INNOVATIVE AND LITHIUM-FREE ADDITIVES FOR THE PRESENT AND FUTURE REQUIREMENTS OF IRON/STEEL AND ALUMINUM FOUNDRIES

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AGENDA

Basics of Sand Additives

Raw material situation & additive development

Productivity

Coating free casting

Special sand reduction

Aluminum casting

With Türkish sands

Conclusion

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BASICS OF SAND ADDITIVES

QUICK INTRODUCTION INTO SAND ADDITIVES

Basic technical reasons for the use of sand additives

- Preventing casting defects
  - E.g., veining (often a side effect of cold box bonded cores)
- Stabilization of casting production

More reasons to use the new additive

- Substitution or reduction of special sands
- Significantly improved core box/tooling cleanliness in core production → higher productivity
- Coating free production under certain conditions
- Improved shake-out in aluminum casting
- Reduced hot tears in steel castings (PEP SET & Cold Box)

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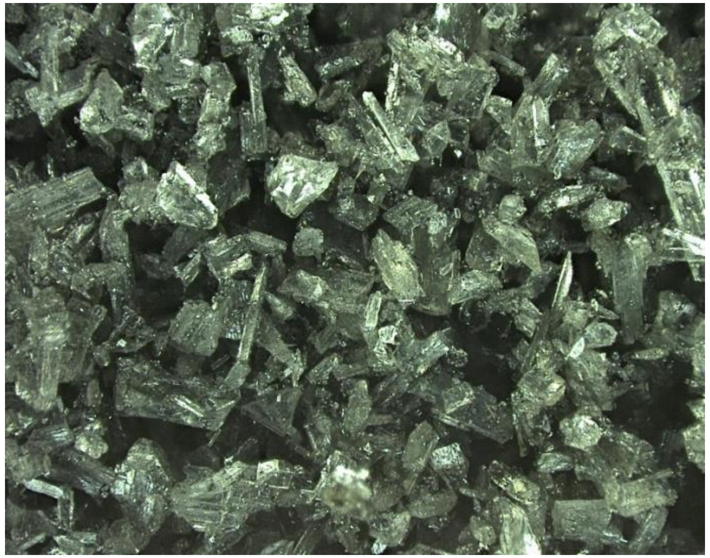
COMPARISON OF DIFFERENT ADDITVE TYPES

Organic Additives
VEINO

Inorganic Additives
ISOSEAL



Hybrid Additives
VEINO ULTRA

Almost all current existing additives are in powder form

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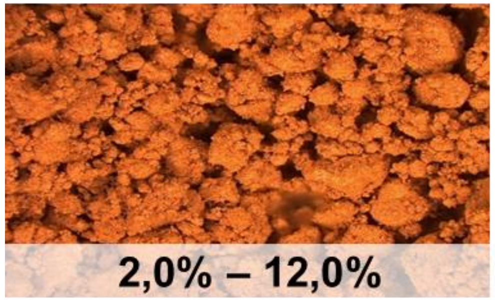
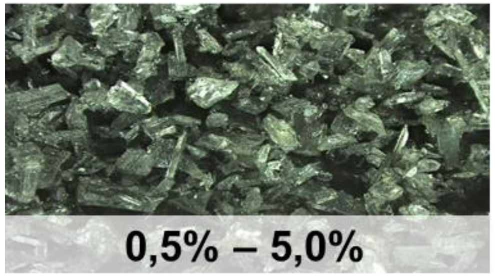
COMPARISON OF DIFFERENT ADDITIVE TYPES

		Advantages	Challenges
	**Organic Additives** • Hardwood- / plant-based granulate • Dextrine / starch	• Good dosing properties • Very effective against veining • Renewable raw materials	• Impregnated additives • High gas & odor development • Tooling contamination (wipe off performance) • Expensive additive production
	**Inorganic Additives** • Iron oxide • Ceramics • Minerals	• Low, almost no gas emissions • Party, not necessary to increase the binder amount • Coating-free casting possible • Reduced tooling contamination	• High addition amount • High raw material cost
	**Hybrid Additives** • Organic & inorganic raw materials	• Lower gas emissions • Coating-free casting possible • Low tendency to deformation • Reduced tooling contamination • Replacement of special sands	• Partly a difficult dosing • Impact on core strength

FUNCTION OF SAND AQDDITIVES – ORGANIC ADDITIVES

- Organic components in pouring process:
  - burn, carbonize and soften
- Sand grains expand into recently formed spaces
- Use of organic additives
  - Iron castings
  - Brake discs, brake caliper
  - Hydraulic parts
  - Engine blocks
- Not suitable for coating-free production
  - Few exceptions possible

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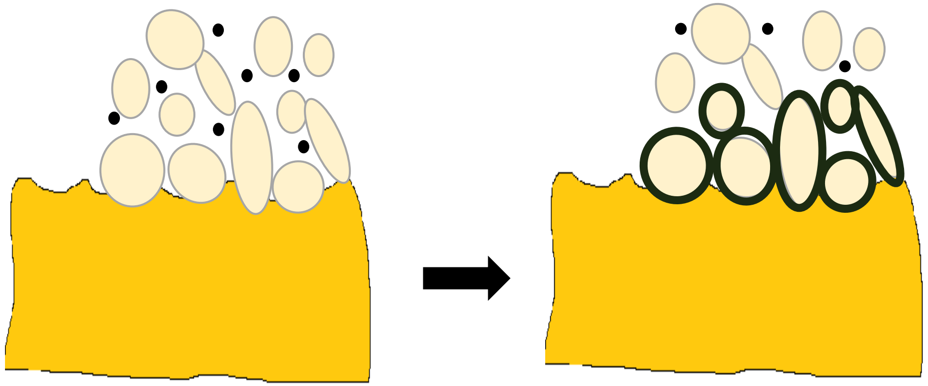
FUNCTION OF SAND ADDITIVES – INORGANIC ADDITIVES

- Minerals develop a pasty transition phase (sintering phase)
- Acts as a buffer against silica expansion
  → Increasing of hot tensile strength
  → Improving of thermo-elasticity
  → Influencing wetting of the silica sand grains by the casting material
  → Substances with a lower expansion factor leads to less stress
  → Substances with high thermal conduction
- Very suitable for
  - Steel, brass & iron
  - Turbo charger
  - Engine blocks
  - Hydraulic parts
- Coating-free production possible



