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Welcome to the event!

Håkan Andersson, Joakim Berlin

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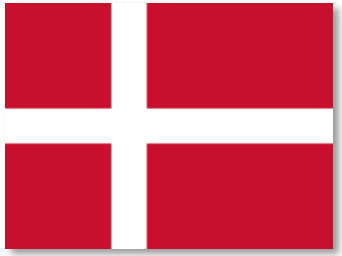

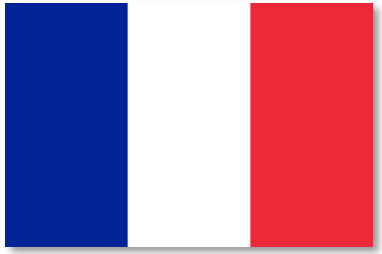


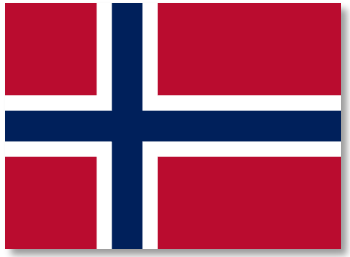



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Calderys Group Introduction

Erik Bachman

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AGENDA

01 Calderys overview

02 Calderys business segments

03 Vertical integration

01 Calderys overview

About Calderys

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Calderys is a leading global provider for industries operating in high temperature conditions.

The Group specializes in thermal protection for industrial equipment, with a wide range of refractory products and advanced solutions to enhance steel casting, metallurgical fluxes and molding processes.

Our international network of experts ensures an end-to-end offer with tailored services.

Drawing on over 150 years of experience, we support our customers in their energy transition needs.

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Calderys and HWI combination

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- **In 2023, Calderys became a privately owned company combined with HarbisonWalker International.**
- **Combining Calderys and HWI means more products, more service options, and an expanded reach for the benefits or our customers.**
- **Calderys is the name of the combined organization and its headquarters are located in Paris, France.**
- **HWI is now a member of the global Calderys family and is the brand for the Americas region of the Group.**

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HWI A MEMBER OF CALDERYS

Calderys Group at a glance

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One of the biggest refractory solutions provider in the world

150+ years of experience

30+ countries host our operations with sales in **100+** countries

~50 plants on the **5** continents

5,800+ people and contractors in over **30** countries

50+ nationalities represented in our workforce

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Over 150 years of experience

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1860 - 1920

1865
JK. Lemon establishes Star Fire Brick Company in Pittsburgh, USA

1875
Hay Walker and Samuel P. Harbison purchase Stay Fire Brick Company and form **Harbison-Walker Refractories**

1908
Lafarge invents and patents aluminous cement with refractory qualities – a precursor to monolithics refractories

1914
In the US, William A.L. Schaefer develops the first monolithic refractory and creates the Pliable Firebrick Company, also known as **Plibrico**

1920s – 1960s

1926
Stollberg is created in Mülheim, Germany, for the production of casting auxiliary materials

1934
Silver & Baryte Ores Mining Co. S.A. (**S&B**) is founded on Milos Island, Greece

1938
Lafarge creates SECAR, subsidiary wholly devoted to refractories

1970s – 2010s

1990
NARCO revolutionizes the ladle refractory market with the invention of **COMANCHE**

1996
Plibrico joins the **Imerys Group**

2002
ANH Refractories is formed from the combination of **AP Green, NARCO, and Harbison-Walker Refractories Companies**

2004
Imerys acquires **Lafarge Réfractaires Monolithiques**

S&B acquires **Stollberg**

2005
Plibrico International & Lafarge Réfractaires merge under the Imerys Group to form **Calderys**

2010s - 2023

2015
Imerys completes the acquisition of the main activities of **S&B** (incl. **Stollberg**). S&B's activities are renamed Imerys Metalcasting. Stollberg's activities become Imerys Steel Casting Fluxes

2015
ANH Refractories becomes **Harbison Walker International**

2018
Calderys, Imerys Metalcasting and Imerys Steel Casting Fluxes are merged into Imerys' High Temperature Solutions (HTS) Business Area. The decision is made to rename **HTS Calderys**

2020
Three acquisitions boost **Calderys'** operations in high-growth regions:

- Hysil, the leading Indian producer of calcium silicate boards.
- A majority stake of 60% in Haznedar Durer Refractories, a Turkish manufacturer of high-grade monolithic refractories and refractory bricks.
- Sunward Refractories, a Taiwanese producer of monolithics, bricks and tap hole clays

2023
Calderys and **Harbison Walker International** are acquired by a privately owned company and merged together to form the **Calderys Group,** with HWI becoming **HWI, a member of Calderys** and the brand for the Americas region of the Group

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Industries we serve

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IRON & STEEL

Our portfolio of products ranges from acidic monolithics to basics and bricks, while our services include everything from ironmaking and continuous casting to the full steel process equipment.

FOUNDRY

As experts in ferrous foundries, we offer an array of turnkey solutions for Foundry refractories, as well as core and molding sand additives.

THERMAL

We offer a wide range of end-to-end refractory solutions for industrial furnaces, including projects for aluminum, cement, glass, and energy and environment industries, amongst others.

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Calderys worldwide presence

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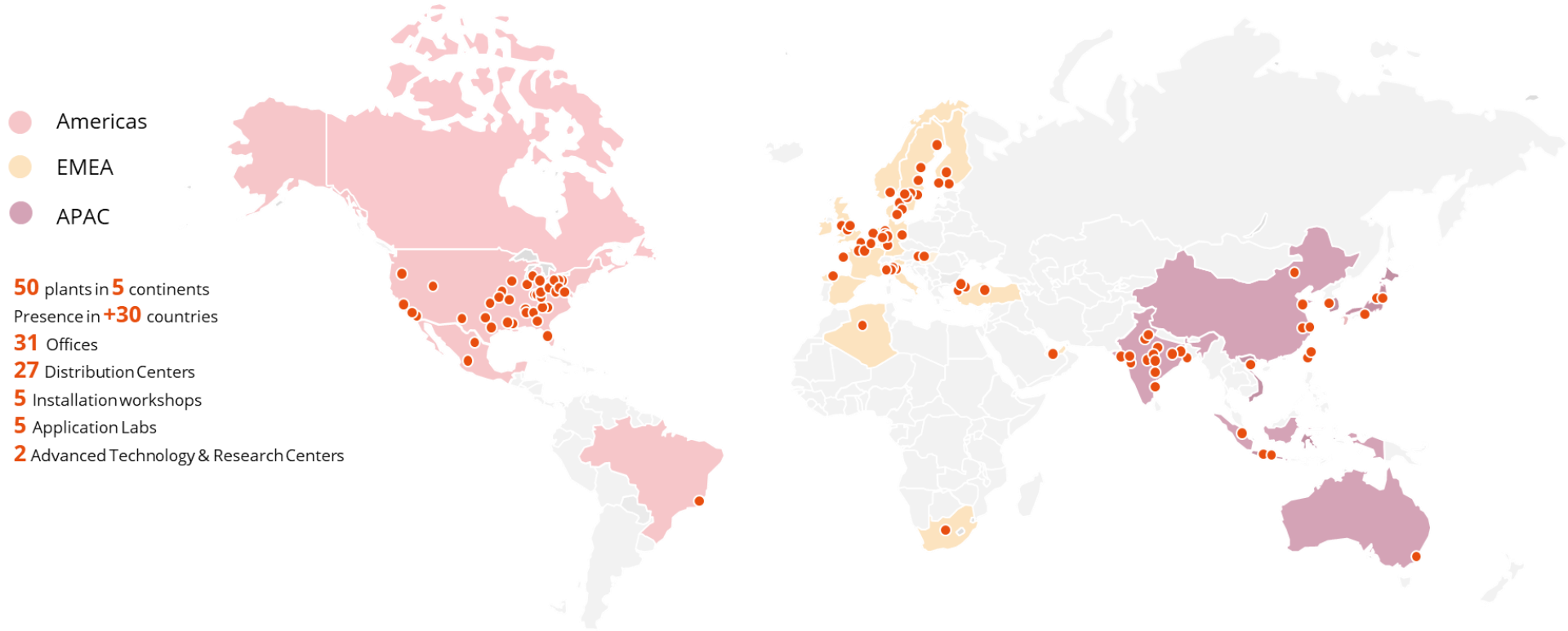

50 plants in **5** continents
Presence in **+30** countries
31 Offices
27 Distribution Centers
5 Installation workshops
5 Application Labs
2 Advanced Technology & Research Centers

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Calderys worldwide presence – Zoom in EMEA

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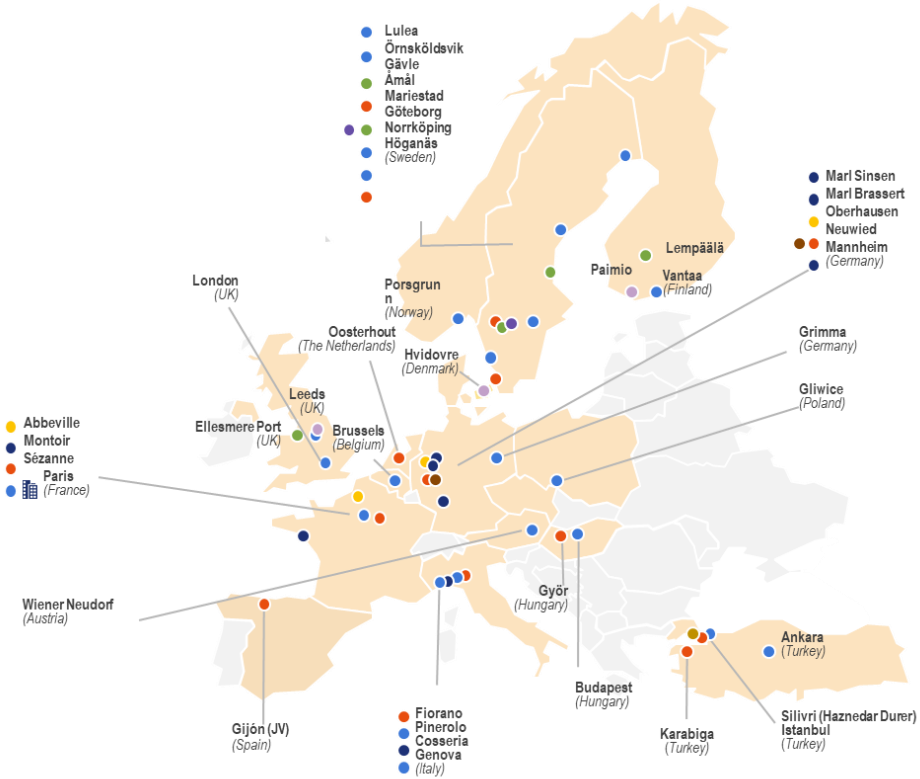
- Refractories plant
- Green Molding Sand plant
- Steel Casting Fluxes plant
- Office
- Installation workshop
- Distribution Center
- Application Lab
- Advanced Technology & Research Center
- Foundry Service Center



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Our strategy

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People are the foundation of our strategy, which is based on three pillars and supported by three priorities.

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Our commitment to health and safety

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We integrate health and safety into every aspect of our business - it's part of our DNA.

Our goal is to achieve zero accidents and zero work-related illnesses.

Our Group-wide safety program - safe. - aims to help us reach this objective. The program is based on four pillars:

Safety First.

We encourage our employees to take the time to do things properly and empower them to stop the job if safety conditions do not meet our policies and protocols.

Advancing Communication.

We encourage clear communication about our health and safety protocols and procedures. Only if they are clearly understood will they be successfully applied.

Fostering Collaboration.

We care about each other, we share best practices and work together to maintain a healthy and safe environment.

Encouraging Ownership.

We encourage employees to understand the impact of their actions on themselves, colleagues, contractors and customers. Everyone is accountable for health and safety, whatever their role.

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Embedding sustainability in everything we do

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Our Sustainability program leverages our power as a global organization, strengthening our approach to sustainability.

The program based on three pillars:

BEING COMMITTED TO OUR PEOPLE AND COMMUNITIES

We have an ethical and compliant approach, encouraging inclusivity and respecting diversity. Our culture of transparency reflects the expectations of our customers and other stakeholders. We support the communities in which we operate, creating shared value and long-lasting benefits.

IMPROVING OUR OWN ENVIRONMENTAL FOOTPRINT

To protect our planet, we must act to reduce our environmental footprint. We strive to achieve this by increasing the circularity of our materials through recycling and reuse, and by growing the share of renewable energy in our operations.

HELPING OUR CUSTOMERS IN THEIR ENERGY TRANSITION NEEDS

We aim to deliver new products and services to drive change across the industry. We play an important role in helping our customers with high quality, efficient and sustainable solutions.

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02 Calderys business segments

Iron & Steel

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High value-added functional solutions for the containment of liquid metal, thermal protection of industrial equipment, and the enhancement of steel's purity and flow

Main products portfolio included in full-package offers

- **Aluminosilicate monolithics** (conventional, low/no cement, C/S bonded, plastics/rams/mortars)
- **Magnesia monolithics** (gunning and dry ramming masses, dry vibratables, sprays, plastics/rams/mortars)
- **Tap-hole clay for blast furnace**
- **Bricks** (Mg, Mg-C, Mg-spinel, AMC, dolomite, MAC, fire-cray, high-alumina)
- **Precast shapes**
- Gas purging plugs, lances and accessories
- **Casting fluxes** and automatic feeders
- **Gunning machines** ladle, BOF-converter, EAF
- And more...

Services

- Product & tailor-made design & cost optimization
- Refractory design
- Engineering
- Installation
- Maintenance
- Repairs
- Precast services

Main customers

ArcelorMittal, Steel Dynamics, NUCOR, USS, TATA STEEL, thyssenkrupp, CLIFFS

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Thermal

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End-to-end refractory solutions for industrial furnaces

Main products

- Monolithic refractory materials
- Acidic (alumina) bricks
- Wide range of monolithic refractory products, including low porosity gunning and spraycast
- Insulating castables for energy savings in high temperature furnaces
- Self adapting, and repair solutions for high temperatures up to 1,800°C
- Pre-dried, precast shapes for faster installation
- Magnesia Spinel and Magnesia-Chrome Bricks

Services

- Customized product selection based on furnace operations
- Tailor-made design and engineering based on project needs
- Project and site management
- Installation services including low porosity gunning, and spraycast services
- Dry-out services for refractory lining
- Inspection and after-sales service

Main customers

LafargeHolcim, e.on, Shell, HEIDELBERGCEMENT, Novelis, Valmet, LKAB, Phillips 66

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Major markets for Thermal

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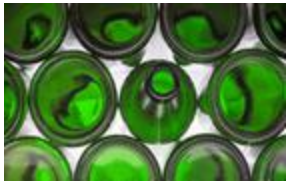
Aluminum

World leader in monolithic refractories for the aluminum industry, we provide a range of solutions designed specifically for contact with aluminum to major OEMs and end-users in more than 70 countries.

Cement

End-to-end solutions, combining innovative products, engineering know-how, project management and installation services.

Glass



Over 85 years of research and development in the glass market have enabled us to pioneer innovative glass solutions.

Energy & Environment

Our global offer covers all needs – from maintenance to management of full turnkey projects.

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Major markets for Thermal

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Copper and Heavy Non-Ferrous

We support customers in the primary and secondary copper and heavy non-ferrous industries across the globe.

Industrial Minerals

Calderys provides bricks and monolithic refractory solutions for extraction, refining and beneficiation of industrial minerals.

Chemicals Engineering & Petrochemicals

High-quality refractory products combined with customized end-to-end project services.

Space Exploration

For more than 60 years, we have been a pioneer in delivering refractory launch pad solutions to the space flight industry.

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Foundry

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A complete offering with local expertise for the foundry industry

Main products

- **Refractory castables:** acidic, neutral and basic dry vibration mixes, gunning, self-flowing, patching and ramming products and bricks
- **Melt additives** such as CALDE® SHIELD
- Low-dust perlite **slag coagulants**
- Accessories and equipment
- Green molding sand additives
- Core sand additives
- Special sands

Services

- Material selection
- Project management
- Product analysis and metallurgical consulting
- Design
- Installation/ Installation training
- Logistics
- Off-site relining
- Remote assistance
- Connected silos technology
- Dry-out and commissioning
- Material training

Main customers

SLR Gruppe · Döktaş · DONPER · EB BRUHL · FONDERIA DI TORBOLE EF GROUP · brembo

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03 Vertical integration

Partnering with you every step of the way

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Raw Materials Selection & Testing | R&D | Engineering & Design | Manufacturing | Logistics & Delivery

Project Management | Installation & Supervision | Dry-out & Commissioning | Technical Support | Molding Defect Consulting

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New Generation of Foundry Services

Håkan Andersson

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01 The Nordic Service

Nordic Service model

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Calderys Quartzite quarry in Åmål (Sweden)

Local craftsmanship and global expertise Redefined to meet our customers' needs

- The Nordic Service modell implemented and tested and ready to roll out around the globe.
- 24/7 Service contracts
- Partnership agreements
- Broad level of expertise, not only in refractory installations, making Calderys your One-Stop-Shop

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Vison of Service Center Mariestad

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02 Service Center

Service Center Mariestad

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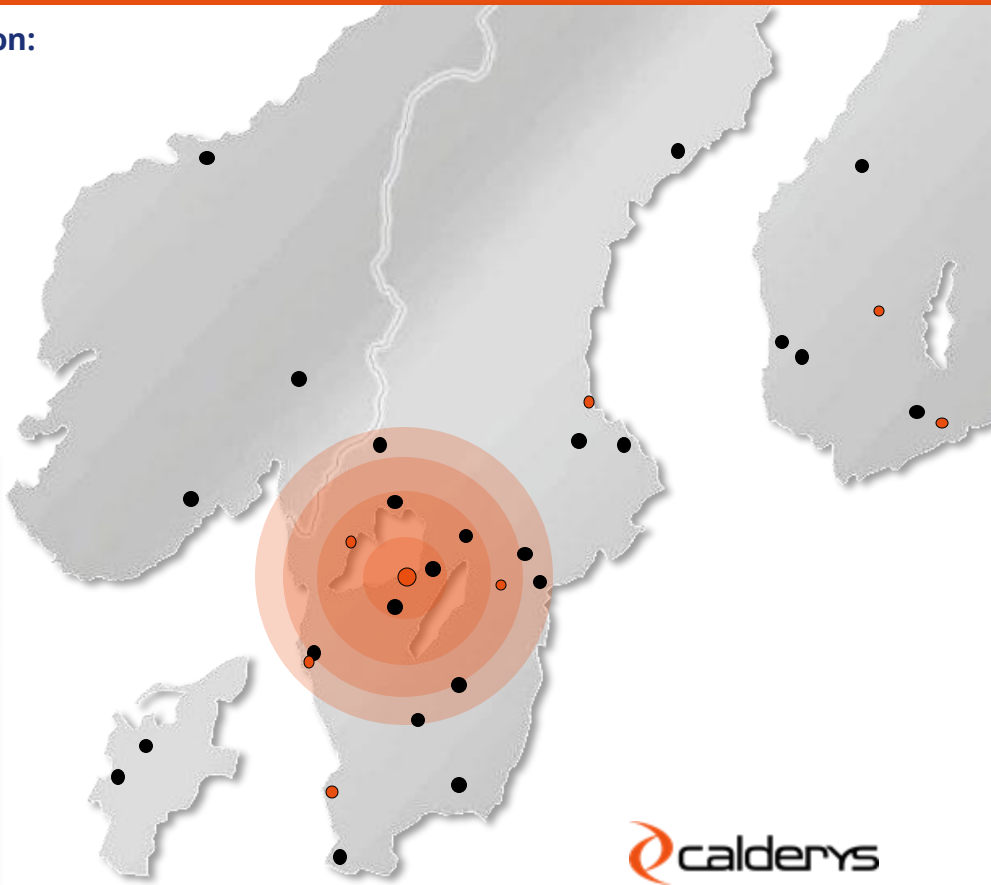
We offer comprehensive turnkey solutions, with high focus on:

- Refractory pre-fabrications (“precasts”)
- Mechanical services
- Inductor renovation
- Installation of ladles, runners, and presspour furnaces
- Refractory maintenance
- Breakout and handling of old refractory
- Different dryout and sintering possibilities
- Storage capabilities

With the highest focus on safety and customer reactiveness



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Service Center Mariestad

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Custom-built installation hall with a focus on:

- Safety standards
- Flexibility
- Controlled installation environment
- Dust control
- Shorter lead times and higher adaptability
- Warehouse for customer storage

Mixer Station. Focus on safety and ergonomic solutions

We ensure the properties of the material by monitoring moisture, grain size distribution, and temperature.

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03 Projects & Precasts

Examples of in-house projects and precasts

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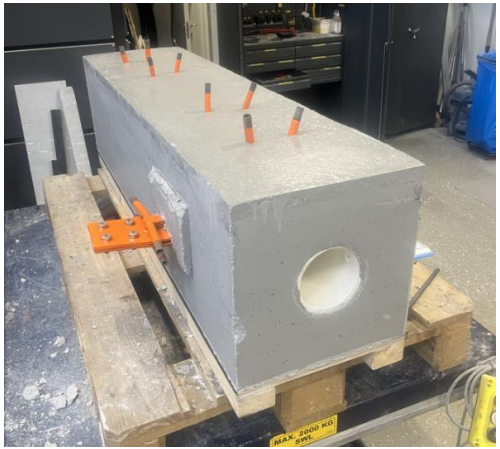
Inductors

Repairs, lining

Furnace Inductors,
mechanicle repair, refractory installation

Induction heaters

Full renovation



Full mechanicle and refractory repair of induction heaters

Ladles

...and more!

Breakout, mechanicle repair, lining, dry-out

One-stop-shop for CIF Top-part renovations

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Examples of precasts

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Precast Ladles

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With our **unique patented concept**, we offer a prefabricated solution that **enhances safety** while ensuring greater **flexibility** and **availability** in our customers' production processes.

Together with carefully selected partners, we also provide mechanical solutions and ladles.

Added safety features ensure safe operations throughout the entire lifespan of the ladle.

Concept customizable and testet for ladles up to 15 Metric tons

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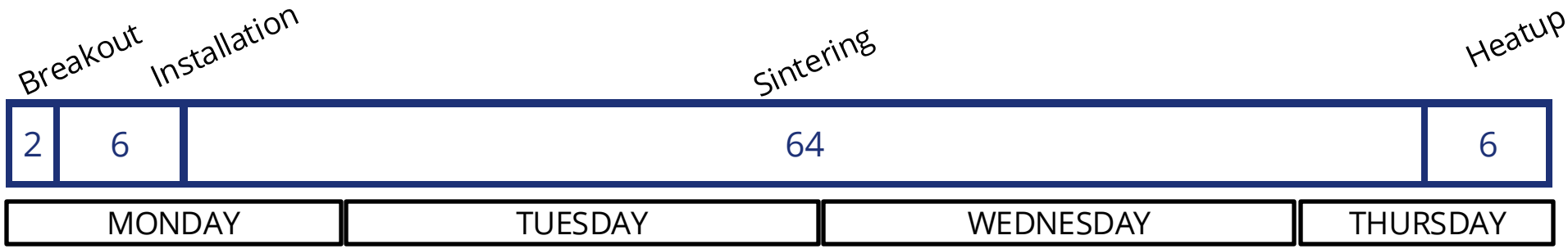
Precast Ladles



04 3D Printing

3D printing services

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Dedicated Room for 3D printing.

From concept to reality

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3D printing services

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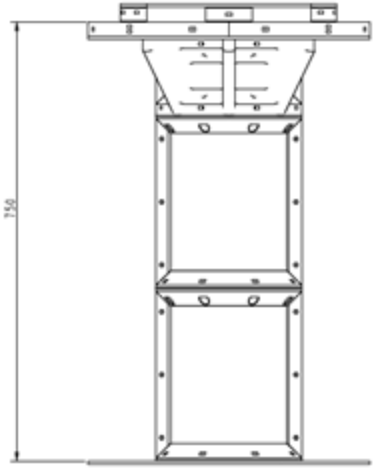
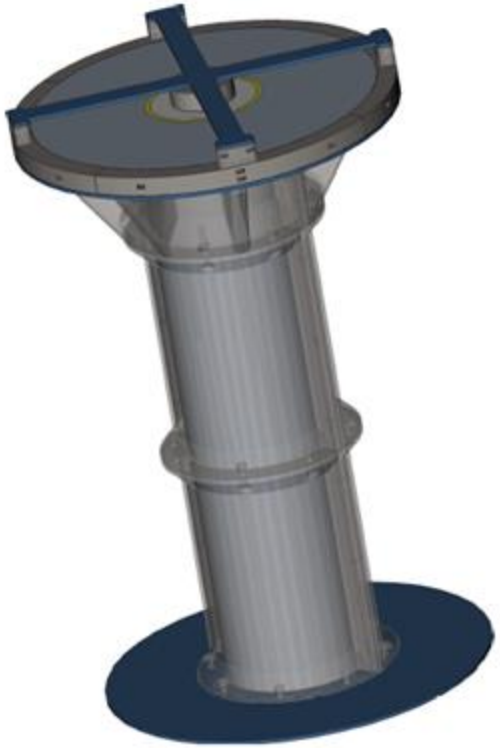
Advantages

- Complexed shapes
- High durability
- Price
- High flexibility





3D printer former

Finished prefabricated piece

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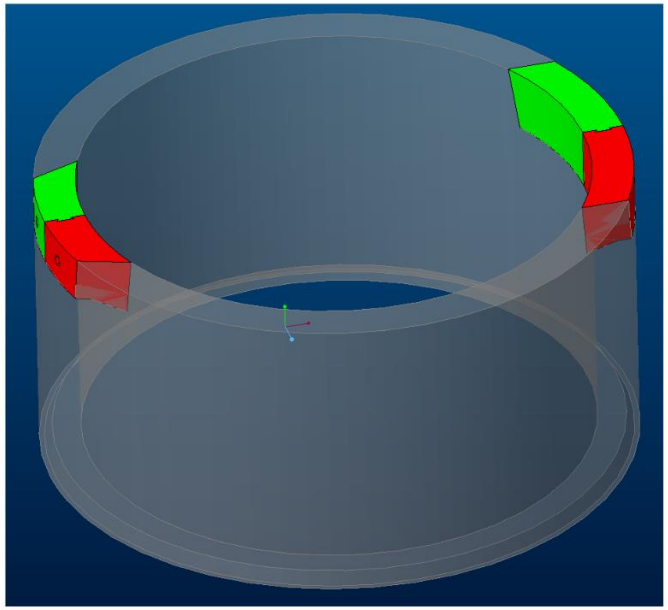
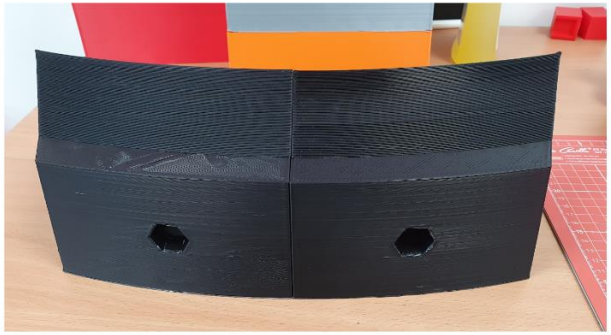
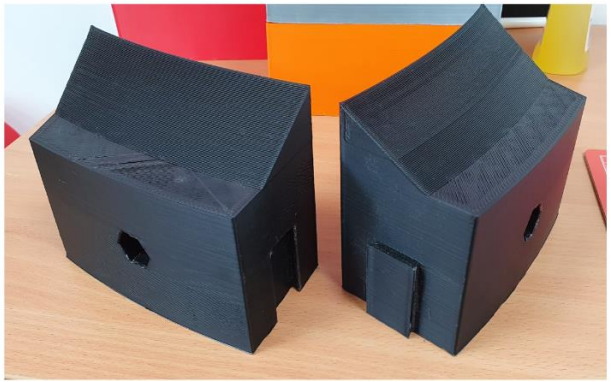
3D printing services







3D printed CIF

3D printing services

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3D printed molds ready for casting

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3D printing services

Casted preshape

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FOUNDRY SAND RECLAMATION AS A SERVICE

Jukka Nieminen, Mikko Immonen

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AGENDA

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01 Company

02 Reclamation technology

03 Green sand reclamation

04 Sand as a service model

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01 Company

History of Resand: Innovation from Finland to the World

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Resand was founded as Finn Recycling, providing metal recycling service for foundries

2016

Cooperation with Aalto University and Finnish foundries begins

2017

Proof of concept: first sand was regenerated

First commercial SAAS deliveries to foundries from Nuutajärvi service center

2019

2021

Cooperation with Freiberg University

2022

Funding from The Finnish Climate Fund

2023

First reclaiming unit at customer's site in Raahe

First customer in Germany

First custome r in Spain

Entry to Italy

2024

2025→

02 Reclamation technology

Resand reclamation technology, combination of thermal and mechanical treatment

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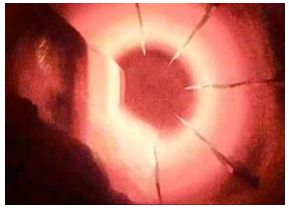
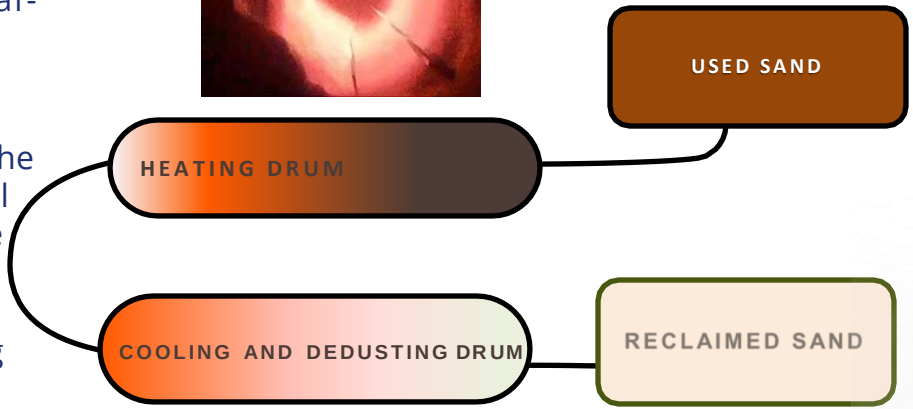
- Patented twin-drum system for thermal-mechanical reclamation.
- Step 1: cleaning the sand with thermal reclamation in the first drum.
- Step 2: Dedusting and cooling the sand in the second drum.
- Step 3: Mechanical attrition (Green sand).





