11-13 September / Eylül 2014
TÜYAP Fair, Convention & Congress Center, İstanbul
7th International Ankiros Foundry Congress
7. Uluslararası Ankiros Döküm Kongresi

«Innovative Binder and Refractory Coating Solutions For Highly Complex Castings»

«Kompleks Döküm Parçaları İçin Yeni Bağlayıcılar ve Refrakter Kaplamaları»

Amine Serghini
(Metko HA)

4.Oturum: Kalıp ve Maça Teknolojileri

4th Session: Mould & Core Technologies

Oturum Başkanı/Session Chairman: Dr. Türsen Demir (Çukurova Kimya End. A.Ş.)

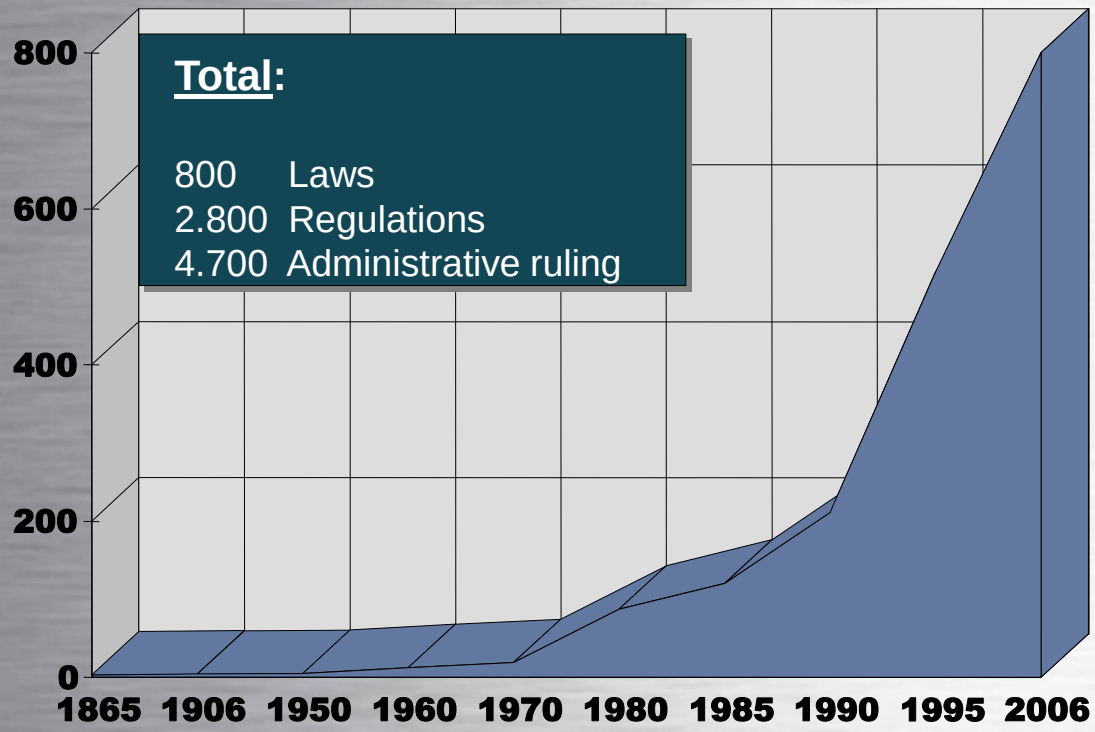
HÜTTENES-ALBERTUS
CHEMISCHE WERKE GMBH

7th International Ankiros Foundry Congress
September– 12th, 2014

Innovative binder and refractory coating solutions for high complex castings

Amine Serghini* & Dr. Klaus Seeger

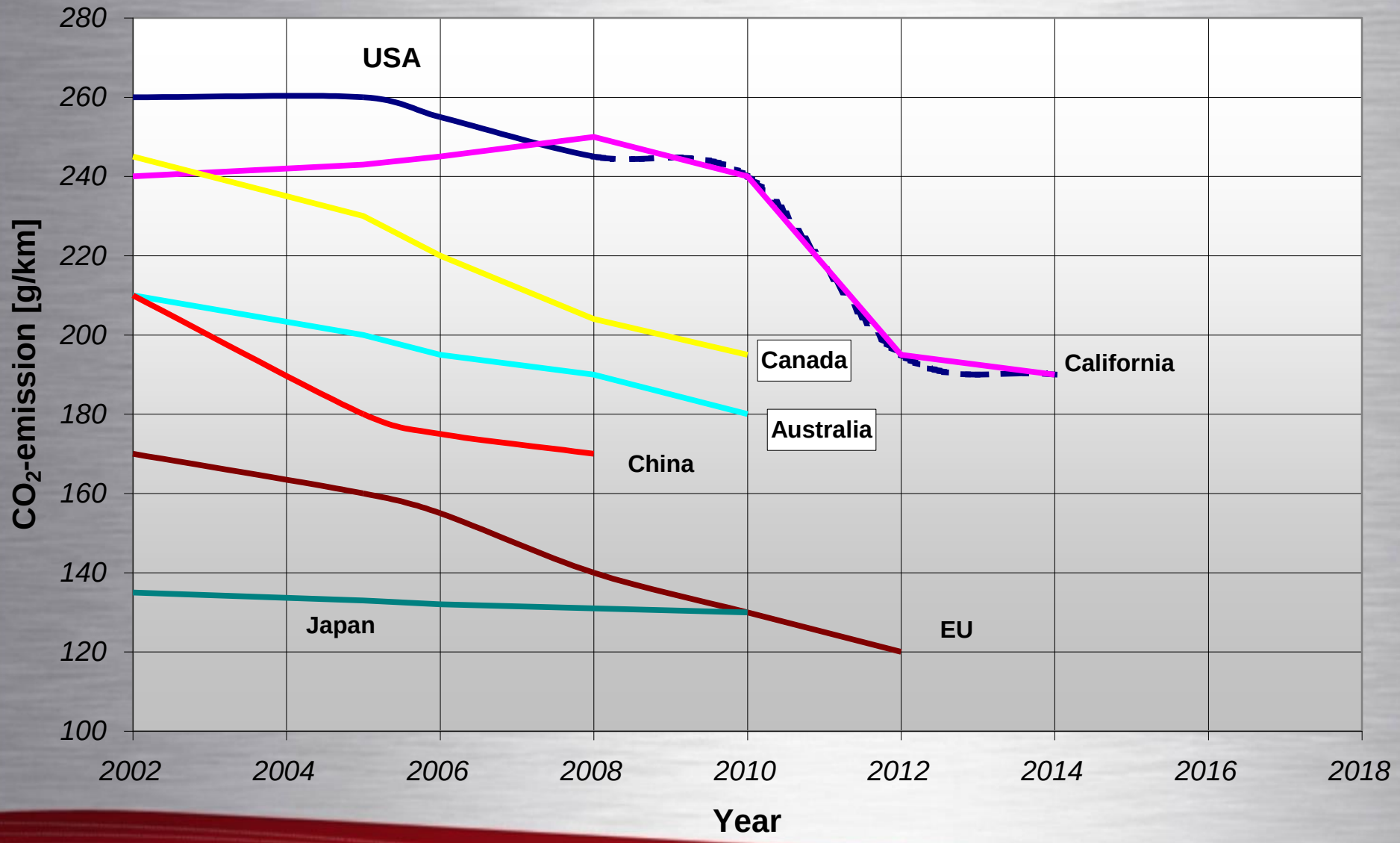
ENVIRONMENTAL REGULATIONS IN EUROPE



1865 - 1970: 20 Laws
1971 - 1985: 94 Laws
1986 - today: >> 800 Laws / Guidelines

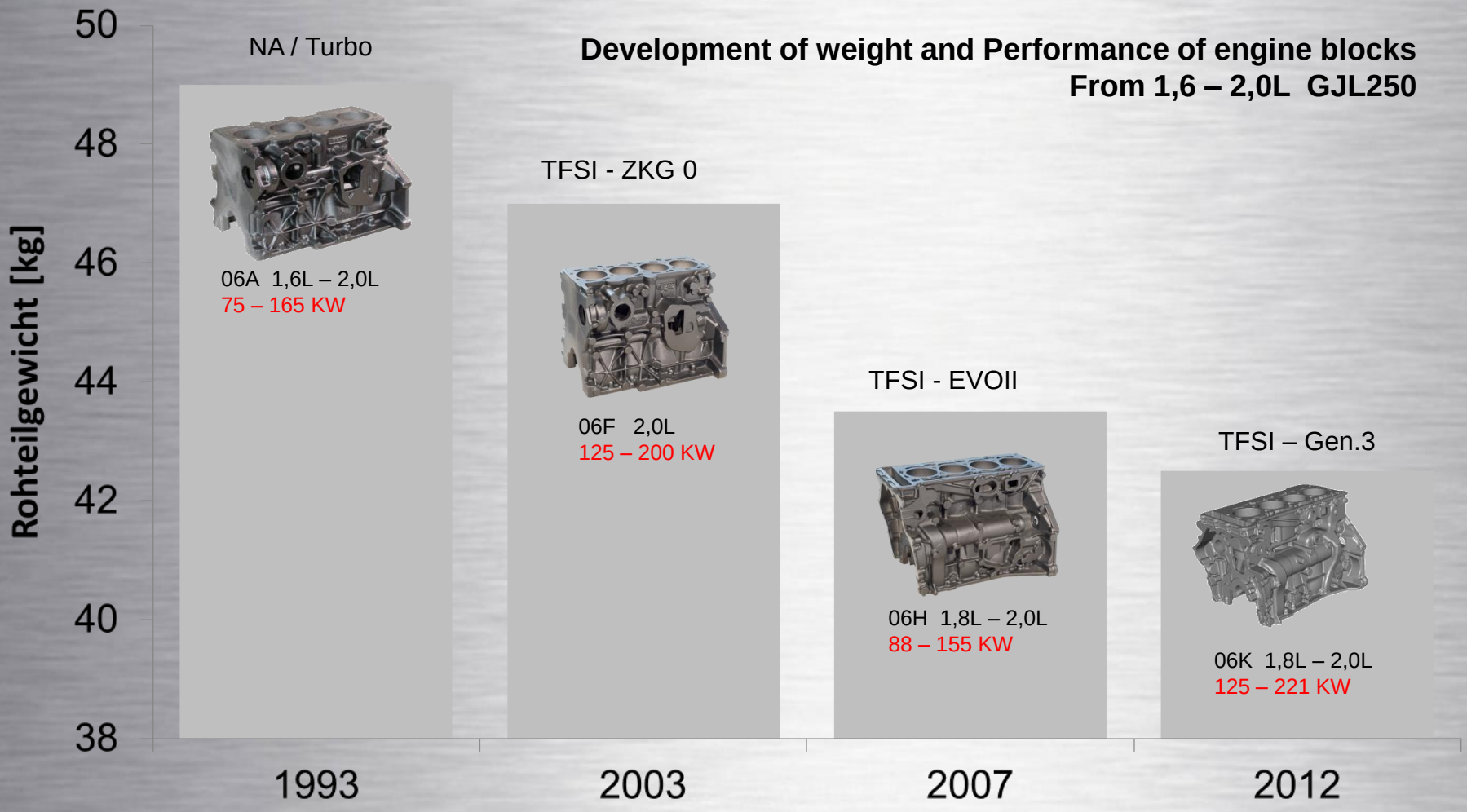
With a growing environmental consciousness the number of environmental laws and guidelines increased dramatically in recent years.

