Inorganic binders – benefits – state of the art – actual use

UNIVERSITÄT DUISBURG ESSEN
Offen im Denken

Prof. Dr.-Ing. Thomas Steinhäuser

SOUTH AFRICAN METAL CASTING CONFERENCE 2017

History

- 1995 start of development, University of Duisburg
- 1996 first patents
~ 2000 first serial production (cylinder heads)
~ 2005 several producers with similar systems in the market
- 2017 serial production of automotive parts (BMW, VW, Mercedes Benz, etc.)

Benefits

Eliminate emissions, increase productivity/quality :

- core production,
- casting
- decoring / shake-out
- sand reclamation

Cost efficiency:

- lower/no costs for waste disposal
- reduced costs for exhaust air treatment

Inorganic binder system

Sodium silicate: $x\ SiO_2 \bullet y\ Na_2O \bullet z\ H_2O$

Additives to optimize the process/ casting surface

Inorganic process

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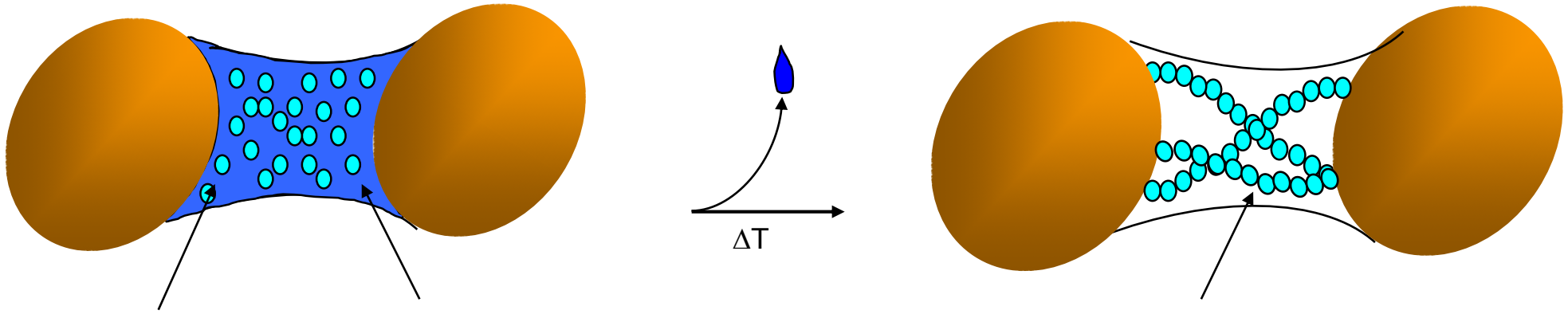
Main process differences vs. existing technologies

1. Hardening by physical elimination of water
2. Tool temperature 280° – 360°F (140° – 180°C)
3. Microwave drying/ hot air gassing