Electrically heated unit

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Our Reclaiming process cleans the sand efficiently from impurities

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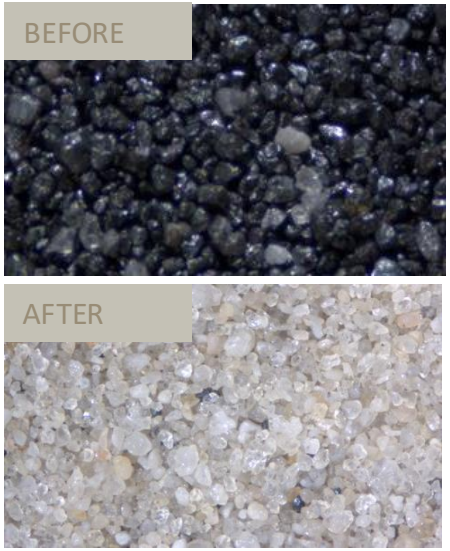
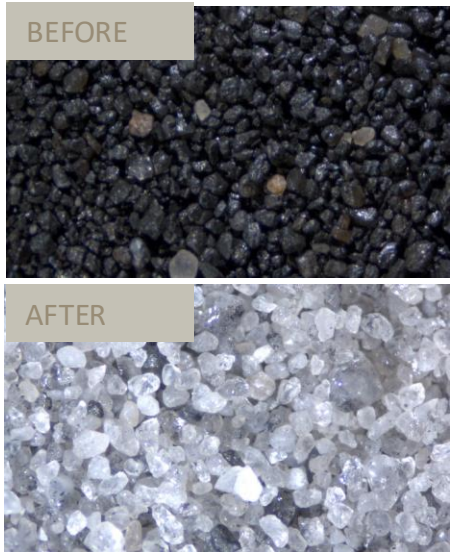
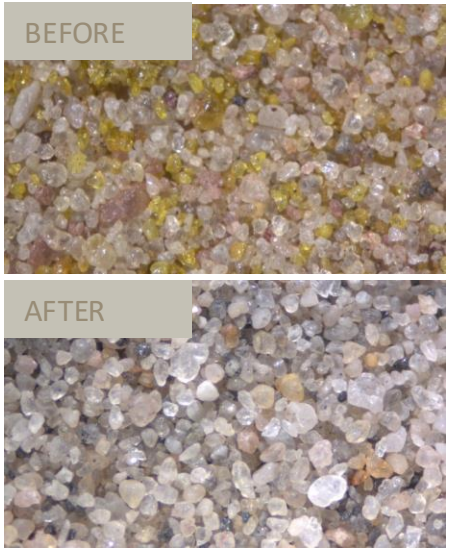
Microscopic images of the sands below



Resin Sand (Phenolic)



Resin Sand (Furan)



Cold Box core sand

Green Sand (bentonite bonded)

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03 Green Sand Reclamation

Green Sand Reclamation, What happens in elevated temperatures

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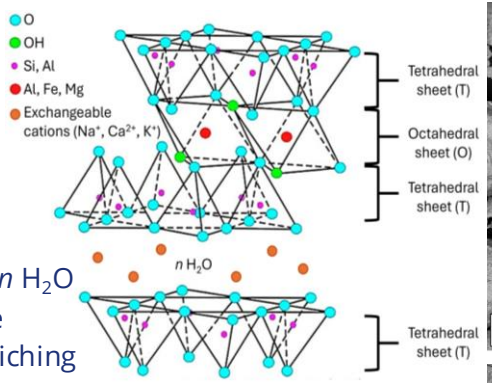
TYPICAL COMPOSITION OF GREEN SAND

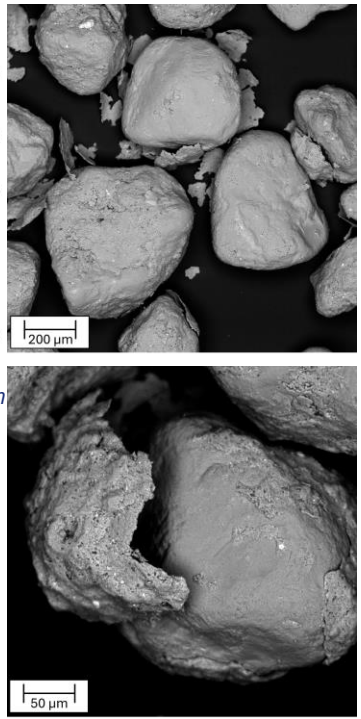
- Silica sand > 85 wt%
- Bentonite 5–10 wt%
- Carbon containing additive 2,5-7 wt%
- Water 2–3 wt%

BENTONITE

- Main component is montmorillonite: $(Na,Ca)_{0.33}(Al,Mg)_2(Si_4O_{10})(OH)_2 \cdot n\ H_2O$
  - Chemically described as hydrated Na-, Ca-, Al-, Mg- silicate hydroxide
  - Laminar 2:1 TOT structure: Two tetrahedral (T) sheets of Si/Al sandwiching one octahedral sheet (O) of Al/Fe/Mg
- Crystal water (H_2O) and chemically bonded -OH groups



Structure of montmorillonite (modified from DOI:10.4236/ampc.2015.52010).



SEM-BSE images of green sand grains.

BEHAVIOR AT ELEVATED TEMPERATURES

1. Dehydration 100–300 °C
   - Absorbed and interlayer water (between planar layers) is evaporated
2. Dehydroxylation 500–550 °C or 650–700 °C (depending on the bentonite type)
   - Structural water, i.e., hydroxyl groups (-OH) are disintegrating and releasing from the lattice by forming water
   - Bentonite is deactivated, its water absorbing properties are lost, loosely bound dead clay on the sand surfaces
3. Crystal structure decomposition, recrystallization > 850 °C
   - Crystal structure formation into an amorphous form
   - Strongly bound, sintered clay, oolitic deposits & high-temperature phases formation on the sand surfaces

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Green Sand Reclamation, What are important aspects to reach succesfull reclamation results

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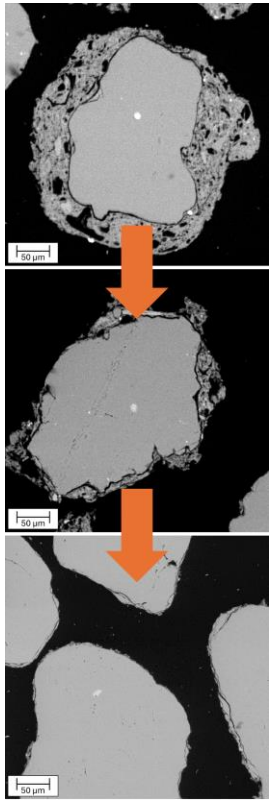
MAIN OBJECTIVES

1. Burning of residual carbon – Exothermic reaction
   - $C + O_2 (g) = CO_2 (g)$
2. Evaporation of residual (crystal and structural) water – Endothermic reaction
   - $H_2O (l) = H_2O (g)$
   - Embrittlement of the crystal structure and deactivation of bentonite
3. Avoiding deactivated, loosely bound dead bentonite from reacting with silica grains
   - Essential to avoid sintering or further formation of an oolitic layer
4. Removal of the oolitic layer (formed during casting due to heat exposure)
   - Not too intensive attrition and thus high dust generation and low yields of reclaimed sand
   - Particle size distribution must be kept optimal for further use in a foundry
5. Separation of fine fraction (detached bentonite and weakened sand grains) from the reclaimed sand

ACHIEVING THE OBJECTIVES & SUCCESSFUL RECLAMATION OF GREEN SAND WITH RESAND TECHNOLOGY

- Extensive research and process development & optimization
  - Research cooperation with TU Bergakademie Freiberg, Gießerei-Institut
- Precise process control and possibilities for process adjustment
  - Temperature and oxidative conditions controlling
- After successful reclamation, the reclaimed sand suitable to be used also in Cold Box system
  - Better gas permeability has also been observed in the reclaimed sand compared to new sand

SEM-BSE images of cross-sections of green sand grains.



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Green sand reclamation, different methods can be used depending on the objectives

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DIFFERENT PROCESSING METHODS FOR GREEN SAND DEPENDING OBJECTIVES:

- Prosessing method 1: Drying, light attrition, thermal treatment, light attrition
- Prosessing method 2: Thermal treatment, light attrition

METHOD 1.

- **Step 1. Drying and light attrition**
  Result: removed dust contains
- **Active clay 30-50%**
- **Active coal 10-20%**
- **Re-use?**

Step 2. Thermal treatment and light attrition
Result:

- **Active clay content < 0,2%**
- **LOI ~ 0,1%**
- **Oolithisation < 3,0%**
- **pH ~ 8**

METHOD 2:

- **Step 1. Thermal treatment and light attrition**
  Result:
- **Active clay content < 0,2%**
- **LOI ~ 0,1%**
- **Oolithisation < 3,0%**
- **pH ~ 8**
- **Total yield ~ 70%**

Important to achieve low Active clay and Oolithisation content with the highest possible yield.

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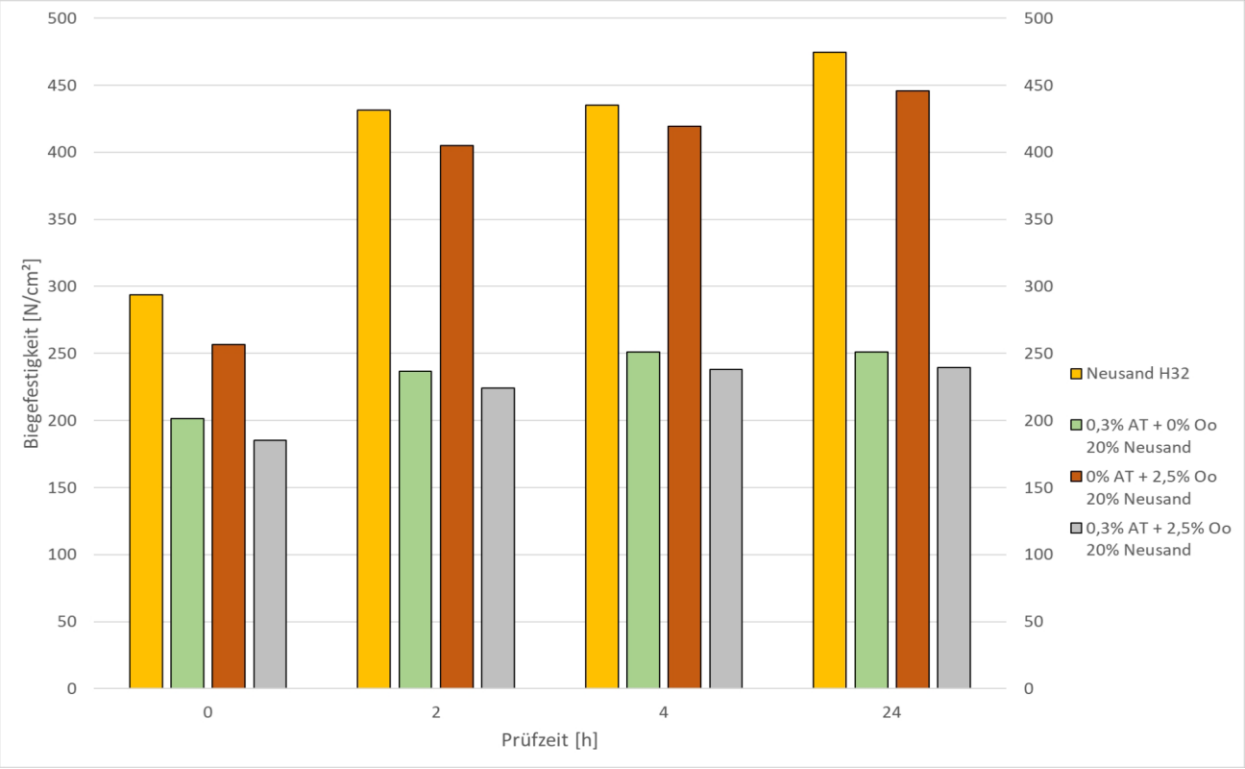
What affects most on strength values when using reclaimed sand in Cold box process

CALDERYS MEET 2024

EVEN A SMALL AMOUNT OF ACTIVE CLAY IN RECLAIMED SAND AFFECTS ON ACHIEVABLE STRENGTHS IN THE PUR COLD BOX PROCESS



AT = Aktive Ton = Active bentonite

Oo = Degree of oolitisation

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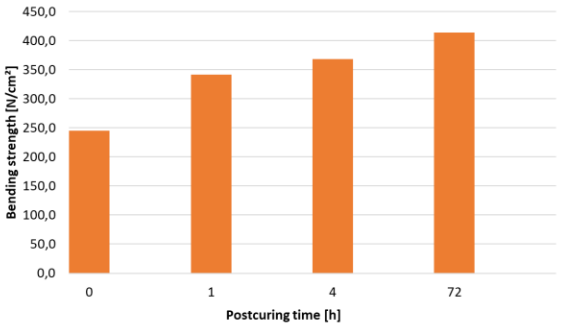
Achieved bending strength with Resand technology in Coldbox 2024

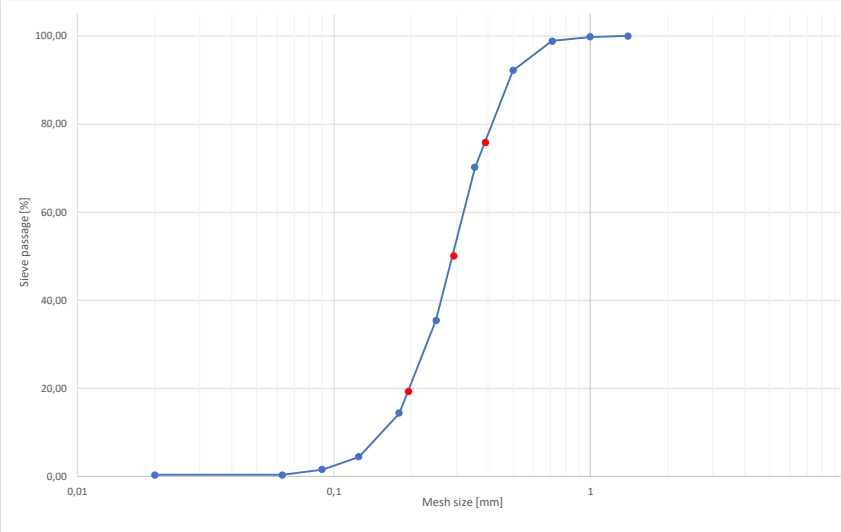
Datum	15.3.2024	**Recepie**	Content	[%]
Laboratory	Foundry-Institute - Sand - Laboratory		Sand	70%Reg./30%Neusand
Processor	hä		Additiv	-
Temperature	22,9°C/30%LF		Binder	0,8% / 0,8% HA st. binder
Test instrument	Biegefestigkeit Prüfmaschine		Temp. Reg./Sand	

Cut-off time	**Measuring time [h]**	**Mass bar [g]**	Average	Standard Diviation	**Bending Strength [N/cm²]**	Average	Standard Diviation
	0	145,0	145,5	0,4	231,6	245,3	10,3
		145,5			247,7		
		146,0			256,6		
	1	145,5	145,3	0,2	337,0	341,8	4,5
		145,0			340,6		
		145,5			347,8		
	4	145,5	145,5	0,0	367,4	368,6	1,7
		145,5			367,4		
		145,5			371,1		
	72	145,0	145,2	0,2	405,0	413,8	8,1
		145,0			412,0		
		145,5			424,5		



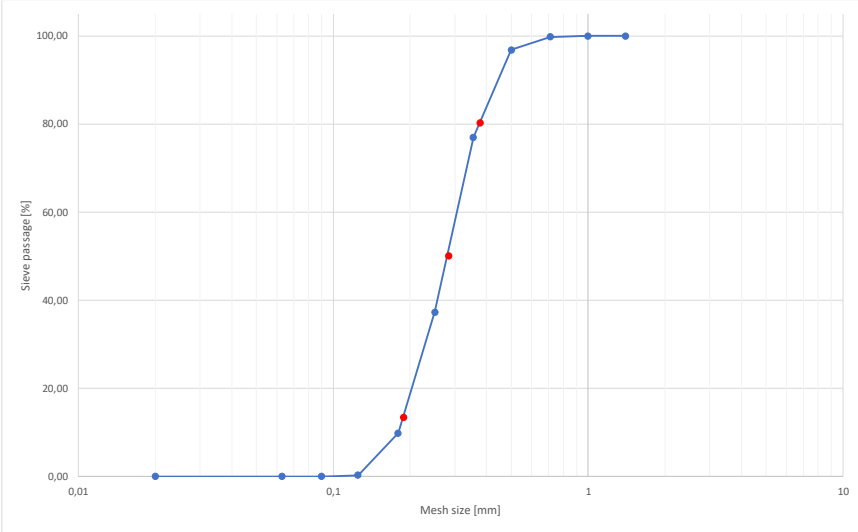
Grain size distribution, no significant change caused by the reclamation

Used sand



Mean grain size [mm]	0,294
Degree of uniformity [%]	56,59
AFS-Number	52,23
Theoretical specific surface area [cm²/g]	88,93

Reclaimed sand



Mean grain size [mm]	0,284
Degree of uniformity [%]	66,78
AFS-Number	50,14
Theoretical specific surface area [cm²/g]	85,04

Several years of extensive research on different green sand reclamation methods

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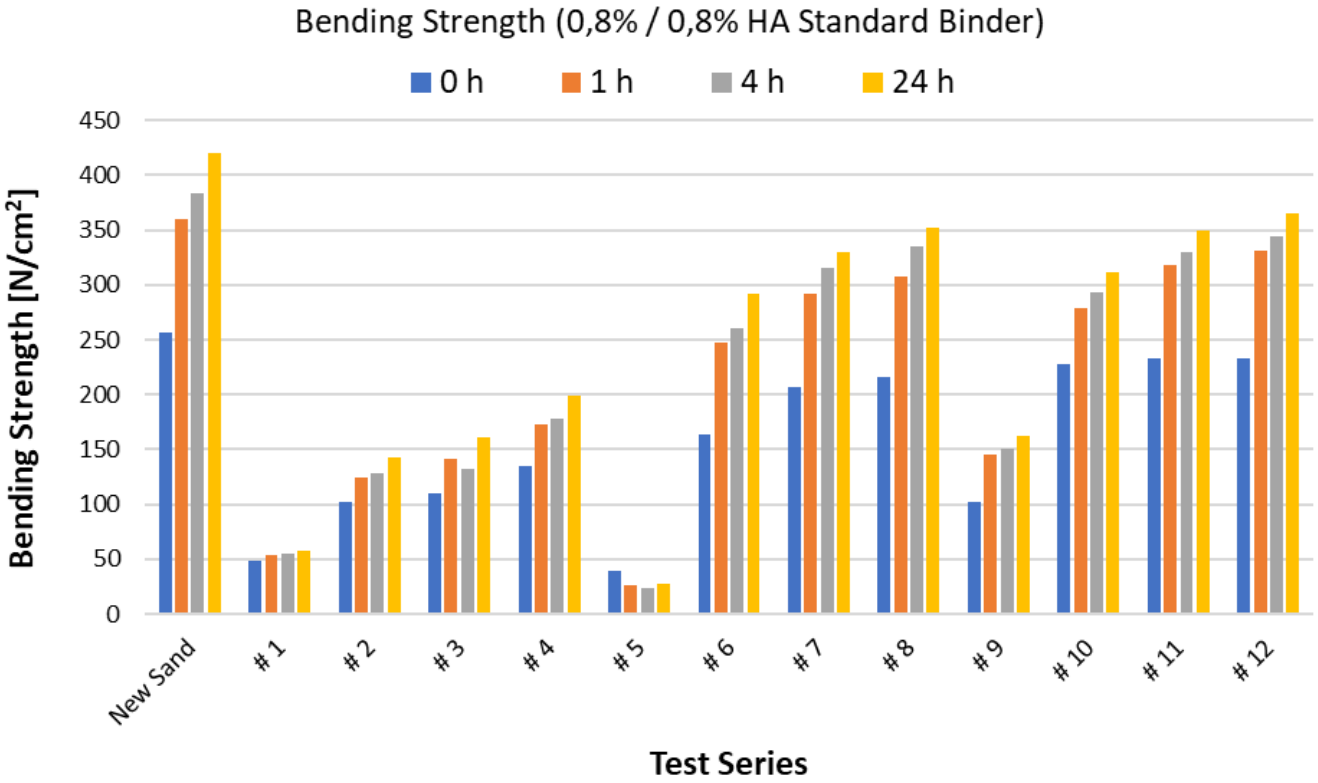
AN EXTENSIVE SERIES OF TESTS USING DIFFERENT RECLAIMING METHODS AND PROCESSING PARAMETERS HAVE BEEN CARRIED OUT TO DETERMINE THE BEST RESULT



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04 Sand as a service model

The business model: SAAS Unit on site in the foundry, easy way to start sand reclamation

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SAAS UNITS IN TWO SIZES

Capacity of the unit max. 2,5ton/h
Gas-fired
Can be installed outside
Low space requirement

Capacity of the unit max. 1 ton/h
Fully electrical
Can be installed outside
Low space requirement

- The operator is the customer
- Resand takes care of maintenance and servicing ("all-in") including process monitoring by means of remote monitoring
- Customer pays SaaS fee and energy costs on site

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With Resand technology, sand can be used again and again and save natural resources

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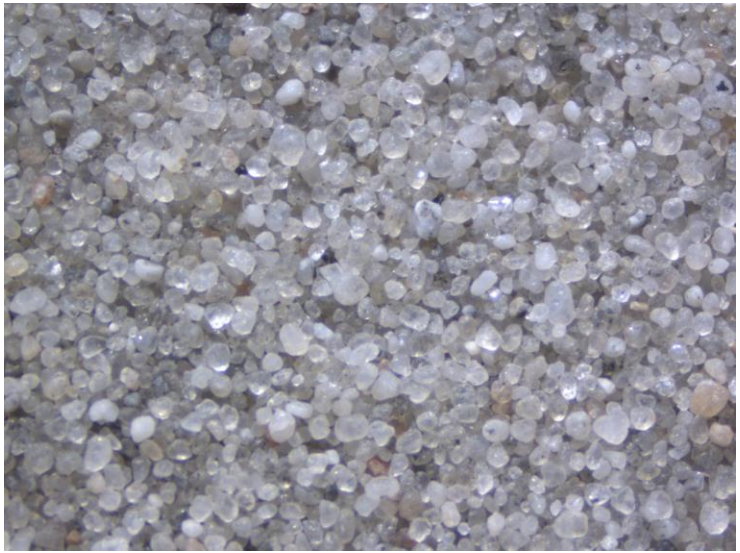

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Thank you
for your attention

CALDERYS
MEET 2024

CALDERYS MEET 2024

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Producing Non-Iron Castings in Green Sand

26-27 September 2024
VÄSTERÅS, SWEDEN

Eren Koc

Team Leader DISA Non-Iron &
Area Sales Manager SIMPSON OEM Europe

DISA
A Norican Technology

CALDERYS MEET 2024

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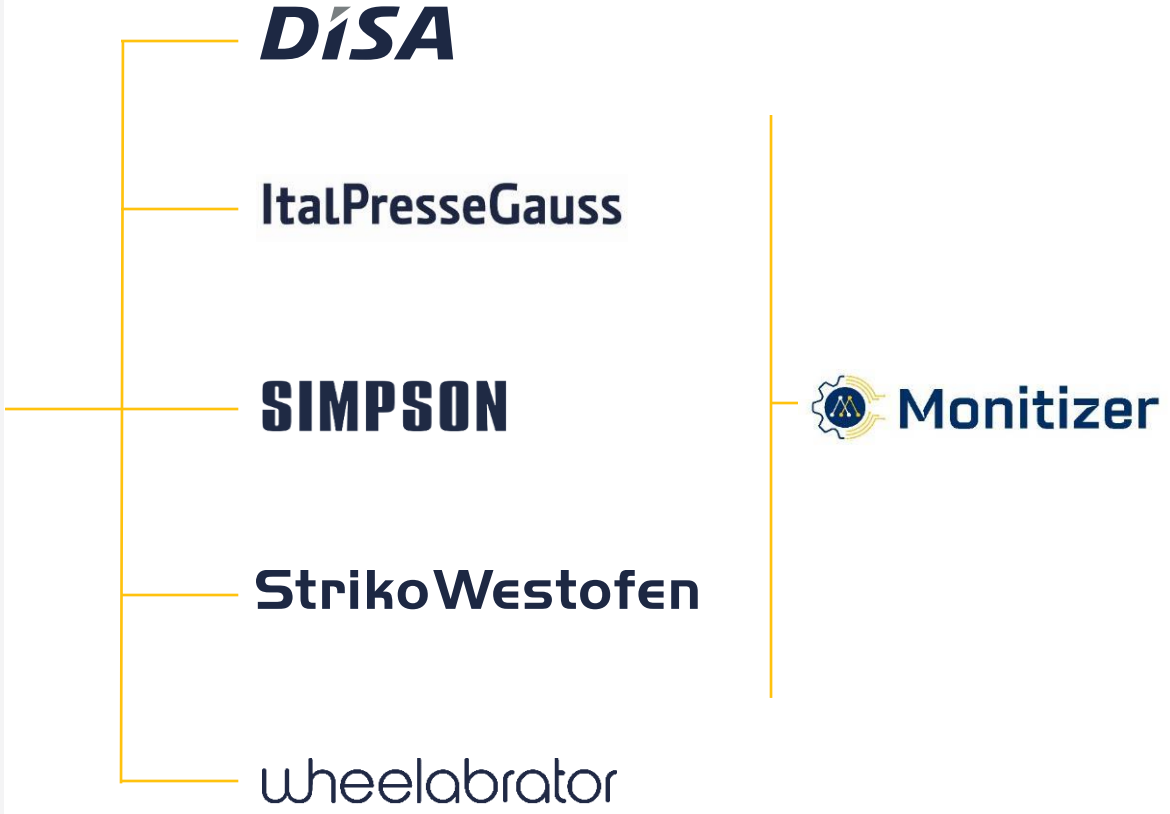
Norican Group
Shaping Industry



Technologies we offer

Norican Group
Shaping Industry

StrikoWestofen | SIMPSON | DISA | ItalPresseGauss | wheelabrator | Monitizer

Melting

Sand Preparation & Multi-Cooler

Vertical

Turnkey Die Casting Cell

Wheelblast

Collect & visualize data

Dosing

Sand Testing

Matchplate

High Pressure Die Casting

Airblast

Analyze production data

Pourin g

Sand Reclamation

Horizontal

Gravity / Low Pressure Die Casting

Specialist peening services

Use AI to intervene in production processes

Non-Iron on DISA
Your Complete Foundry Supplier

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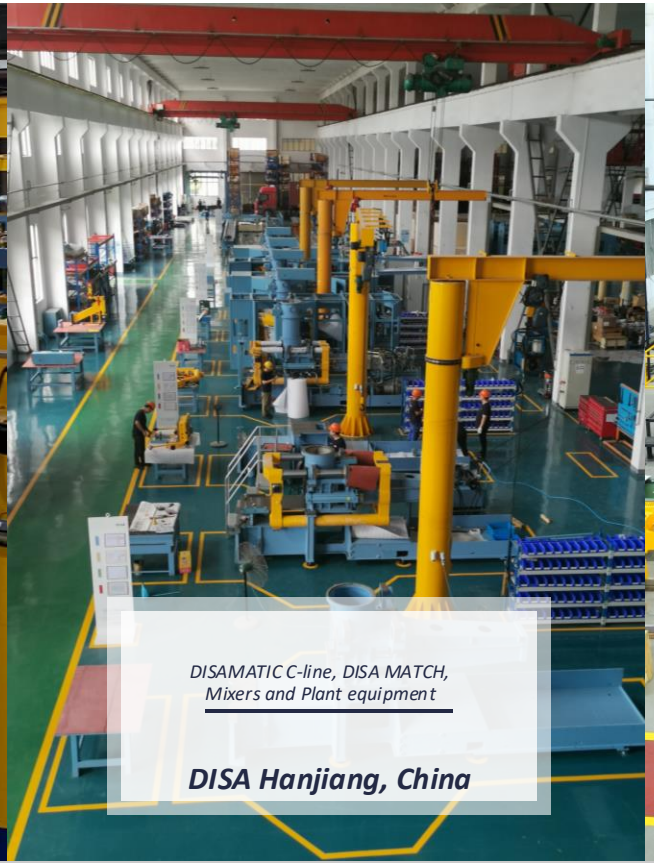
As a complete foundry partner and a market leader of moulding equipment, we have the ability to turn an empty field or an existing building into a complete, modern foundry.

