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7. Uluslararası Ankiros Döküm Kongresi

«Efficient and Economic Application of Coatings»

«Verimli ve Ekonomik Kaplama Uygulamaları»

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(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.)

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EFFICIENT & ECONOMIC APPLICATION OF COATINGS

Simon Turley – Huettenes- Albertus GmbH

ANKIROS

12th September 2014

Foundry Cost Implications

- Casting defects are costing the foundry industry due to scrap and rework.
- This can be influenced by incorrect coating application
- Coating application is important and it is also essential to applying the coating correctly and efficiently
- This presentation describes problems associated and illustrates ways to help avoid them

Presentation summary

Refractory Coating Definition

- Refractory coatings are dried, heat resistant refractory layers
- They form a dense cover which protects bonded sand moulds from molten metal

Reason for coating:

To work together in producing the perfect casting by eliminating casting defects leaving a smooth cast finish

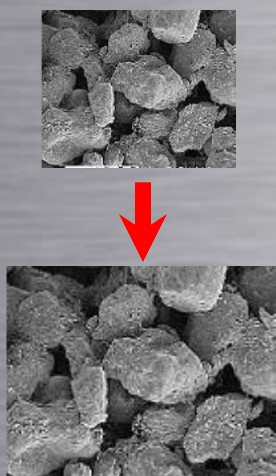
What is achieved by coating

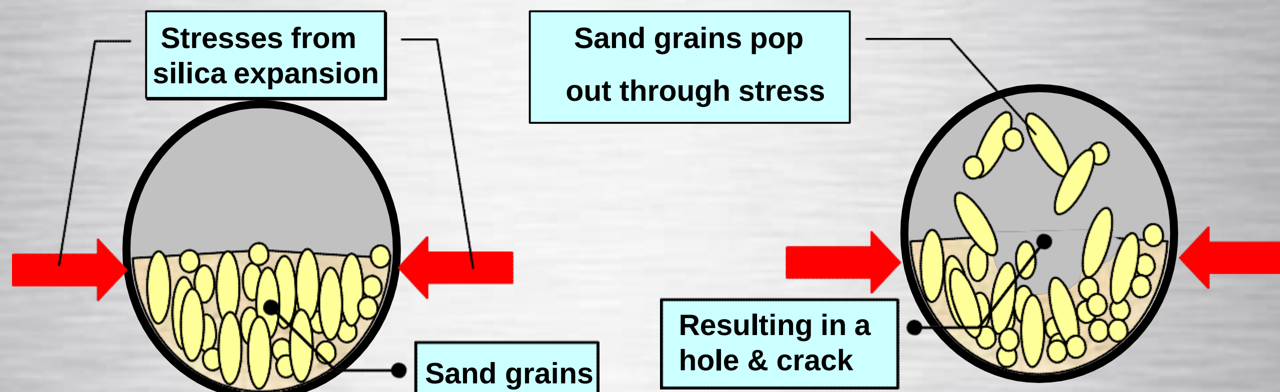
- Optimised surface finish
- Resistance to Veining by insulation of the core
- Opposing Metal Penetration & Burn on defects
- Reduction of mould scabbing
- Enhanced casting release
- Barriers against metal mould reactions

Veining Defect Control

Formation: Mould or core sand expands stress builds and cracks form.

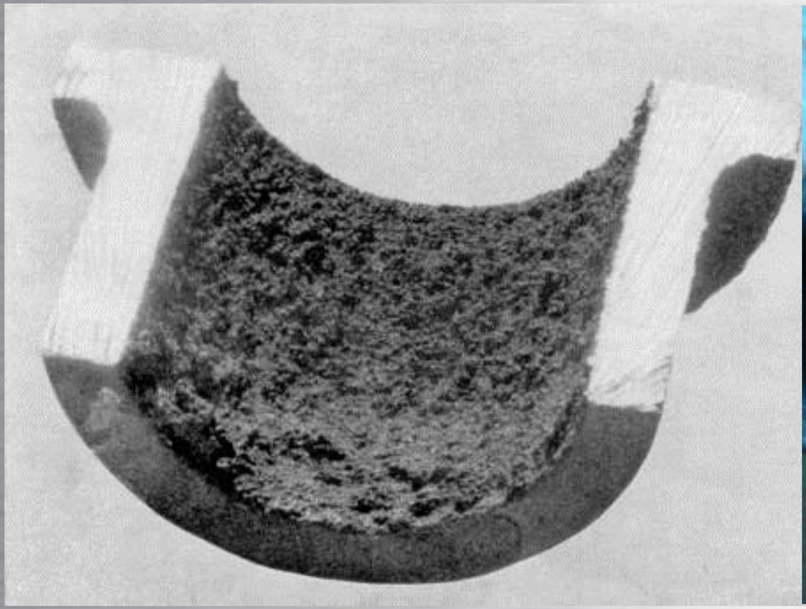
Influencing factor: Alpha to beta phase Expansion of Quartz sand @ 575°C by occupies a 1.3 vol % expansion