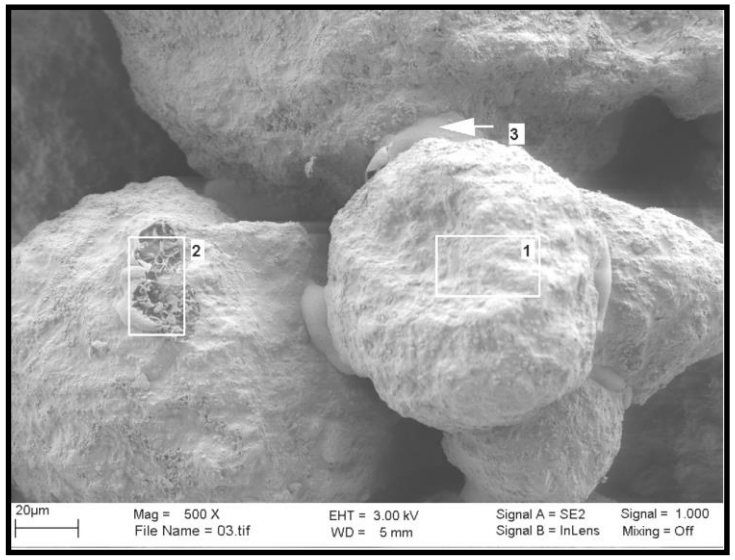
Inorganic binding processes



Sodium silicate binder

solvent: water

AWB-binder-bridges



Inorganic process

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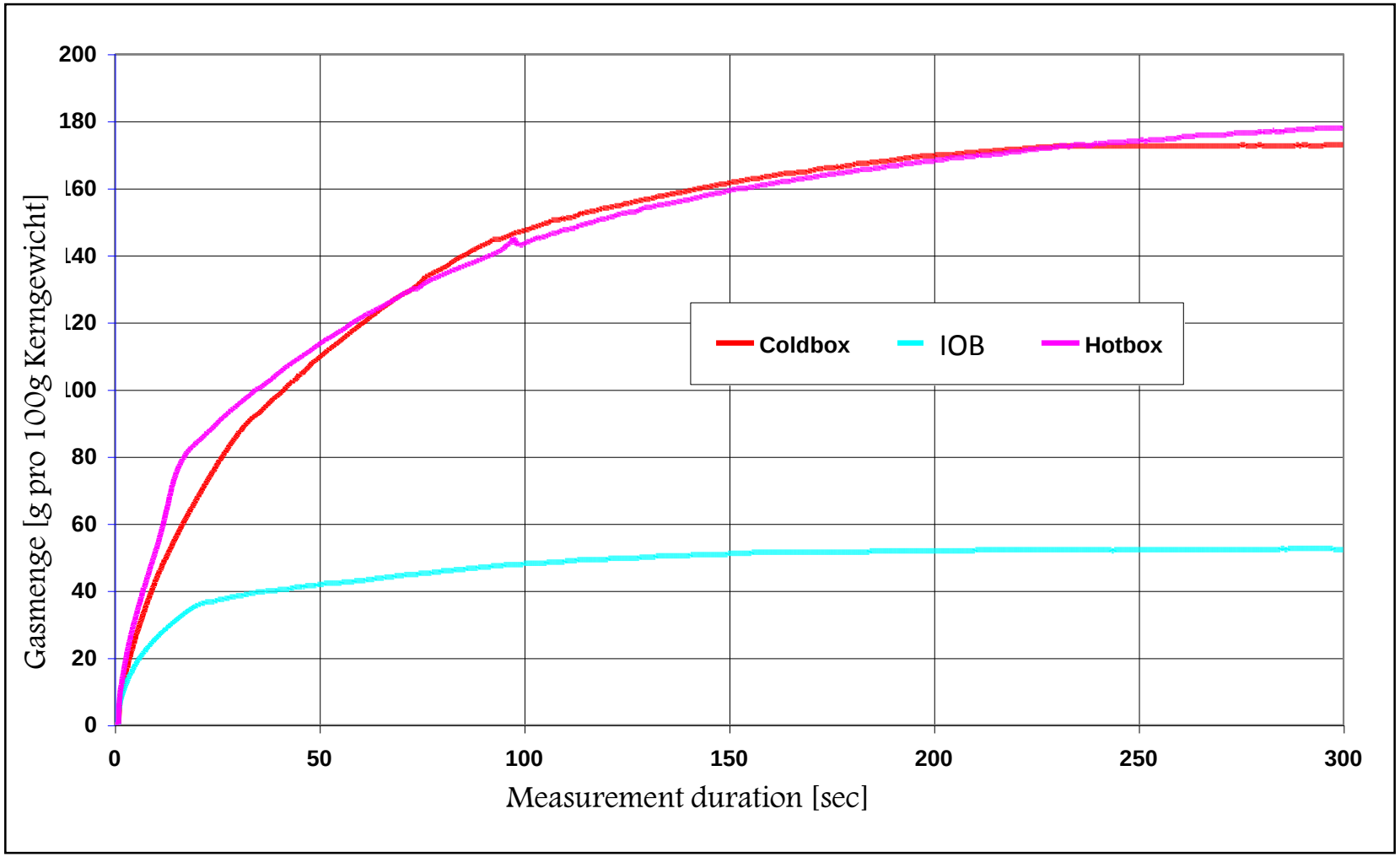
4. Cores storable for several weeks when fully dried
5. Less core gas, less casting defects

Cogas-Test


Gasmenge [g pro 100g Kerngewicht]
200
180
160
140
120
100
80
60
40
20
0
0
50
100
150
200
250
300
Measurement duration [sec]
Coldbox
IOB
Hotbox