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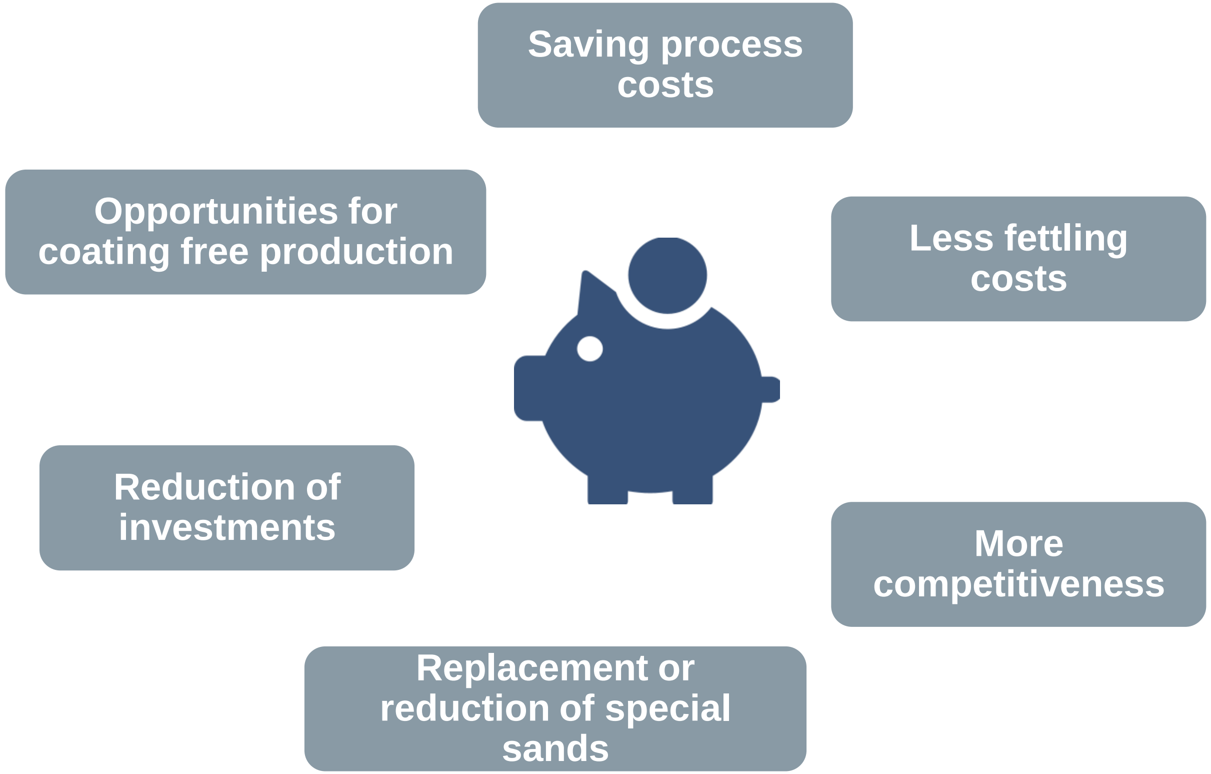
FUNCTION OF SAND ADDITIVES – HYBRID ADDITIVES

- Hybrid additives =

  organic + inorganic raw materials

- Suitable for
  - Iron, steel
  - Brake discs, brake caliper
  - Hydraulic parts
  - Engine blocks
  - Cylinder heads
- Coating free production possible

→ Best of both additive types



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WHICH IS THE BEST ADDITIVE (AND AT WHAT AMOUNT)?

The question which is always addressed to us.

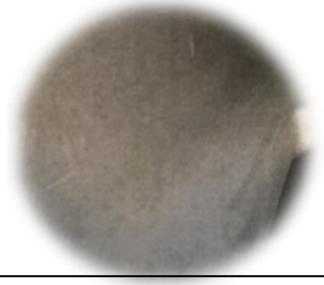
Molding material, binder type, binder amount	Core or mold	Human
Complexity, geometry		Environmental influences
Machines, engineering, tools, core boxes		Variations in the process, limits, tolerances
Casting material		Add-on to molding material: **Additives**
Casting conditions		
Coating		

THE MOST SUITABLE ADDITIVE

→ Good castings with organic, inorganic or hybrid additives

→ Individual solution(s) needed

750 kg in GJL
Cold Box core
additive & coating from competition supplier



Identical casting
Cold Box Core
With engineered ASK Additive
&
ASK coating

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RAW MATERIAL SITUATION & NEW DEVELOPMENTS

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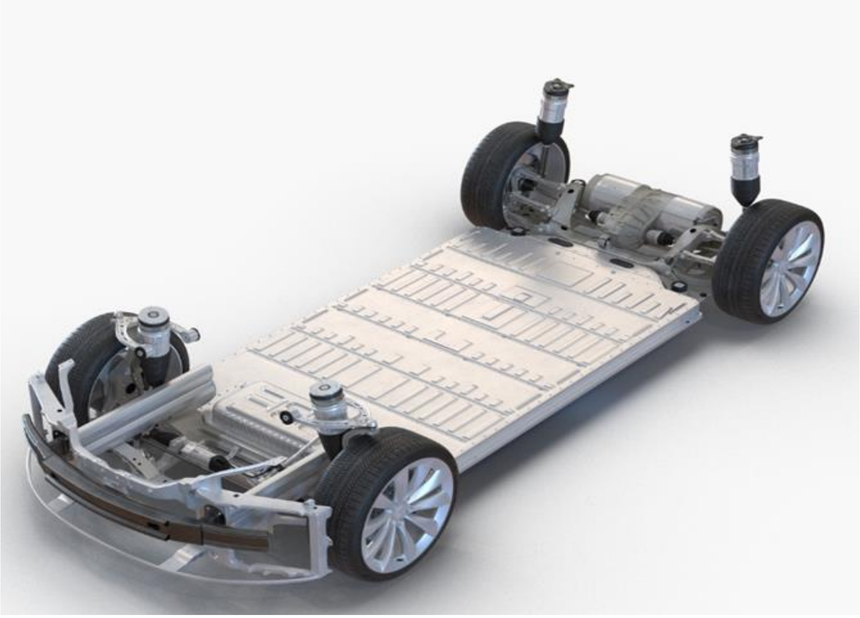
We advance your casting

RAW MATERIAL SITUATION - LITHIUM

- The most important inorganic raw material in additives are/were based on expensive Lithium Mineral
- Lithium is also a key component for rechargeable batteries
- E-Mobility has led a significant shortage and enormous increase in price of the Lithium (up to 5 times within 6 years)

Source: VDI Konferenz Bremen, Christian Heiselbetz



Source: Turbosquid.com

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SEARCH AND SELECTION OF RAW MATERIALS

ASK has R&D for additives in Europe (Germany) & USA
ASK has an own additive production, which is located in Germany

Methods of comparison:

- Chemical comparison
- Grain size comparison
- Strength comparison
- Heating microscope
- Casting comparison

  (lab tests – at ASK Hilden Casting Pilot Plant)
- Field trials in foundries

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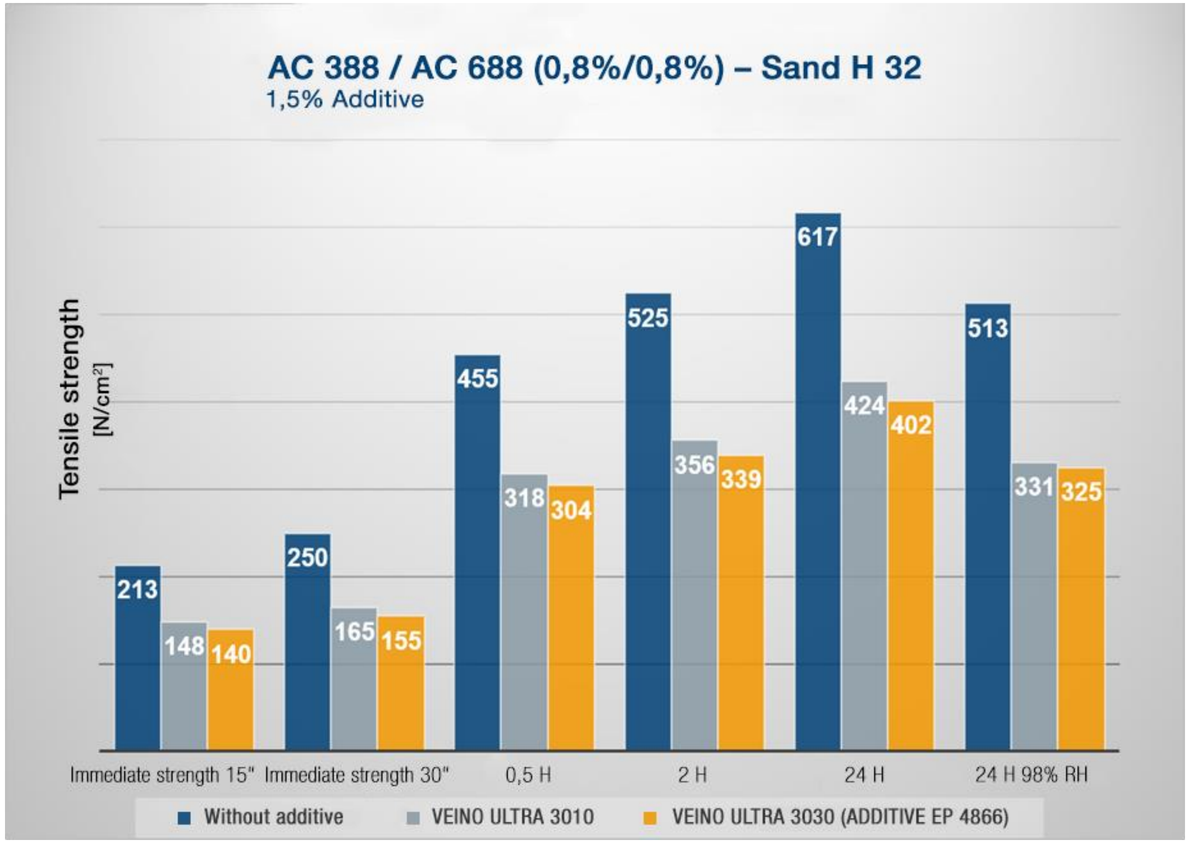
ALTERNATIVE PRODUCTS - COMPARISON

