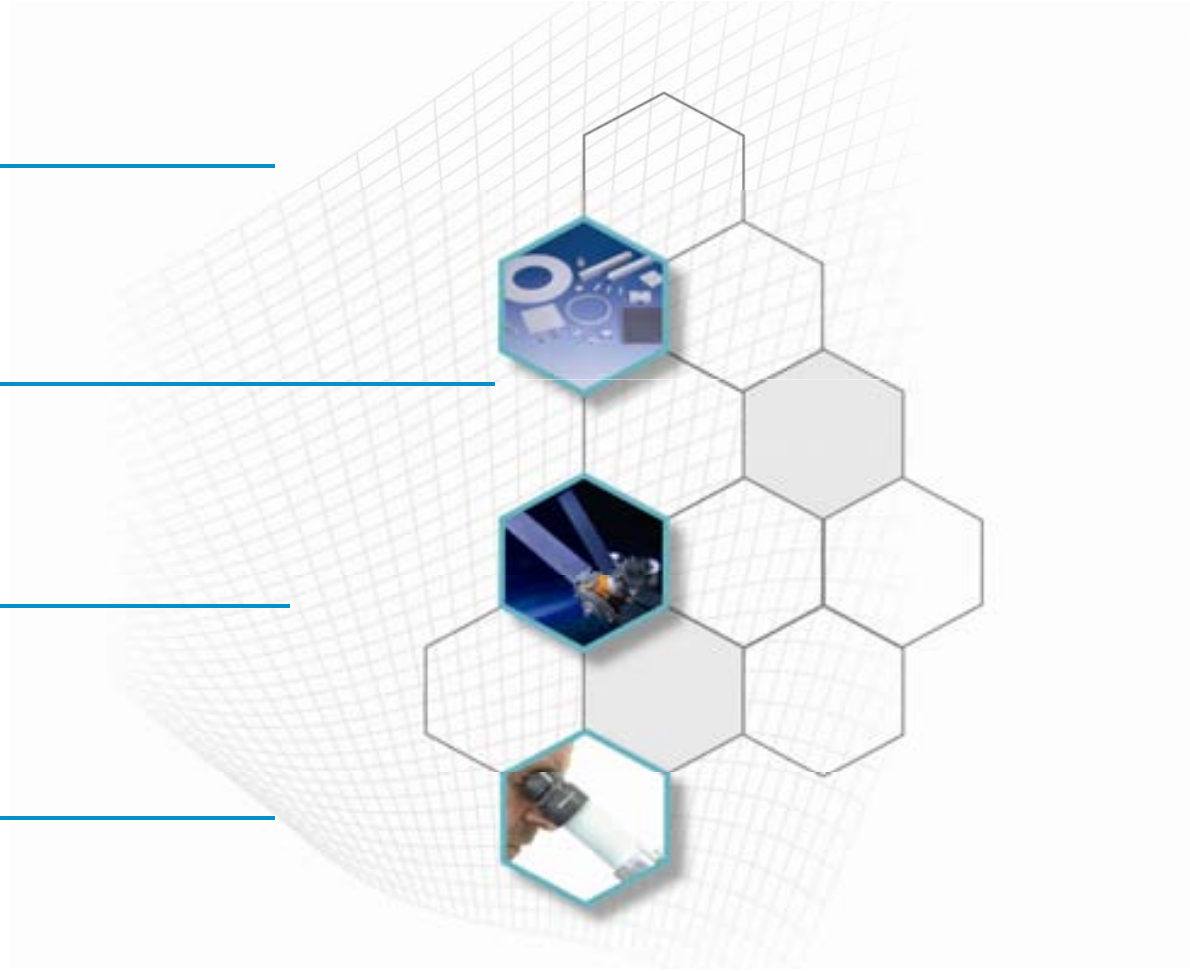
- Sintertechnology

Henze BNP AG

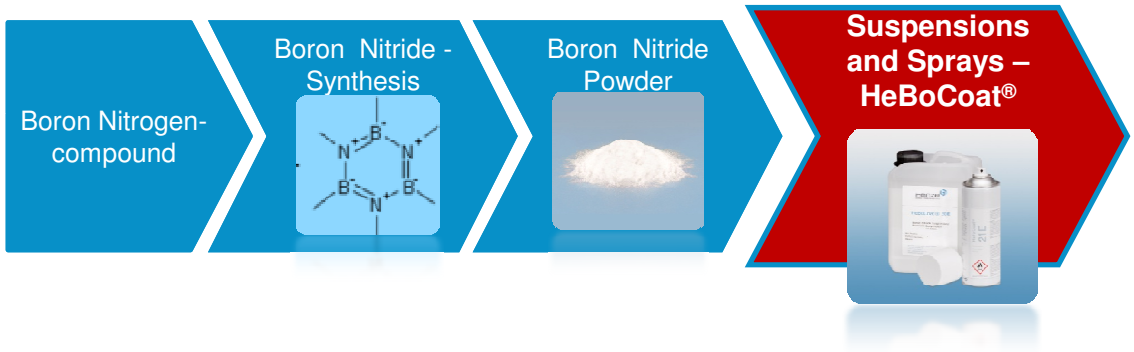
HeBoFill® and typical applications

HeBoSint® and typical applications

HeBoCoat® and typical applications



From BN Powder to HeBoCoat®



HeBoCoat® Typical Water-based Boron Nitride Coatings

HeBoCoat®-Typ	~10W	~alucast	~433W
Basis	Water	Water	Water
Binder	Aluminium oxide	Aluminium oxide	Boron oxide
Max. Temp. Binder in C	> 300	>300	> 300
Solid content	35%	35%	15%
Colour	Grey	Red	White
Sticking behaviour	+	+	+
Releasing behaviour	++	++	++
Lubrication	o	O	++
Processing	P / S	P / S	P / S

Legend: P = Painting, S = Spraying ++ very good + good o medium - less

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Typical Industries for the Application

Aluminium Casting

Application of HeBoCoat® alucast / 10W

Where to apply the Boron Nitride Suspension HeBoCoat® alucast / 10W?

- Continuous casting
- Production of logs and slabs
- Coating of refractory launders and other materials
- Protection from the melt, releasing effect, non sticking