Inorganic process

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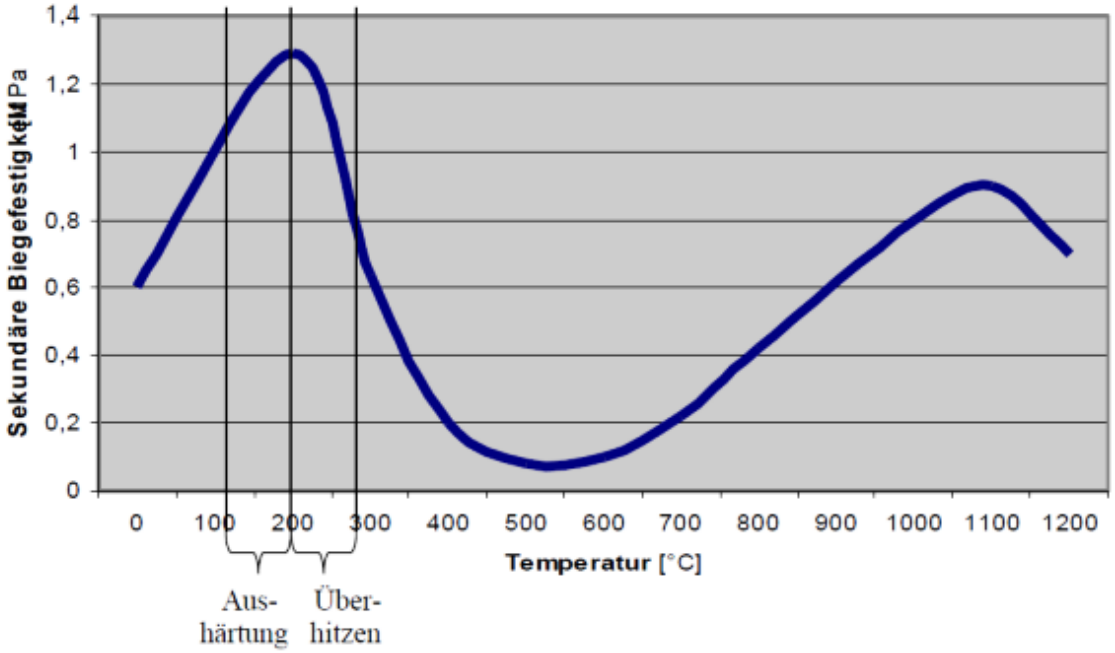
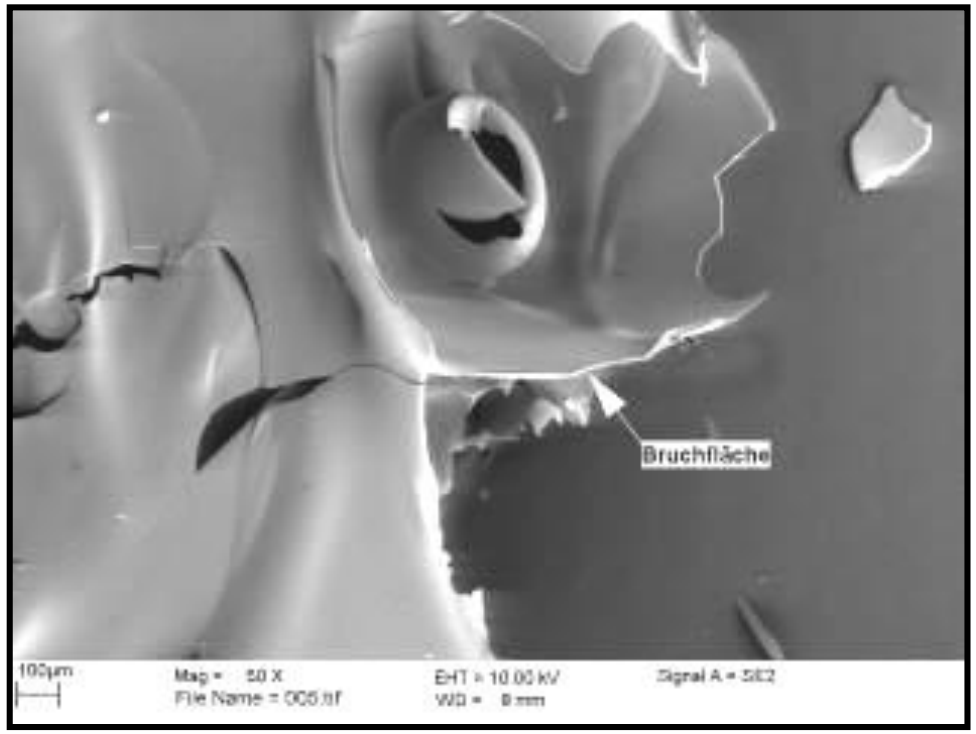
6. Good shakeout

Bending strength subject to temperature





T=100 bis 200°C => free water evaporates

T=200 bis 600°C => bonded water (OH) disappears
=> shrinking + cracking of binder bridges