CO_2-Emission standards for PC Worldwide



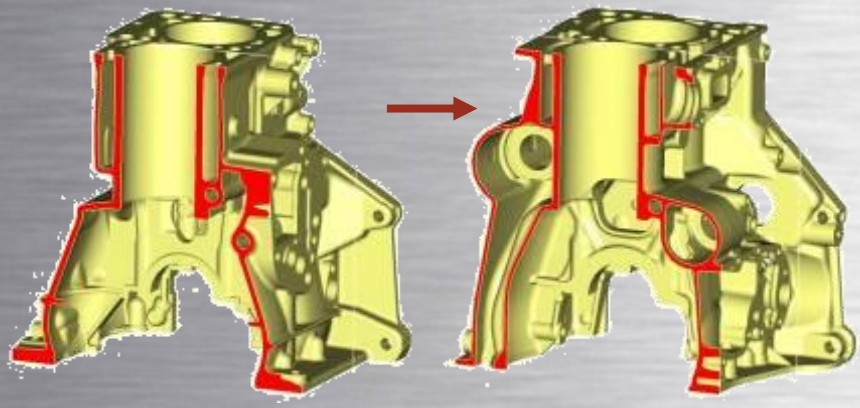
Light Construction using Downsizing

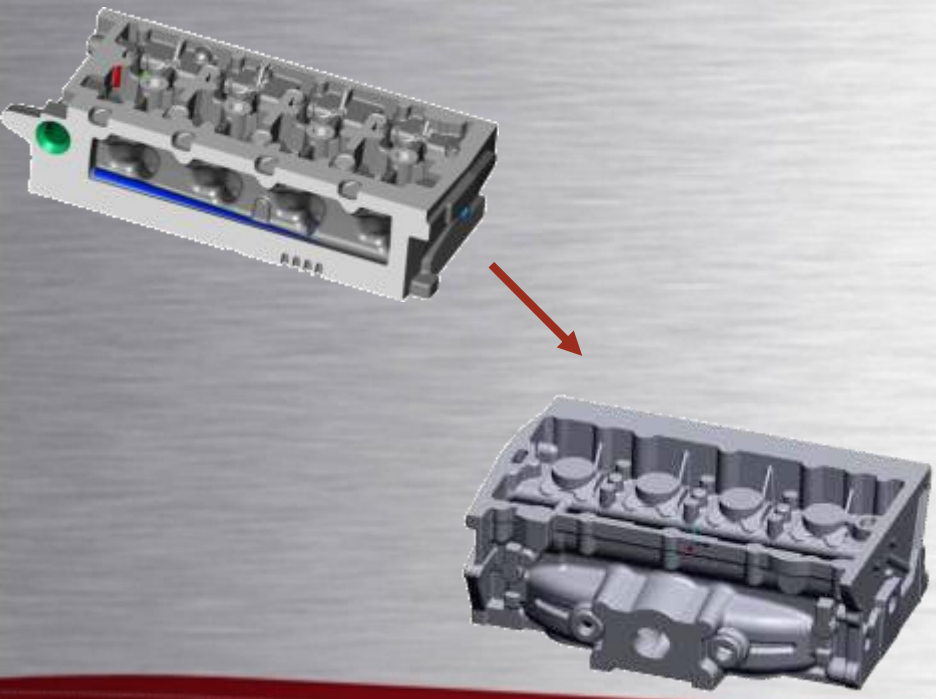
Development of weight and Performance of engine blocks
From 1,6 – 2,0L GJL250



source: W.Görtz – Die Herstellung von hochkomplexen ZKG
Eisenwerk Brühl FST Duisburg 2014

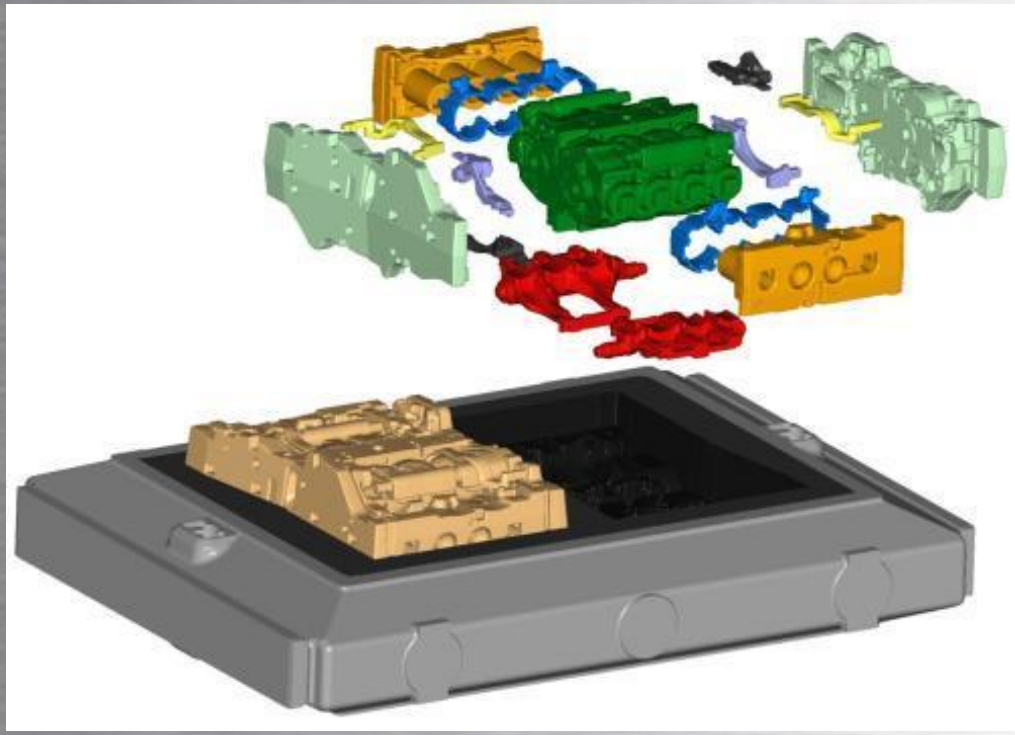
Challenges by downsizing



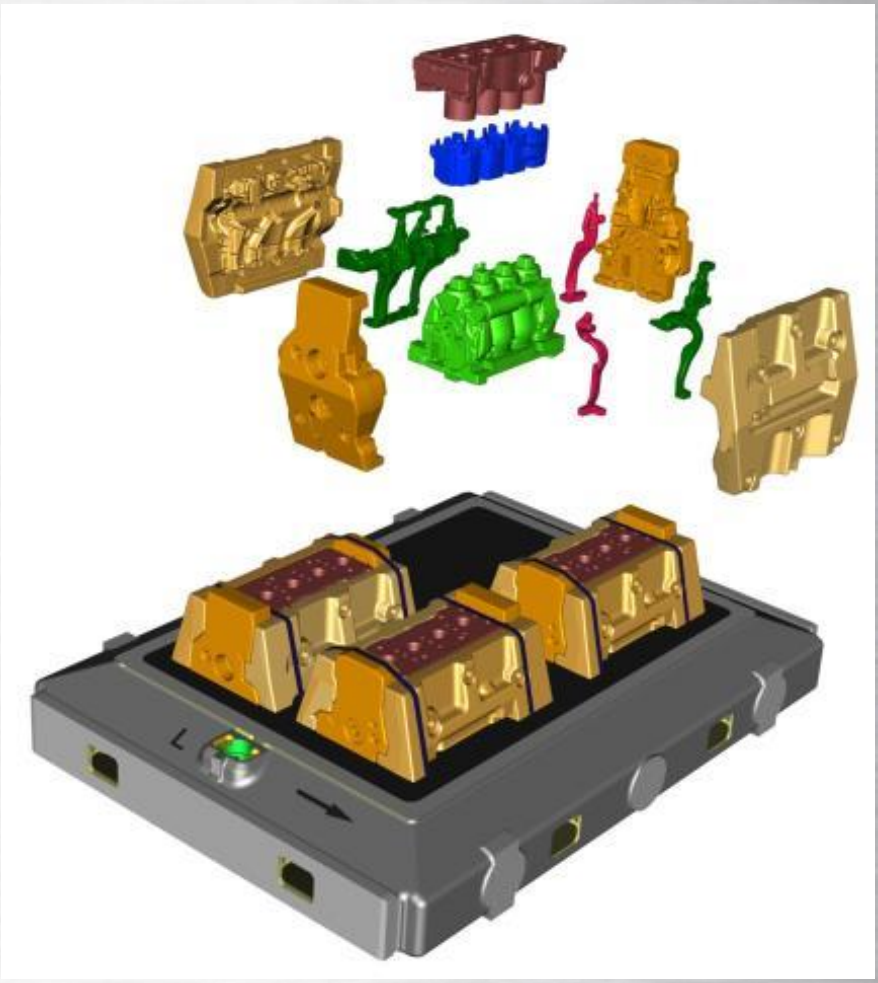


- Integration of different parts in the casting
  - higher core complexity
- Light construction
  - core package production
    - higher binder consumption
  - thinner wall thickness
  - restricted tolerance
- Higher component load
  - constant metallurgical proprieties
  - Need for feeders
- Lower costs
  - Automation