VEINO ULTRA 3010 – VEINO ULTRA 3030



VEINO ULTRA 3010 = original → contains lithium

VEINO ULTRA 3030 = lithium-free alternative

Without additive VEINO ULTRA 3010 VEINO ULTRA 3030

Casted at the ASK Pilot Plant in Hilden
GJL, **uncoated**, 1420° C

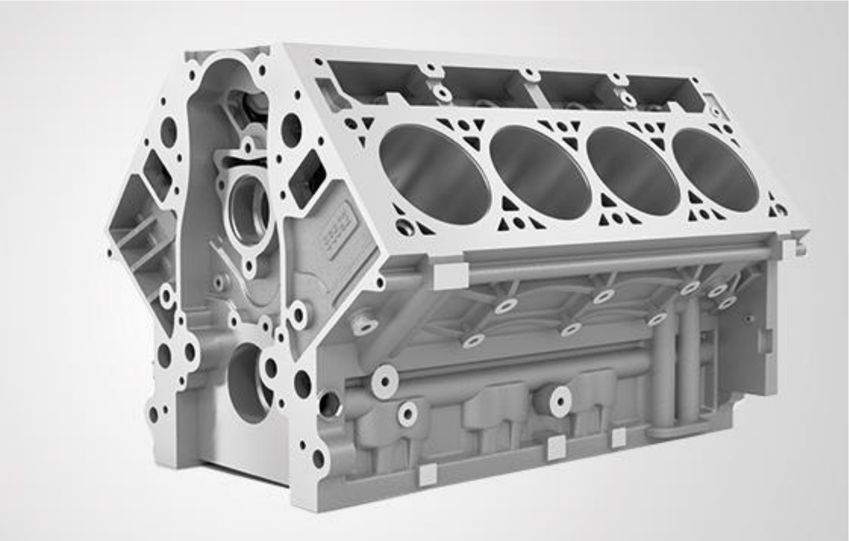
Fig.: Dome core

HIGH PERFORMANCE PRODUCTIVITY

IRON CASTING: INNOVATIVE ADDITIVES & FOUNDRIES

Objectives

- Low-addition quantities
- Good anti-veining effect
- Very good sand flowability ensuring optimum contour accuracy
- Improved core box cleanliness as compared to standard sand mixtures reduced tool downtimes!
- Reduction / substitution of special sands
- Additive composition: ideally inorganic or hybrid (lithium-free)



Location	Germany
Capacity:	Approx. 170,000 MT/Y
Casting material:	Grey/Ductile Iron
Casting program:	Up to 5 million cylinder blocks
Customer:	Passenger car sector

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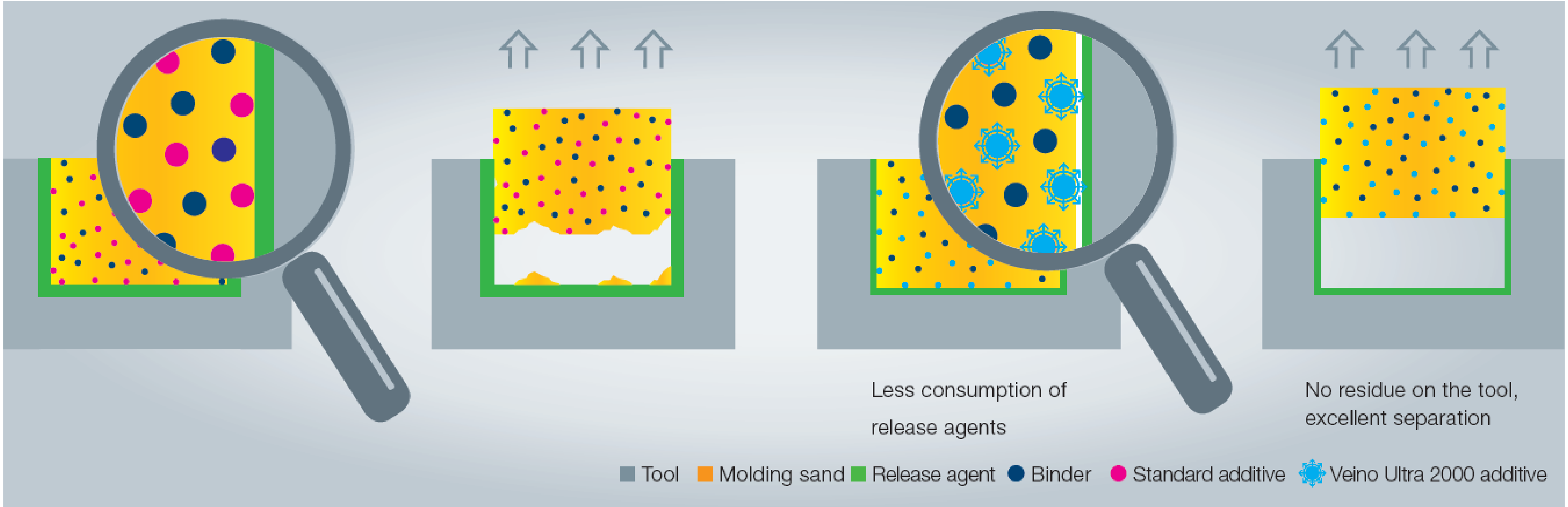
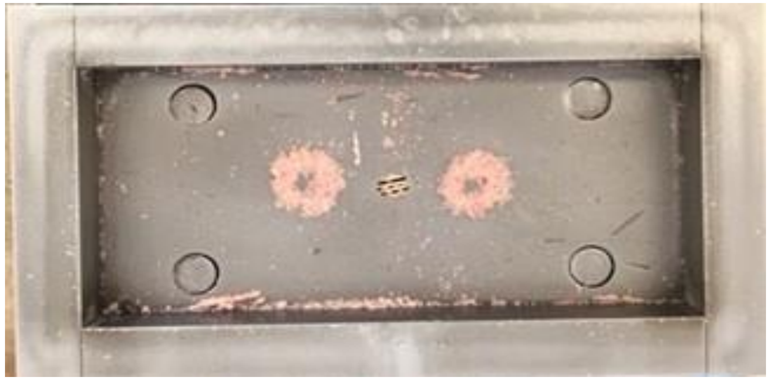
RELEASE EFFECT – VEINO ULTRA 2000 (PATENTED)