T >750°C => secondary glas melt

Inorganic process

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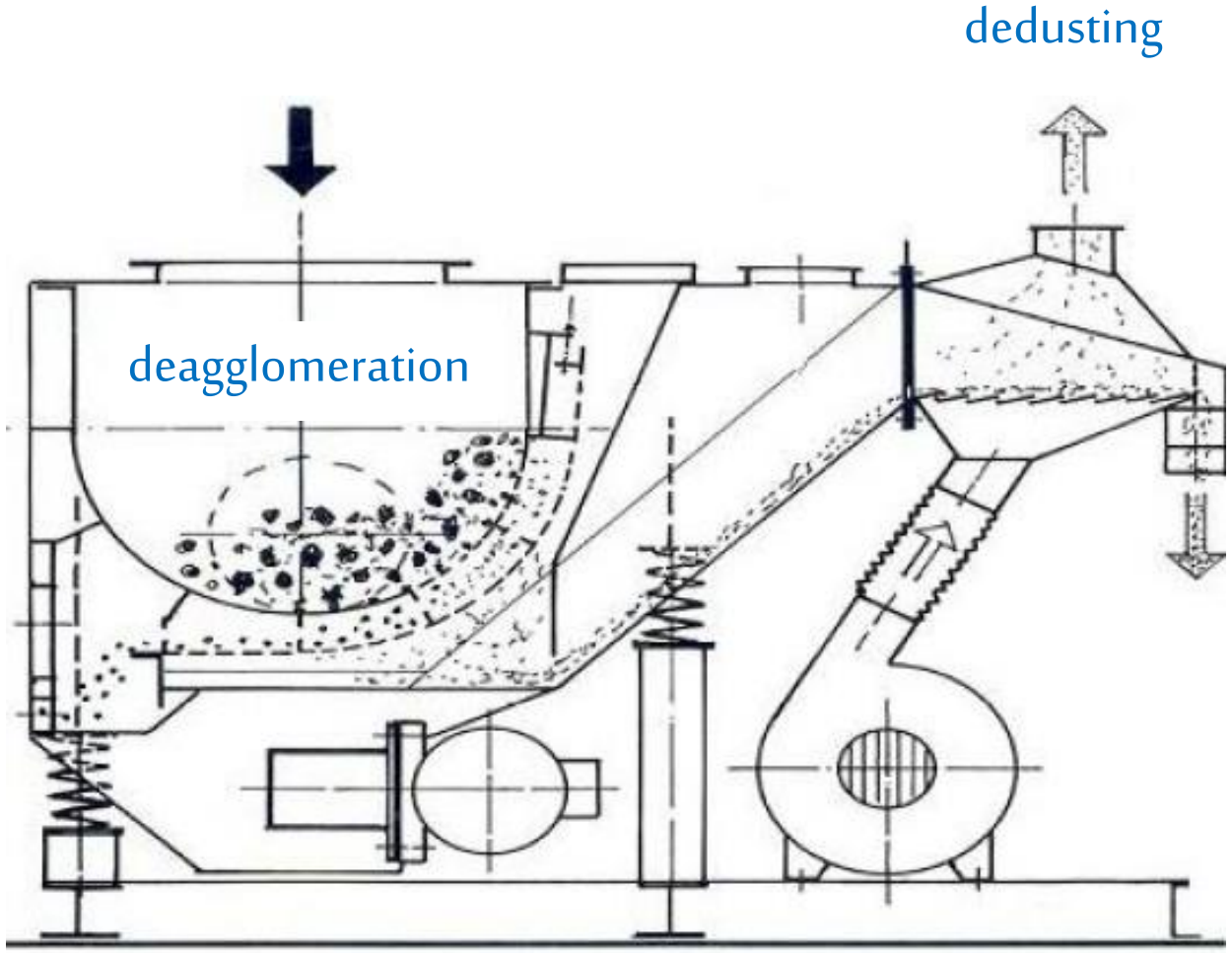
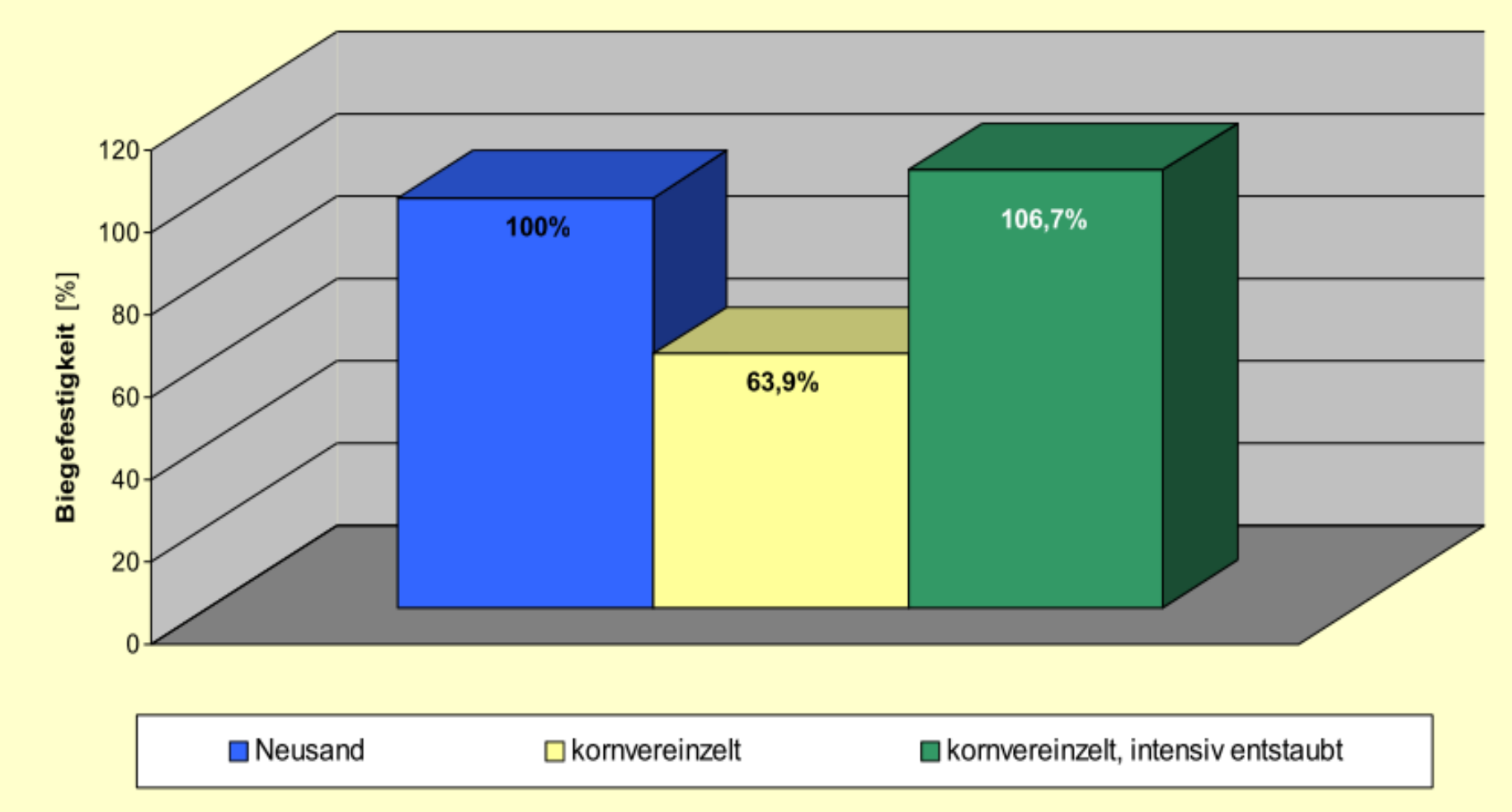
6. Good shakeout
7. reclaimable

Reclamation

Vibramill



Comparison bending strength reclaimed new sand



Inorganic – Process flow chart

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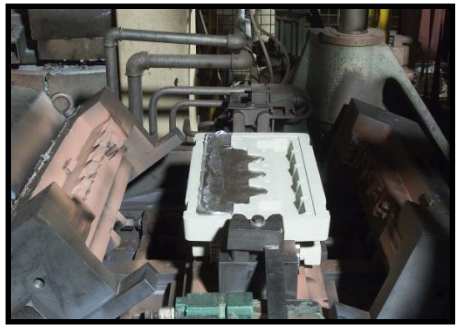
mixing