Enhanced complexity



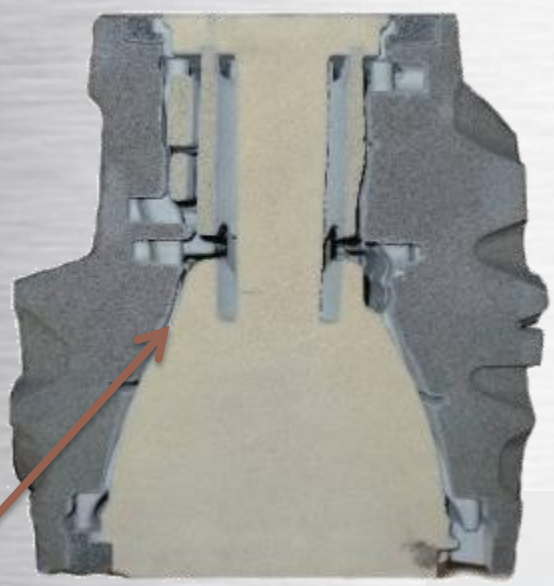
- **40 cores/ Flask for 4 engine blocks**
- **173,6 kg core sand / Flask for 4 engine blocks**

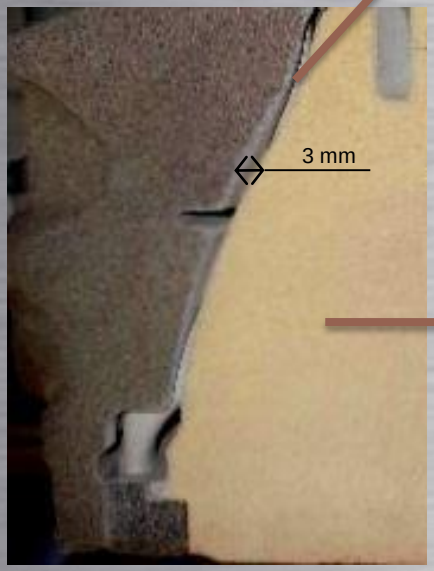


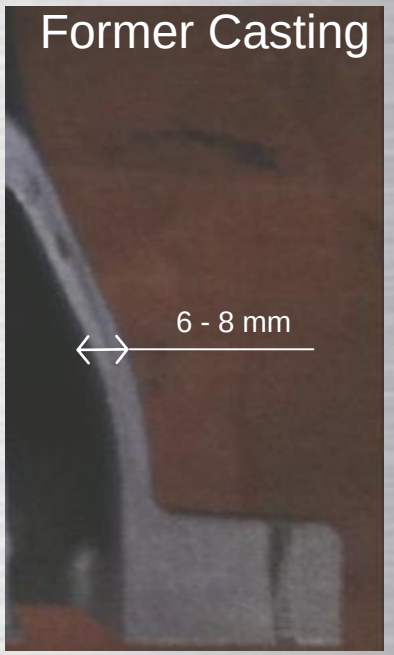
- **56 cores/ Flask for 4 engine blocks**
- **333,4 kg core sand / Flask for 4 engine blocks**

source: W.Görtz – Die Herstellung von hochkomplexen ZKG Eisenwerk Brühl FST Duisburg 2014

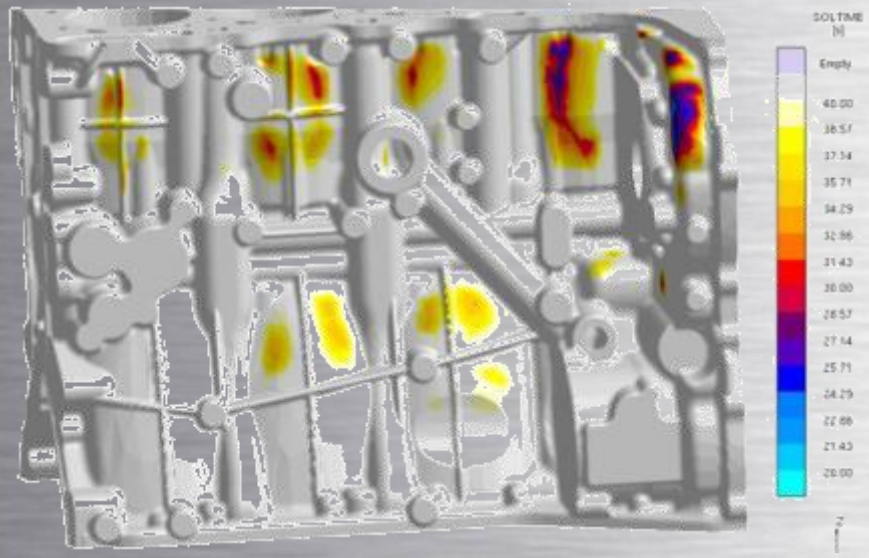
Wall thicknesses and tolerances for new engine casting