IRON CASTING: INNOVATIVE ADDITIVES & FOUNDRIES

Sand sticking tendency (without any release agent)

- Silica sand
- No additive
- 0.80% binder per part
- After 20 cycles



- Silica sand
- 2% standard additive (competition)
- 0.80% binder per part
- After 20 cycles

- Silica sand
- 2% VEINO ULTRA 2000
- 0.80% binder per part
- After 20 cycles

- The integrated "release effect" ensures that considerably less material is deposited on critical points below blow tubes.
- Patented technology

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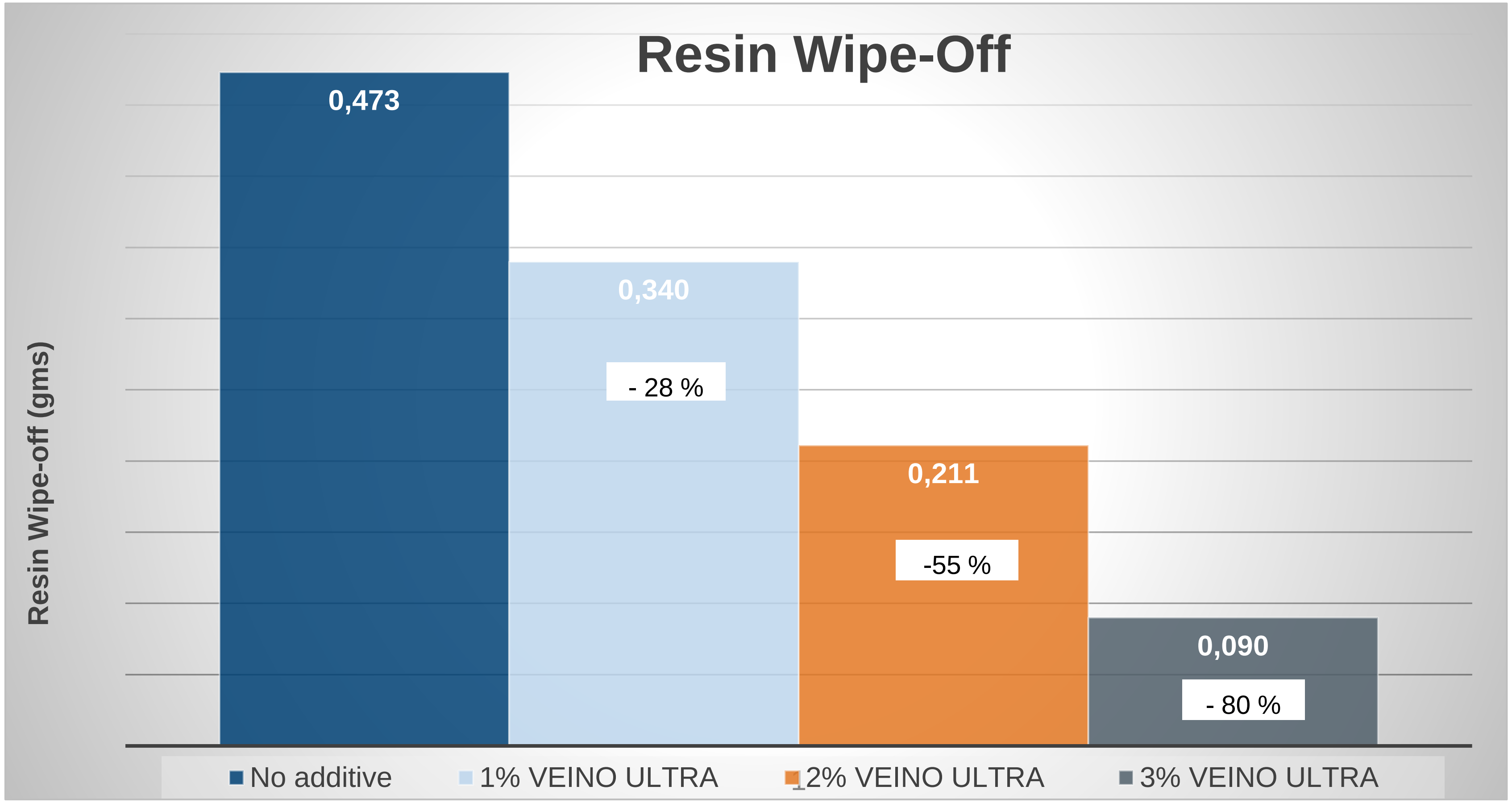
IRON CASTING: INNOVATIVE ADDITIVES & FOUNDRIES



After 20 cycles <u>without using any release agent</u>

Sand/resin wipe off depending on VEINO ULTRA 2000 addition

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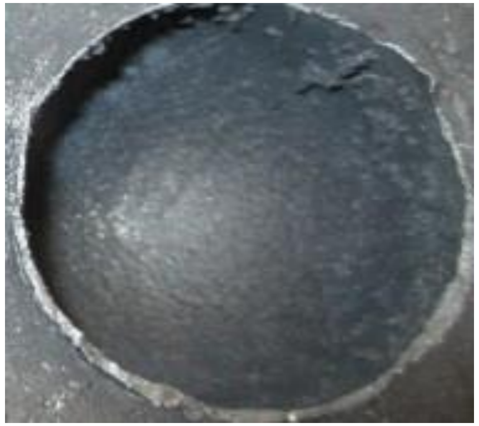
IRON CASTING: INNOVATIVE ADDITIVES & FOUNDRIES

Current status

- VEINO ULTRA is implemented in serial production
- Hybrid additive (no Li) with Low addition rate < 2%
- Less resin wipe off than with standard sand mix
- Very good flowability of the core sand with good contour accuracy from the 1st core onwards
- Good anti-veining effect
- Reduction and replacement of various special sands and other sand additives possible

- Silica sand, 0.80% binder b.o.s.
- 2% standard additive (coated)



- Silica sand, 0.80% binder b.o.s.
- 2% VEINO ULTRA (coated)