  (liquid aluminium tends to stick!)

- Coating of casting ladles (liquid aluminium attacks steel!)

logs

slabs

automatic ladle

Application of HeBoCoat® alucast / 10W

Where to apply the Boron Nitride Suspension HeBoCoat® alucast / 10W?

- Coating of the casting table, HeBoCoat® prevent sticking of Aluminium






Application of HeBoCoat® 433W

Where to apply the Boron Nitride Suspension HeBoCoat® 433W?

- Ingot casting

- Molds have to be coated for protection against the melt

- Launders, to guide the aluminium flow

HeBoCoat® Ethanol-based Boron Nitride Coatings

HeBoCoat®	~20E* / 21E	~400E*/401E	~400EBA
Basis	Ethanol	Ethanol	Eth/Acet
Binder	Polymer	Silikat	Silikat
Max. Temp. Binder in C	< 300	> 300	> 300
Solid content	20%	12,5%	12,5%
Color	white	white	white
Sticking behaviour	+	++	++
Releasing behaviour	++	++	++
Lubrication	++	+	+
Processing	P / S / D	P / S / D	P / S / D

Legend: P = Painting, S = Spraying, D = Dipping ++ very good + good o medium

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Application of HeBoCoat® 21E

Where to apply the Boron Nitride Spray HeBoCoat® 21E?