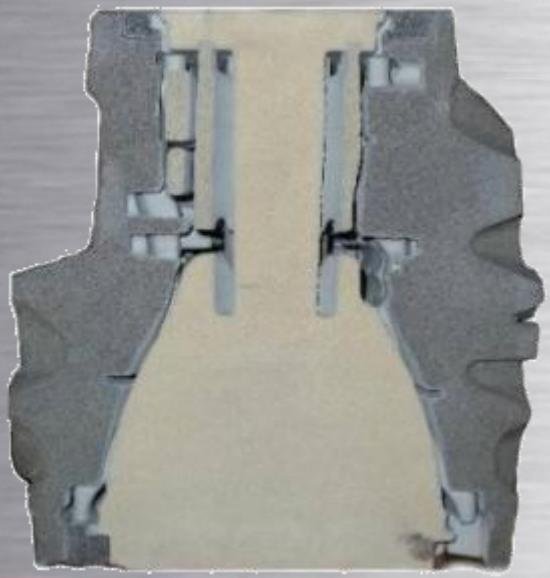


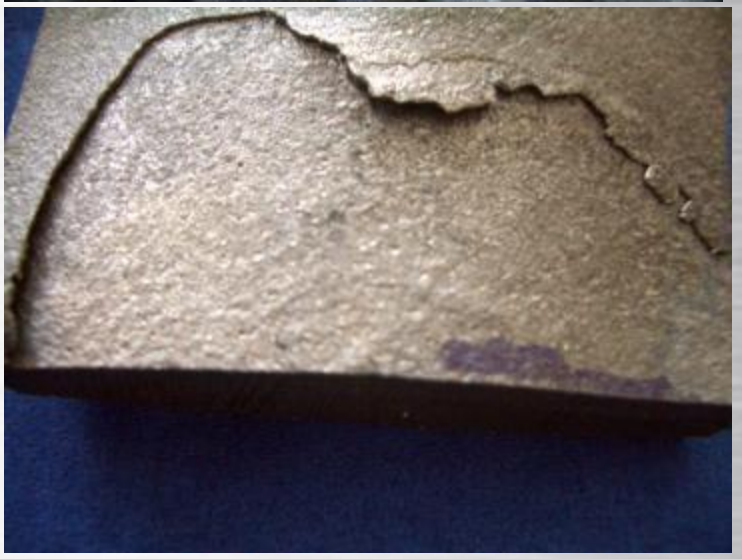




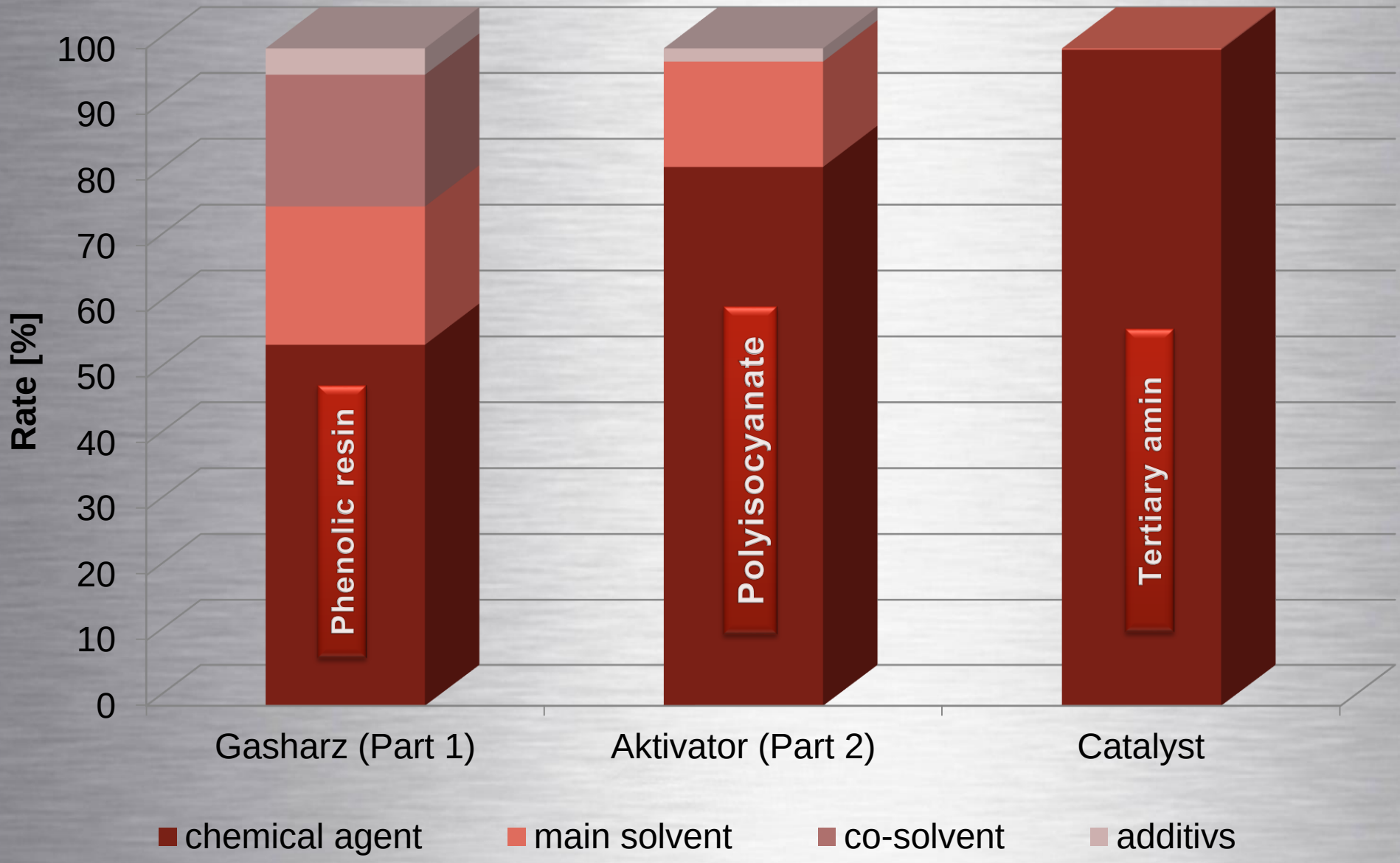
Wall thicknesses and tolerances for new engine casting







Composition of the various Cold-Boxcomponents



Solvent behaviour in PU-Cold-Box resin

Primarily:

- To reduce the viscosity of the base resin

Secondary

- To enhance several properties of the binder

Solvent influence:

- The gas behaviour of the binder system
- The Hazardous and fume emission of the binder
- The odour emission after pouring

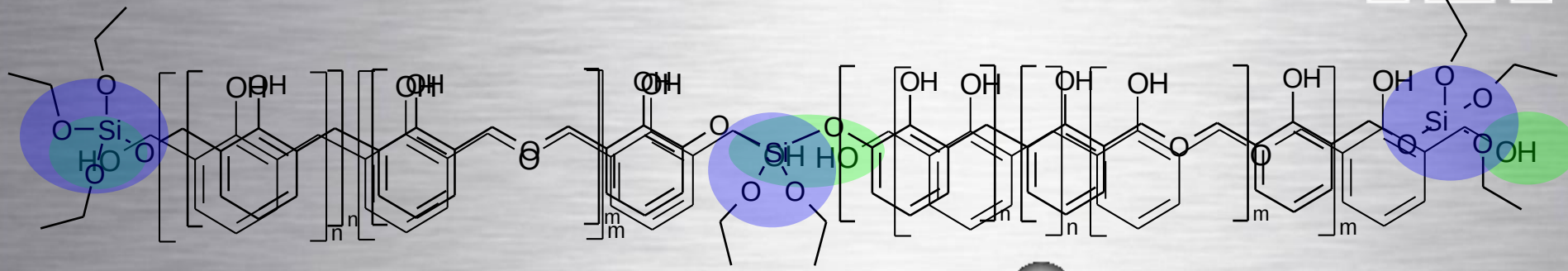
Reducing the solvent content:

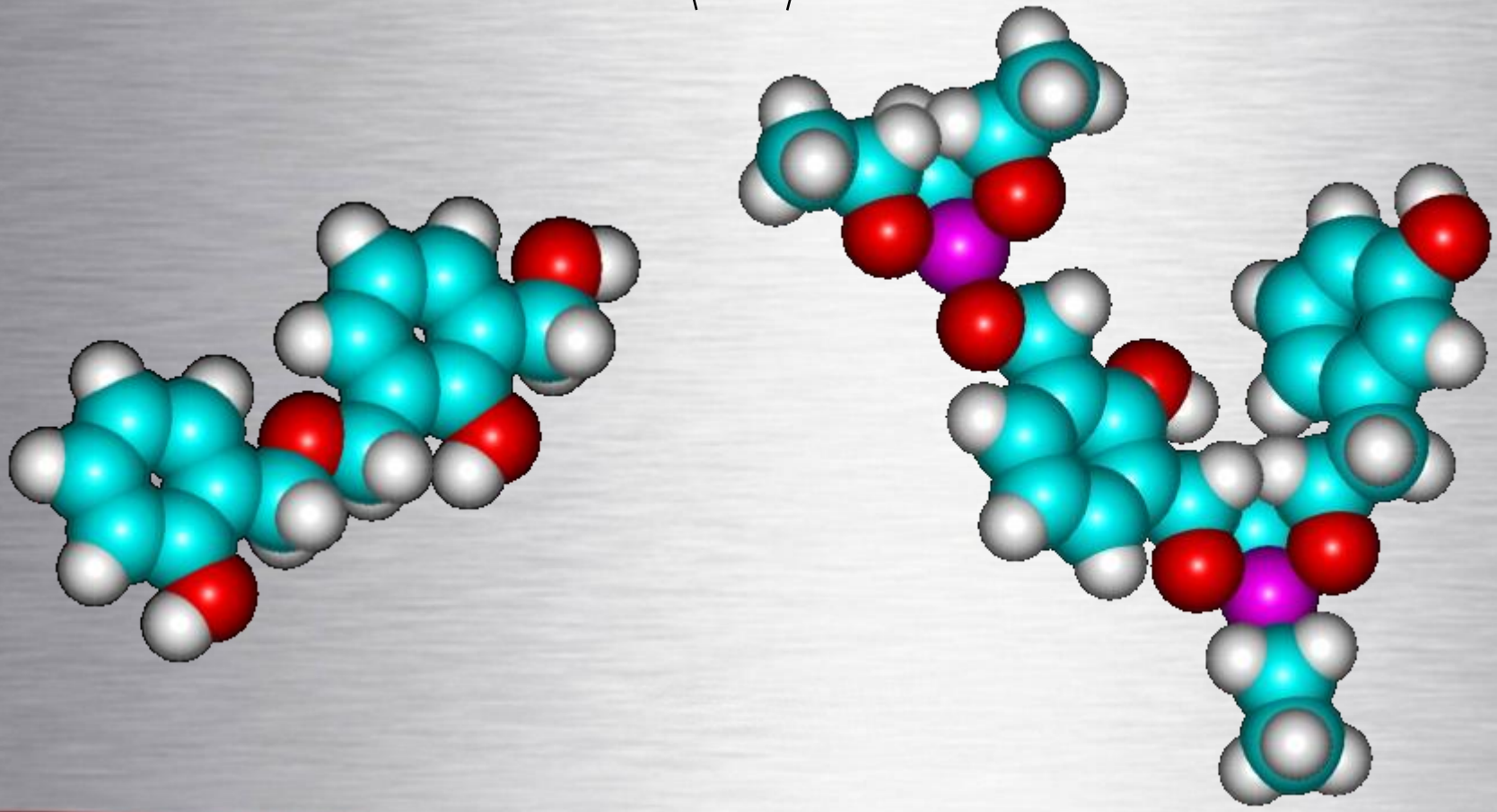
- Reducing the viscosity of the base resin