Poured at ASK Pilot Plant in Hilden
GJL, **coated**, 1420° C

COATING FREE CASTING WITH ADDITIVES

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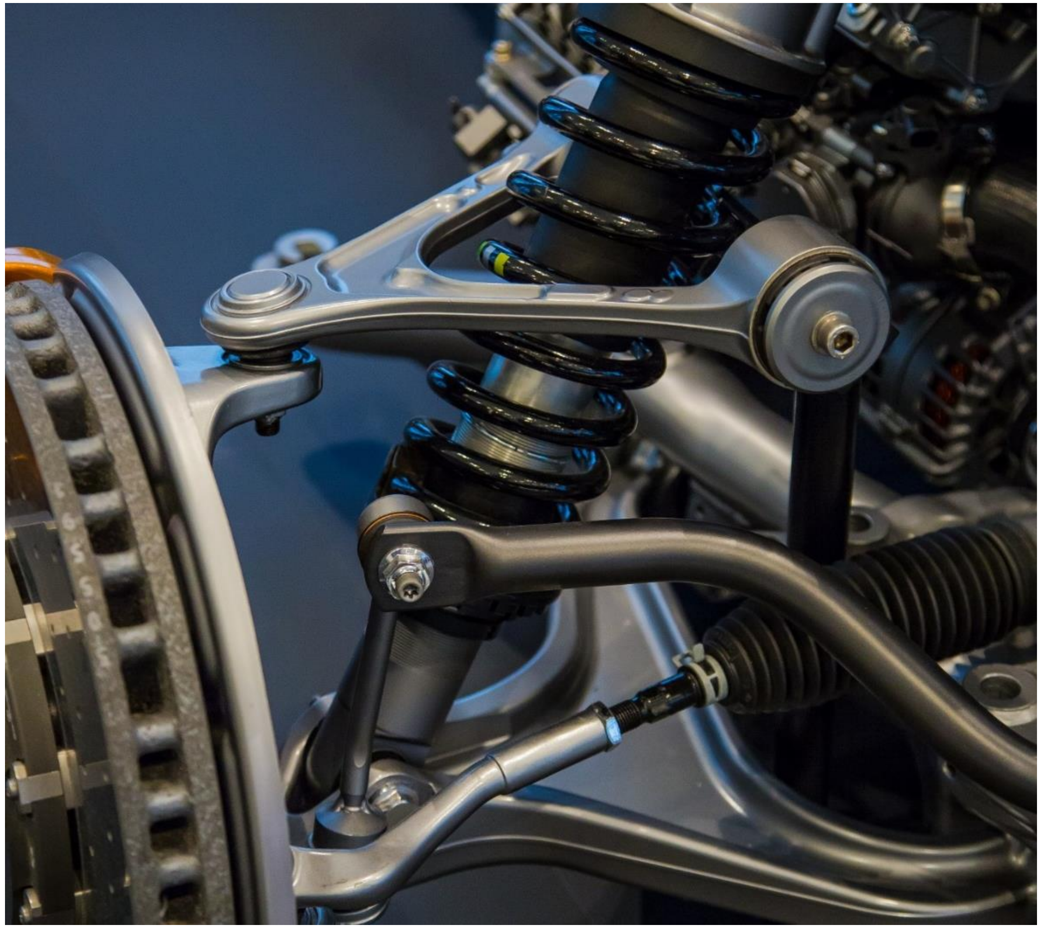
COATING FREE CASTING WITH ADDITIVES

Castings in EN-GJS, cores **uncoated** with Additive VEINO ULTRA

Brake caliper

COATING FREE CASTING WITH ADDITIVES

Castings in EN-GJS, cores **uncoated** with Additive VEINO ULTRA



Suspension frame
Uncoated with VEINO ULTRA

COATING FREE CASTING WITH ADDITIVES

Castings in EN-GJS, cores **uncoated** with Additive VEINO ULTRA

Wheel part of a truck

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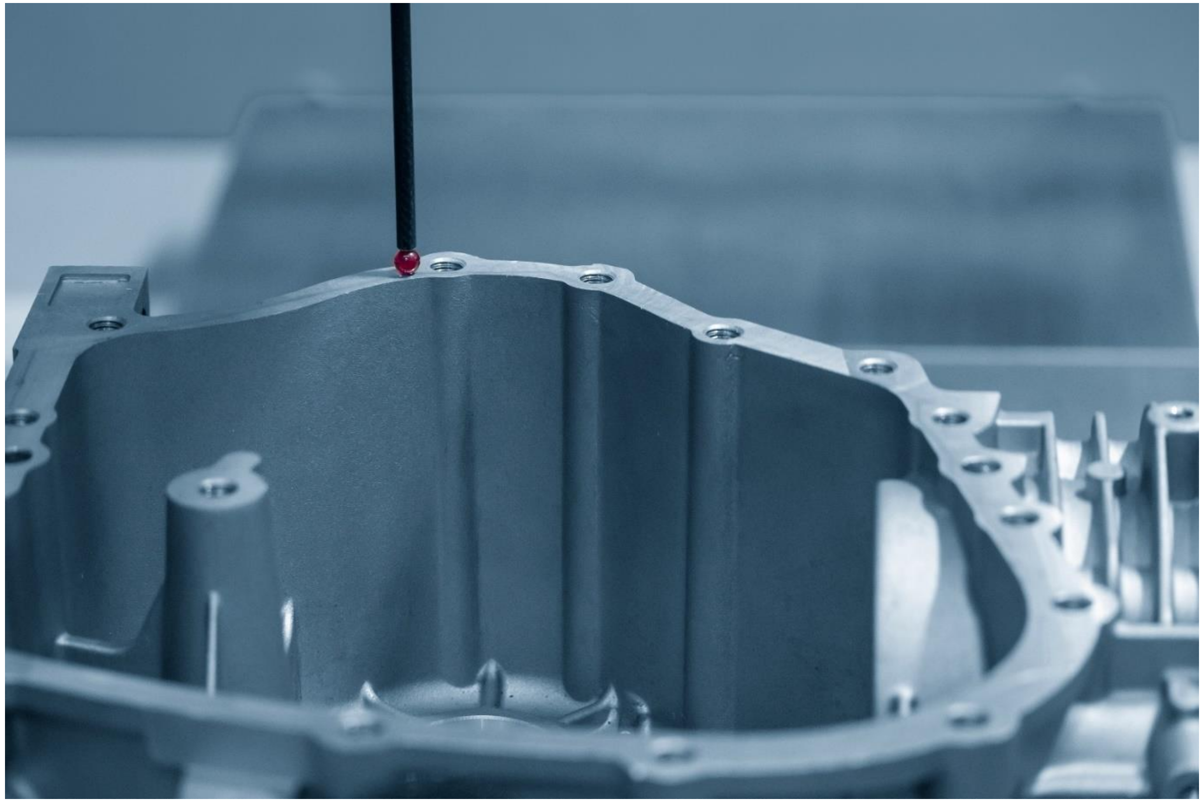
COATING FREE CASTING WITH ADDITIVES

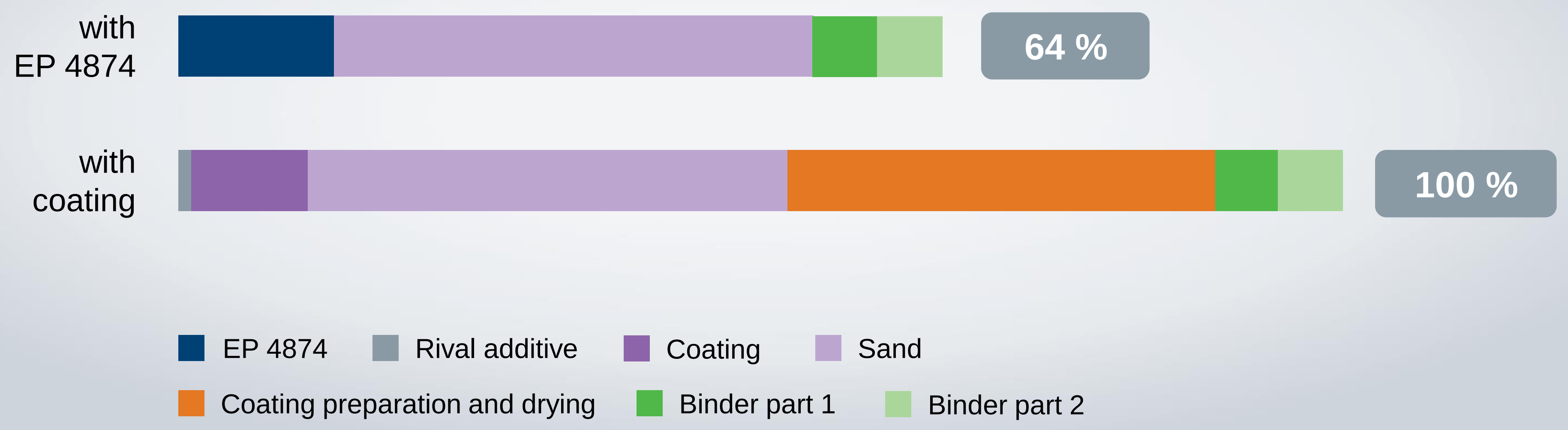
Castings in EN-GJL, cores **uncoated** with Additive EP 4874