1	*Sand plants*
2	*Moulding lines*
3	*Sand and casting cooling*
4	*Filter systems*
5	*Shot blast machines*
6	*Digital connections*

World-Class Technology Centers

Research and Development Center, DISAMATIC, DISA MATCH

DISA HQ, Taastrup DK



DISAMATIC C-line, DISA MATCH, Mixers and Plant equipment

DISA Hanjiang, China

DISAMATIC C-line, DISA MATCH, DISA FLEX, Mixers and Plant equipment

DISA Tumkur, India

Non-iron DISA lines across the World

12 STEEL DISA LINES IN **6** COUNTRIES

34 ALU DISA LINES IN **1** COUNTRIES

3 COPPER DISA LINES IN **7** COUNTRIES

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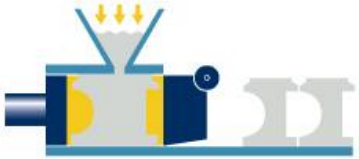
Non-Iron on DISA

Advantages

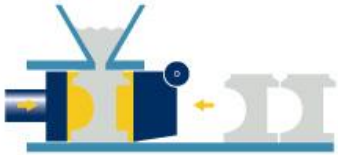
- **Good surface quality**

  (e.g.,6.35µm Ra - 33.40µm Rz - Figures for Alu*)
- **Flexible productivity** - Speed at 75 to 555 moulds (shots) per hour with core setting
- **Fast tool changing time** – just 1 – 5 minutes
- **Low-cost patterns** - From wood to tool steel (starting from ~1500 Euros)
- **High pattern lifetime** - 500.000+ moulds (shots) with low pattern maintenance cost
- **Short lead times** - quick from CAD design to casting
- **Low manpower** - High output per line with few people to operate

The DISAMATIC Technology – Vertical Moulding



1 Sand shot



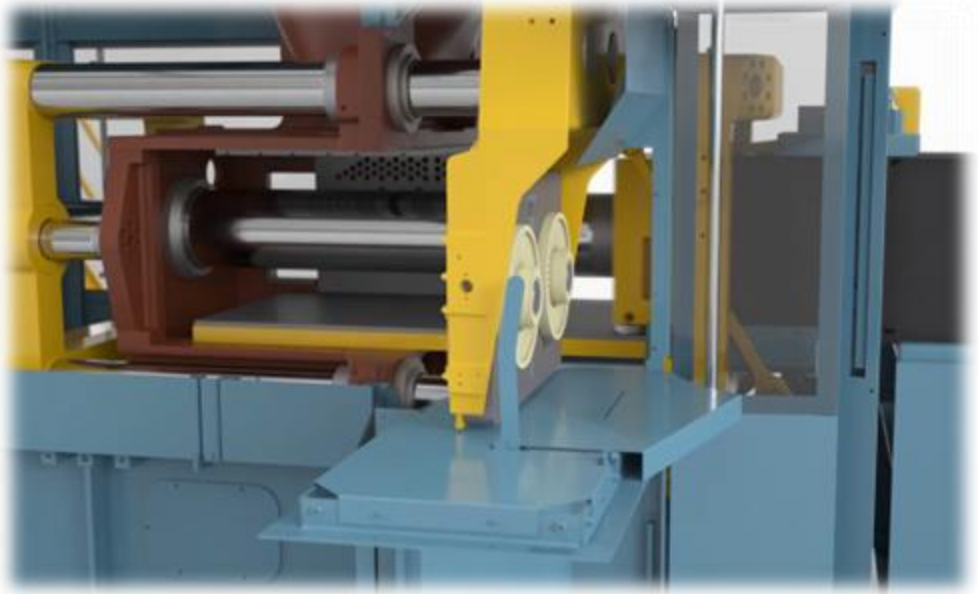
2 Mould squeeze

3 Stripping & chamber opening

4 Mould close up

5 Stripping and returning

6 Closing the chamber



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Shaping Industry

Core setting Vertical - Automatic

- Core setting is done with automatic core setter.
- Cores held on the mask by vacuum
- Everyday millions of cores put in place by this method.

→ **Meaning a proven and very efficient technology**

Easy production changeover (QPC)

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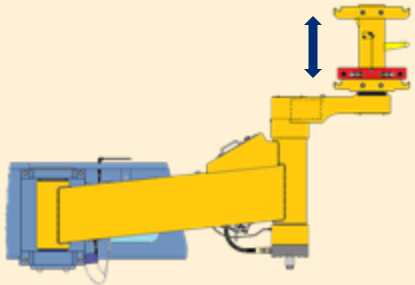
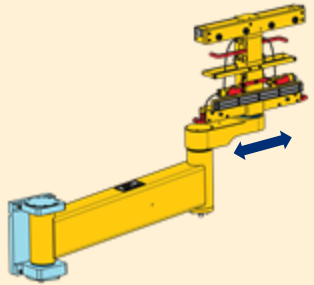
DISA A Norican Technology

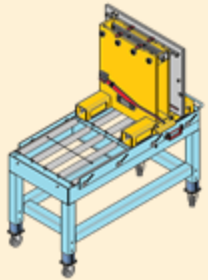
Gripping and lifting design for **DISAMATIC D3**



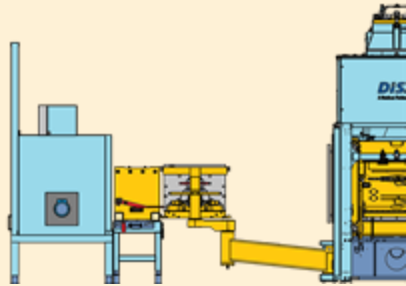
Rolling and locking design for **DISAMATIC D5**



Moveable table for **safe transport of pattern plates**



Pattern plate preheating unit for **optimal pattern temperature**



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The DISA MATCH technology – Horizontal Moulding

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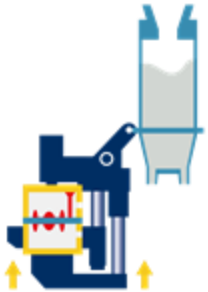
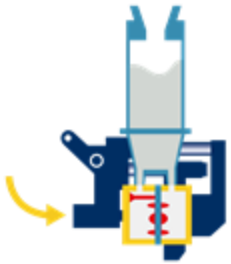
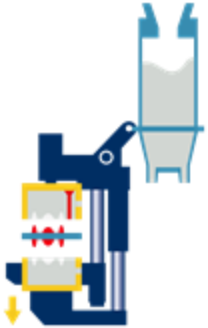


1 Flask close-up



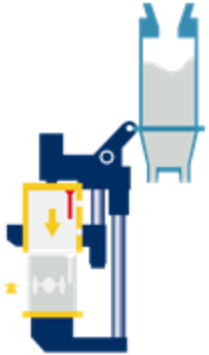
2 Roll down

3 Blow/squeeze



4 Matchplate release

5 Mould close



6 Mould push out

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High accuracy core setting (CSE)

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DISA
A Norican Technology

3-4 x

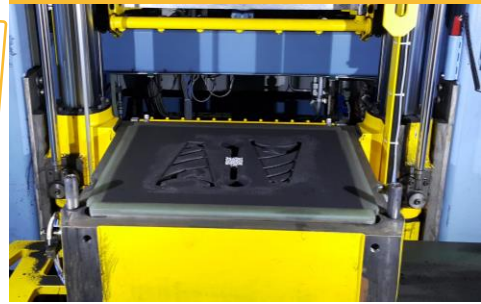
More time available for core setting

5-12 s

Core setting cycle time

Improved operators ergonomi with **ideal core setting position**

Fixed drag flask for **high precision core setting**



Core mask guide pins allow **fast change without adjustments**

Operator light for **brighter working conditions**

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Easy and quick production changeover (QMC)

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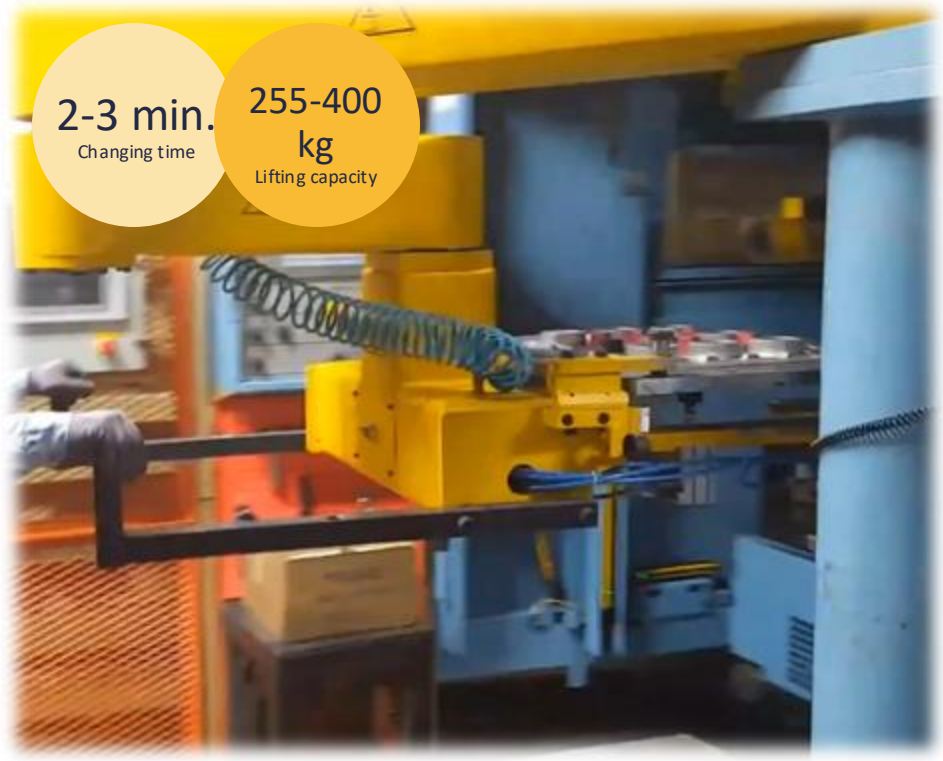
DISA
A Norican Technology



User-friendly change-unit can be **operated by anyone**

Spacious area with light curtains for **optimal working conditions**

DISA QMC enables matchplate **change in 2-3 minutes**

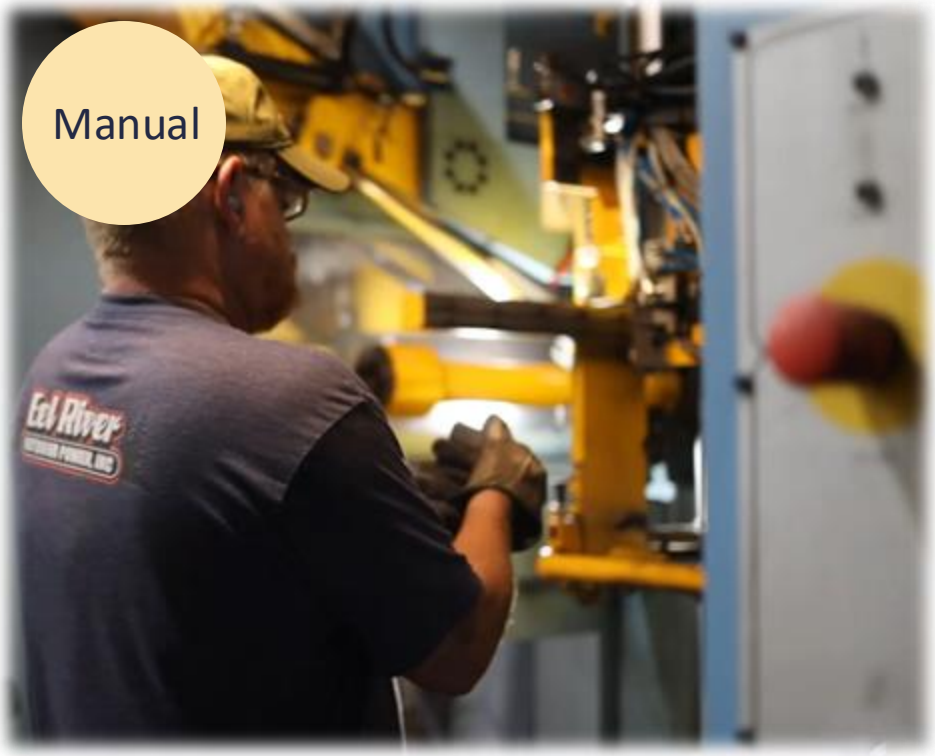
Enhance workplace by **removing heavy pattern plate lifting**

Norican Group
Shaping Industry

Easy and quick production changeover (Manual)

CALDERYS MEET 2024

DISA
A Norican Technology



User-friendly change-unit can be **operated by anyone**

Spacious area with light curtains for **optimal working conditions**

DISA QMC enables matchplate **change in 2-3 minutes**

Enhance workplace by **removing heavy pattern plate lifting**

Norican Group
Shaping Industry

Pouring – Hand – Ladle

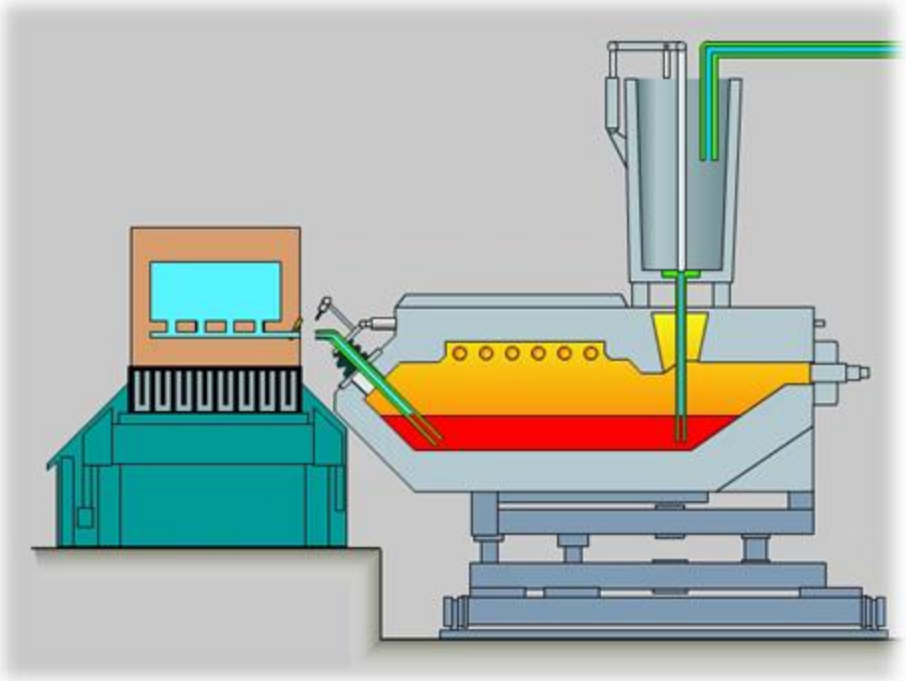
- For aluminium, copper alloys and steel castings most castings can be poured by hand – ladle

› Simple and cheap solution
› Suitable for
  › slow-medium production
  › short series
  › different alloy production

Pouring – Robot – Spoon

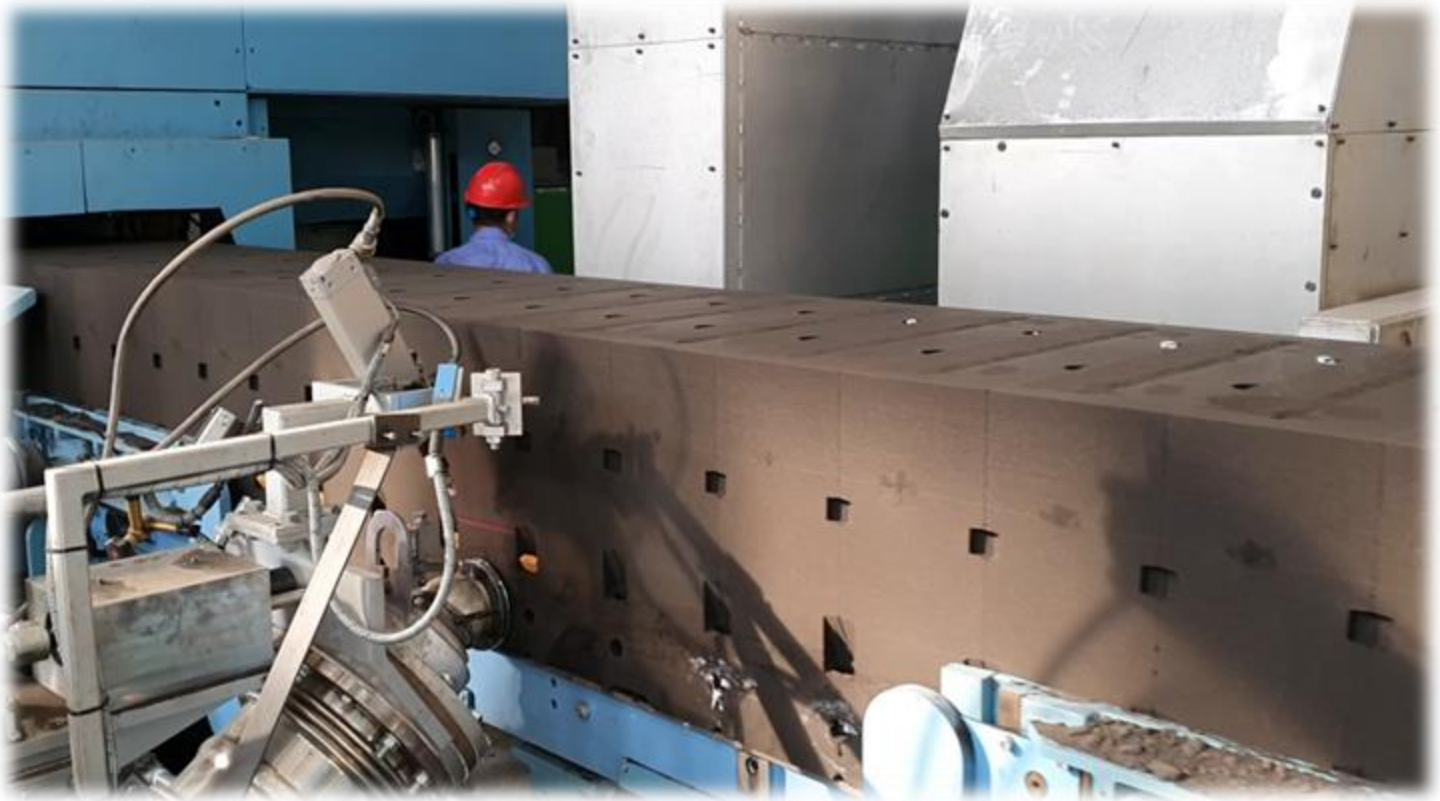
- Fully or semi-automated robot solutions can be applied for more accurate pouring application.

› Less dependency on labour
› Less operational cost
› Medium budget



Pouring – Advanced – Low Pressure

- Aluminium oxides have a negative impact on the mechanically properties
- Very important to reduce the formation of oxides in order to have highest possible mechanical properties
- Laminar flow with very good control over the melt, no splashes, no turbulance
- Pouring is done from the lower part of the mould side with a pressurized furnace to secure laminar calm flow
- A core is used to close to runner bar



- Green sand moulding and especially vertical green sand moulding has proven to be a very cost-efficient way to produce iron castings
- This cost efficiency can be transferred to production of Non-Iron castings

It is now feasible to produce Aluminium & Bronze & Steel castings in green sand

Modern moulding equipment now exists matching these smaller yearly volumes

Aluminium Castings Made on DISA

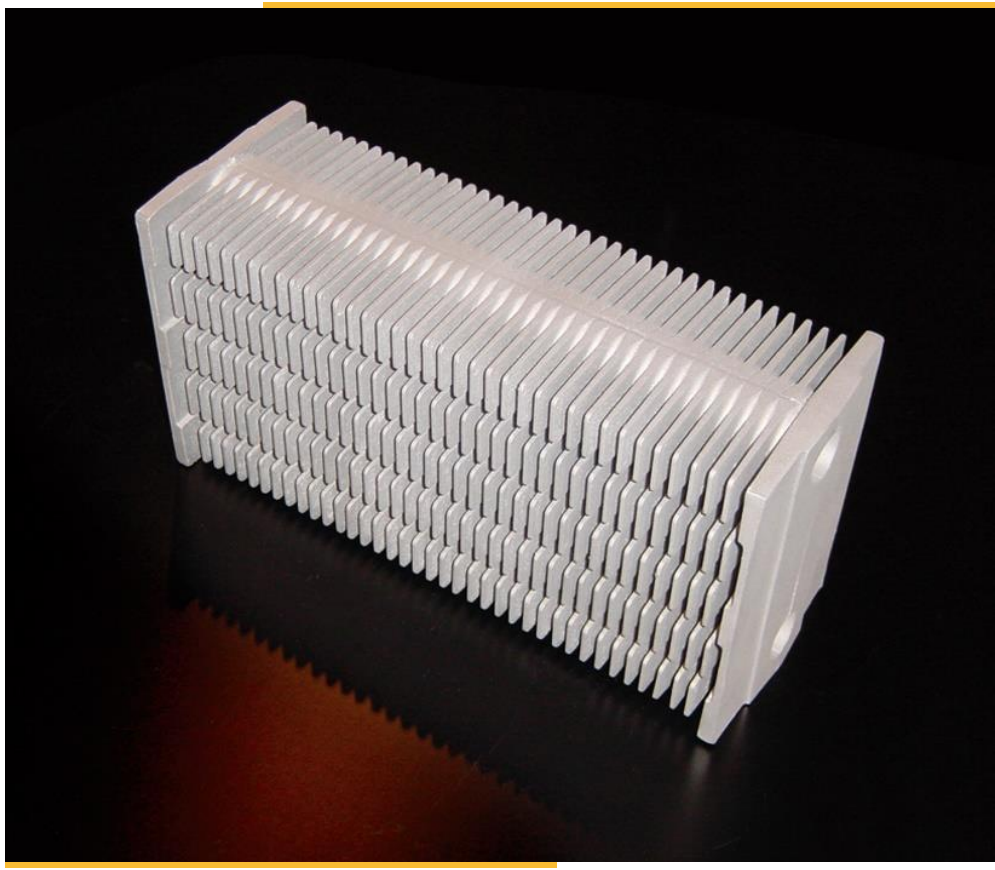
BASE CASTING

Alloy: AlMg
Casting Weight: 10.7 kg
Castings per mould: 1
Produced on: DISA MATCH 32/32
Foundry name: Trio Foundry Inc.
Country: USA

Aluminium Castings Made on DISA

HEAT EXCHANGER

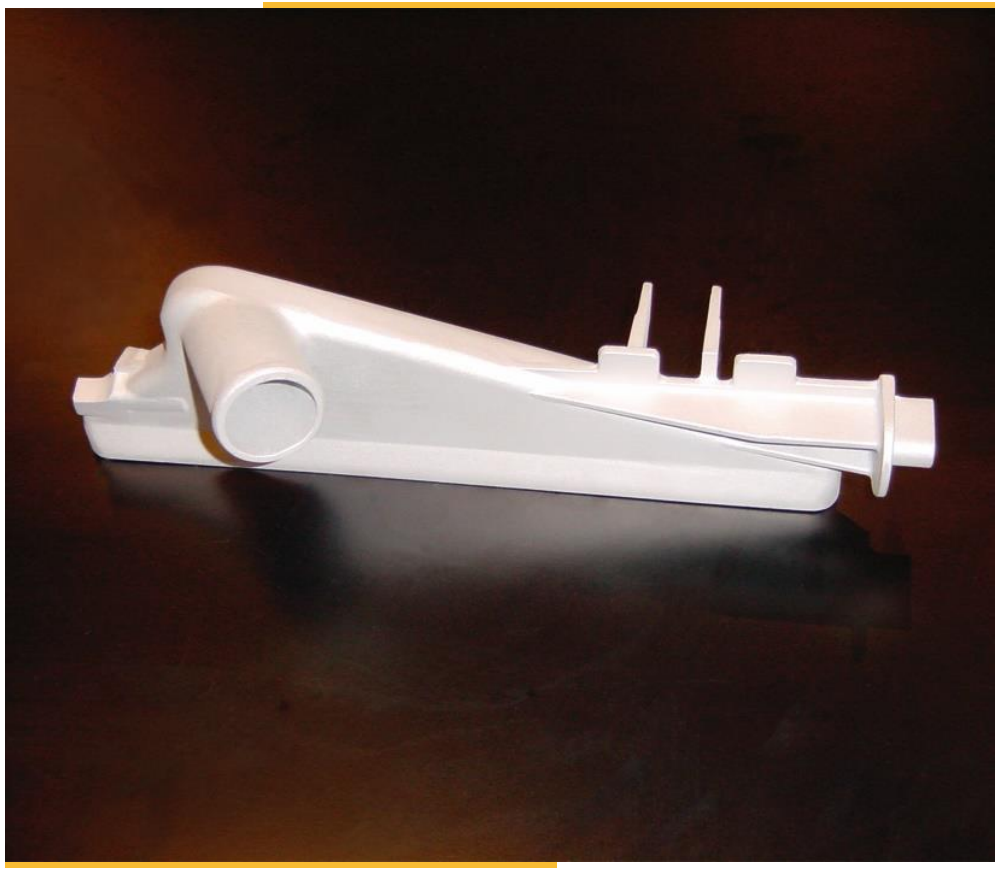
Alloy: A356
Casting Weight: 5.2 kg
Castings per mould: -
Produced on: DISAMATIC 2120-C
Foundry name: ATL
Country: UK