Viscosity of the base resin

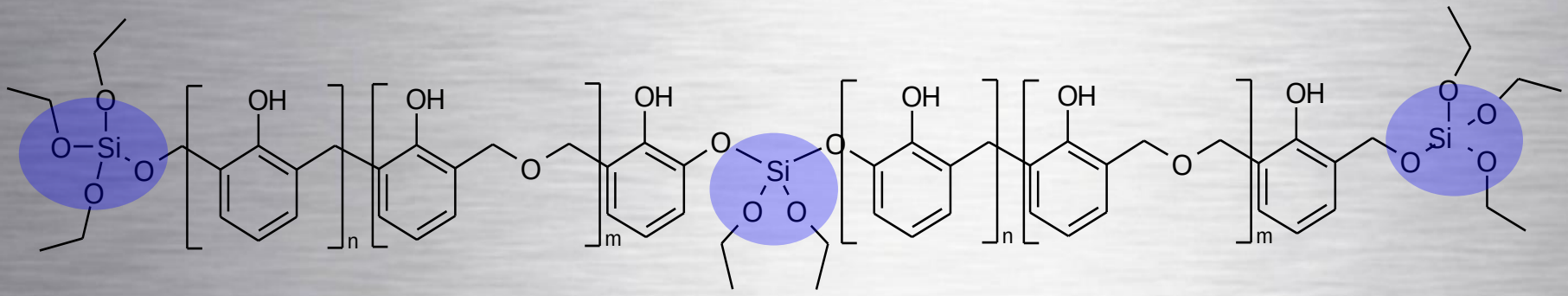
- Modify the structure of the binder

Structure of various Cold-Box-Resins



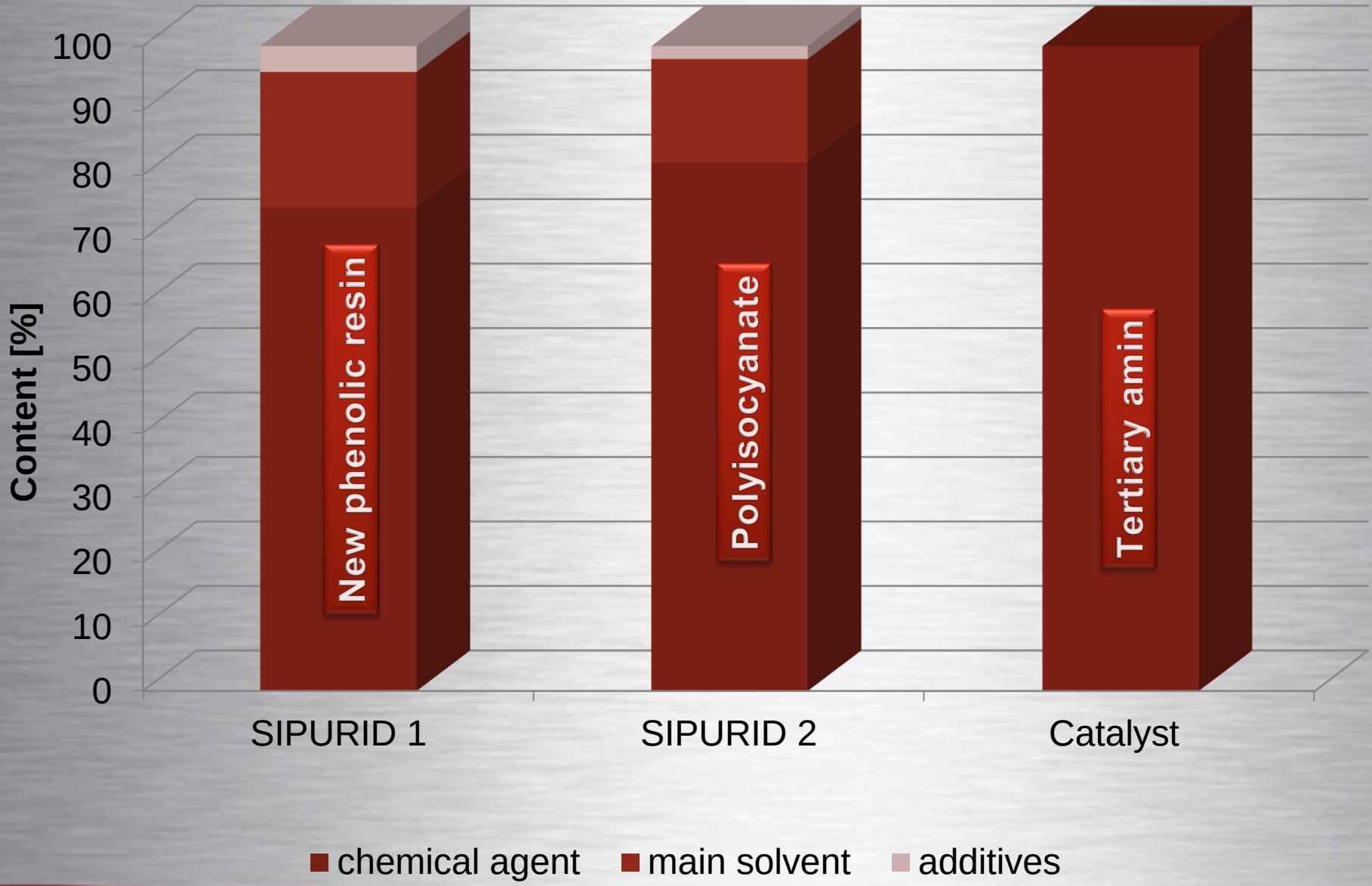


SIPURID-Structure - properties

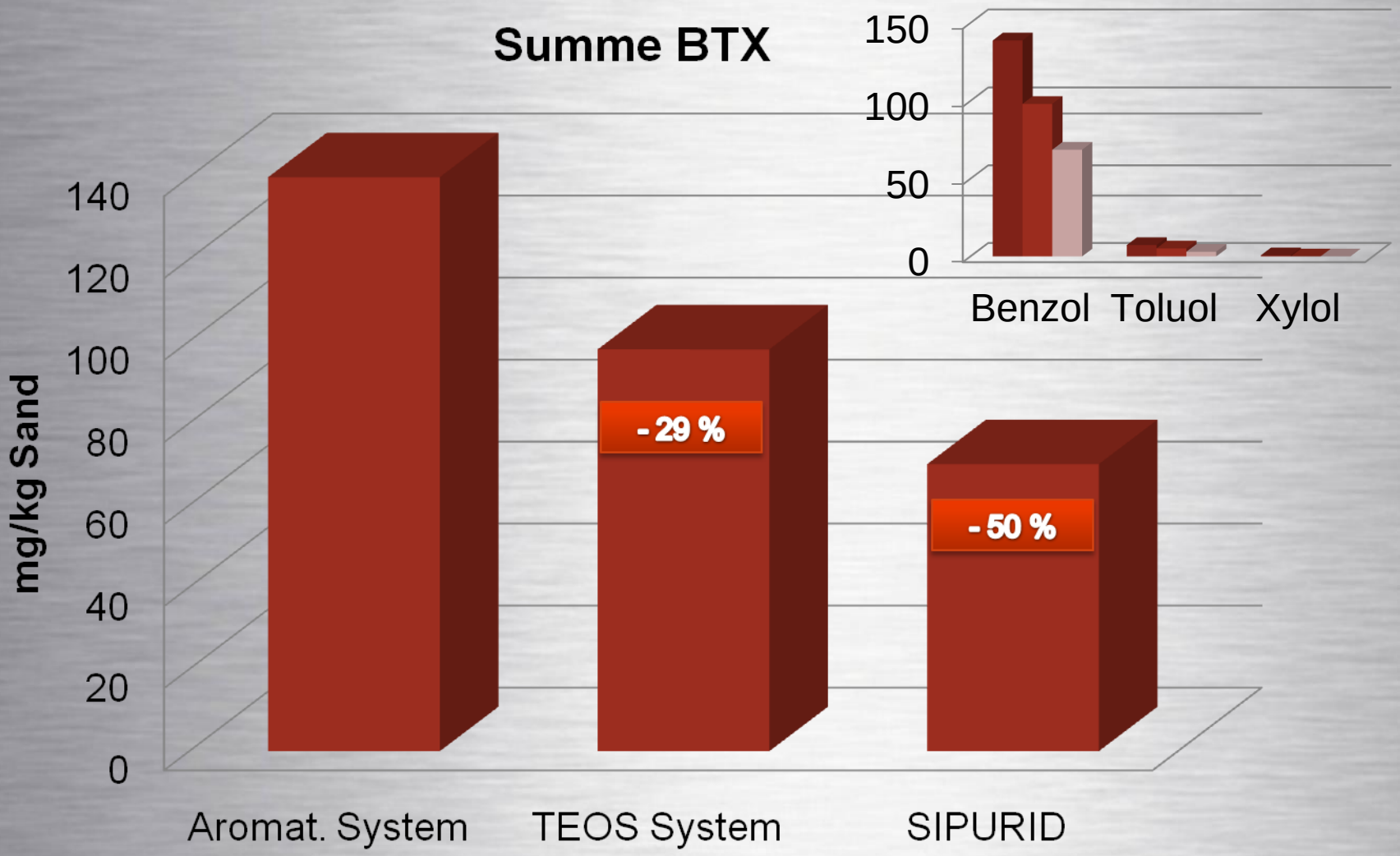


- 1. Reduction of the OH-Groups → **Polarity** reduced
  - → Application of simple solvent packages possible
  - → Viscosity of the base resin is reduced
    - → Application of less solvent possible
  - → Amount of Isocyanate can be reduced
- 2. Increase of the molecular mass
  - → thermal stability improved

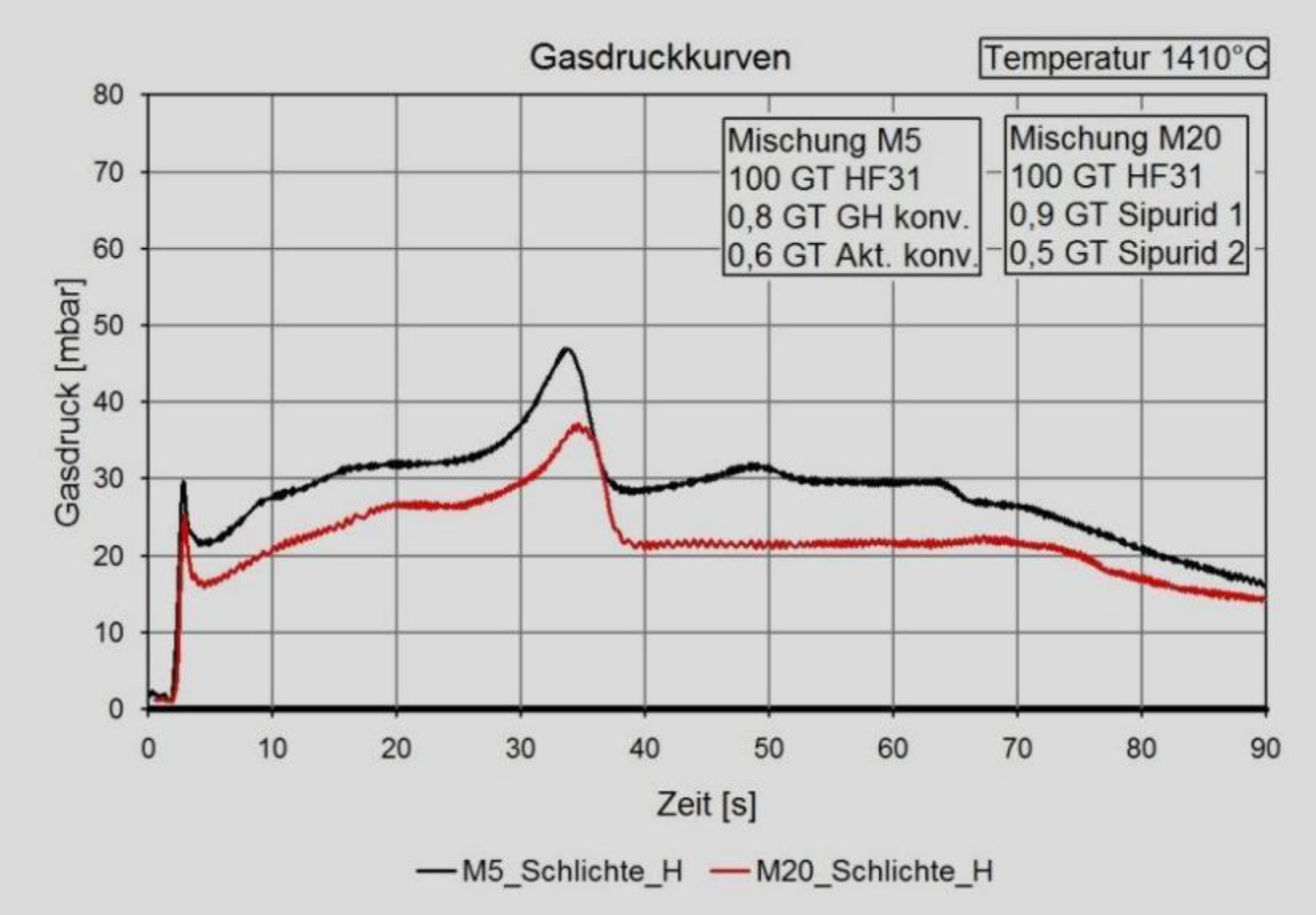
Composition of the various Cold-Box components