Housing GJL 250
120 kg

COST EVALUATION -> CASTING WITHOUT COATING

Example overall costs per 1 metric ton of sand



Example from an European foundry- before „energy cost explosion“

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CASTING WITHOUT COATING: NEW PROJECT: AUTOMOTIVE FOUNDRY IN EUROPE

Coresand Cost Calculation

	Reference (serial production)	Project
Material	Cost per casting(€)	Cost per casting(€)
Silica sand new sort 2	0,00	1,86
Silica sand new sort 1	1,31	0,00
Reclaimed sand	1,63	1,63
Binder Part 1	1,80	2,25
Binder Part 2	1,74	2,98
Standard additive	1,17	0,00
new additive		6,37
Coating	2,27	0,00
Total quantity mixed (kg)		
Total material costs (€)	7,5	14,2
Dipping & Drying	9,8	0,0
cost per Part	19,6	14,2
saving per Part [€]		5,3
Annual saving (€/Year)		**344.846**

- Even higher material costs in coresand composition,
- Enormous annual savings possible

✓

✓✓

✓✓✓

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REDUCTION OF SPECIAL SAND

SPECIAL SANDS & MINERALS

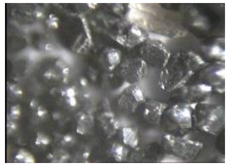
TYPICAL ADDITION RATIO: 30 – 100 %

Advantages:

- High efficiency against casting defects
- Hardly gas emissions

Drawbacks:

- Very high material costs
- Reclamation
- Disposal costs & Environment (Chromite)
- Negative effects on the sandsystem possible



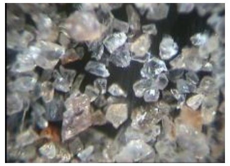
Chromite

Fieldspar

Chamottesand

Zirconsand

Ceramic sands



Andalusite

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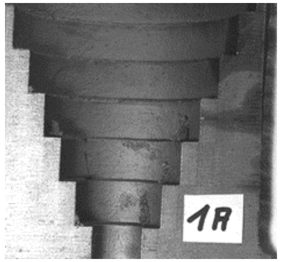
REDUCTION & SUBSTITUTION OF SPECIAL SANDS

Description/
illustrative
model

Core= 2,2 kg



Casting= 12 kg

100 % reclaimed

100 % Fieldspar sand

100 % reclaimed sand
+ 5% Veino Ultra 3030

<u>Casting parameters:</u>
100% sand (+Additive), 1,0 % Part 1, 1,0 % Part 2
Step cone core half uncoated, half water based coating
Alloy:GJL 250 Pouring temperatur:1420 ± 5 °C Casting height: 550 mm

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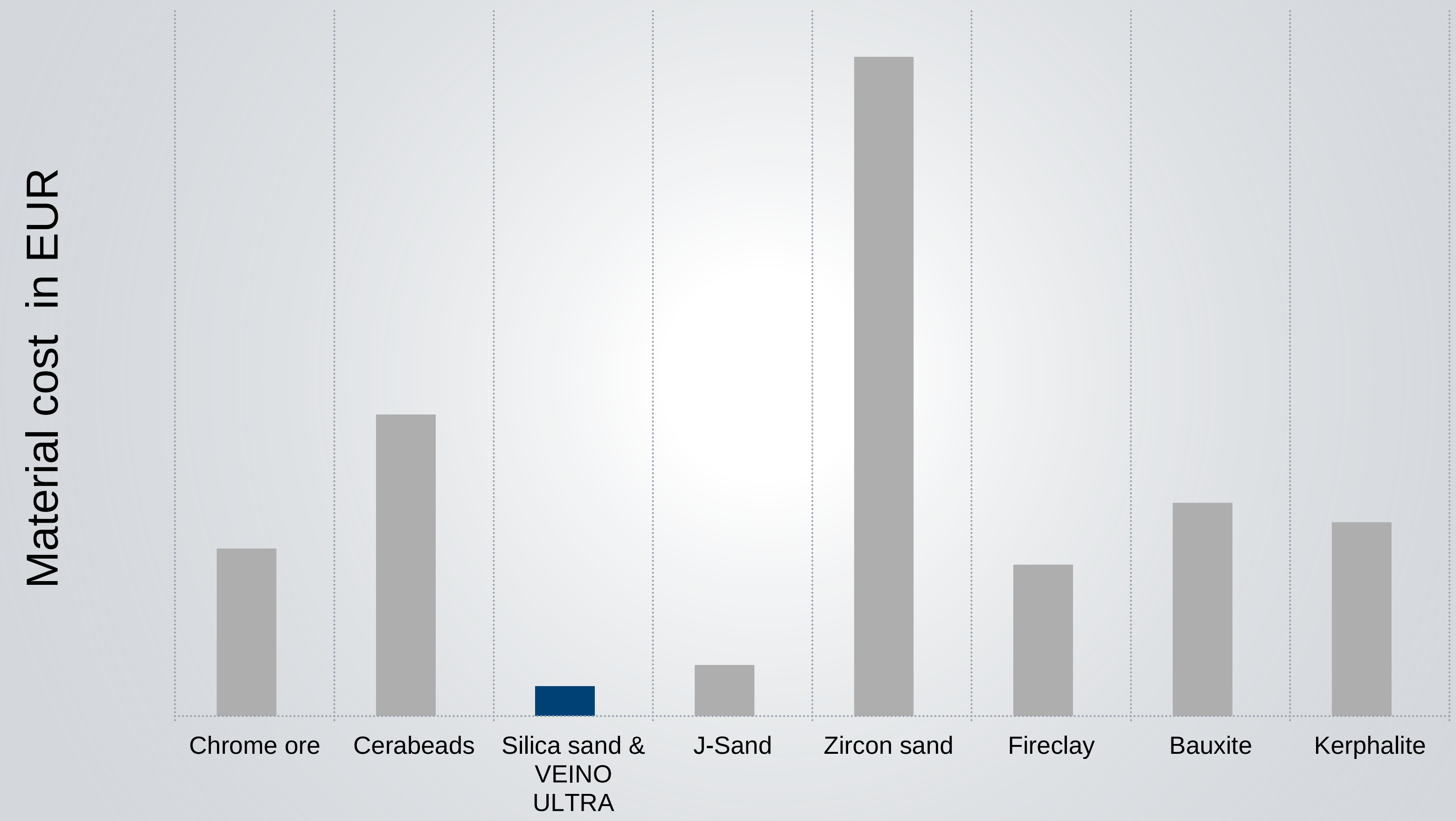
REDUCTION & SUBSTITUTION OF SPECIAL SANDS

Core with pure silica sand & additive VEINO ULTRA

Cylinder head – water jacket cores
Standard production with > 70% special sand

Silica sand and additive

COST EVALUATION SPECIAL SANDS



Sand & additive costs = with max. additive addition rate!