Core shooting

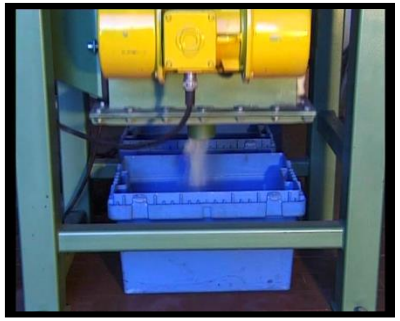
Microwave drying

Core storage



casting

decoring



Sand reclamation

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Improvement of the surface properties

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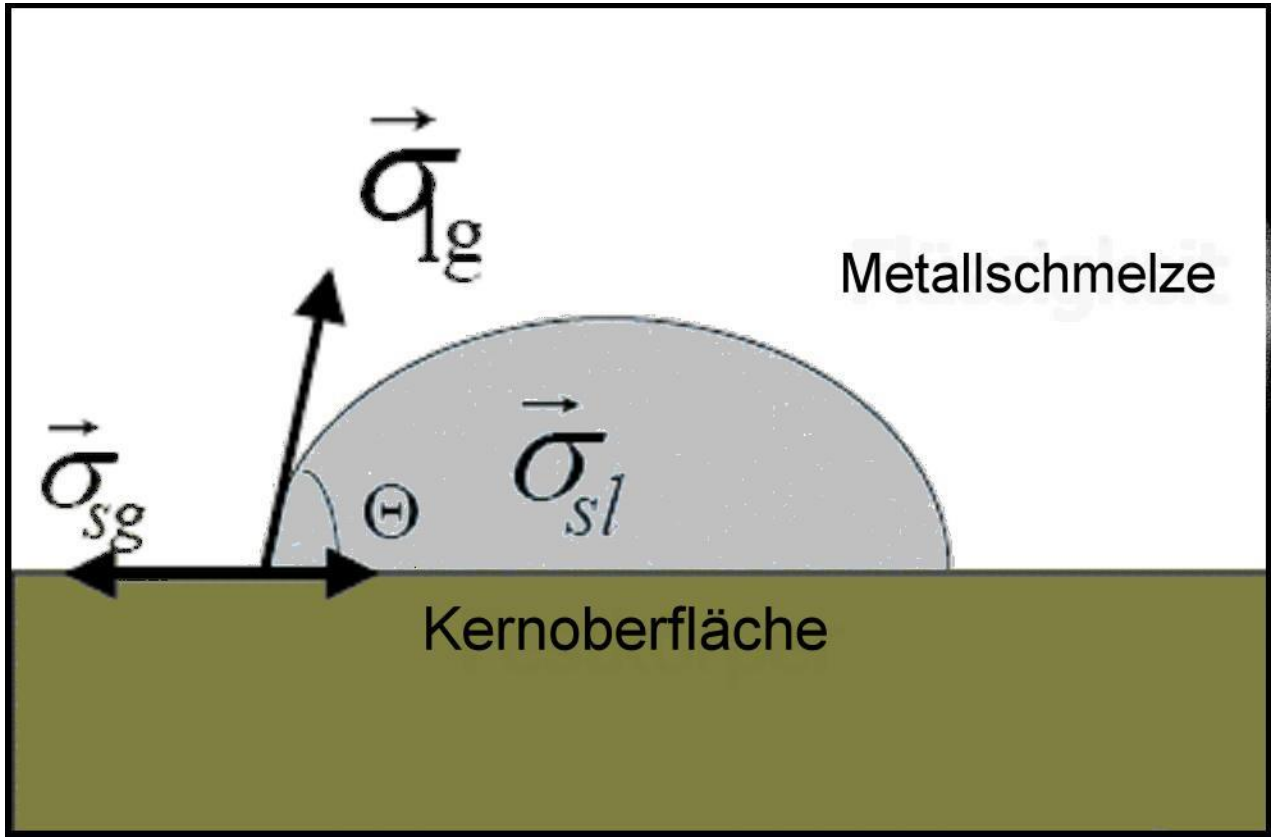
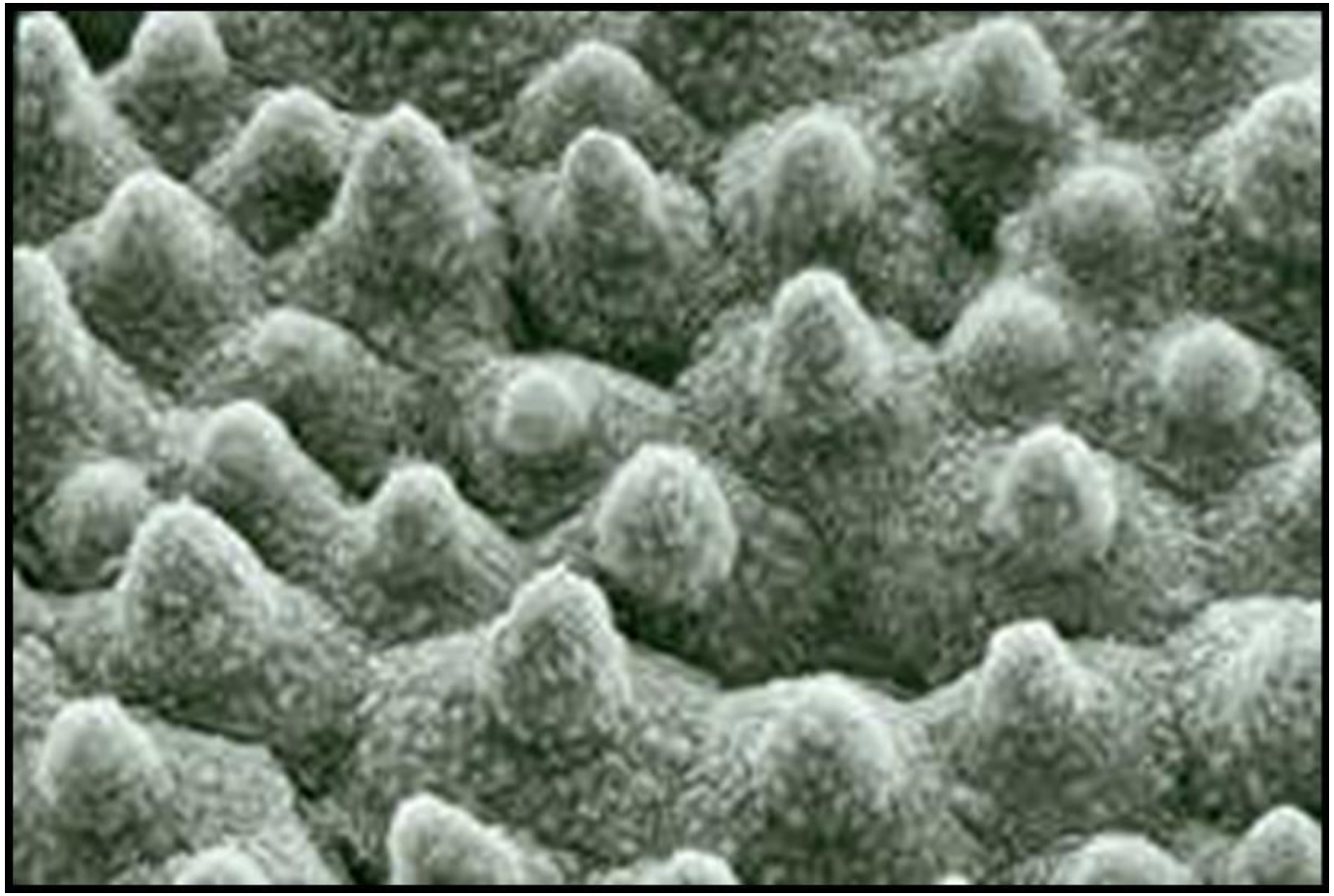
Prevention of sand adhesion