Emissionen – Hazardous- BTX values



SIPURID: reduce of gas pressure into the core



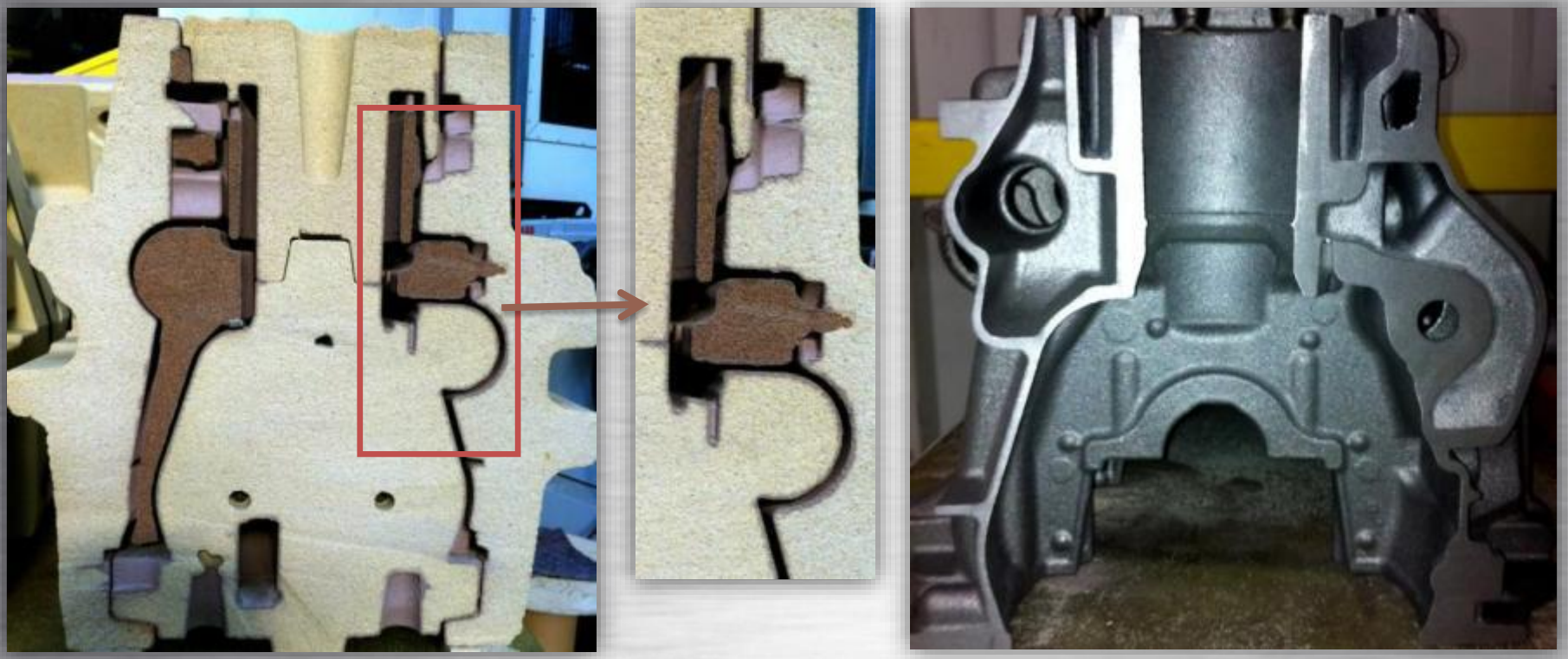
SIPURID– Practical experiences

Standard binder

New binder

Wall thicknesses and tolerances for new engine casting

Due to the high complexity of these castings the number is increasing especially in filigree thin and very complex cores. The risk of gas-related casting defects will increase.



Section through a core package in casting position by cutout over a range of core and a section of the corresponding cylinder block

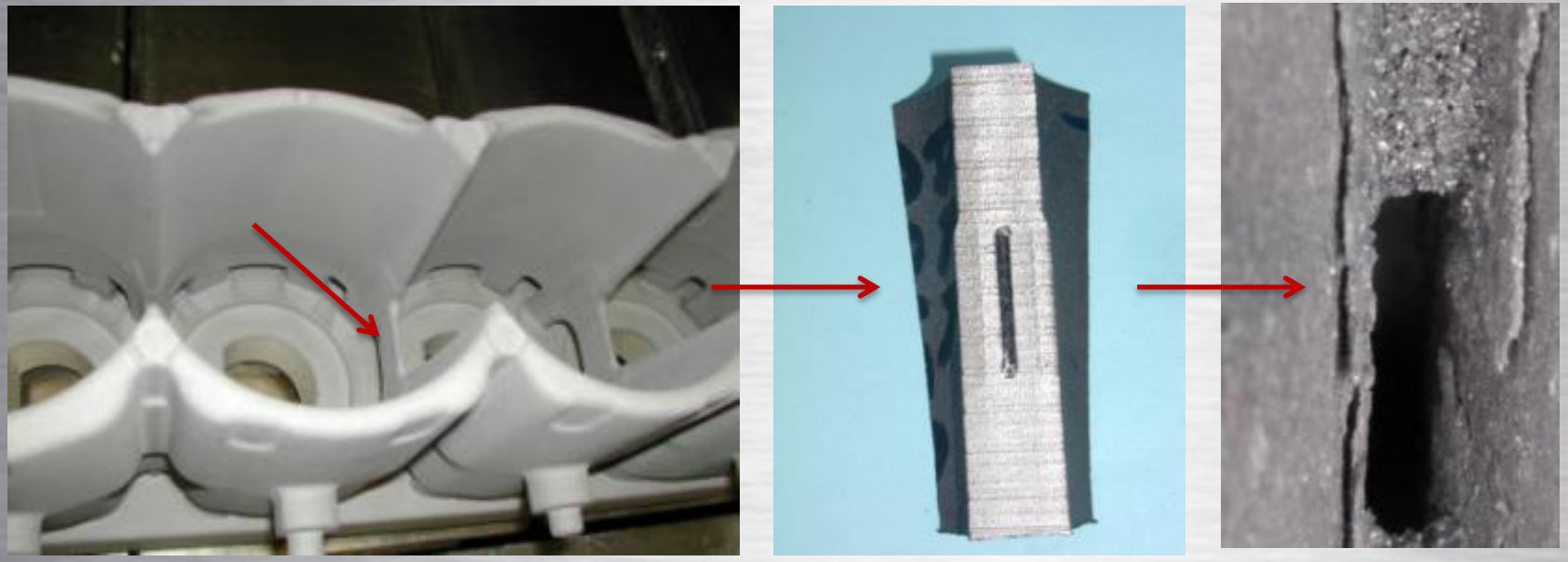
Wall thicknesses and tolerances for new engine casting

For the production of complex castings in the core package technology the use of more specific and tailored coatings to their production is necessary.