* Higher bulk density of Chromite sand & Zircon sand is considered

COST EVALUATION SPECIAL SANDS

Product	Cost with special sand [€/Y]	Cost w/o special sand [€/Y]
Special sand	~ 800.000	-
Silica sand	-	~ 30.000
Additive	-	~ 60.000
Total costs for core molding material (w/o binder)*	~ 800.000	~ 90.000
Savings	**~710.000 €/Year**	

Example from an European foundry

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SAVING PROCESS COSTS

SAVING PROCESS COSTS

Less cracks & erosion in steel castings with Additive VEINO ULTRA RS 4

Initial Situation

- Cold Box core
- Silica sand
- Additive
- Uncoated

Topics

- Sand erosion
- Hot Tears

VEINO ULTRA RS 4

- Practically no erosion
- Up to 50% less Hot Tears
- Patented additive

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SAVING PROCESS COSTS

Less cracks & erosion in steel castings with Additive VEINO ULTRA RS 4

Initial Situation

- Polyurethan-Isocyanat NoBake
- Silica sand
- Chromite sand
- Black Iron Oxide as additive
- coated

Topic

- Hot Tears

NOW: VEINO ULTRA RS 4

- 60-80% less welding costs
- Patented additive

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ADDITIVES FOR ALUMINUM

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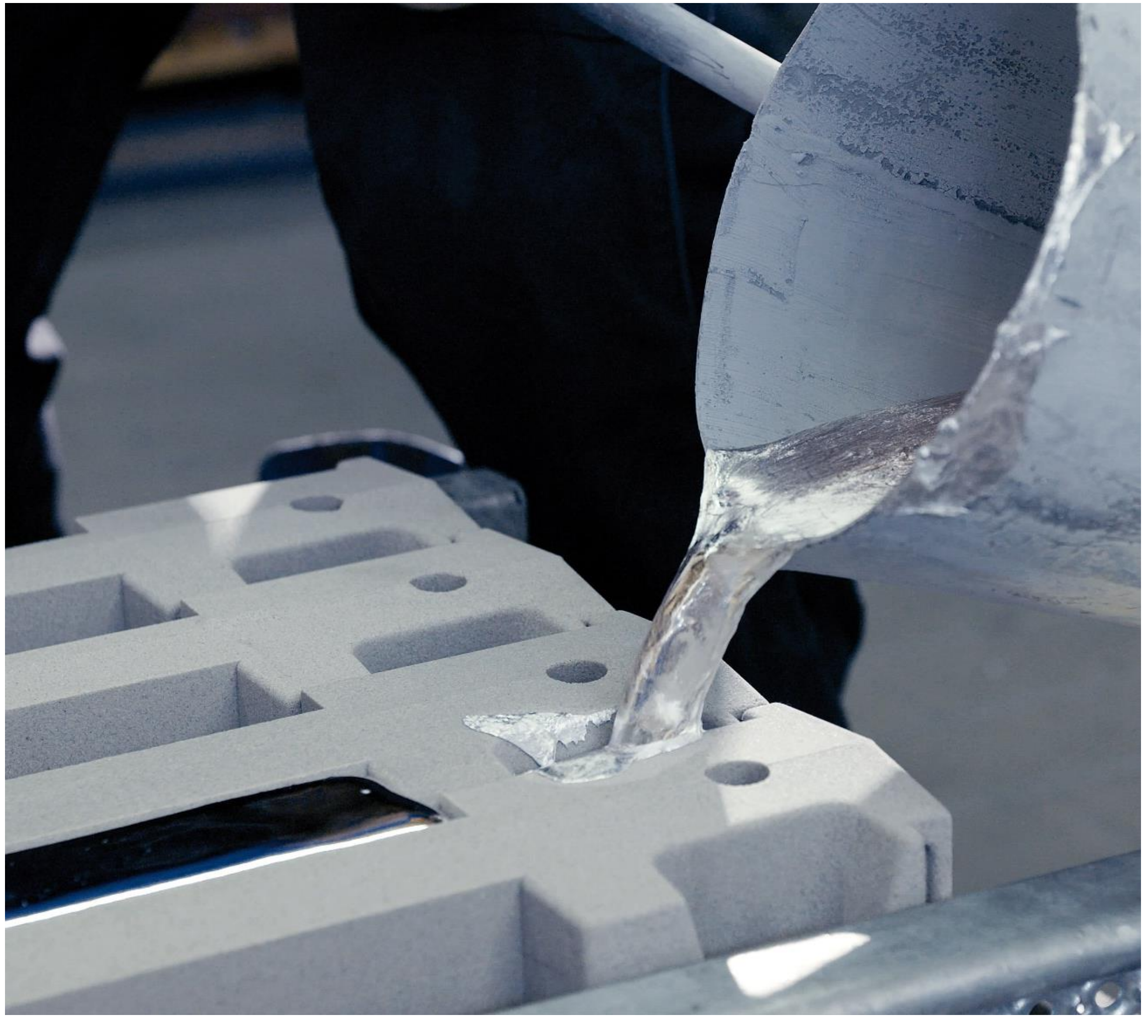
ALUMINUM CASTING: BETTER SHAKE-OUT

Objectives

- Improvement of shake-out with cold box bonded cores
- Low addition rate
- Additive formulation = inorganic



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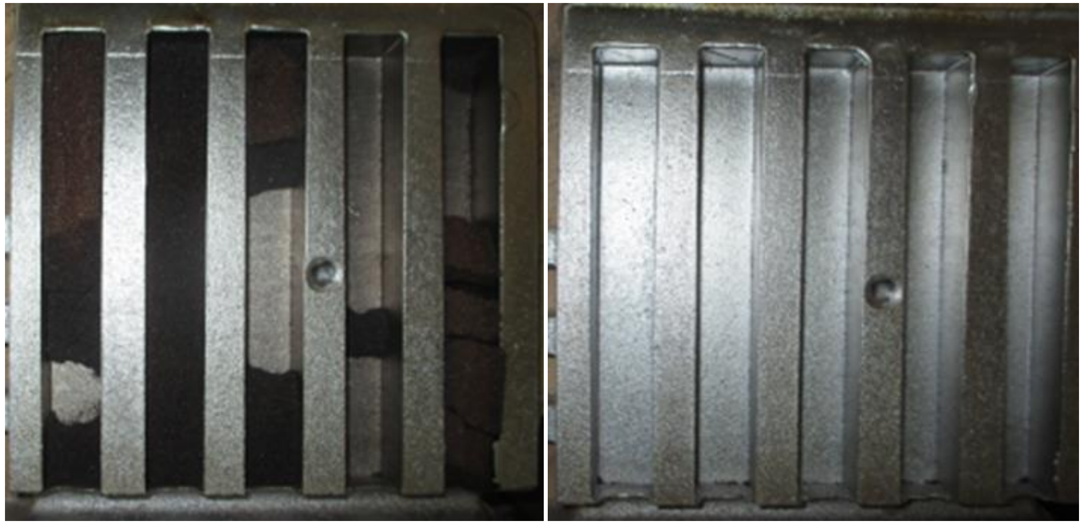
ALUMINUM CASTING: BETTER SHAKE-OUT