Aluminium Castings Made on DISA

TANK INLET

Alloy: AISi
Total Weight: 1.4 kg
Casting Weight: 0.94 kg
Castings per mould: 1
Produced on: DISAMATIC 2110
Foundry name: Jæger
Country: Denmark



Aluminium Castings Made on DISA

IMPACT CUP

Alloy: AlSi7Mg
Casting Weight: 1.05 kg
Castings per mould: -
Produced on: DISAMATIC 2120-C
Foundry name: ATL
Country: UK

Aluminium Castings Made on DISA

HEAT EXCHANGER

Alloy: Al
Casting Weight: 7.6 kg
Castings per mould: 2
Produced on: DISAMATIC 240-C
Foundry name: Saint Jean
Country: Spain

Aluminium Castings Made on DISA

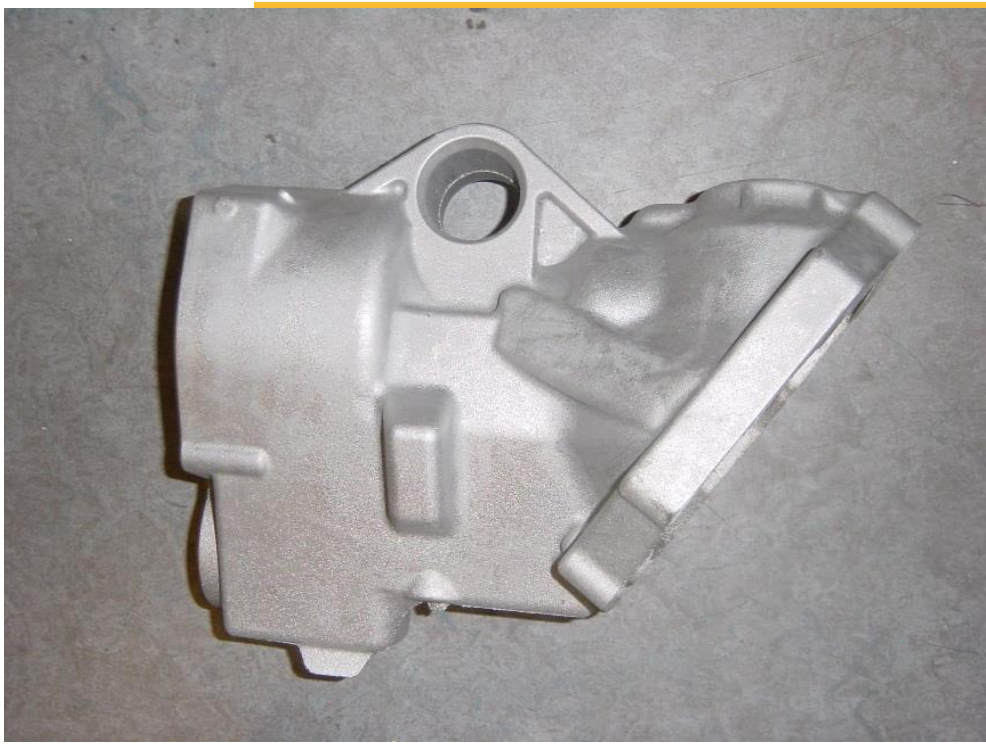
CONNECTION PART

Alloy: AlSi7Mg
Casting Weight: 1.25 kg
Castings per mould: -
Produced on:
Foundry name:
Country:

Aluminium Castings Made on DISA

TRANSMISSION HOUSING

Alloy: AISi7Mg
Casting Weight: 4.5 kg
Castings per mould: 1
Produced on: DISAMATIC 2013 B
Foundry name:
Country:



Aluminium Castings Made on DISA

VENTILATOR WHEEL

Alloy: AISi
Total Weight: 0.28 kg
Casting Weight: -
Castings per mould: 2
Produced on: DISAMATIC 2110
Foundry name: Rüther
Country: Germany

Aluminium Castings Made on DISA

INTAKE MANIFOLD

Alloy: AlSi8Mg
Casting Weight: 2.7 kg
Castings per mould: 1
Produced on: DISAMATIC 230-C
Foundry name: BREA
Country: France

Aluminium Castings Made on DISA

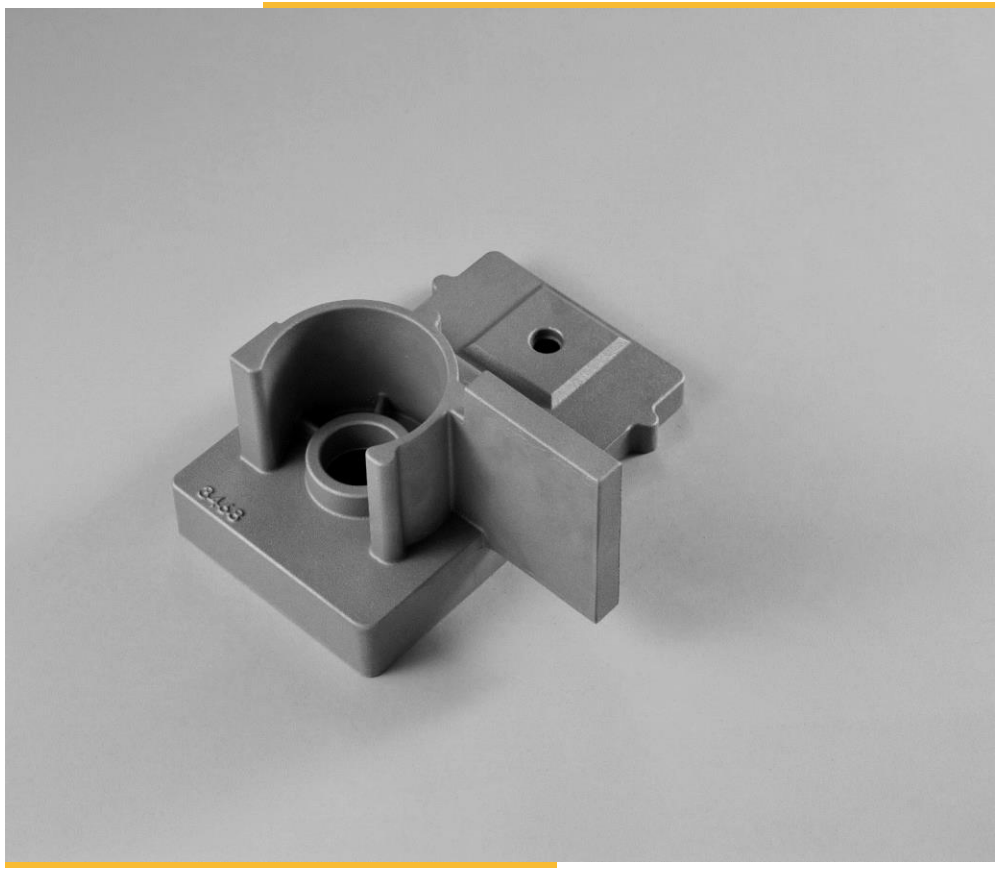
BUMPER BRACKET

Alloy: AlSi7Mg
Casting Weight: 0.3 kg
Castings per mould: 9
Produced on: DISA 2120-C
UTS: 203 +/-2 Mpa
Yild strength: 144 +/- 1.6 Mpa
Elongation: 13.5 % +/-0.75 %
Tolerances: < 0.15 mm

Aluminium Castings Made on DISA

FLANGE

Alloy: AISi
Casting Weight: 2.15 kg
Castings per mould: -
Produced on: DISAMATIC 2110
Foundry name: Rüther
Country: Germany



Aluminium Castings Made on DISA

STEERING WHEEL

Alloy: Al
Casting Weight: 0.6 kg
Castings per mould: 1
Produced on: DISAMATIC 2110
Foundry name: Scherb
Country: Germany

Aluminium Castings Made on DISA

CONTROL ARM

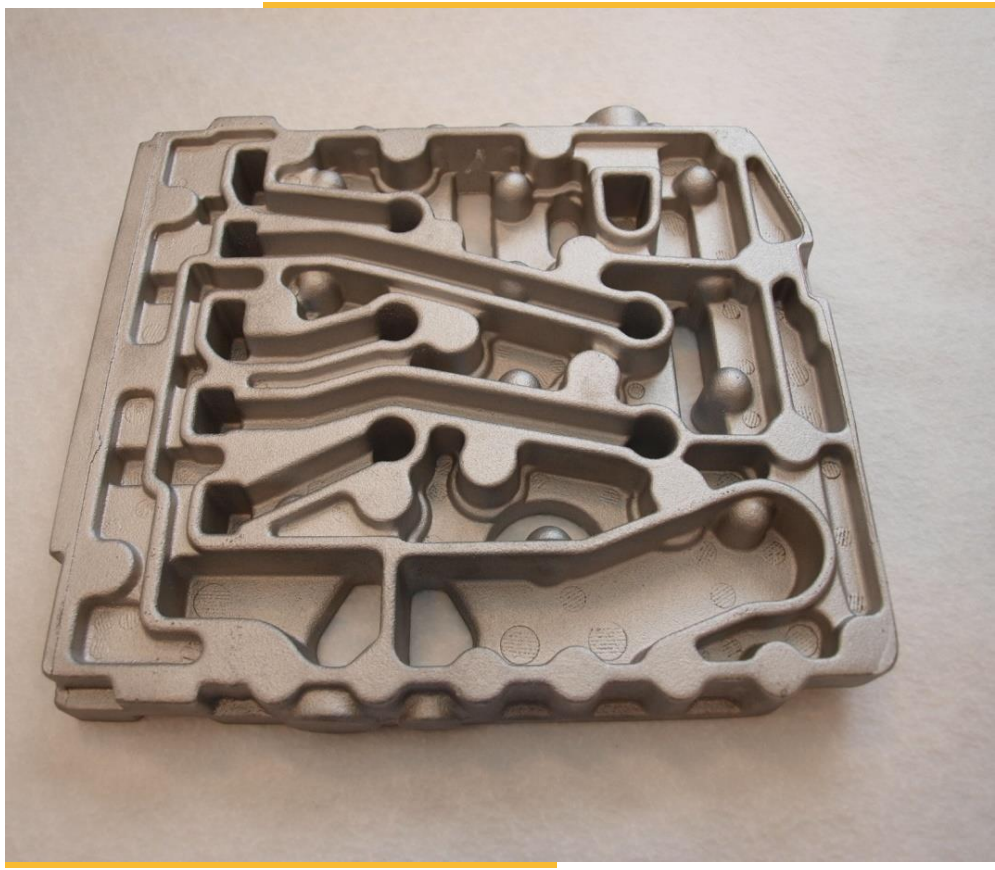
Alloy: AlSi7Mg with T6
Casting Weight: 5.0 kg
Castings per mould: 1
Produced on: DISAMATIC 2013 B
Foundry name: DISA
Country: Denmark

Elongation:	**Obtained 6 %**	**Demand >3 %**
Yield strength:	**Obtained 245 MPa**	**Demand >200 MPa**
Ultimate tensile strength:	**Obtained 309 MPa**	**Demand >250 MPa**

Aluminium Castings Made on DISA

HYDRAULIC BLOCK

Alloy: AlSi8Cu3
Casting Weight: 3.2 kg
Castings per mould: 1
Produced on: DISAMATIC 2110
Foundry name: Scherb
Country: Germany



Aluminium Castings Made on DISA

GAS VALVE

Alloy: AlSi7Mg0.3 T6
Casting Weight: 2.38 kg
Castings per mould: 2
Produced on: DISA MATCH 130 (20/24)
Foundry name: Littlestown
Country: USA

Aluminium Castings Made on DISA

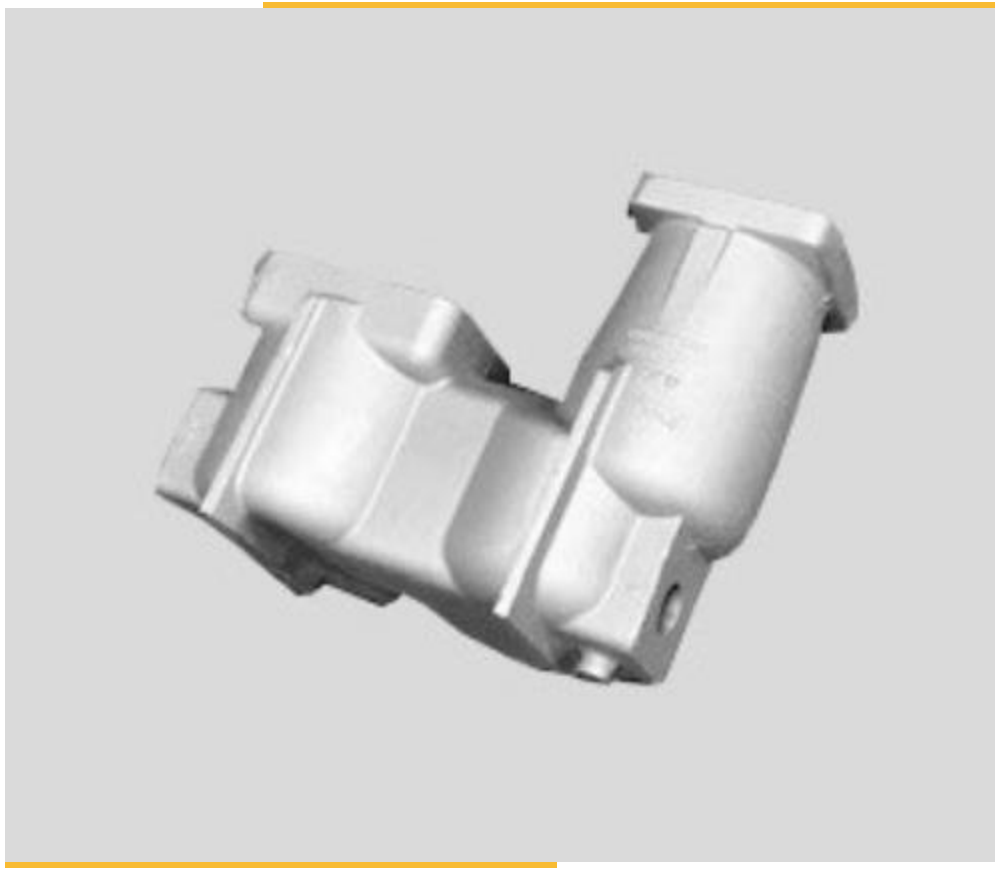
FLY WHEEL HOUSING

Alloy: AlSi7Mg
Casting Weight: 3.9 kg
Castings per mould: 1
Produced on: DISA MATCH 20/24
Foundry name: Aluminum Castings
Country: USA

Aluminium Castings Made on DISA

COMPRESSOR

Alloy: AlSi7Mg
Casting Weight: 5.1 kg
Castings per mould: 1
Produced on: DISA MATCH 20/24
Foundry name: Aluminum Castings
Country: USA



Copper Alloy Castings Made on DISA

IMPELLER

Alloy: ALU BRONZE
Casting Weight: 2.6 kg
Castings per mould: 1
Produced on: DISAMATIC 2110
Foundry name: MT Jæger
Country: Denmark

Copper Alloy Castings Made on DISA

FLUSH VALVE

Alloy: BRONZE RG5
Casting Weight: 1.2 kg
Castings per mould: 4
Produced on: DISAMATIC 2110
Foundry name: Duratex
Country: Brazil

Copper Alloy Castings Made on DISA

WATER SUPPLY PART

Alloy: BRONZE
Casting Weight: 8 kg
Castings per mould:
Produced on:
Foundry name:
Country:

Copper Alloy Castings Made on DISA

BALL VALVE BODY

Alloy: BRONZE

Casting Weight: 0,4 kg

Castings per mould:

Produced on: DISA MATCH 14x19

Foundry name: Ford Meter Box

Country: USA

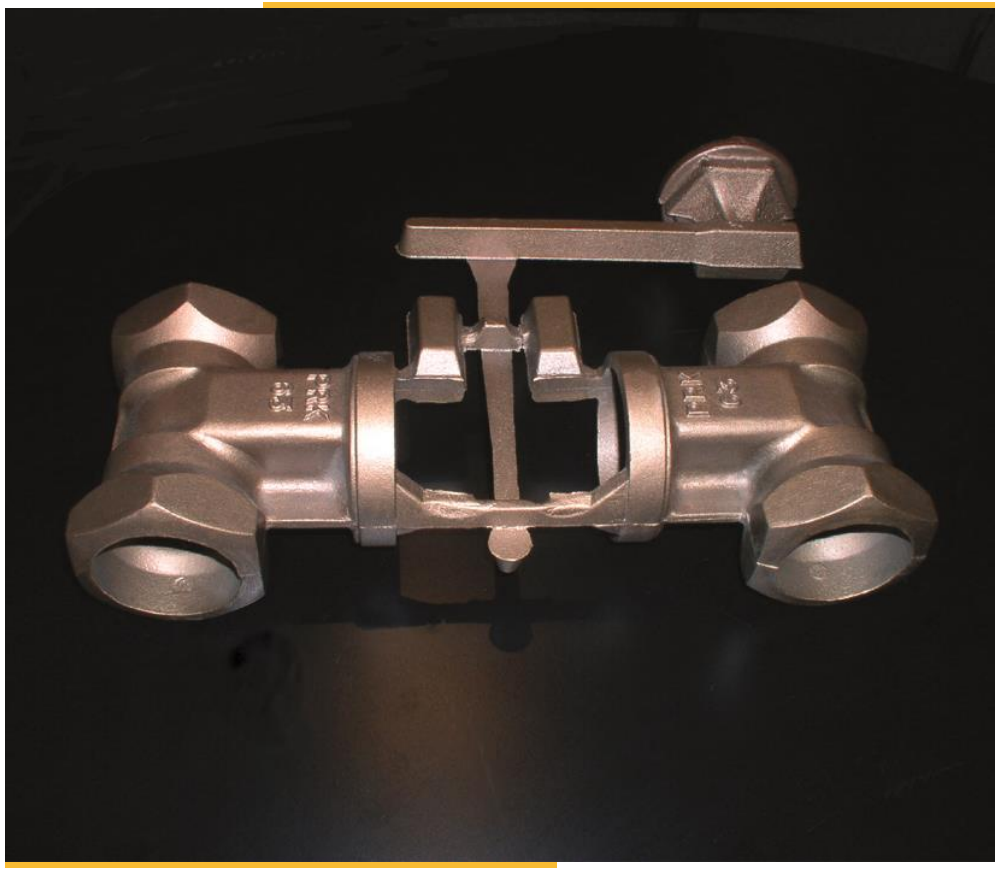
Copper Alloy Castings Made on DISA

VALVE HOUSING

Alloy: BRONZE
Casting Weight: 4,8 kg
Castings per mould:
Produced on:
Foundry name:
Country:

Copper Alloy Castings Made on DISA

VALVE BODY



Alloy: BRONZE
Casting Weight: 3.05 kg
Castings per mould: 2
Produced on: DISAMATIC 2110
Foundry name: Jæger
Country: Denmark

Steel Castings Made on DISA

CONTAINER CORNERS

Alloy: Steel
Casting Weight: 10.5 kg
Castings per mould: 1
Produced on: DISAMATIC 2110
Foundry name: DISA Test
Country: Denmark

Steel Castings Made on DISA

MANIFOLD

Alloy: Steel
Casting Weight: 8 kg
Castings per mould: 1
Produced on: DISAMATIC 2110
Foundry name: DISA Test
Country: Denmark

Thank you for your attention !!! - Questions ???

CALDERYS MEET 2024

calderys

SEPTEMBER 26, 2024

Sustainable and digital

Twin transition in Swedish foundries

Åsa Lauenstein, RISE

CALDERYS MEET 2024

Åsa Lauenstein

Senior researcher at RISE

Cast steel components and the casting process

Engaged in the twin transition of Swedish industry

– green and digital!

RISE
Research Institutes of Sweden

- More than 30 locations in Sweden and abroad
- Was formed in 2016 by merging 30 smaller institutes
- 3300 researchers, engineers, and specialists
- 130 laboratories and demonstration facilities
- Competence within materials transition, mobility, digitalisation, energy, sustainable societies, health care and life science
- Transition management and life-long learning

RI.
SE

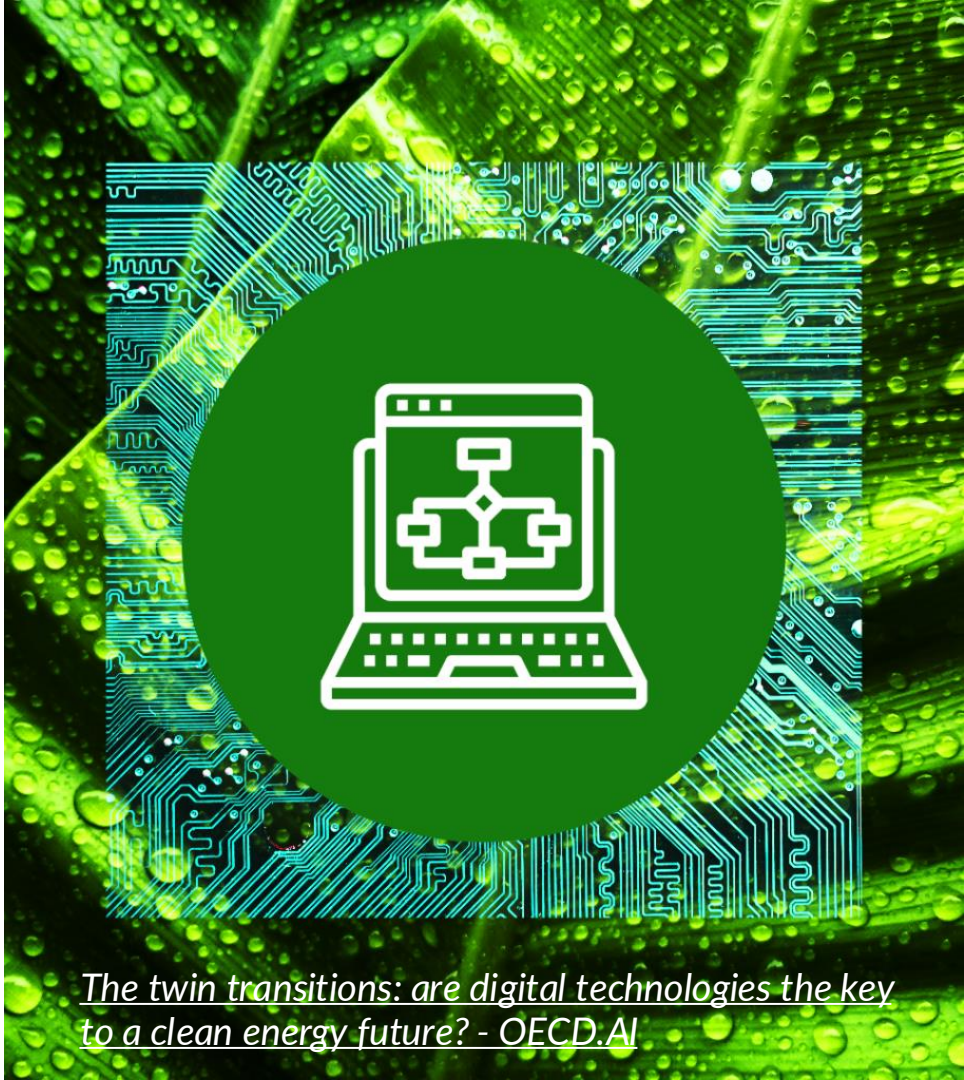
Agenda

1. Twin transition – what?
2. Towards a sustainable foundry
3. Towards a digital foundry
4. Twin transition – where to?

Twin transition – what?

Twin transisition:

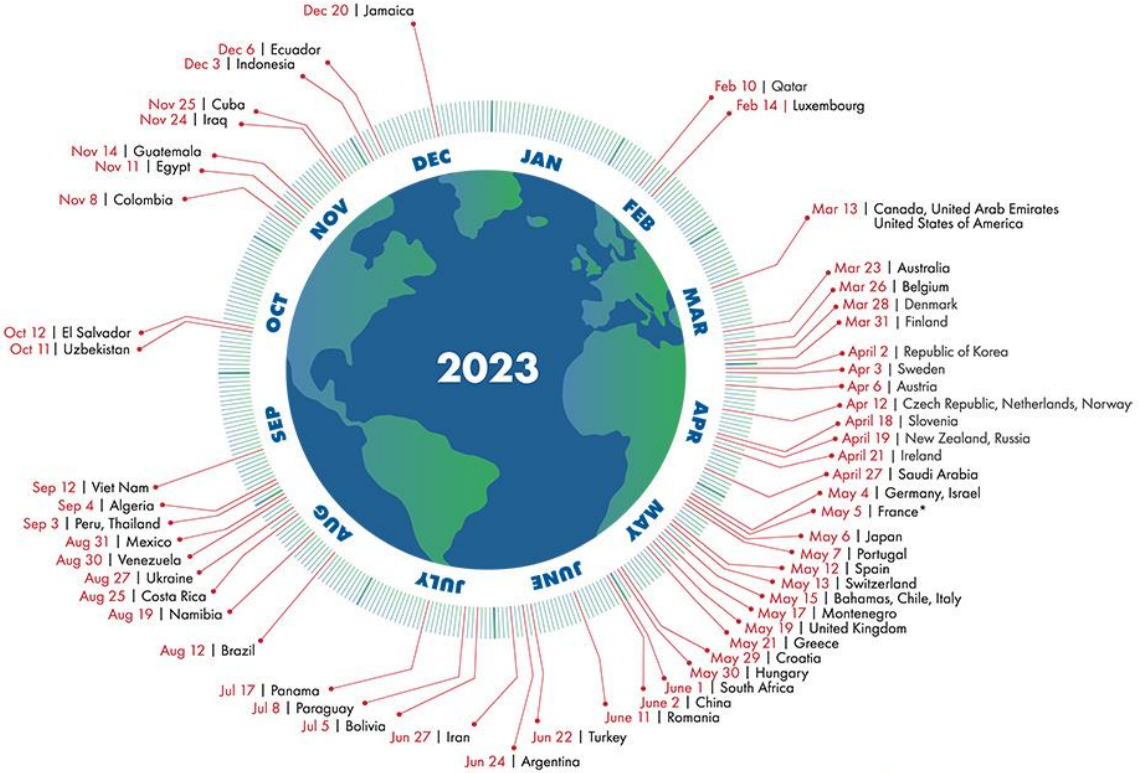
Green and digital



The twin transitions: are digital technologies the key to a clean energy future? - OECD.AI

Country Overshoot Days 2023

When would Earth Overshoot Day land if the world's population lived like...



For a full list of countries, visit overshootday.org/country-overshoot-days.
*French Overshoot Day based on nowcasted data. See overshootday.org/france.