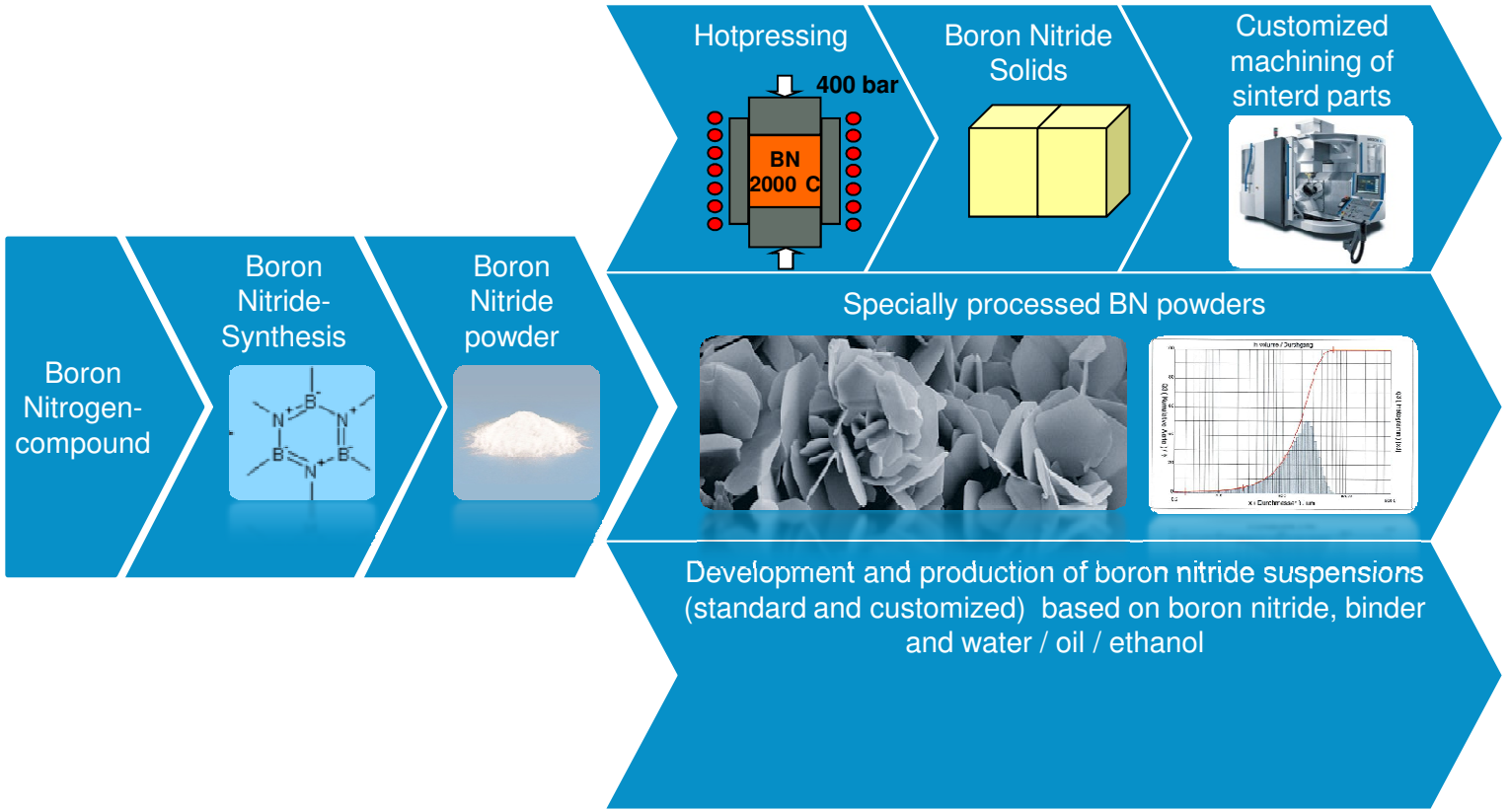
Al Extrusion to improve the Aluminium flow during initial pressing

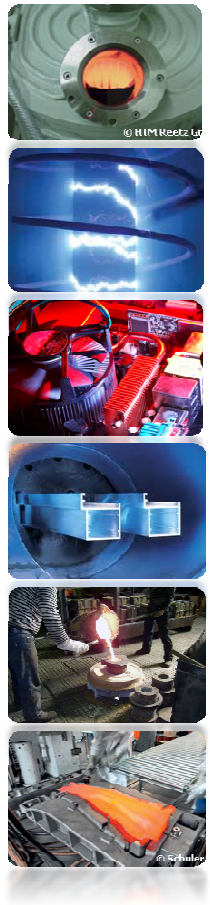
Application of HeBoCoat® 401E/401EBA

Where to apply the Boron Nitride Spray HeBoCoat® 401E/401EBA?

Welding to prevent sticking of sputters

Management summary





Dank u well!
Thank you!