Shake-out improvement test

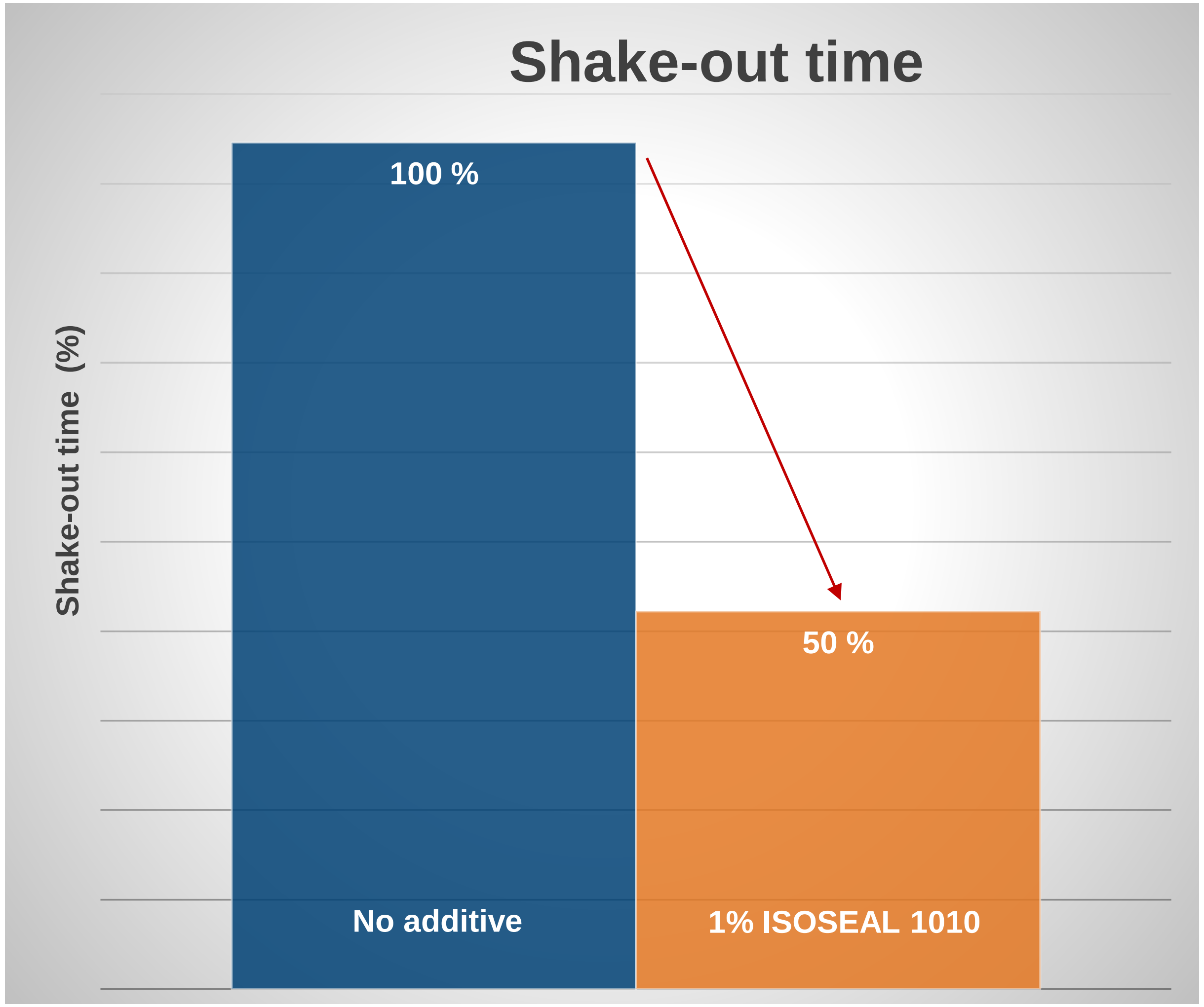
H 33	H 33
1.3%* ECOCURE	1.3%* ECOCURE
1.3%* ECOCURE	1.3%* ECOCURE
No sand additive	ISOSEAL 1010

Aluminium – uncoated cores – casting temperature approx. 650°C



10 x | 5 x

Pneumatic hammer 2 bar, 3 seconds each



*Deliberately high addition rate (2,6 % in total) of binder to provoke bad shake out

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ADDITIVES FOR ALUMINUM AUTOMOTIVE FOUNDRIES ISOSEAL 1010 (FOR COLD BOX)

✓ **Shakeout improvement on cold box bonded cores after casting by approx. 40 %**

Small quantities added; on average 1% additive.

Customer statements/observations:

✓ Reduction of condensate formation in the SPM
✓ Less residual dirt in the casting
✓ Coating sometimes not necessary
✓ Fewer gas defects
- Increase of the pH-value of the reclaimed sand

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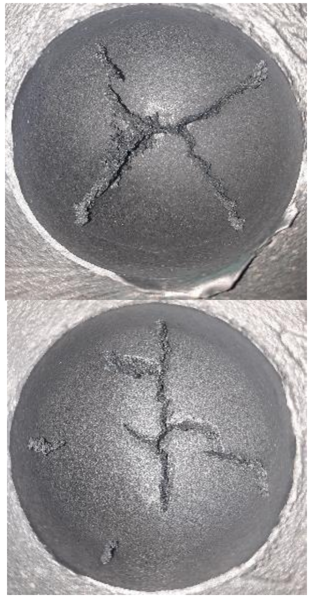
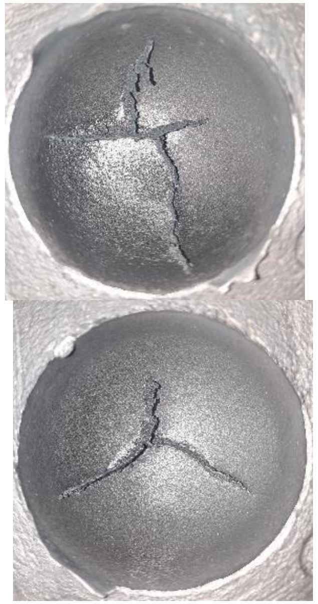
EXAMINATION WITH TÜRKISH SAND

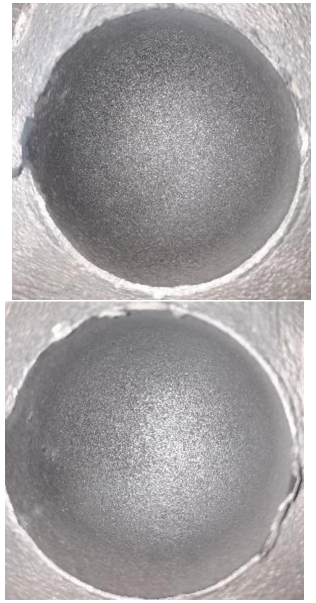
SAND COMPARISON GERMAN & TÜRKISH SAND

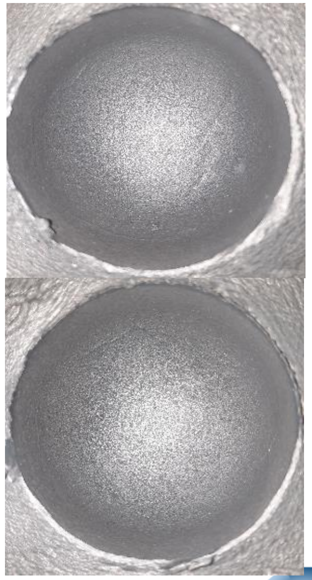
SILICA SAND	FROM GERMANY	FROM TÜRKIYE	FROM TÜRKIYE	FROM TÜRKIYE
PART 1 [%]	0,80	0,80	0,80	0,80
PART 2 [%]	0,80	0,80	0,80	0,80
Additive	without	without	EP 4874*	VEINO ULTRA RS 4*
[%]			1,0	1,0
Water based coating. Flowcup time 13,0 sec/4 mm				

EP 4874= Hybrid
VU RS 4= Inorganic









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CONCLUSION

FINAL CONCLUSION

Additives are High Tech Products

Productivity

- Reduction of casting defects, scrap and rework
- Elimination of the coating process on ductile iron castings

Economics

- Elimination or reduction of special sands
- Less process costs
- Substitution of lithium containing minerals

Technology

- Improves environmental performance & sustainability of casting
- Increases quality & effectiveness

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THANK YOU FOR YOUR ATTENTION.
DO YOU HAVE QUESTIONS?