- Coating
- Addition of a gas former
- Substitution of silica sand by non wettable material
- Modification of sand wettability by additives

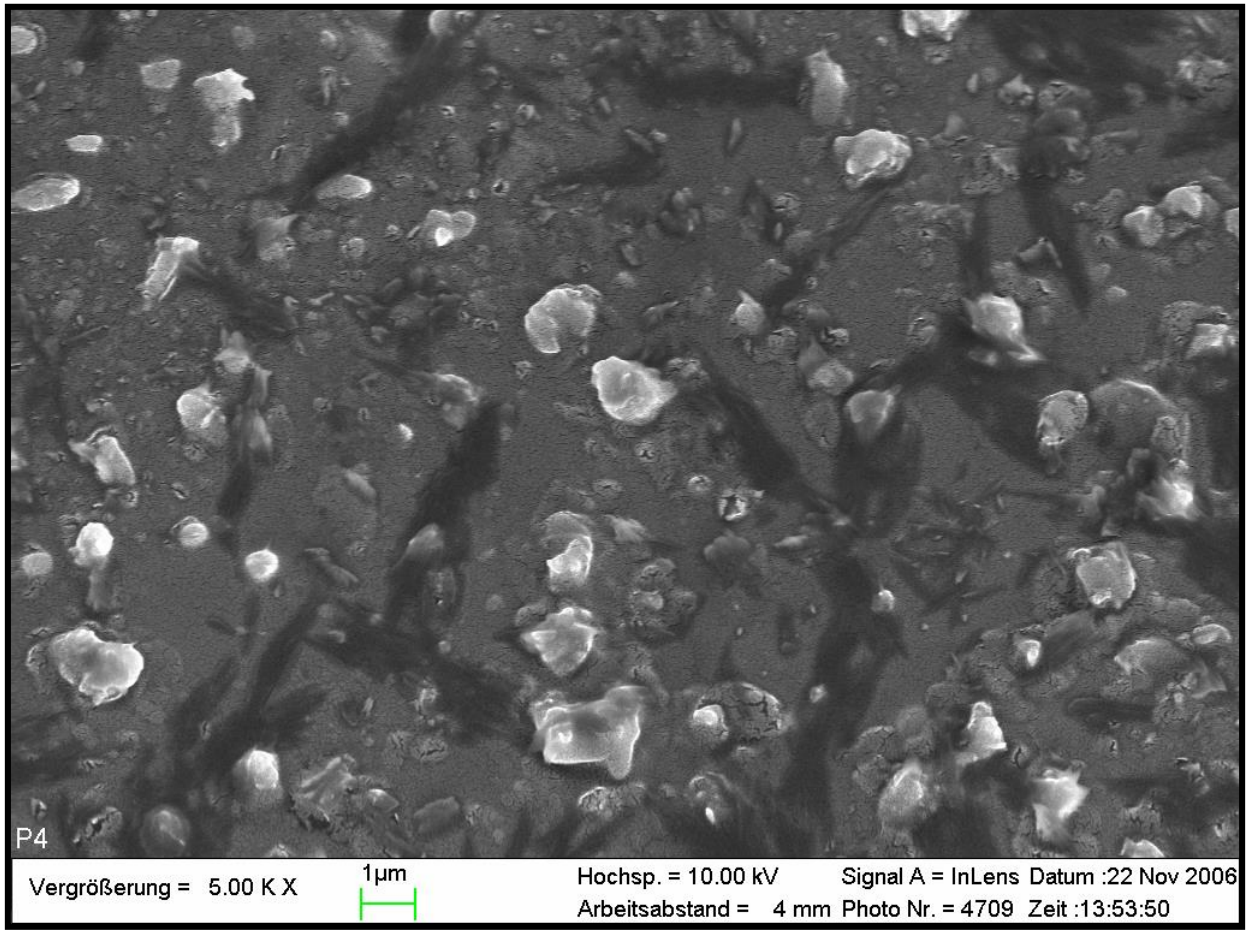
Wettability



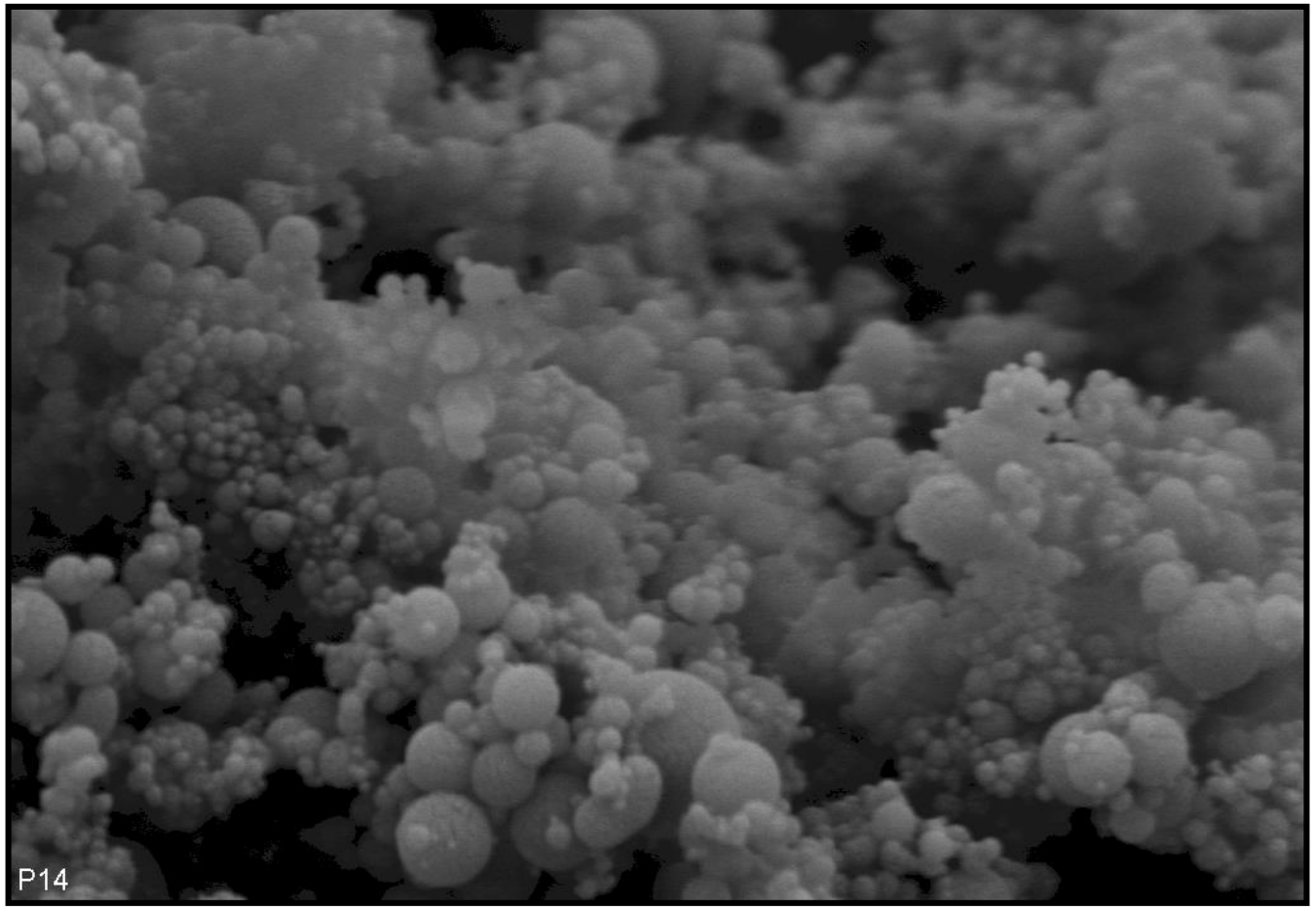
SEM-picture: Surface lotus leaf



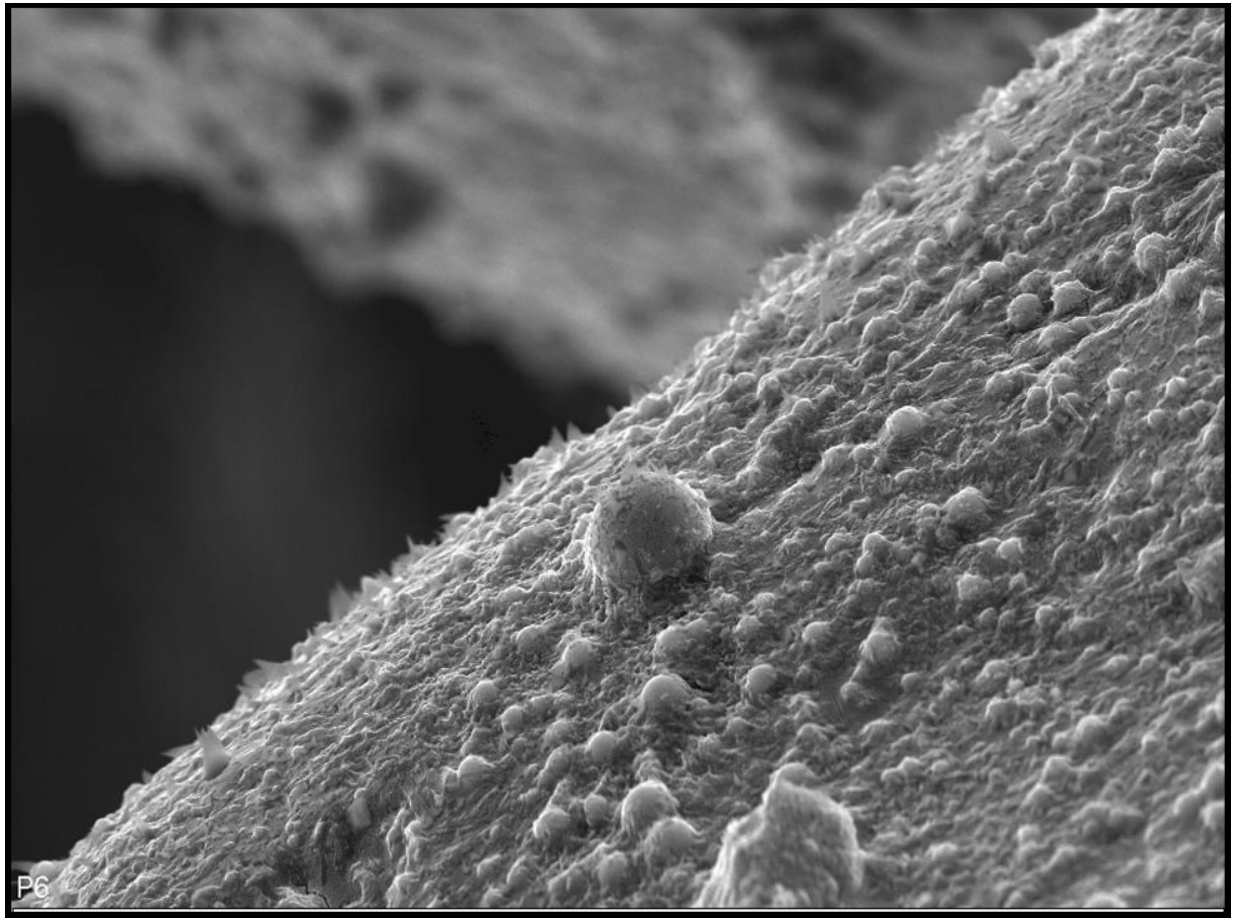
SEM-picture: Surface silica sand



SEM-picture: nano particles



SEM-picture: silica sand with nano particles