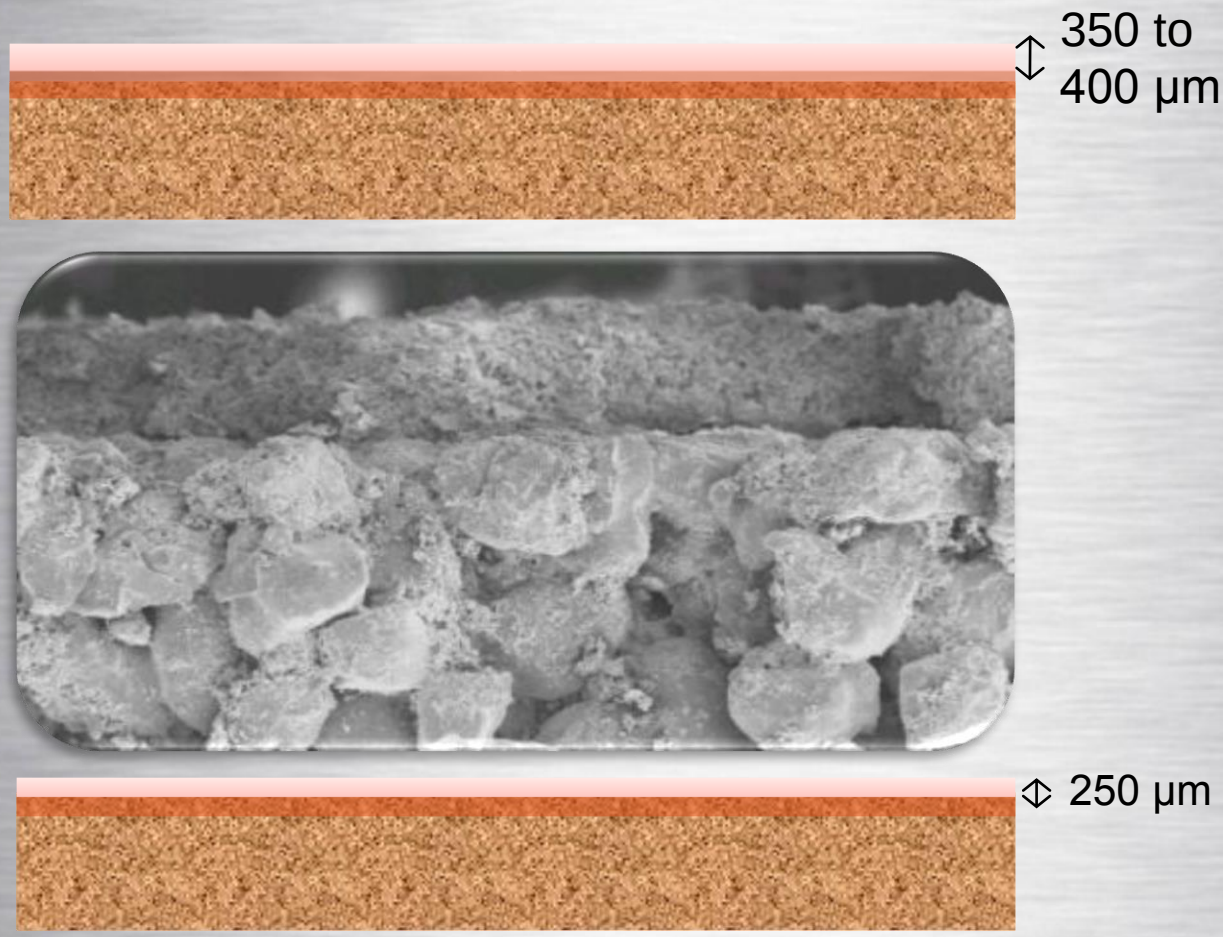
coated side part of a core package with integrated channel cores

- uniform application thickness
- very effective against sand expansion defects
- controlled gas permeability
- controlled refractoriness

Wall thicknesses and tolerances for new engine casting



Wall thicknesses and tolerances for new engine casting



Task

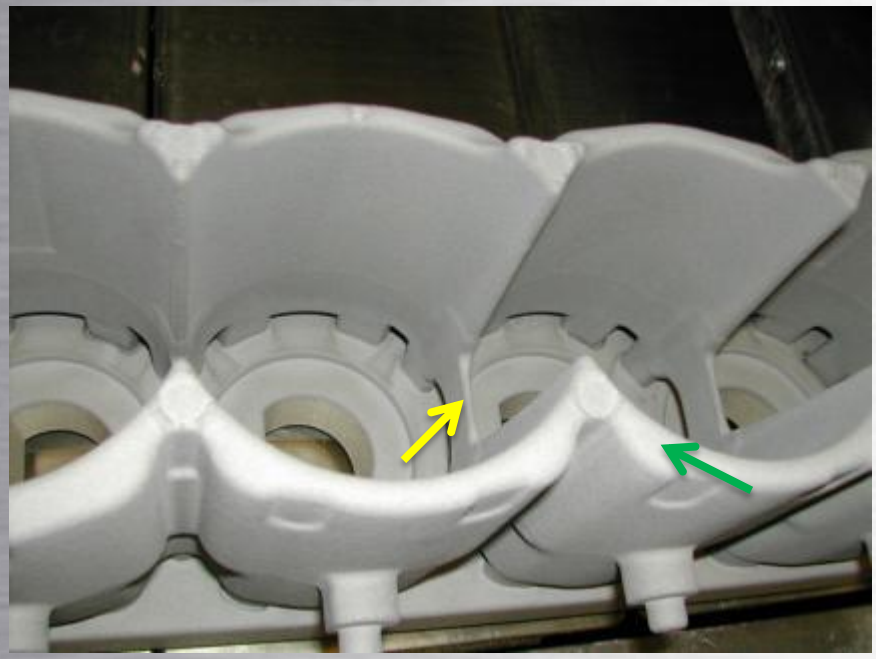
- Formulation of suitable coating which can be applied thin and still eliminates casting defects such as veining or penetration and offer an excellent peel-off from the casting

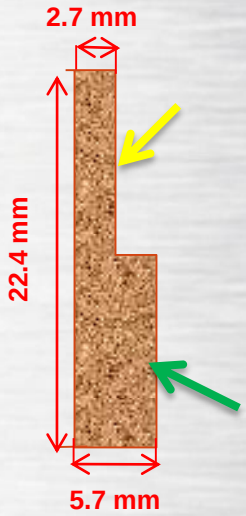
Testing carried out to improve cleanliness

Method:

- A test casting was carefully designed to demonstrate adherence in thin wall sections
- Dipping procedure was improved to ensure constant coating thickness
- Various coating formulation types were trailed
- Test bars were produced, coated dried and inserted into the test moulds ready for casting

Simulation of casting geometry



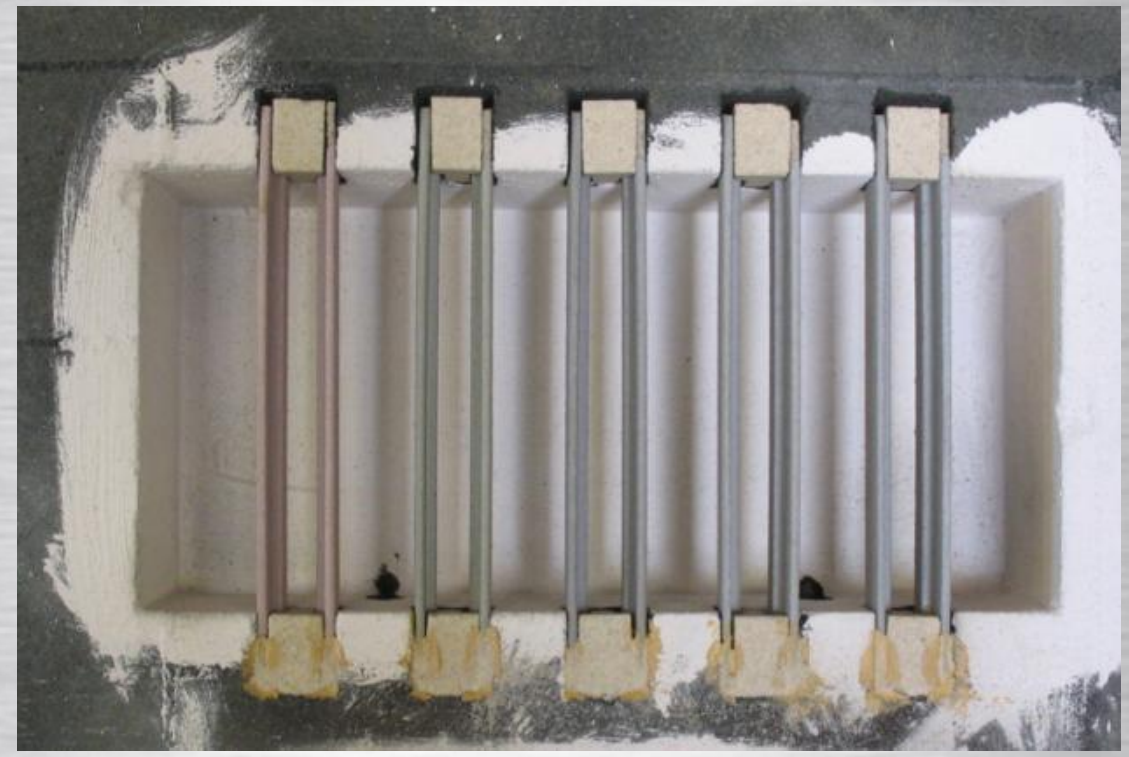


Casting test: view of the mould

Grey Iron

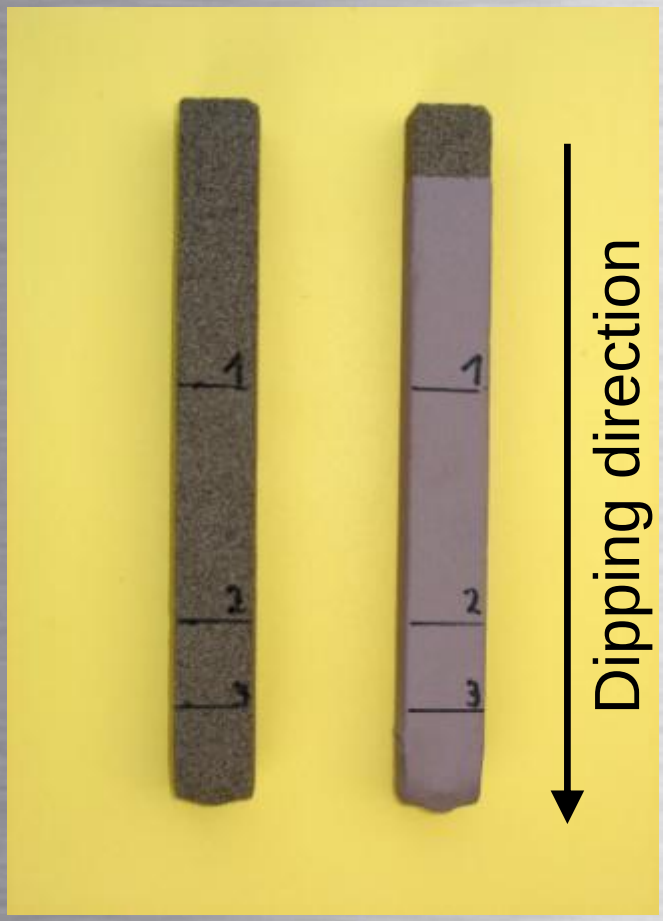
Casting temp.: 1450 °C

Casting weight: 21 kg



The thin test bars simulate the customer conditions and the different applied coatings show the performance of this

Measurement of layer thicknesses on test bars



- Test bars were measured in positions 1 – 3
- Coating applied with an automatic dip machine
  - Dipping time: 3 sec.
  - Hold time: 5 sec .
  - Removal : 3 sec.