Source: National Footprint and Biocapacity Accounts, 2022 Edition
data.footprintnetwork.org

EARTH OVERSHOOT DAY

Global Footprint Network
Advancing the Science of Sustainability

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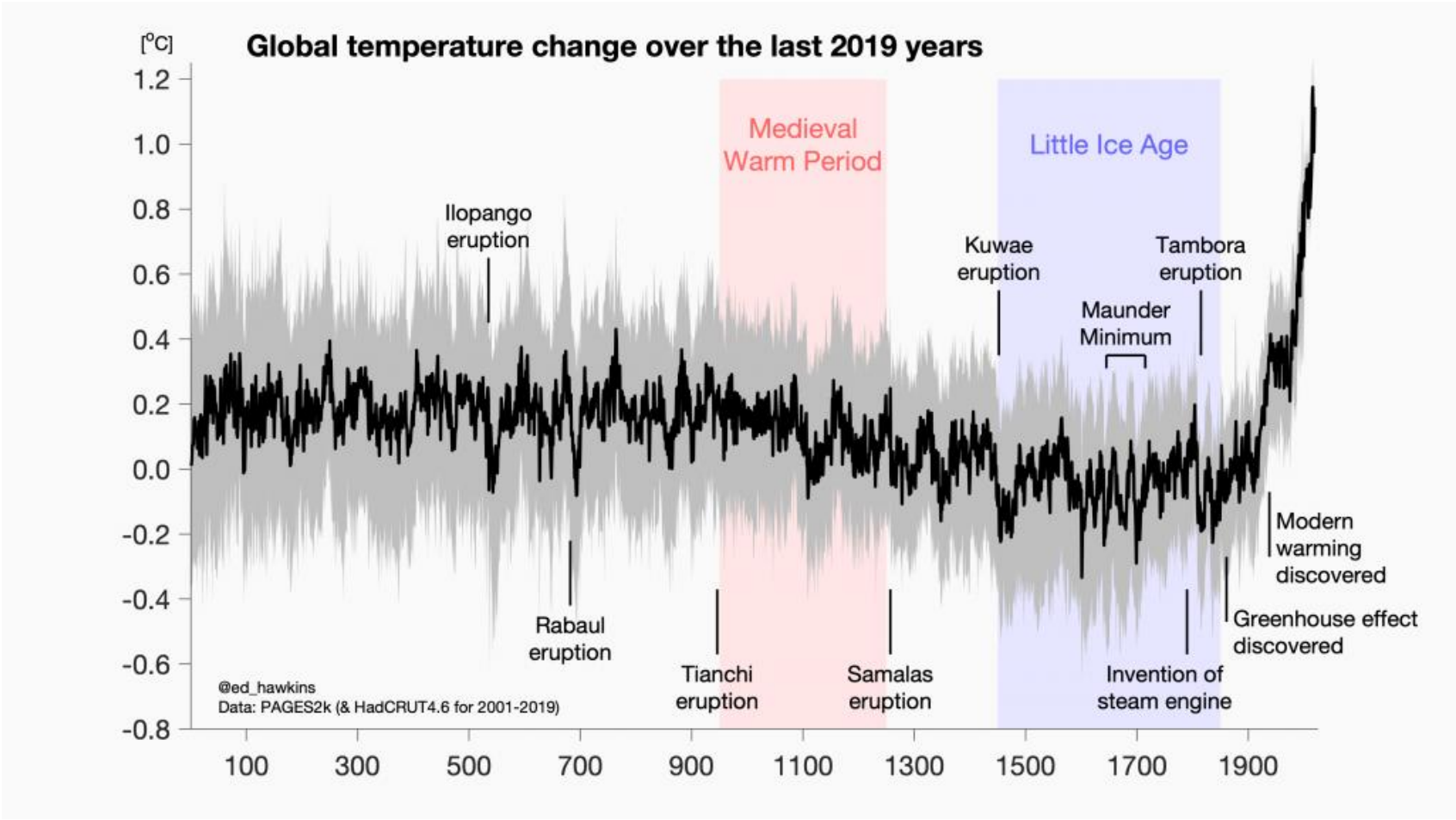

[°C]
Global temperature change over the last 2019 years
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
100
300
500
700
900
1100
1300
1500
1700
1900
Medieval Warm Period
Little Ice Age
Ilopango eruption
Rabaul eruption
Tianchi eruption
Samalas eruption
Kuwae eruption
Maunder Minimum
Tambora eruption
Invention of steam engine
Greenhouse effect discovered
Modern warming discovered
@ed_hawkins
Data: PAGES2k (& HadCRUT4.6 for 2001-2019)

17 global sustainability goals

Through Agenda 2030, the UN member states have committed to 17 global sustainability goals.

They were adopted in 2015 and are intended to contribute to **socially, economically and environmentally sustainable development** and be achieved by 2030 in all countries of the world.

Keys to sustainability

- Fossile-free steel and concrete industry
- Energy and material effeciency
- Circular economy, bioeconomy
- New materials, biomaterials
- Green startup companies
- Agenda 2030, EU Green Deal

2024 trends

- Sustainable technical solutions
- Digital applications for resource efficiency
- AI supporting R&D
- Democratic generative AI
- Cybersecurity and continuous risk assessment

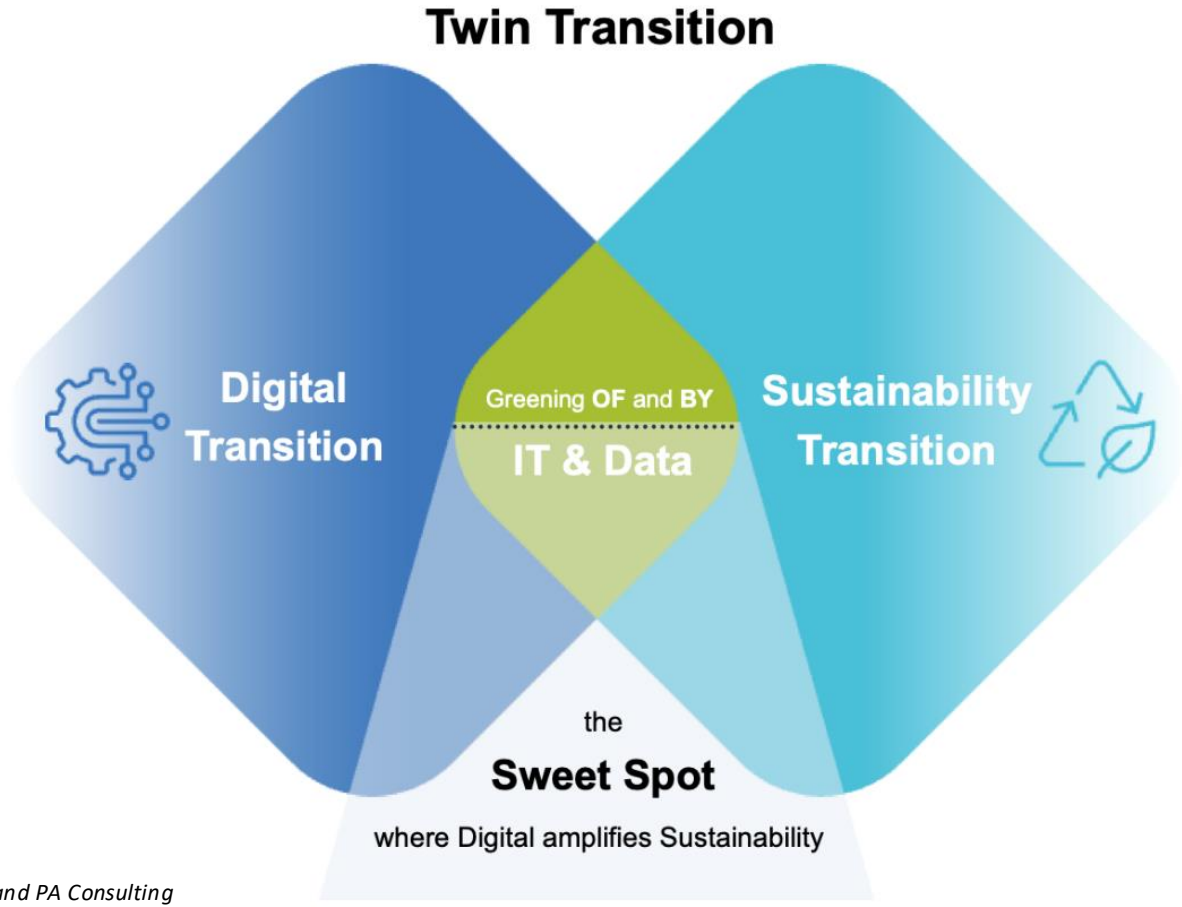
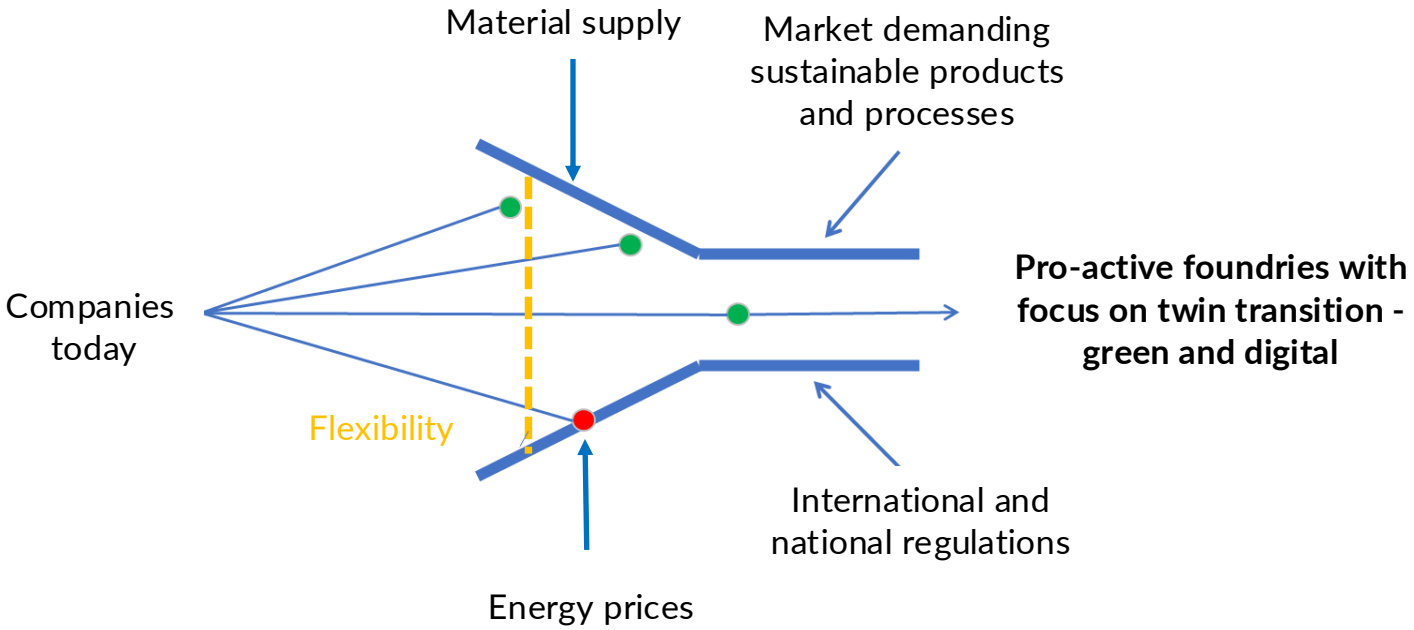


Image: Royal Schiphol Group and PA Consulting

Pro-active foundries



Towards a sustainable foundry

Automation

Åtta gjuterier ställer om

- Projektet heter Gjutna produkter med resurseffektiv tillverkning och affärsmodeller (Greta). Det består av tre delar:
- 1. "Resurseffektiv energianvändning" fokuserar på konkreta lösningar som värmeåtervinning, värmepumpar, optimerad värmeberedning eller energilagring. Fossilfria lösningar prioriteras.
- 2. "Resurseffektiva materialflöden" handlar om att skapa förutsättningar för cirkulära materialflöden.
- 3. "Resurseffektiv design" fokuserar på att designa och konstruera gjutna komponenter för hållbarhet i alla led.
- **Deltagande:** Apes Kulltorp, Bactiv Gudmundslyttan, Bruzaholms bruk, Landshyttan Stål, Norrlandsgjuteriet, Scania CV, Smålandia Stålgjuteri och Volvo Powertrain.
- **Forskningsutförare:** Rise och Högskolan i Jönköping.
- **Finansiärer:** Svenska Gjuteriföreningen, Vinnova och Metallska Materialfonden.

Åtta stora och små gjuterier deltar i en gemensam satsning att bli fossilfria. Förutom Bruzaholms bruk (bilden) ingår bland annat Scania CV och Volvo Powertrain.

”Gjuterier har en viktig roll”

BRANSCHPROJEKT

I Sverige finns omkring 100 större och mindre gjuterier, som sammanlagt producerar omkring 300 000 ton gjutgods per år. Det motsvarar cirka 2 procent av Europas totala produktion.

Projektet Greta (Gjutna produkter med resurseffektiv tillverkning och affärsmodeller) beskrivs som gjuteriindustrins största hållbarhetsprojekt någonsin.

Åtta svenska gjuterier medverkar, däribland jättarna Scania och Volvo Powertrain, som ensamma står för en betydande

startades av Svenska Gjuteriföreningen efter diskussioner med flera medlemsföretag.

– Gjuteriindustrin har alltid haft en viktig roll i samhällets metallkretsloppt, genom att smälta ner förbrukade metallvaror och gjuta nya detaljer av dem. Men trots att branschen har ett lågt utsläppsavtryck i förhållande till andra industrier och andra länder, ser vi ändå möjligheten att minska vår klimatpåverkan genom att bli mer resurseffektiva, säger Diana Bogic, tillförordnad vd och generalsekreterare på Gjuteriföreningen.

Projektet strävar bland annat efter att öppna för återvunna materialflöden där man i dag använder jungfruliga, att hjälpa gjuterierna fasa ut fossila bränslen, och de har en enorm erfarenhetsbank att dela med sig av genom Greta-projektet.

klimatavtryck genom effektivare energianvändning.

– Den svenska gjuteriindustrins arbete med hållbarhet ser vi redan i dag som en konkurrensfördel, och vi tror att det i framtiden kommer att bli en ännu större parameter vid val av leverantör. Att bli mer resurseffektiv har dessutom den fördelen att det oftast leder till minskade kostnader, säger Diana Bogic.

Rise är koordinator och tillsammans med Högskolan i Jönköping forskningsutförare.

– Metodiken kan sedan andra gjuterier ta del av och applicera i sin egen verksamhet. Scania är deflutiet ett av de gjuterier som går i täten när det gäller att fasa ut fossila bränslen, och de har en enorm erfarenhetsbank att dela

Därtill har Rise en forskningsenhet med 20 personer, som jobbar heltid specialiserat på gjuterifrågor.

Åsa Lauenstein.

– Exempelvis forskar de på de kemiska tillsatser som används i gjuteriprocessen. Det här är ett område som inte beforskats särskilt mycket tidigare, trots att gjuterierna länge jobbat med att lösa ut fossila bränslen, säger Åsa Lauenstein.

Överlag ligger den svenska gjuterinäringen långt framme, både vad gäller resurseffektivitet och med att minska sitt klimatavtryck. Det anser både Åsa Lauenstein och Diana Bogic.

i dag begränsar både produktion, tillväxt och energieffektivisering är tillgången på el. På kort sikt handlar det om överföringsmöjligheterna. På längre sikt har vi en nationell utmaning med den enorma efterfrågan på el som kommer, säger Diana Bogic.

Osäkerhet om effektillgången kan få gjuterier att välja bort investeringar i ny teknik, som skulle minska deras klimatpåverkan.

– Överföringskostnaderna är redan i dag högre än själva elkostnaden. Vi har exempel där gjuterier gjort kraftiga investeringar i resurseffektiva processer som minskat deras energiförbrukning med 17 procent. Men på grund av ökade nätavgifter under investeringstiden, har deras kostnader i stället ökat med 20 procent, säger

Swedish foundries are important for the green transition

100 Swedish foundries play an essential role in many value chains

- Which are the foundry industry’s largest challenges for the climate?
- What will Swedish foundries achieve in 2035?
- What knowledge will be needed to get there?

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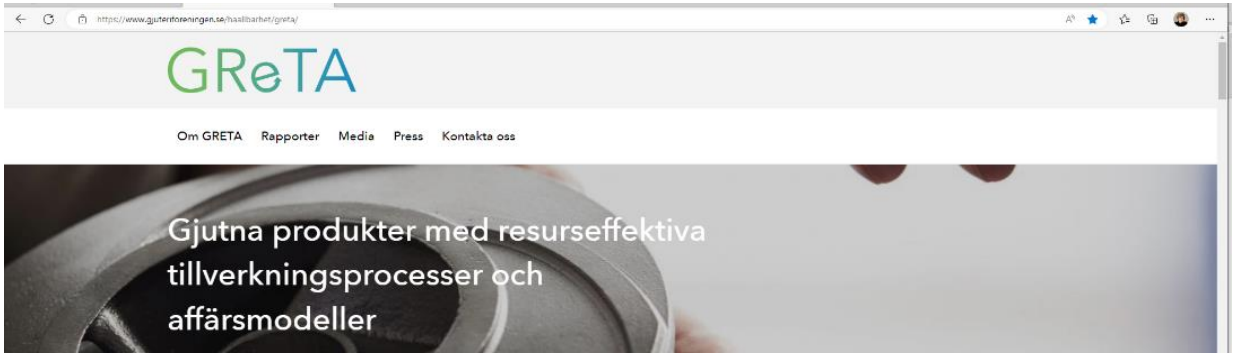


GRETA 2020-2023

GRETA

GRETA-projektet ska ge Sveriges gjuteriindustri förutsättningar för en hållbar omställning med bibehållen konkurrenskraft. Målet är att ge svenska gjuterier verktyg för en hållbar omställning genom mer effektiv resursanvändning.

den 28 april 2023

Dubbel omställning pågår

Det pågår en dubbel omställning, en twin transition: en hållbar omställning som är nödvändig för vårt framtida samhälle, och en digitalisering som erbjuder kraftfulla verktyg för att åstadkomma detta.

den 28 april 2023

Presentation av examensarbete

GRETAs två studenter, Elin Karlsson och Paul Abaci som båda studerar vi Jönköpings Tekniska Högskola, presenterar sitt examensarbete i sal E4404 den 29 maj kl. 14:00 - 14:45. Paul

den 28 april 2023

Förslag till nytt projekt om gjutprocessens klimatpåverkan

Flera järn- och stålgjuterier diskuterar just nu hur man på ett relevant sätt ska kunna beskriva effekten av de klimatpåverkande gaser som frigörs i gjutprocessen.

GJUTERI FÖRENINGEN
Swedish Foundry Association

AGES Kulltorp
Baettr Guldsmedshyttan
Bruzaholms Bruk
Laholm Stål
Norrlandsgjuteriet
Scania CV
Smålands Stålgjuteri
Volvo Powertrain GTO

METALLISKA MATERIAL

JÖNKÖPING UNIVERSITY

RI. SE

HANS 2022-2025

Sustainable casting through utilisation of residual products The project will develop and refine methods for the utilisation of grinding dust, slag, and contaminated chips in metalworkning and melting companies.

- Residual products will be locally converted to raw material, strengthening circularity.
- Local business models will lead to environmental benefits and cost savings

Each year, the steel foundry at Sandvik SRP in Svedala alone produces produced 230 tonnes of heat treatment oxides and 3100 tonnes of slag, only to landfill. These rest products correspond to 1500 tonnes of pure metal.

RISE – Research Institutes of Sweden – alexander.leicht@ri.se

SANDRA 2023-2028

Reduce the environmental impact of the sand molding process in foundries by developing a **machine learning sand reclamation model**, in order to

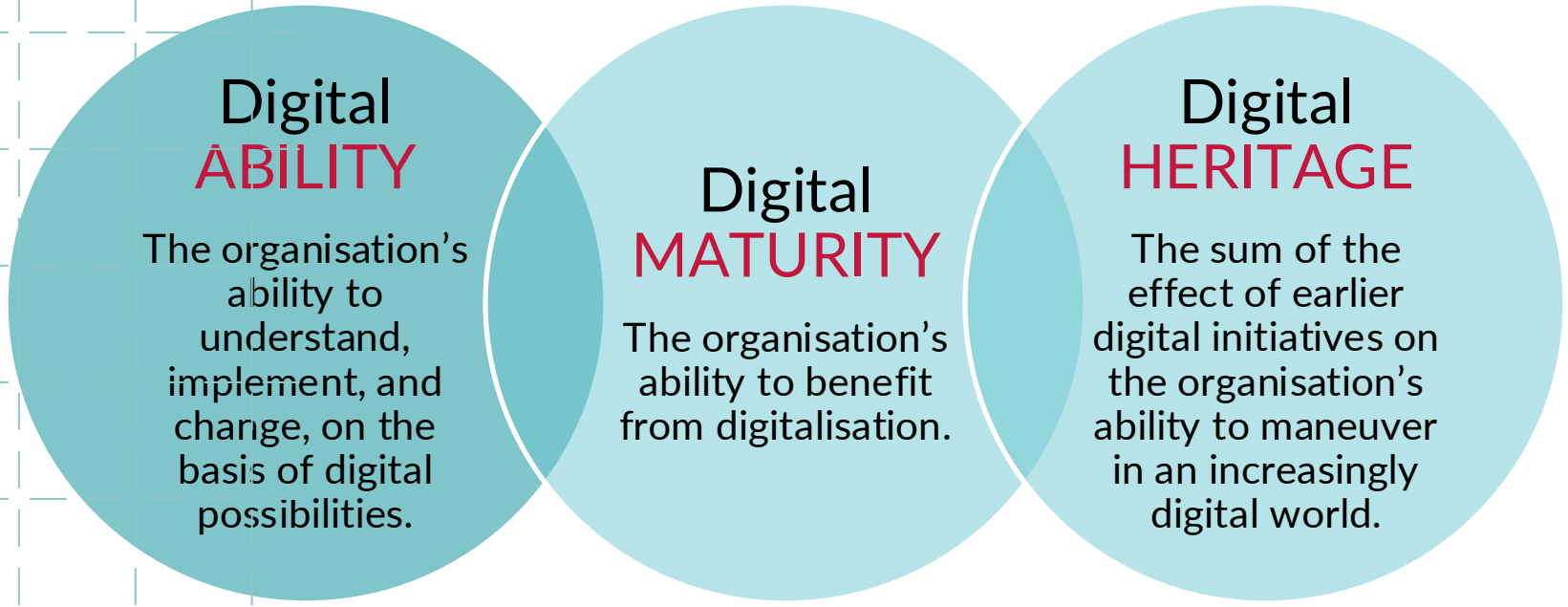
- Optimize process parameters
- Better manage sand recycling process
- Optimize material consumption
- Increase the process predictability and thereby increase the quality of castings.

Towards a digital foundry

Digital foundry of tomorrow

What new, digital tools and competences will be needed to ensure and develop a foundry's green transition:

- Efficient use of energy and resources?
- Robust and flexible processes?
- Traceability and quality assessment?
- Climate declarations and other transparent systems for increased sustainability?


Digital
ABILITY
The organisation's ability to understand, implement, and change, on the basis of digital possibilities.
Digital
MATURITY
The organisation's ability to benefit from digitalisation.
Digital
HERITAGE
The sum of the effect of earlier digital initiatives on the organisation's ability to maneuver in an increasingly digital world.

RI.SE

ReVär 2023-2026

Efficient heat treatment of cast steel with digital tools

- Cooperation between RISE, five steel foundries and the Swedish Foundry Association
- Develop simulation models for optimization and control heat treatment processes for steel castings
- Possibilities for energy and resource efficiency will lead to the initiation of supplementary measures and the development and commissioning of new digitized systems for process control

The digital tools being developed give foundries a whole new flexibility in the heat treatment process, as times, temperatures, furnace packing numbers and other parameters can be easily adjusted to achieve the desired quality outcome for a large number of products and alloys.

SMYG 2024-2027

Smart image analysis for surface defects on cast components

- Swedish foundries want to be better at detecting and evaluate defects on the surface of a cast component
- The idea of the project is to streamline the quality control of castings and make it more accurate by using **computer vision systems** with the help of **physics-based machine learning.**
- Robust hybrid methods will produce relevant synthetic training data for the vision systems.

A streamlined and more accurate detection of surface defects will decrease the amount of cassations and reworking for a more efficient use of resources, improve the working conditions and work content in the quality control stations, and ensure an even and high and quality of delivered cast products.

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PassPå 2023-2025

Industrial needs for traceable and circular product flows through **digital product passes**

- Cooperation with seven metal manufacturing companies
- Create a consensus for the work with DPP through training and guidelines
- Managing the industrial conditions and needs for product passports
- Actively contribute to international framework for industrial symbiosis – create new standards for circular economy

RISERS

About RISERS | Why standards for industrial symbiosis? | Newsroom | Resources | Co

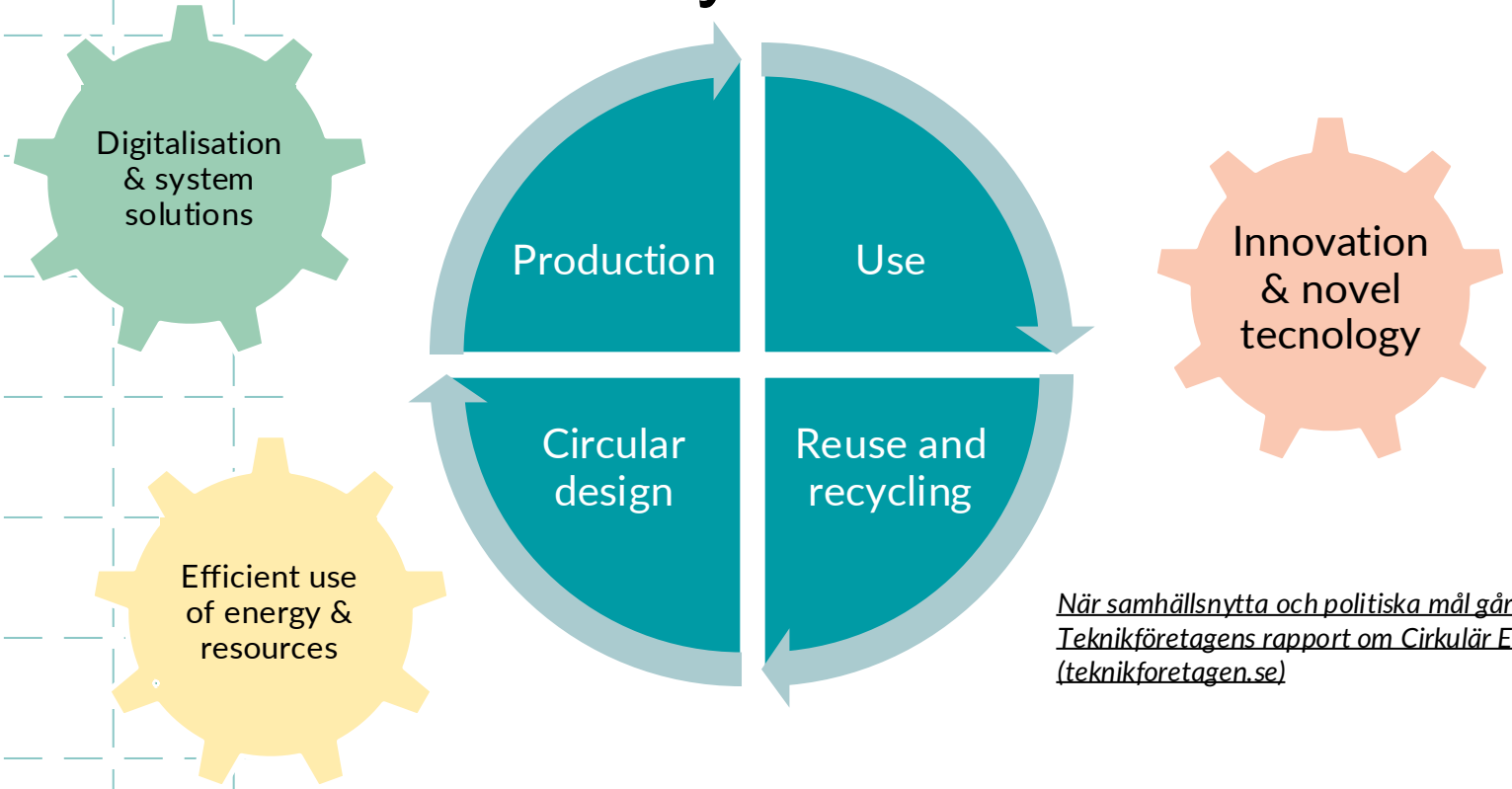
A Roadmap for Industrial Symbiosis Standardisation for Efficient Resource Sharing

Learn more

Contact us

Twin transition – where to?