Casting without / with nano particles

without nano-particles

With nano-particles

Castings

Selection of Cores produced with AWB

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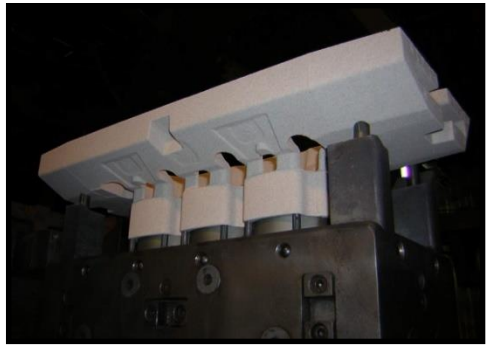

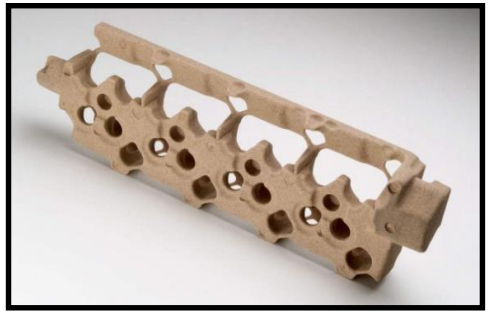
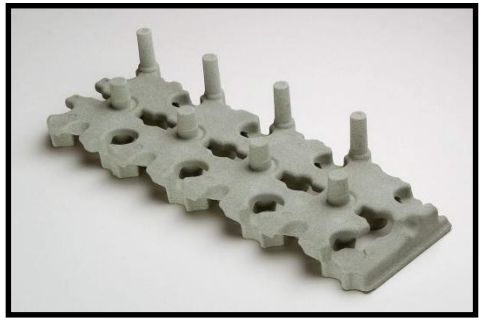

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Thank you very much for your attention !