Sand mixture:

100 pbw Silica sand

1.6 pbw Cold-Box binder

Layer thickness of different coatings

3/5/3s

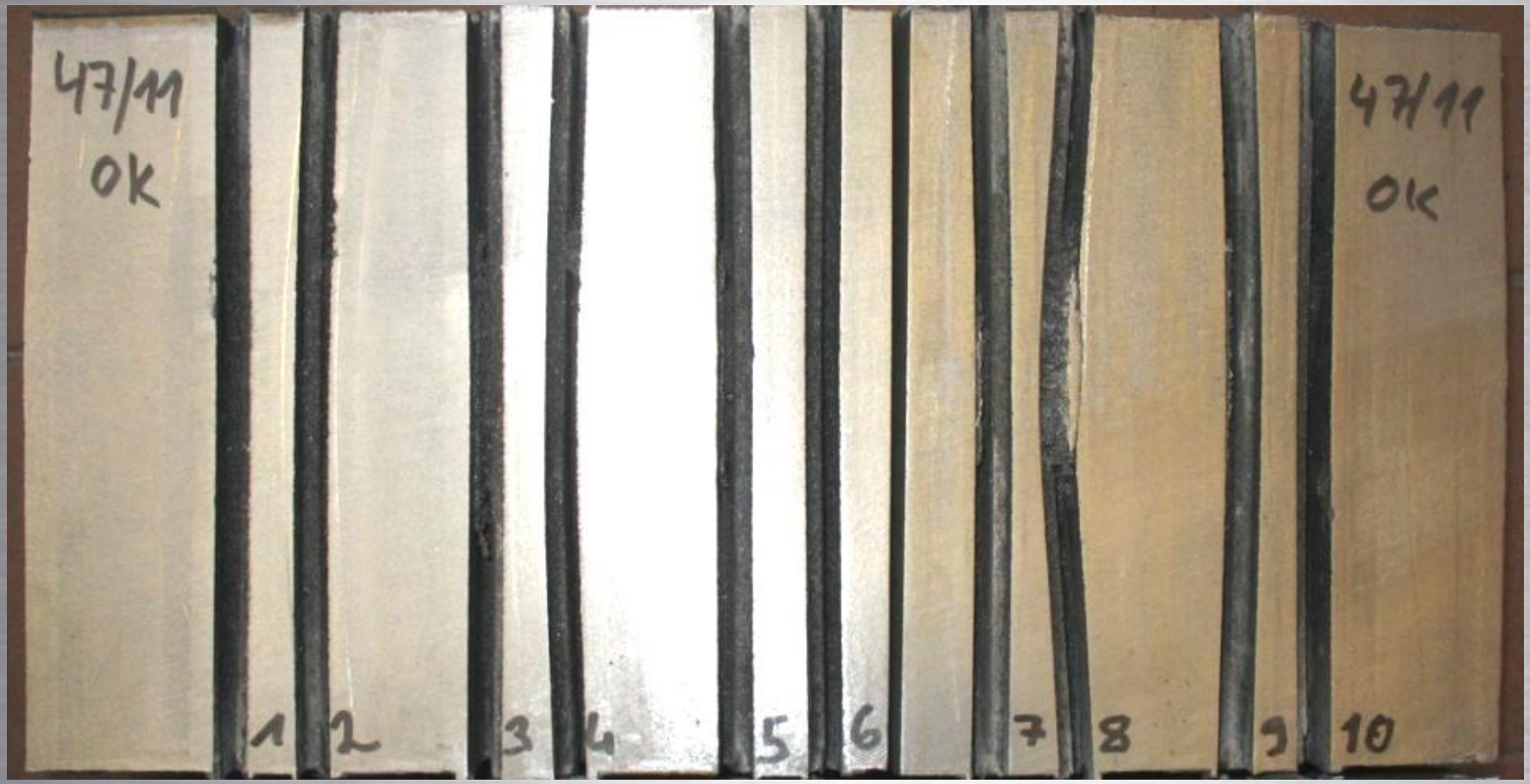
	Coating A	Coating B	Coating C	Coating D	Coating E
Layer [µm] Position 1	400	390	450	350	220
Layer [µm] Position 2	490	440	510	360	220
Layer [µm] Position 3	500	450	520	370	230
Δ Layer 1 to Position 3 [µm]	100	60	70	20	10

Observations:

Lower part of the core always has a tendency to pick up more due to the higher pressure forces, building thickness onto the sand core

- Choice of coating is important in obtaining consistent thickness on cores

Peel-off of different coatings



- The above shows the sectioned casting with reduced adherences in section 9 and 10

Peel-off of different coatings

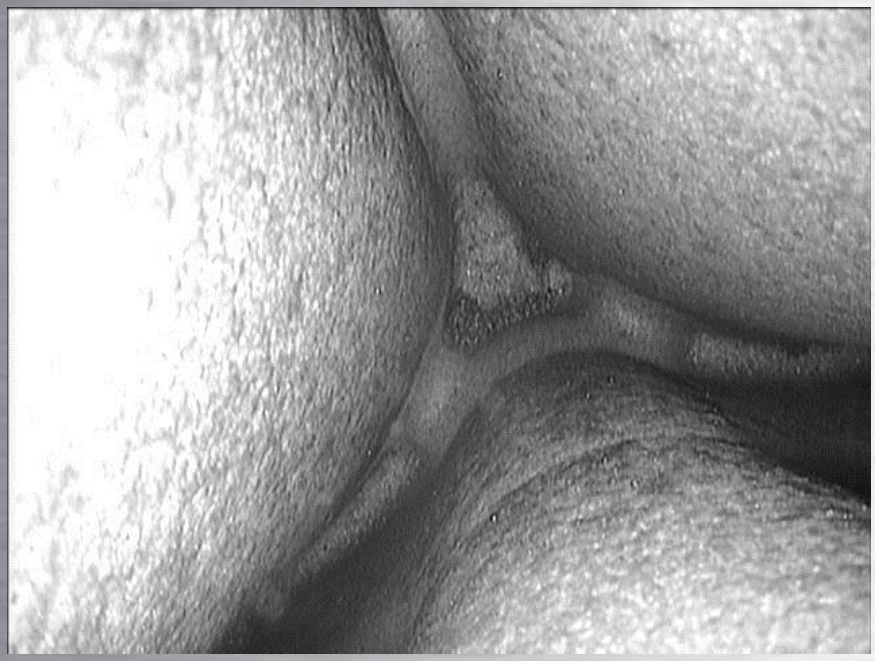
Coating A

Coating E

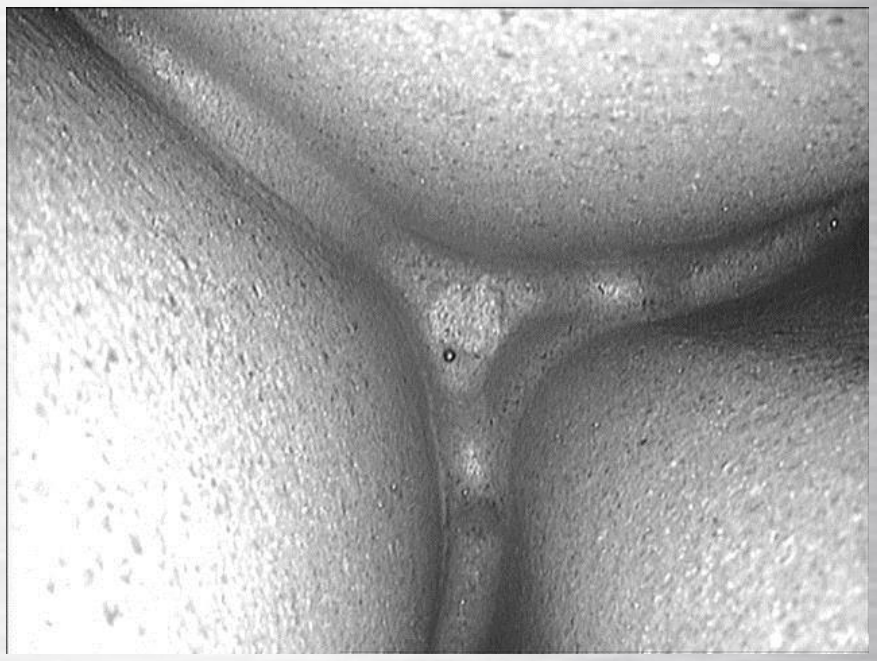
Cleanliness

Cleanliness after casting / peel-off of the refractory coating

example: casting surface around the water jacket



Extensive sticking of the refractory coating on the casting surface



Barely any refractory coating residues to be found on the casting surface

(Source: Neue Halberg Guss GmbH, Brebach)

Summary

- Thin-walled engine blocks with integrated functionalities to reduce the CO_2 emission of future generations of motor vehicles
- The number of cores increases significantly and the complexity as well
- Engine blocks are therefore produced by core package method with vertical pouring
- New requirements for core binders and particularly for the coating materials and their compositions:
  - to cope with the task of gas evolution or gas problems
  - to avoid expansion defect by low coating thickness
  - to enhance the release of the coating after casting
- To guarantee a constant working condition an automatic viscosity control has been developed

Thank you for your attention!