Circular economy with twin transition



När samhällsnytta och politiska mål går hand i hand – Teknikföretagens rapport om Cirkulär Ekonomi (teknikforetagen.se)

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Twin transition challenges

Definitions
- Circular economy is important, but hard to define

Regulations and legislation
- Regulations must be adapted to circular economy

Logistics
- Circular economy demands new solutions for logistics and local presence

Teccnical challenges
- Material reuse, traceability, and standards

Organisation & business models
- Challenges present organisational structures

Knowledge exchange and cooperation
- Coordination within and between business

När samhällsnytta och politiska mål går hand i hand – Teknikföretagens rapport om Cirkulär Ekonomi (teknikforetagen.se)

The way forward

- Be aware of changing needs: competence, recruitment, reorganisation, transition
- Plan for continuity: Long-term goals, priorities, and funding
- Focus on Twin transition (green and digital) will create trust and a dedicated organisation
- Try new ways of working and new business models

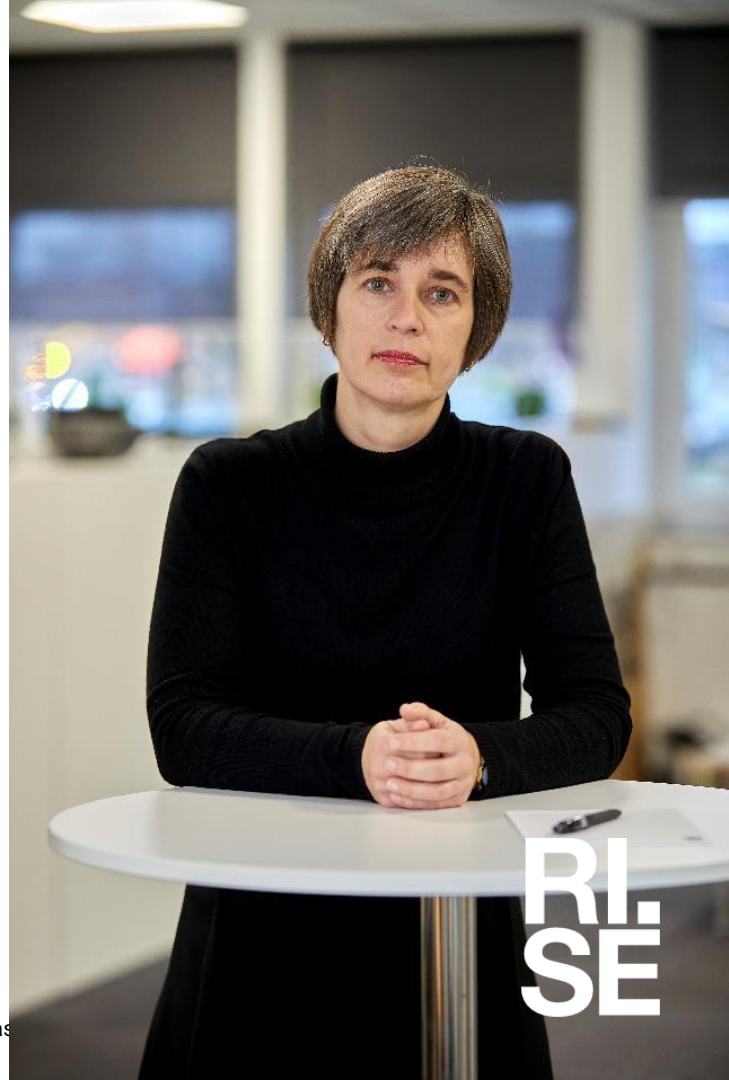
Remember: digitalisation needs not be that dramatic!

... if it is allowed to be hands-on!

Åsa Lauenstein

asa.lauenstein@ri.se

010-228 4904



CALDERYS MEET 2024

calderys

“Challenges and opportunities for the foundry and castings industry - views from a UK perspective”

Dr P Murrell FICME
www.castmetalsfederation.com

CALDERYS MEET 2024

- About the casting and foundry industry globally and in the UK
- Why energy matters to foundries
- Key trends and challenges
- Our approach to Net Zero
- The opportunity – metals recycle forever
- Inspiring the next generation
- Some conclusions

CEO of the **Cast Metals Federation**

Degree in Metallurgy – BSc Hons, then PhD in Fatigue & Fracture at Cranfield University

CMF is the Trade Association for the UK Castings Industry: representing and supporting foundries in the UK.

- Our Members are companies in the UK castings industry - Foundries and some suppliers.
- 85% of UK production in membership.

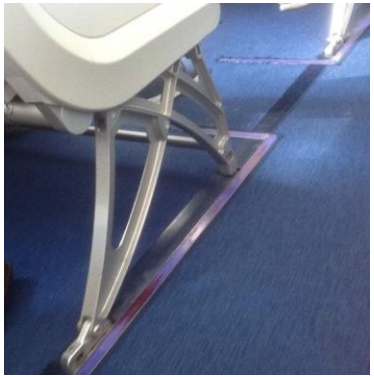
Next few years will be spent on:

- Competitiveness & innovation;
- Skills & diversity;
- Sustainability & net zero.

BEST OF BRITISH CASTING

CALDERYS MEET 2024

Global Castings Industry



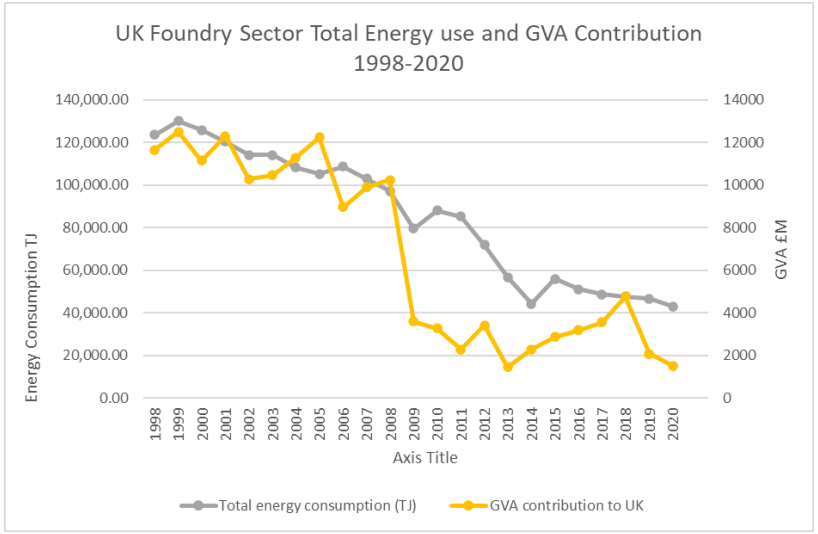
Global Production in 2021

China	54.3 Mt	
USA	?	46.3 Bn dollars in sales in 2022
India	12.5 Mt	
Japan	4.6 Mt	
Germany	3.95 Mt	
Turkey	2.96 Mt	
Mexico	2.86 Mt (2020 data)	
S Korea	2.39 Mt	
Russia	2.2 Mt (2019 data)	
Brazil	2.1 Mt	
UK	0.5 Mt	

(Source: Modern Castings, AFS, Pub Jan 2023)

About the UK Industry

- 350 foundries, across the UK
- Many investment casting foundries
- A strategic and ‘sovereign’ industry for the country
- Medium sized businesses
- Around 23000 jobs (?)
- £2bn GVA (but down from £12bn in 2000)
- Emissions reduction as a side-effect of lost jobs, reduced national and regional wealth and economic resilience.



CALDERYS MEET 2024

Industry Trends

- More challenging materials
- More challenging applications
- Larger castings – more use of castings for structural parts
- Greater automation
- Increased use of technology
- Increased productivity
- Right first time
- Faster turnaround
- More prototyping
- More innovation
- **Greater sustainability & resource efficiency**
- **Increased environmental controls**

https://char.gy/about

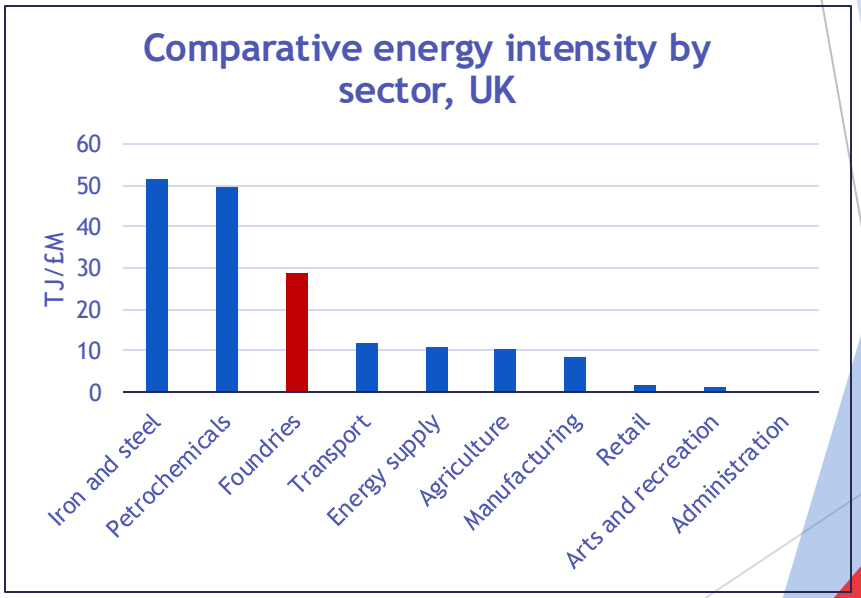
The Net Zero Challenge

- Cost of energy – energy unit costs – energy is already higher for businesses (in the UK),
- Carbon accounting, pricing and taxes – CBAM,
- Grid & infrastructure connection costs is a barrier to carbon reduction projects,
- Price volatility,
- Financial investment risks – future order security,
- Fuel switching – natural gas to other (hydrogen, bio fuels….)?

De-carbonised energy matters

- Foundries are ten times more energy intense than office-based businesses and energy can easily account for 20% of turnover
- UK industrial energy prices are sometimes more than three times those of global competitors
- Competitor economies are using decarbonisation to protect their industry

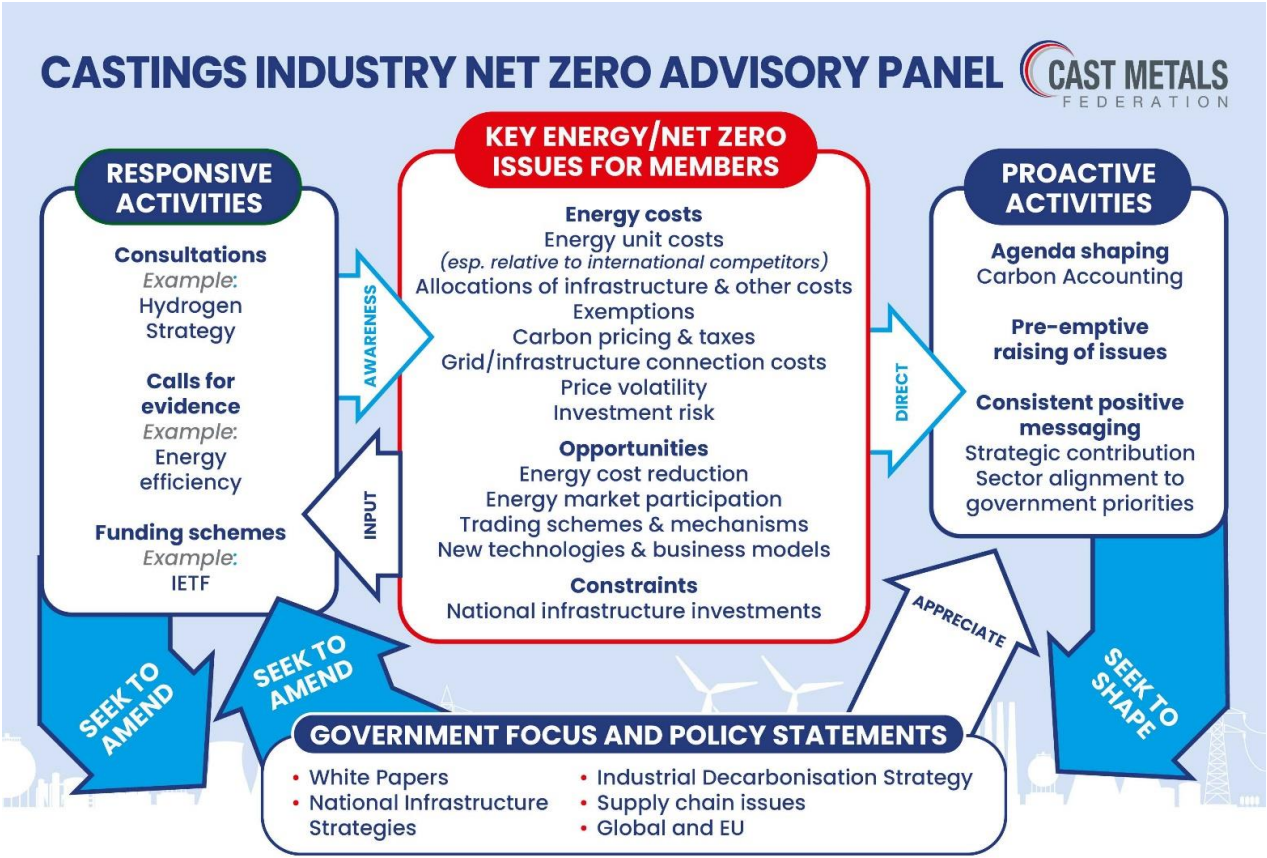
Source: ONS 2023



CALDERYS MEET 2024

Climate Change Act 2008

CHAPTER 27


CASTINGS INDUSTRY NET ZERO ADVISORY PANEL
CAST METALS FEDERATION
RESPONSIVE ACTIVITIES
Consultations
Example:
Hydrogen Strategy
Calls for evidence
Example:
Energy efficiency
Funding schemes
Example:
IETF
AWARENESS
INPUT
KEY ENERGY/NET ZERO ISSUES FOR MEMBERS
Energy costs
Energy unit costs
(esp. relative to international competitors)
Allocations of infrastructure & other costs
Exemptions
Carbon pricing & taxes
Grid/infrastructure connection costs
Price volatility
Investment risk
Opportunities
Energy cost reduction
Energy market participation
Trading schemes & mechanisms
New technologies & business models
Constraints
National infrastructure investments
DIRECT
PROACTIVE ACTIVITIES
Agenda shaping
Carbon Accounting
Pre-emptive raising of issues
Consistent positive messaging
Strategic contribution
Sector alignment to government priorities
SEEK TO AMEND
SEEK TO AMEND
APPRECIATE
SEEK TO SHAPE
GOVERNMENT FOCUS AND POLICY STATEMENTS
White Papers
National Infrastructure Strategies
Industrial Decarbonisation Strategy
Supply chain issues
Global and EU

CASTINGS INDUSTRY NET ZERO ADVISORY PANEL

CAST METALS FEDERATION

FINGER ON THE PULSE

CMF Members are informed (and can plan investment and technology strategies)

CMF Members are aware of (new) market opportunities

- What is being done?
- Who is doing it?
- Is it relevant and to whom?
- What will be the impact?
- What will be achieved wrt net zero?

OUTPUT #1

INPUTS & INFLUENCES

Government Policy

- White & Green papers
- Consultations
- UK Gov't Investment
- Innovation strategy

Macro energy trends

National vs local solutions

- Industry clusters

Strategic plans from other sectors

- EIIs & Foundation Industries

OUTPUT #2

INFLUENCE POLICY

Policy is informed by industry

Industry can adapt / plan / survive / thrive

- **What is planned?**
  energy mix, infrastructure, carbon pricing & taxes...
- **Impacts of decisions on industry:**
  Carbon leakage risks
  Levelling-up agenda

Industry/ CMF Member - involvement & engagement

- Data and evidence from industry to back-up arguments
- Surveys
- Fund studies and research
- Fund data analysis/surveys
- Attend meetings
- Read/comment on reports

Stakeholders

- Technology providers
- Energy providers
- Equipment developers
- Researchers - Innovate UK, Universities and RTOs

Scope

All processes/alloys
All company sizes/locations

- Energy sources/inputs
- Energy bills & the price of energy, including non-commodity costs
- Embedded Carbon
- Carbon pricing
  - demand side policies
- Infrastructure costs
- Energy efficiencies
- Heat recovery

Our voice

How:

Responses to Consultations and Calls for Evidence (CFE).

Regular updates on UK Government Policy & funding opportunities.

Letters to Ministers.

Roadmap for the UK Industry.

What:

Consultations and CFE

- UK Govt Net Zero Review
- Electricity Market Reform
- Non-domestic market review (closing Sept 23)
- Industrial electrification (closing Oct 23)
- CFE on UK Battery Strategy
- Carbon Leakage Consultation

Regional Policy Initiatives:

- WM Industrial Energy Taskforce
  - EBRS/EBDS
  - Intermediaries
  - Energy Efficiency for Industry
  - Structural reform
- Doncaster City Council (RP/PM)

CALDERYS MEET 2024

Roadmap to a Globally Competitive Net Zero UK Foundry Sector

- Reform energy markets to enable UK foundries to access clean electricity at prices comparable to global competitors;
- Provide incentives for early capital investment in zero carbon furnaces and production equipment that are as accessible for mid-sized foundries as they are for large refineries and foundation industries;
- Accelerate development and implementation of demand-side policies that incentivise customer demand for low carbon components; particularly product-level carbon labelling and accompanying standards;
- Support these policies with effective trade policies that create global markets for low carbon UK components and prevent low carbon components being replaced by high carbon substitutes;
- Encourage release of land by local and regional authorities suitable for modern, zero carbon foundries and associated zero carbon energy generation facilities across the country to help ensure that instead of our castings industry drifting offshore (as it has over the past 40 years), international companies will look to relocate to the UK.

Management of Wastes – Transforming Foundation Industries Project case study

- Used foundry sand and refractory shell as well as metallurgical slags and extraction dusts.
- Landfill: increasing costs, reducing availability
- Beneficial re-use – in construction for instance, but there are significant barriers – cost, no incentive for users, transport/ location of waste, variability of product and legislation around ‘waste’.

Casting as a Route to Manufacture

The Casting Process

- **Ancient** – *dating back to c. 6000 BC*
- **Successful** – *Still used for many thousands of products, an expanding range today*
- **Near net-shape**
- **Versatile** – *can create essentially any shape*
- **Fundamental** – *all other metal shaping processes begin with a cast product*
- **Ingenious** – *over 90 different casting processes have been identified*

"Castings are not a commodity – they are complex products and need experience and knowledge to produce"

Dr Wolfgang Hiller of Buderus Guss (after his move from the electronics industry, pub FTJ Dec 2014)

Casting as a Route to Manufacture.

Casting still represents the most cost-effective way of producing a wide range of components in metal, and is the simplest forming method for metal parts.

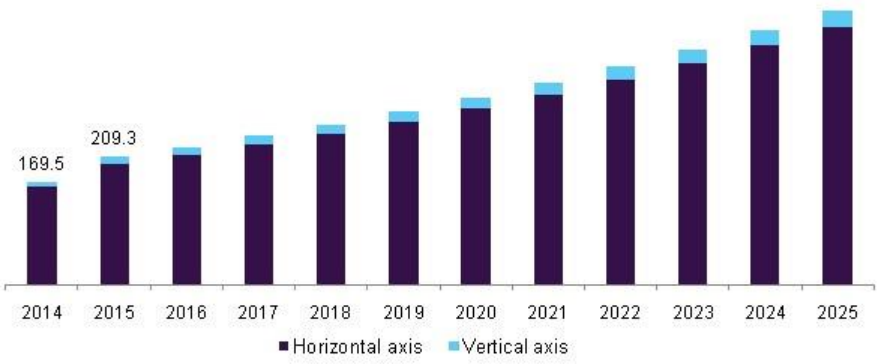
Near Net-Shape Manufacturing.

Casting represents the only way to make some components with complex internal cavities and hollow channels.

Why Casting - New Opportunities

F4OR
Fit For Offshore Renewables

https://ore.catapult.org.uk/what-we-do/supply-chain-growth/f4or/



U.S. wind turbine casting market by type, 2014 - 2025 (USD Million)
https://www.grandviewresearch.com/industry-analysis/wind-turbine-casting-market

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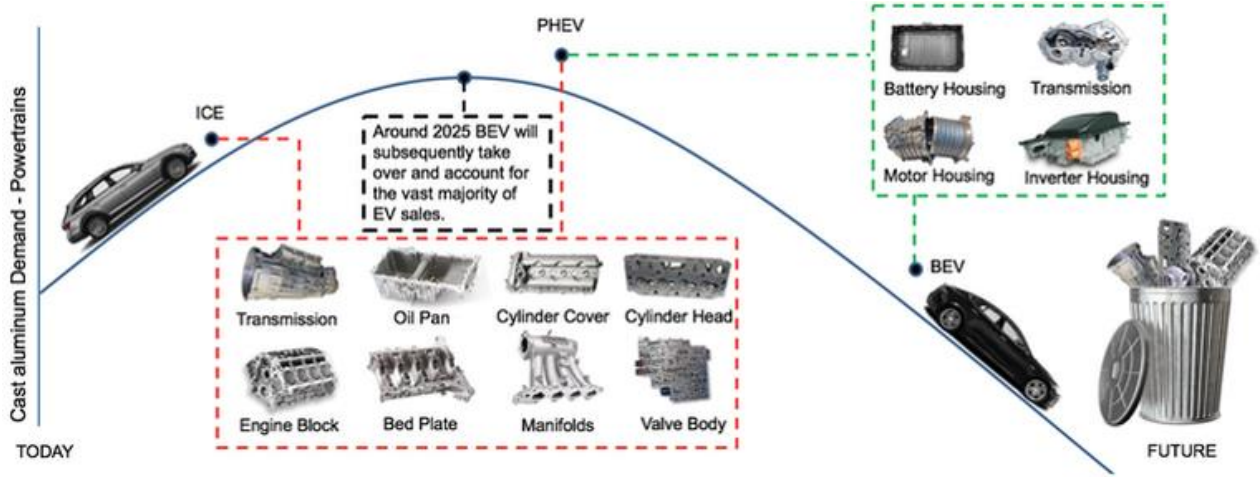
Some of the Good

https://www.foundrymag.com/issues-and-ideas/media-gallery/21931800/electric-vehicles-and-the-prospects-for-aluminum-casting/slideshow?slide=3

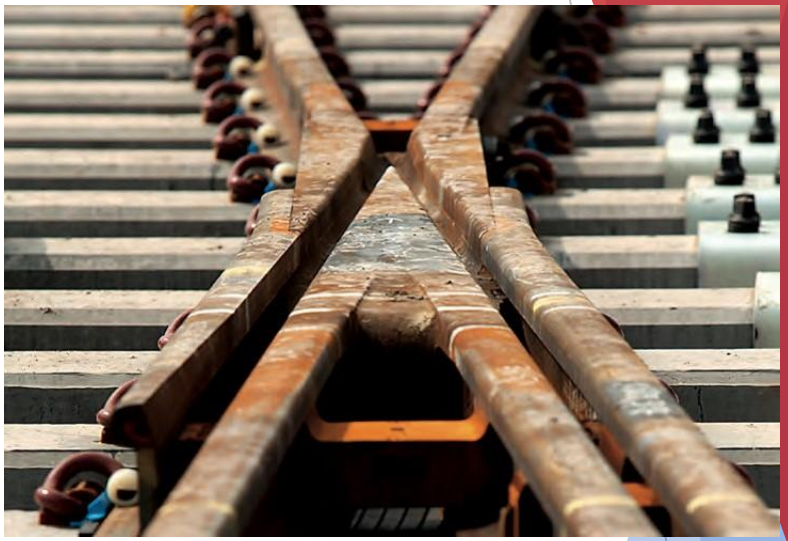


GIGA Press - Tesla is now operating what is believed to be the “world’s largest casting machine” at its Fremont factory.

The electric SUV’s rear underbody is built with only two cast parts, compared to 70 parts for the Model 3.

Shots of molten aluminium weighing 80 kilograms are injected into the cold-chamber casting mould with a velocity of 10 metres per second. The cycle time is ~80–90 seconds, allowing an output rate of 40–45 completed castings per hour, or ~1,000 castings per day. (*https://en.wikipedia.org/wiki/Giga_Press*)

Some of the Good



Progress Rail – South Queensferry

Source:
https://www.progressrail.com/en/Segments/GlobalLocations/Europe/Foundry.html

Focus on applications for castings

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Casting Case Study

Wheel upright investment casting

Working in conjunction with a 3D printing specialist, a foundry has turned an expensive to produce, complex part into an investment casting able to benefit from the economies of mass production.

Customer Requirements – Reduced weight and reduced cost - ability to withstand direct and fatigue loading

Previous Part – Costly via direct metal laser sintering (DMLS) process

Outcome – The conversion from a DMLS printed part to an investment casting means:

- The part is four times stiffer than the original design
- The part is capable of mass production
- The cost and weight is reduced
- Performance characteristics are maintained and indeed exceeded!

Challenges – Complex part, previously unable to cast

Method – Production begins with creating a 3D printed model in PMMA

By utilising the 3D process the mould could be produced in large numbers enabling the component to move to the much cheaper investment process and 3D printed patterns enable the creation of a casting that exceeds previous traditional design restrictions.

Casting Case Study - Cobalt Alloy Valve Cage

Utilising new integrated additive manufacturing and investment casting facilities, William Cook Cast Products has produced a complex valve cage casting made of cobalt-based alloy that is notoriously demanding to produce. The valve cage can withstand corrosion and erosion in an aggressive chemical environment and previously thought to be 'uncastable'.

Component – Valve cage, net weight 70kg (finished conditions, 220kg (as-cast)

Alloy – Cobalt alloy 6B

Customer Requirements – Good as-cast form and finish- with no weld repair - good surface finish

Previous part – several stacked, laminated plates, machined to profile to form individual layers.

Outcome – The conversion to a casting enables the customer to be able to take advantage of;

- Lower overall cost, Unconstrained design i.e. design for purpose not design for manufacture, reduced lead-time and freedom of alloy choice

Challenges

- Complications arising from the size and complexity of the casting with thick sections adjacent to the thin sections.
- Cobalt alloy 6B is a notoriously demanding alloy to produce
- Consideration had to be given during methoding to minimise the potential for high residual stresses during cooling.

See more examples at : www.castmetalsfederation.com/case-studies

Casting Case Study - Cast Prosthetic Multi-Part Cast Thumb for use by Children

Brand new design for multi-part thumb designed by renowned prosthetic hand designer Ted Varley, for use by children who have lost a hand due to injury, congenital conditions, or for other medical reasons, enhancing their quality of life and enabling them to regain confidence and their independence.

Investment casting by Sylatech Ltd – North Yorkshire.

- High level of detail and as-cast surface finish required requiring no machining
- Minimisation of casting weight and maximising internal space for electronics
- Wall thickness down to 2mm for some cast elements and 1mm diameter cast-in holes.
- Design flexibility enabled through use of 3D wax printing
- Samples provided to client with a lead time of just 3 weeks including heat treatment.
- Significant cost savings achieved compared with alternative production processes.
- New design has attracted NHS funding to enable further versions aimed at children.

The company is now looking at further even smaller, lighter designs and are delighted that their castings are changing lives for the better.

Net Zero as an Opportunity?

Castings as lower carbon products -

- **What we make as an industry**
- **Who we supply as an industry**
- **How we make it**

Make it sustainably – energy efficiency, ‘green’ energy

Make it locally - to reduce global transport

The right thing to do

Picture credit – Dreamstime ref 93949503

Sustainability – castings as part of the circular economy

The industry takes secondary metal (scrap) and turns it into new components for the high value manufacturing supply chain.

-> embedded carbon credit

-> CBAM

-> less transport (global shipping)

METAL recycles forever™

https://www.metalrecyclesforever.eu/

Castings as lower carbon products

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Innovation - where the industry uses AM:

Rapid prototyping / small series production

- Printing patterns and tooling - PMMMA
- Printing sand moulds and cores – sand printing
- Printing parts of moulds/cores – sand printing
- Printing jigs and fixtures for measuring /machining – resins?/pmmma
- Printing replacement parts for metal dies – metal printing
- Resurfacing dies using additive layer technologies
- Large-scale printing with recyclable printing medium, to reduce need for pattern storage (Weir Minerals project with the Manufacturing Technology Centre, MTC).

Opportunity for the castings industry?

Next few years for the UK foundry /casting industry

Increase diversity.

Health & safety focus.

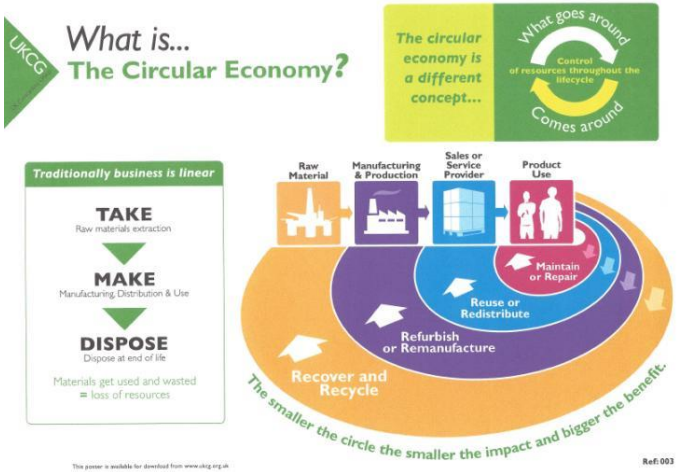
Increased use of automation and robotics to increase productivity.

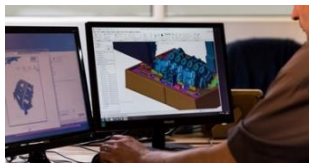
Image - generate a positive image – and then communicate it

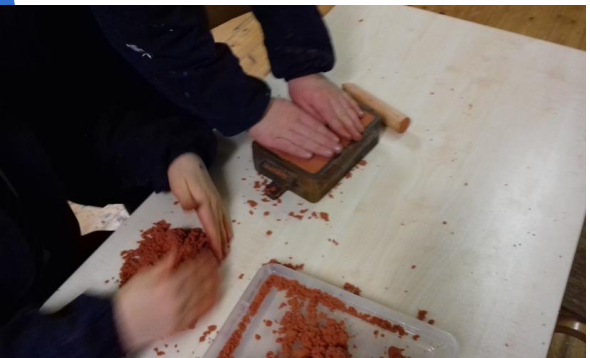
Good jobs - well-paid careers with leadership opportunities, high tech or hands on, problem solving and innovative, team-work.

Focus on contribution / relevance to modern society:

- Circular Economy - re-cycling & re-use of scrap metal
- Public procurement – local sourcing
- Avoiding carbon leakage, energy efficiency….
- Competitiveness - levelling up, jobs.







CASTING THE FUTURE

Casting the Future Foundry Kit

Transportable ‘Foundry in a Box’ kit for use in schools, with teacher pack.

New website to support with downloadable resources and VR experience

https://castingthefuture.com

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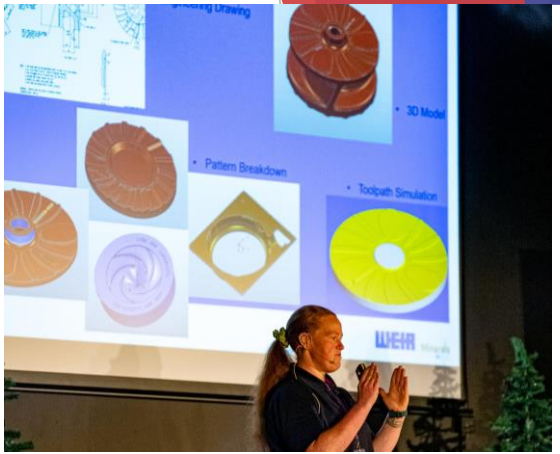
the engineered components that move the world.
A sustainable industry - metal recycles forever
In collaboration with
UCB
United Cast Bar
Produce continuous cast iron bar in two of Europes most prestigious foundries.
CAST METALS FEDERATION
Supporting the UK Foundry & Castings Industry
WEIR
Minerals
Engineered solutions for global mining & mineral processing
Proud to join forces


3D Model
Pattern Breakdown
Toolpath Simulation
WEIR


NORTH STAR

Where to find out more:

Cast Metals Federation: www.castmetalsfederation.com

Casting is the Future – CMF Videos

Casting my future – VR experience

Casting the Future - the role of metals (and foundries)

Casting the Future Foundry kit – for use in schools and colleges

www.youtube.com/@CastingtheFuture/playlists

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Net Zero Challenge – or Opportunity?

Focus on what we make *and*

How we make it

Castings industry already contributes through its re-use of secondary raw materials, eg ferrous scrap, secondary aluminium (value in embedded carbon).

UK ferrous sector has already electrified – so efficient and relatively easy to be ‘green’ (?)

Non-ferrous sector still heavily reliant on natural gas – work needed.

Win-win partnerships with local supply chains to avoid carbon leakage.

Thank-you

Any questions?

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Precast at Volvo, Skövde

Christopher Jensen

26-27 September 2024

CALDERYS MEET 2024

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AGENDA

CALDERYS MEET 2024

01 Volvo, Skövde

02 Change in production

03 Our use of precast

- Transport ladle
- Electric furnace
- 2 ton ladle

04 The benefits of precast

- Timesaving benefits
- Enviromental benefits
- Work efficiency benefits

05 Co-operation and new solutions

01 Volvo, Skövde

Plant overview

The Volvo Plant in Skövde:

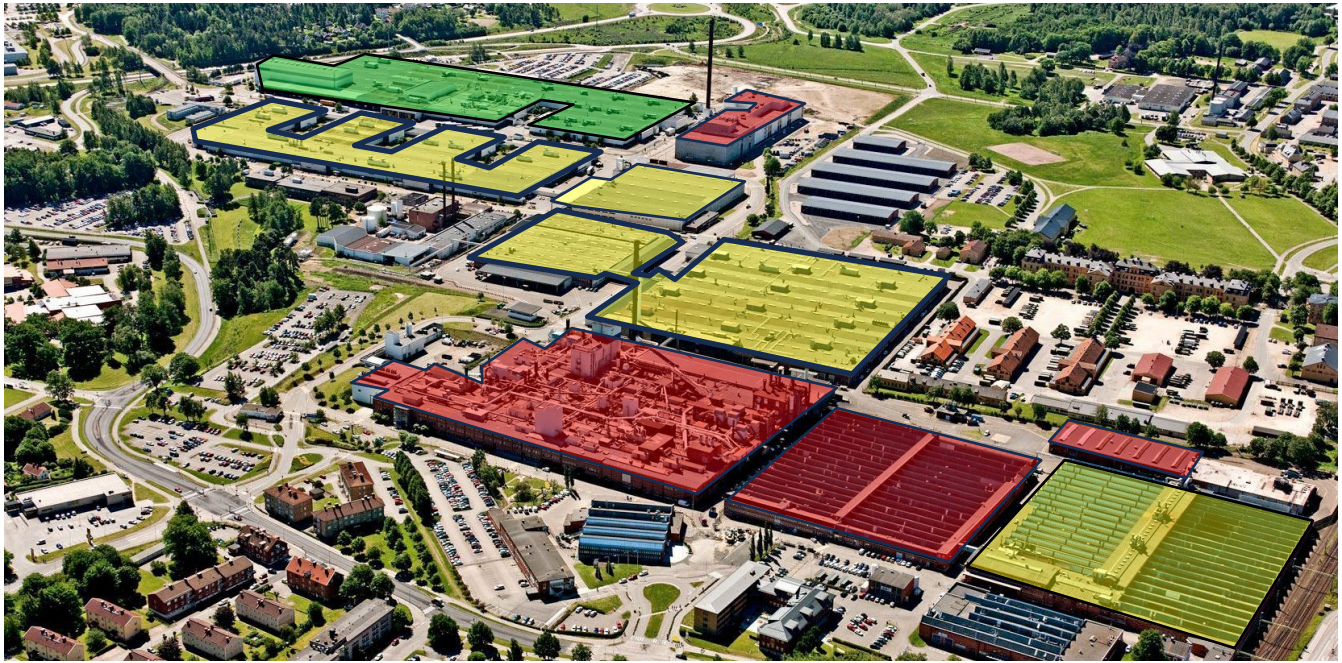
- ~4000 employees
- 560,000m²

- Foundry
- 95 272 ton*

- Machining
- 2 036 079 products*

- Assembly
- 128 906 engines*

* Statistics from 2023. Source: Volvo Group



Volvo Plant, Skövde

Products

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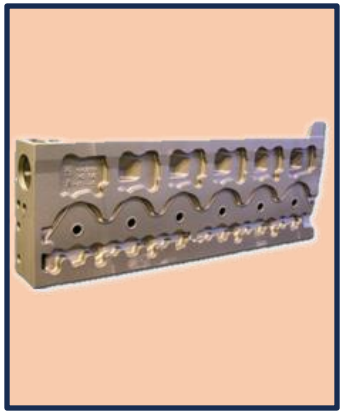
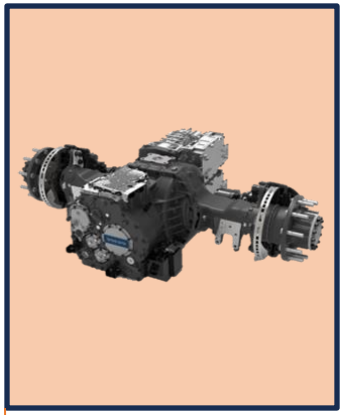
CYLINDERBLOCKS

CYLINDERHEADS



E-AXLES



HUBS

NEW PRODUCTS

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The refractory facility – D2

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Our facility:

- 2160 m²
- Casting refractory material
- Sintering
- Demolition
- Storage
- Inductor- & welding shop

The refractory Facility – D2 (outside)

The refractory Facility – D2 (inside)

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02 Change in production

New Line, new products, new ladles

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What this meant for us:

- New iron qualities
- New pouring furnaces
- Wire treatment
- Increased need for flexibility

Volvo Group investing billions in Skövde

2019-04-08

The Volvo Group is investing heavily in the Skövde plant. Greater flexibility regarding products and materials is the purpose of the investment to be made at the foundry in Skövde. The investment is also an important environmental initiative and involves, among other things, a more sustainable manufacturing technique with reduced consumption of non-renewable materials.

Media statement from Volvo Group in 2019

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Precast - The solution for us

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2T ladle

Transport ladle

Coreless induction furnace

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03 Our use of precast

Range of products

with precast

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2 ton ladle

Transport ladle

Coreless induction furnace

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2 ton ladle

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Transporting iron from holding furnace to pouring furnace and wire treatment stations

- Gray iron
- CGI
- LGI
- Wire treatment
- Wear and tear
- Life cycle of around 4 months
- Silica Mix 0.7A in walls and bottom
- Precast in Calde Cast UB

Transport ladle

Transporting molten iron from foundry to foundry

- 3 ton capacity
- 6 ton per charge
- Batches of 18 tons
- Life cycle of around 60 batches
- Silica Mix 0.7A in walls and bottom
- Precast in Calde Cast UB

Transportladle and forklift

Coreless induction furnace

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Manufacturing iron for cylinderheads and transport

- 6 ton per charge
- Life cycle of over 300 charges
- Silica Mix Q16 BF Rigid in the bottom
- Silica Mix Q16 BF in the walls
- Precast in Calde Cast Gibram

Volvo

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04 The benefits of precast

Benefits

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Time benefits

- Sintering
- Production flexibility
- More products, less hours

Enviromental benefits

- Gas / Electric
- Efficiency (units/sintering)
- Boron-free material

Work efficiency benefits

- Less work, more products
- Minimizing workload

The difference in handling material

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Precast vs casting

05 Cooperation and innovation

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Working together

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- England
- Testing the precast
- Changing the precast
- Trying different materials

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Thank you for your attention

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Molding Solutions: Lustrous carbon, Low carbon, No carbon molding sands

Oleg Podobed, Sandra Böhnke, Frank Siegrist

26-27 September 2024

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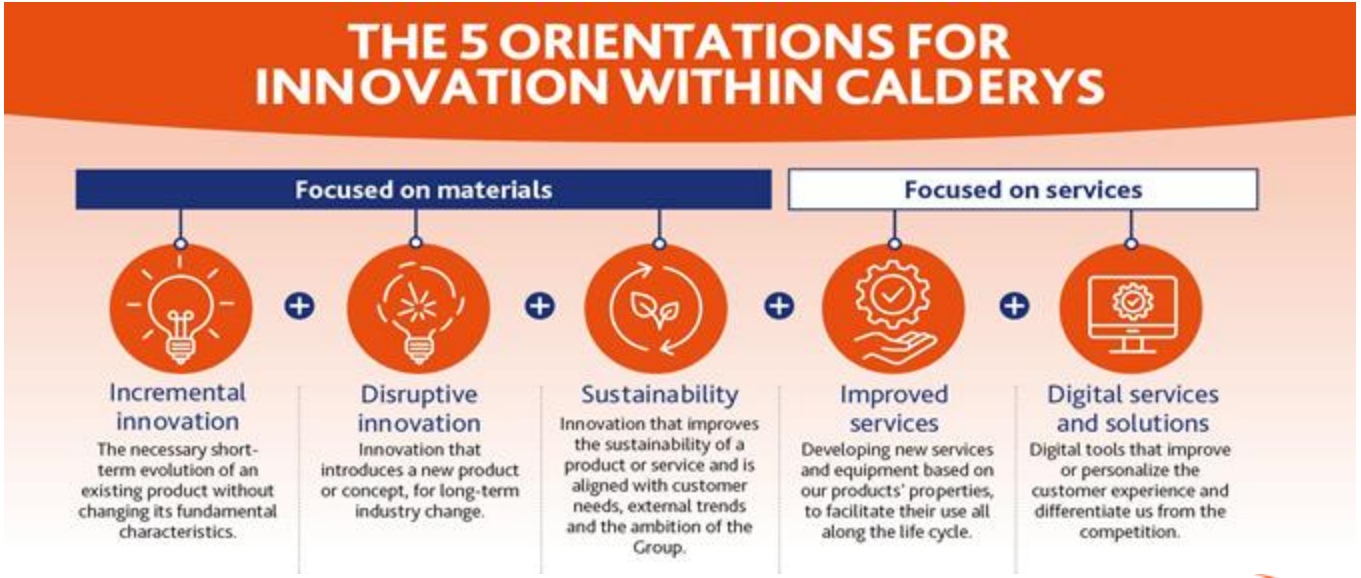
Innovation to address the energy transition challenges

We have embarked on a journey to strengthen our innovation. This involves combining incremental product evolution with disruptive solutions for a low-carbon environment. Sustainability underpins our R&D activity and digital tools will support us to drive new solutions for our customers, their industries and the planet.



Green Deal & Molding Sand

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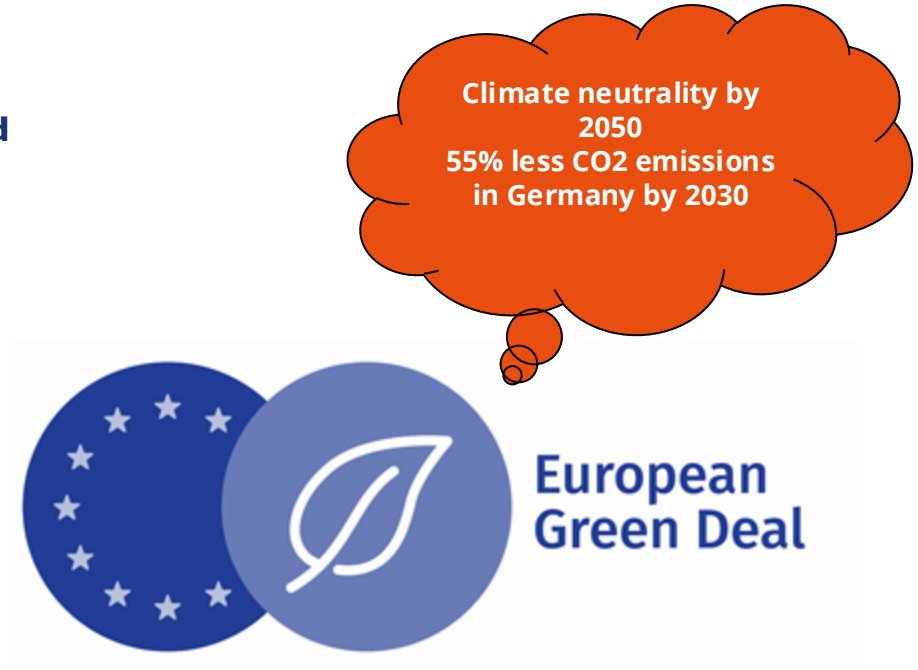
- We are all aware of the challenges towards our foundry processes using fossil fuels and the need to reduce them
- Carbonaceous additives like coal are still a very important, specifically the level of mechanisms impacting the molding sand performance and casting quality
- A substitution requires a thorough analysis
- Several processes in the foundry where fossil fuels are used, molding sand is one of them



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Environmentally friendly concepts

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Reduction

Use of alternative LCF's* with lower emission potential

Adsorption

Adsorbing additives, but the problem is transferred to landfill

Substitution

Alternative additives with similar mechanisms of action

Today's requirements, such as changes in the CO2 footprint, require substitution

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* Lustrous carbon former

Role of organic carbonaceous additives

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Prevention of

Surface defect

Expansion defect

Impact on

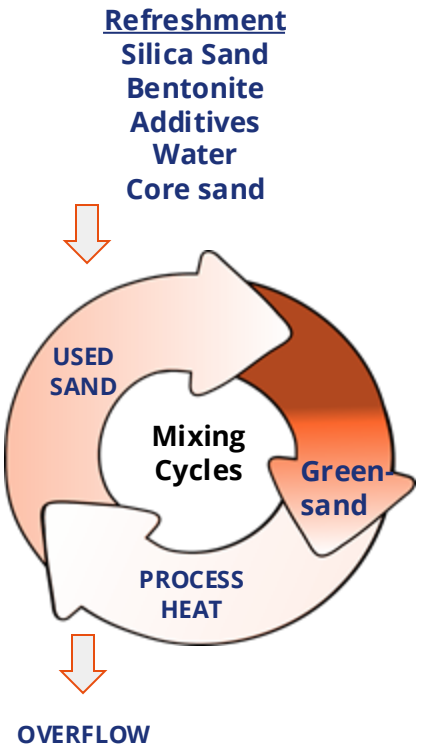
Process performance

positive or negative

Mechanisms

Physically

Chemically



Carbonaceous additives:

- **Volatile Matter (35-95% daf)**
- **High carbon content (71-91% db)**
- **Oxygen content (0.4-16% db)**
- **Hydrogen content (4.5-8.8% db)**
- **Ash content (< 8% db)**

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Mechanisms of action

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Carbonaceous Addtives

- Protection against metal-mold reactions
- Coking residue as an inert filler material
- Softening in the temperature range of quartz-expansion up to 573°C (α-β conversion)

Alternative Materials

1. **Sufficiently high sintering temperature, chemically and physically inert, low adsorption of water**
2. **Higher mold compaction**
3. **Reactive at lower temperatures to reduce stresses**

Keep our eyes on molding material & casting properties,
maintaining constant process parameters at the beginning of substitution

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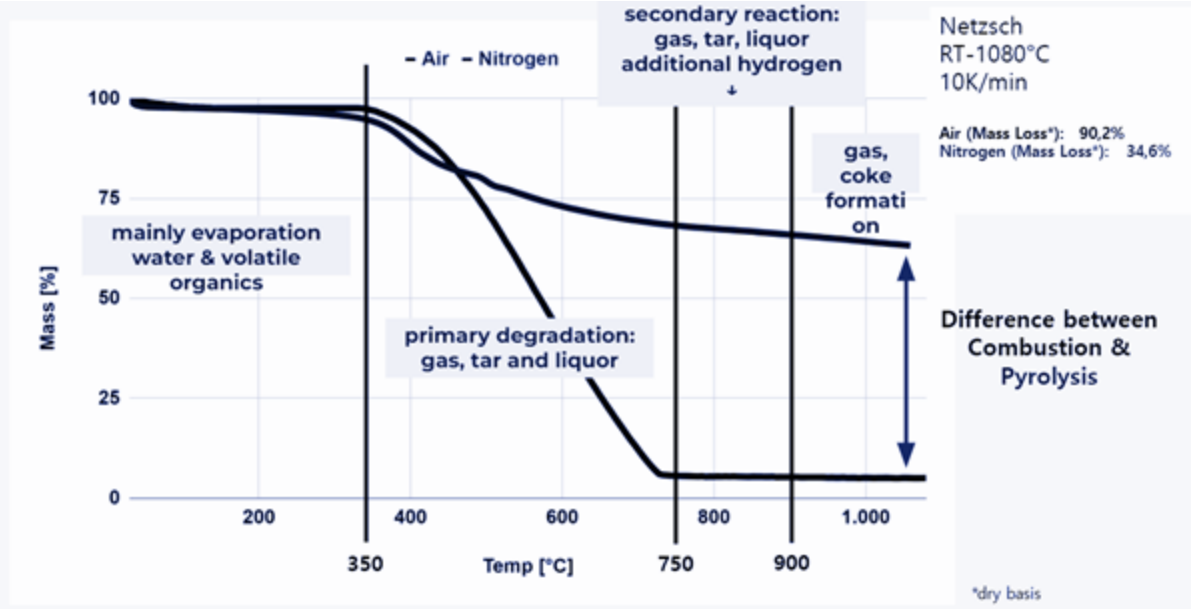
Thermal reactions of coal



573°C α-β Quartz, linear expansion

Bentonite shrinkage

- Lustrous carbon formers like coal are the most reactive compounds in molding sand, undergoing various reactions, starting as low as 350°C
- In an "oxygen-free" atmosphere coal reduces its mass by 35-40% (volatile matter) undergoing various reactions
- This is also the range where Bentonite shrinks (loss of surface and interlayer water) and
- Quartz expands, changing it's crystal structure

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Alternative mechanisms of action

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Due to the complex mechanism of action, it is (generally) not possible to replace coal with one single inorganic additive

1

INERTIA

at pouring temperature

2

COMPACTION

Higher packing density (with adequate gas permeability)

3

REACTIVITY

Temperature range up to 600°C

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Alternative mechanisms of action, 1

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1

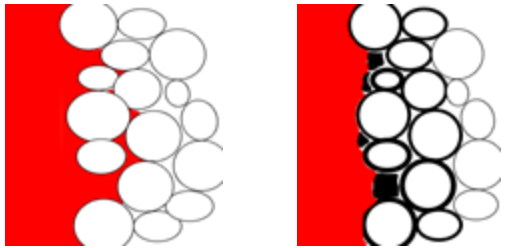
INERTIA

at pouring temperature

Carbonaceous additives behave chemically inert at high temperatures (oxygen-free environment) preventing reactions between mold and metal through the formation of a pyrolytic carbon

Inert behaviour through targeted selection of inorganic materials

Reduced wetting by pyrolytic carbon



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Alternative mechanisms of action, 2

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2

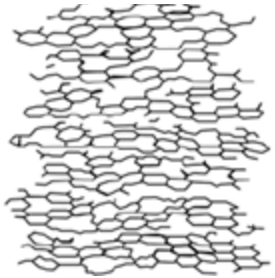
COMPACTION

Higher packing/compaction density (still reasonable gas permeability)

The deposited pyrolytic carbon ensures a low roughness and good casting surface

Targeted selection of inorganic materials results in adequate compaction of the mold with less tendency to surface defects and roughness

Pyrolytic carbon



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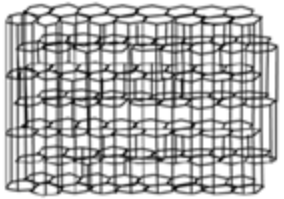

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Alternative mechanisms of action, 3

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3

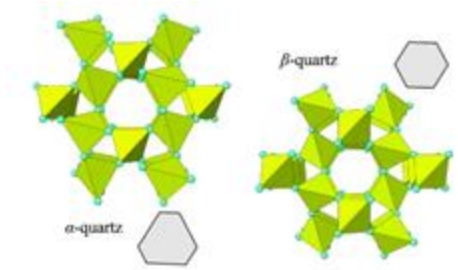
REACTIVITY

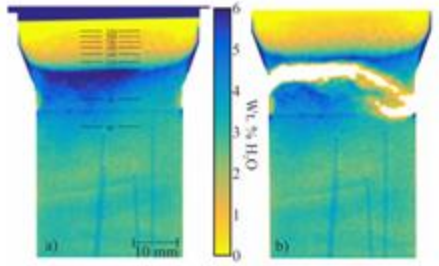
in the temperature range up to 600°C

In the temperature range up to 600°C, tensions occur in the mold and at the same time increased water content in the condensation zone

Coal begins to react at low temperatures, volatile components are released, the coal goes through a softening interval

Selected alternative additives decompose up to 550°C, giving space and reducing stresses





Development stages

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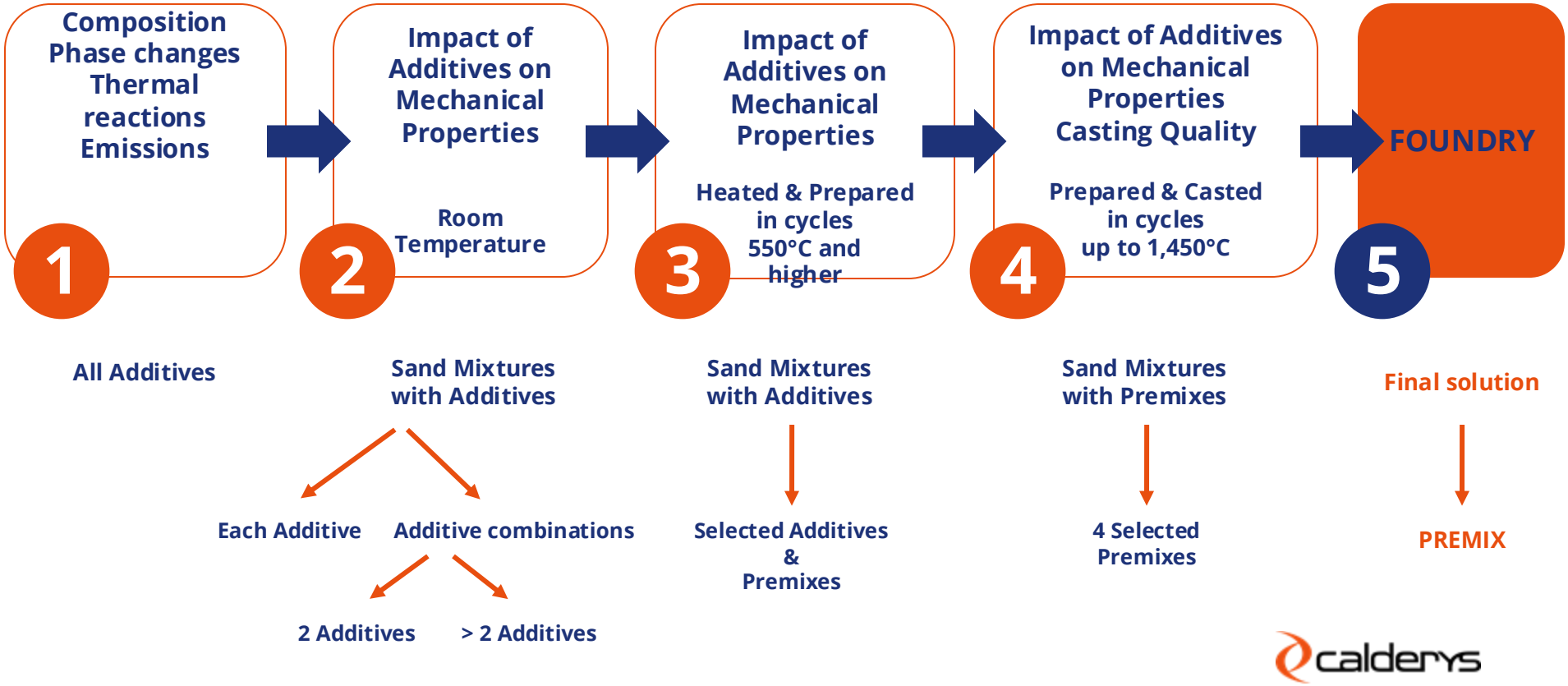

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Development of the new product

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1

Composition
Emissions
Strength
Design of Experiment

2

High temperature and circulation behaviour (internal)

3

Circulation behaviour
Casting tests
Casting quality

4
FOUNDRY

Preparation and heating cycles
Thermal behaviour

Cumulative Processing
& Casting Cycles
Sand adhesion, roughness

FTIR Spectroscopy
Tube furnace (900°C)

- Sample is pyrolyzed in nitrogen atmosphere
- Characterisation of emitted gases

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Compaction depending on the addition of additives

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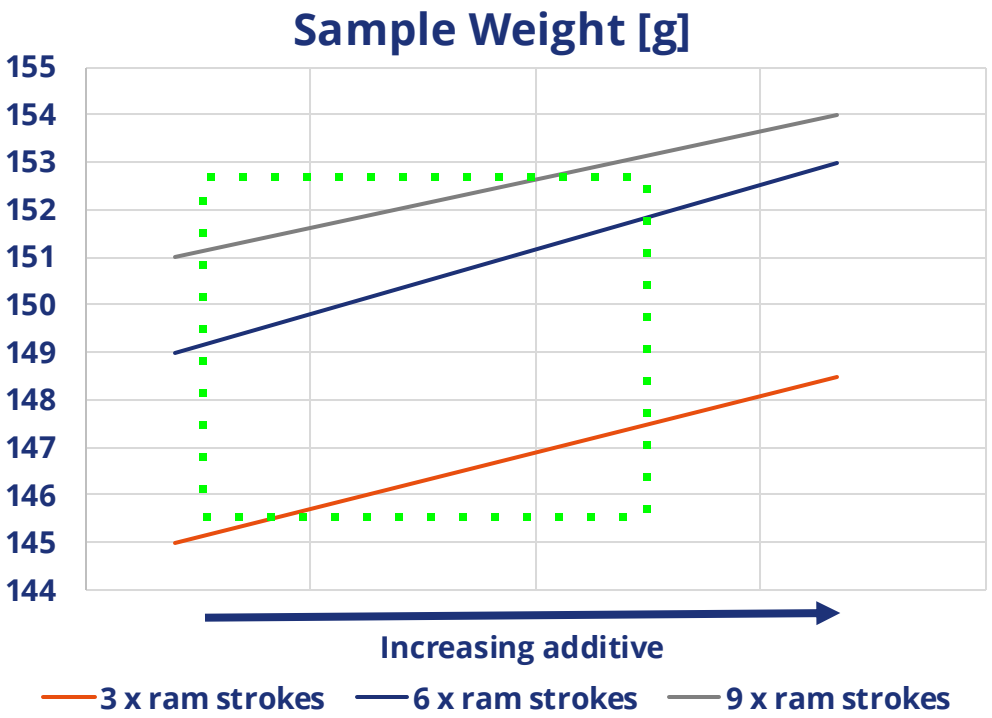

Increased compaction based on addition
Variation in ram strokes
Standard sand mixtures

Specimen weight increases with increasing additive addition

Increase from 145g to 149.5g as well as density 1.47 to 1.52 g/cm², 3 times rammed

The higher the number of ram strokes, the higher the test specimen weight.
With a similar progression in relation to the addition of additives.

Area of activity, standard products and development

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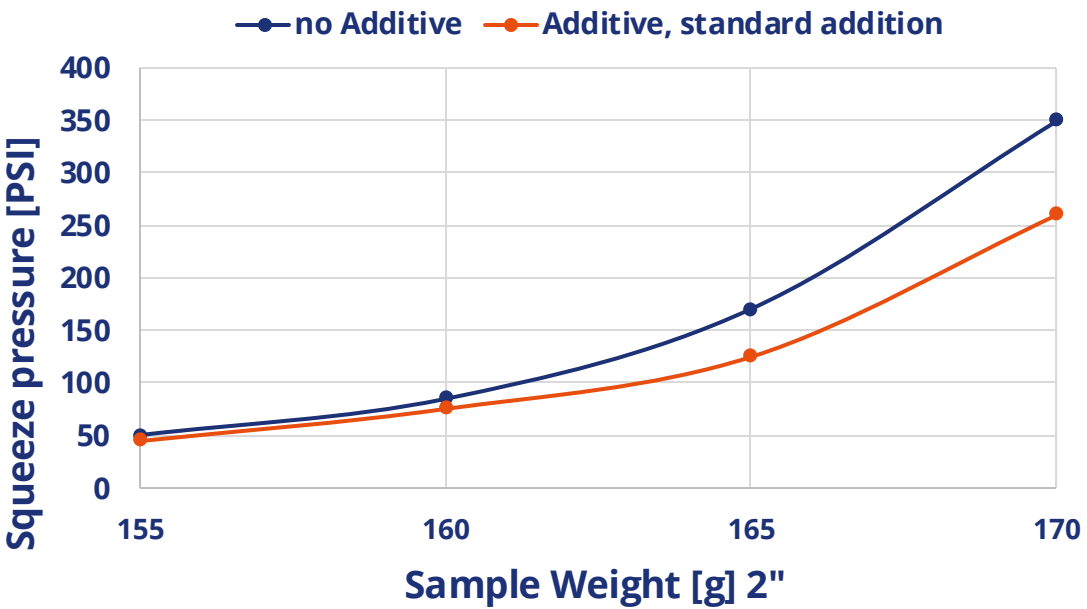
Reduction of squeeze pressure



Pressing of test specimens (2x2”) with different test specimen weights Standard sand mixtures

Even with a small amount of a specific additive, the pressing pressure [PSI], to generate a test specimen, can be reduced

The difference in squeeze pressure increases with increasing amount of sand for the given volume

Deformation and force, example additive 1 ("brittle")

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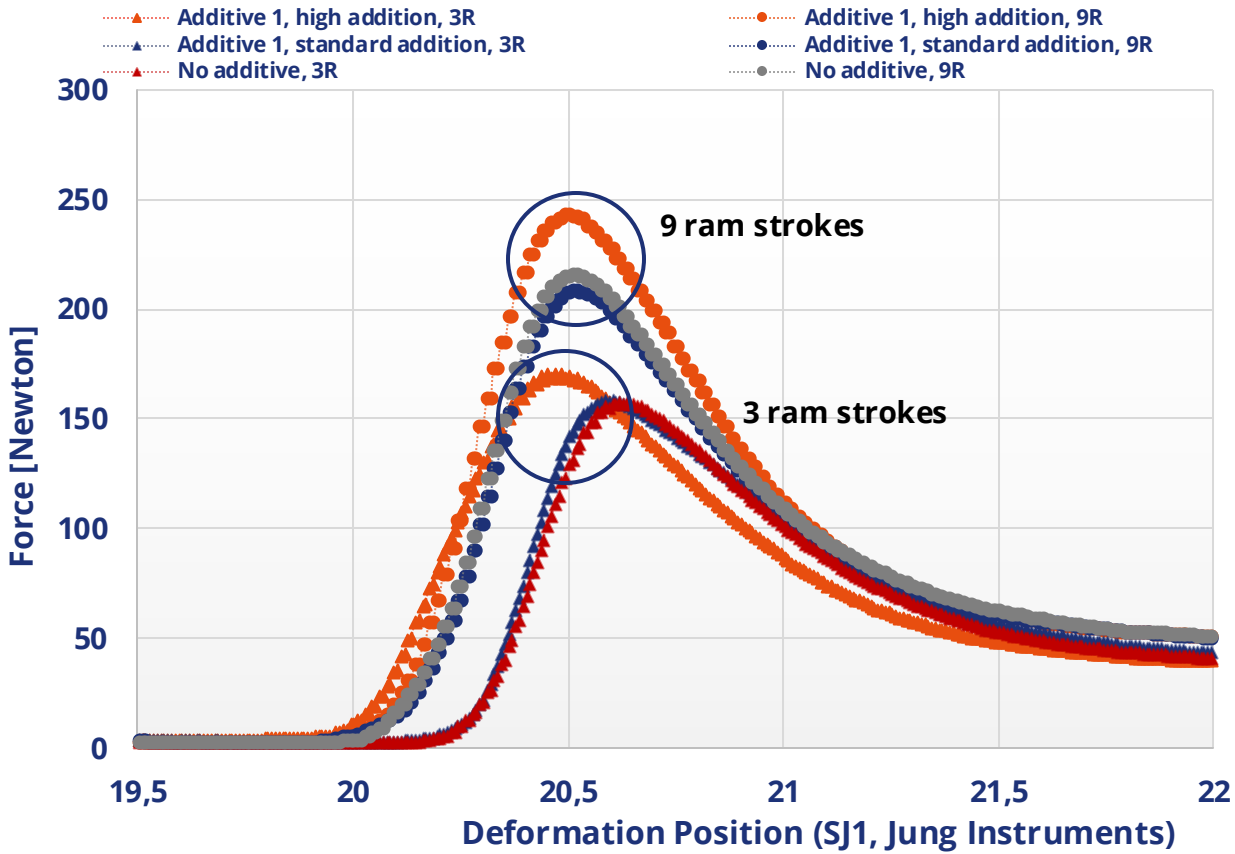

Standard sand mixtures
Deformation and force (SJ1, Jung Instrum.)
Variation in ram strokes
Comparison to mixtures without additive

Small addition of the additive has no influence on the level of strength or deformation behaviour.

With a **massive addition, the strength increases**, but the test specimen reacts more to deformation, the fracture path is shorter, when the compaction energy is lower

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Deformation and force, example additive 2 ("plastic")

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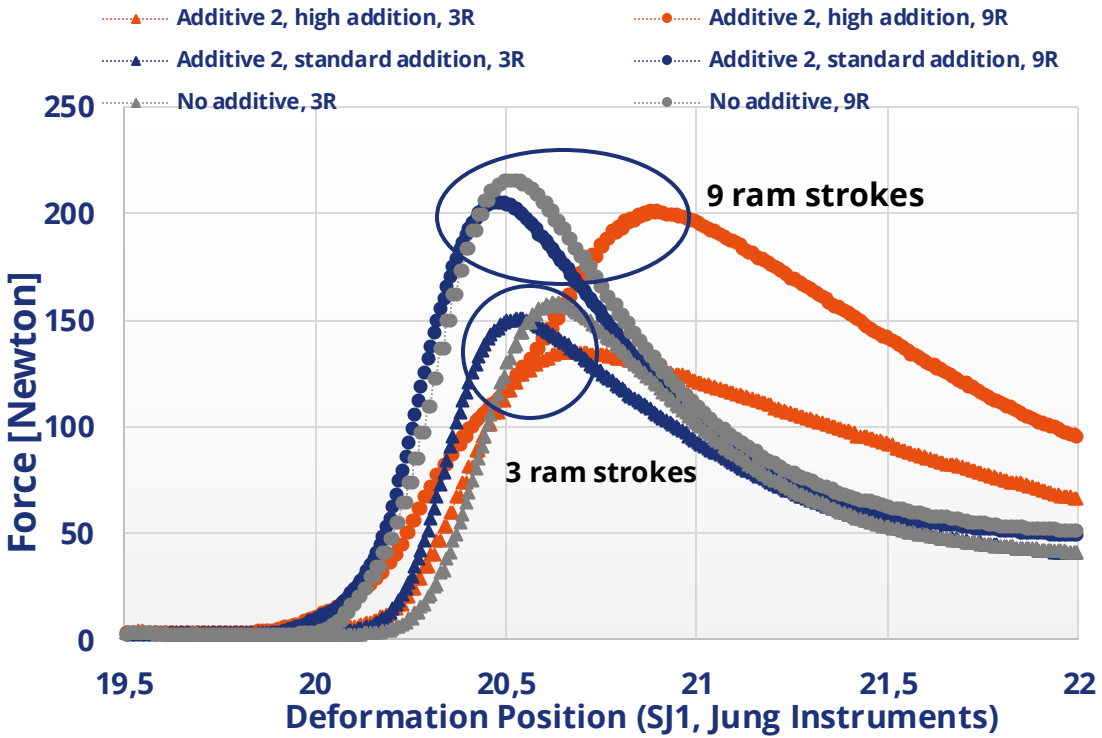

Standard sand mixtures
Deformation and force (SJ1, Jung Instrum.)
Variation in ram strokes
Comparison to mixtures without additive

A small addition of this additive has hardly any influence on the level of strength or deformation behaviour.

With a massive addition, the deformation increases and the strength is reduced.

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Mass loss in the area of quartz expansion

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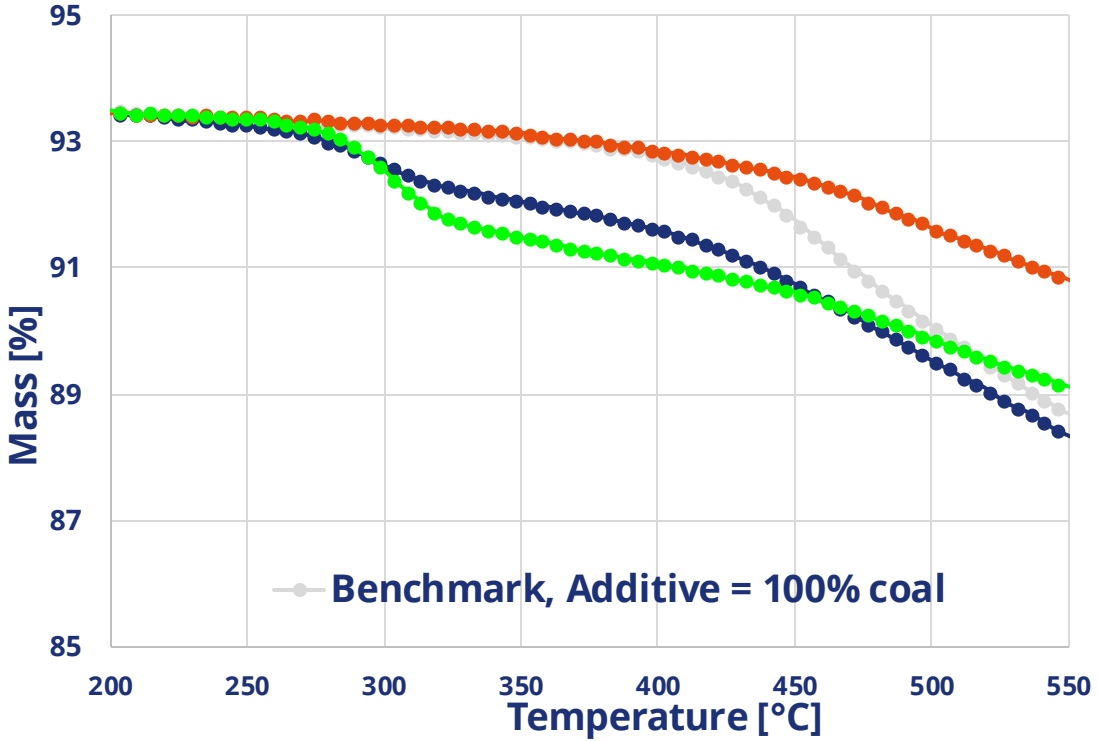

Thermogravimetric Analysis
Bentonite-Additive blends

Alternative 3 without coal

In the area of quartz expansion, Alternative 3 achieves a comparable loss of mass

The reaction starts at lower temperatures compared to the benchmark

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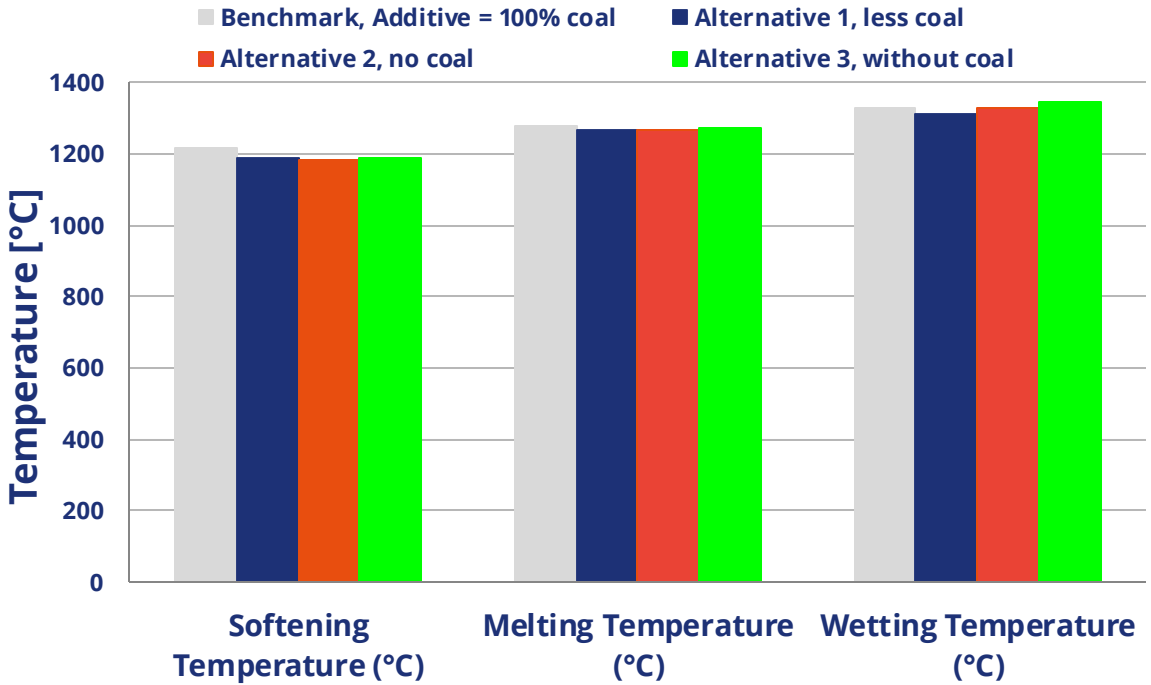
Sintering behaviour



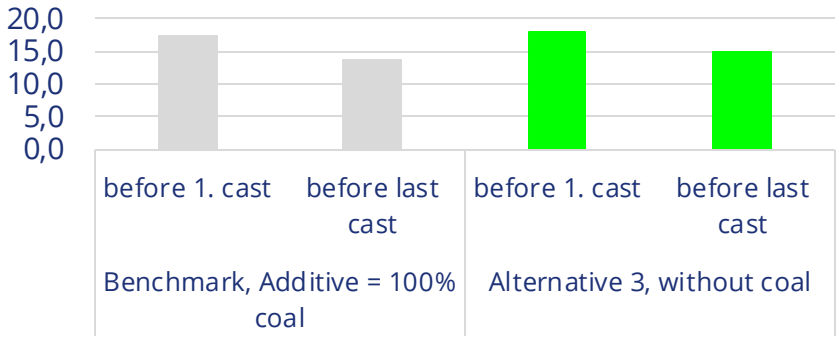
Heating microscope
Bentonite-Additive Blends

Alternative 3 without coal

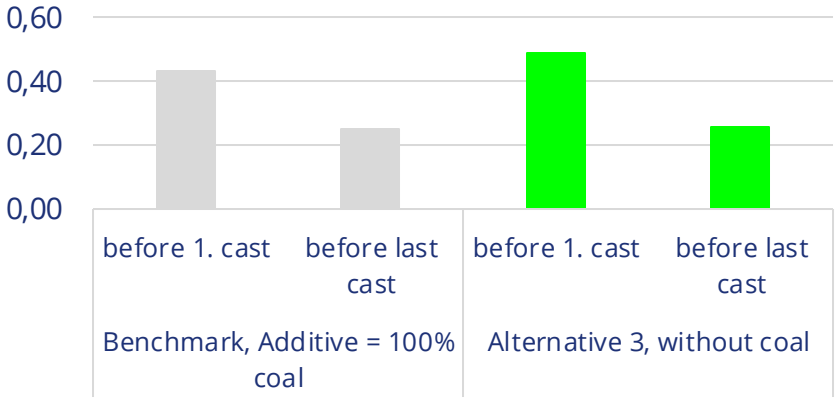
There is no reduction in the sintering temperature

Strength

Green compression strength [N/cm²]



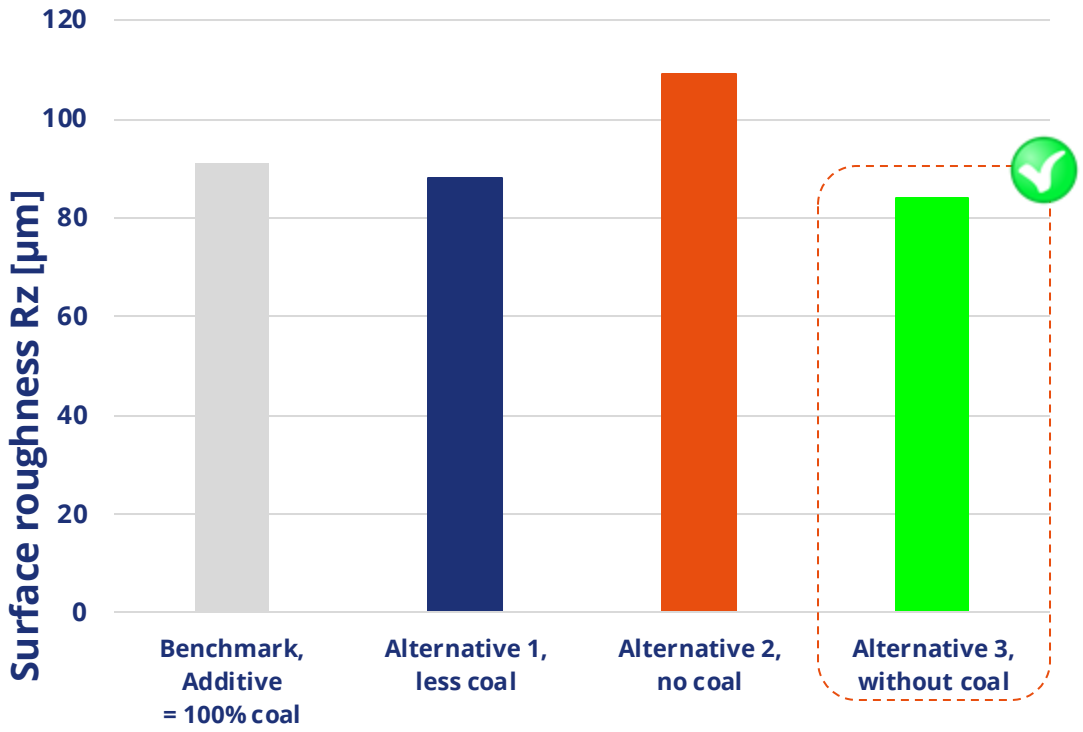
Wet tensile strength [N/cm²]



Standard Test Mixtures

Alternative 3 without coal shows the same or higher strengths compared to the benchmark, having the same bentonite content in the recipe and the sand mixture

Casting quality

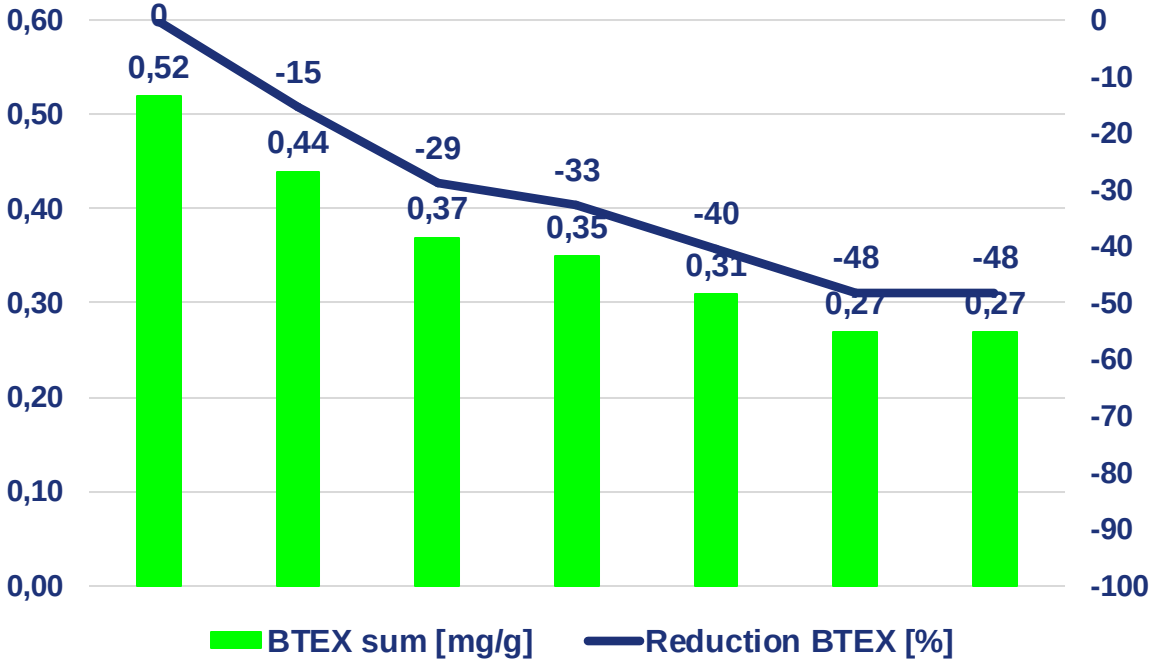


Circulation tests, 4 cycles
Standard mixtures
Cast iron

Alternative 3 without coal

Achieves a roughness comparable to that of the product with carbon

Emissions Step 1 of the transition



Within the conversion period, 50% of the carbonaceous additives were substituted by Alternative 3 without coal

As expected, this also resulted in a reduction in the total of BTEX* emissions by around 50%.

* Benzene, Toluene, Xylene, Ethylbenzene

Achieved reductions using alternative additives

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- Alternative additives are non-fossil, mostly inorganic
- With an 100% exchange rate the following results can be achieved compared to a Benchmark recipe (Bentonite and coal)
  - Reduction of carbon content of more than 50%
  - Reduction of volatiles matter of more than 30%, volatiles matter partly “inorganic”
  - Reduction of emissions (Benzene, Toluene, Xylene, Ethylbenzene) of more than 80%
- Reduction to be compared to the standard product
- CASE STUDIES AND REPORTS WILL FOLLOW SOON

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Benefits for customers

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Low carbon emissions	Reduction of carbon emissions by the substitution of coal and resin by a combination of substitues
Reduction of fossil fuel	Min. 50% reduction of fossil carbonaceous additives and substitution by non-fossil alternatives.
Lower final cost for the customer	Customers will decrease penalties they may get from Government and authorities, improving their plant's P&L, also improving their brand image for their own customers.
Molding sand quality	The product allows to get the same molding sand quality (strength level) and molding sand composition with low carbon emissions. No increase in surface roughness, scabbing or penetration.
Safety	Improved safety avoiding the transportation of dangerous goods

Source: Calderys information

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Thank you
for your attention

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