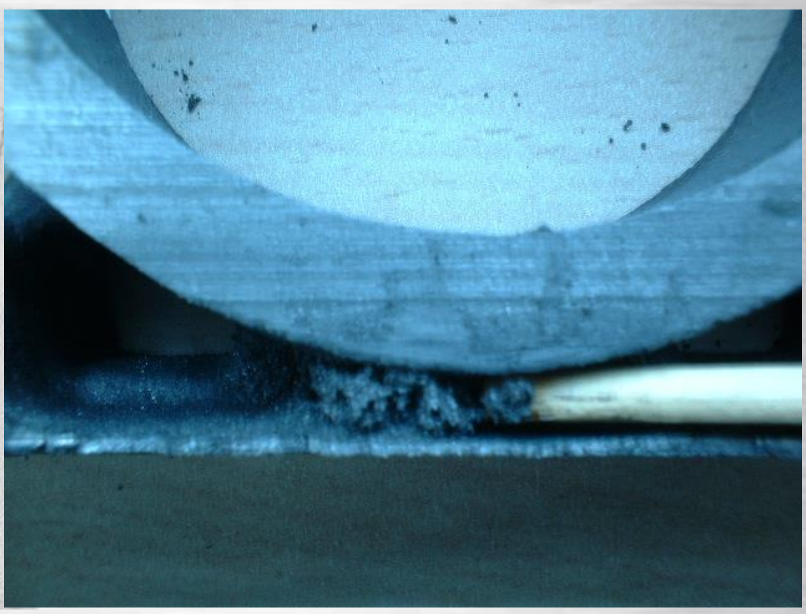




- ➢ High insulating coatings help delay phase change until solidification occurs

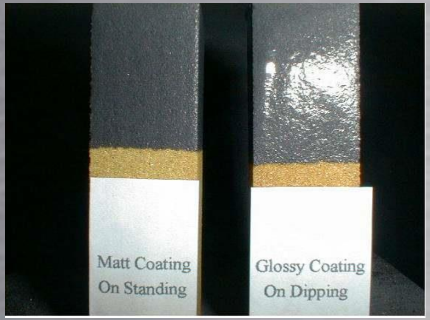
Metal Penetration Resistance





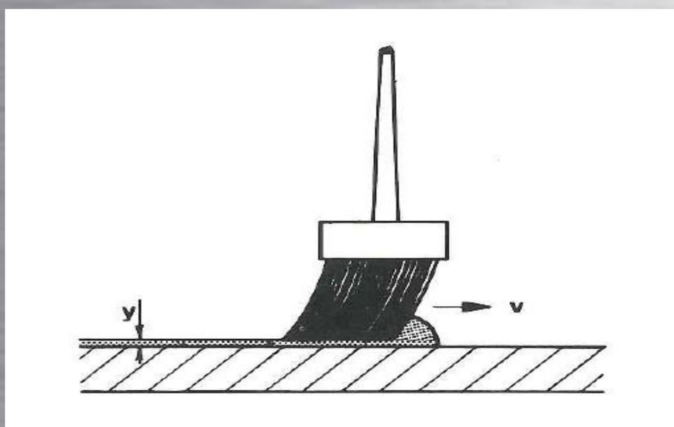
- ➢ High temperature mechanical or chemical breakdown of the bonded sand & eventual metal penetration & fusion.
- ➢ Thinner core sections are especially prone to problems
- ➢ Coating needs to stable, withstand high pour temperatures & abrasion during casting

Critical Properties - Application



- Ensure uniform coating layer without runs or sagging
- Optimal coating thickness
- Adequate drying: No moisture to avoid gas defects
- Good ‘in tank’ suspension & resistance to bacteria
- Satisfactory bond strength prior to casting
- Suitable rheology & application characteristics
- Coating should wet the core or mould adequately
- Suitable penetration of the coating & liquid carrier
- Correct ‘Matt or Gloss time’

Brush Coat Considerations

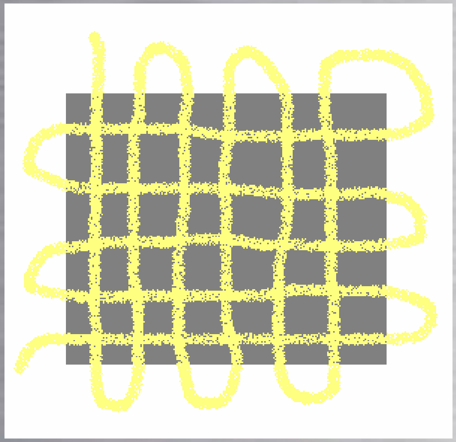


Shear rate D = V/Y

D = velocity of brush (m/s) / coating thickness (m)

- Choose quality brushes to suit size of mould, clean them regularly
- Ensure there is adequate coating volume on the brush
- Brush in a smooth motion directionally. Train all operators to follow the same practice.
- Build adequate thickness with layering to avoid cracking.
- Be wary of brushing after coating has ‘matted out’. Longer matt time is beneficial.
- Ensure an even coverage without brush marks. This versatile application can be carried out in most locations

Spray coating considerations



- Ensure the suitable spray nozzle for process & coating type (0.8 – 2.5mm)
- Control feed & spray pressure to suit application ideally (2- 3 bar) to avoid dry spraying
- Move the gun before applying the trigger reducing overspray & apply square to the mould
- Application distance guide: 200-500 mm (gun to mould). Spray with an oscillating movement to gradually build thickness without runs or tear formation.
- Spray direct to mould corners so that each adjacent wall is coated evenly
- Brushing may still be required for deep crevices & areas difficult to reach with spraying
- Always Clean out spray gun after use. Spray application is environmentally dusty.

Flooding procedure considerations

- Flooding and dipping are the most productive applications. Robotic systems are available
- 100-200 litre holding vessels are set in the region of 2 bar pressure & pumped through
- Coat the mould in a constant action top to bottom, left to right
- Deep pockets are reachable & consistent layer thickness on vertical mould surfaces can be achieved by flooding.
- Empty excess coating from deep crevices by tilting the mould
- Wait for coating to matt out before tilting the mould back : reducing flow marks
- Sieve out any contaminated sand in the sieve unit

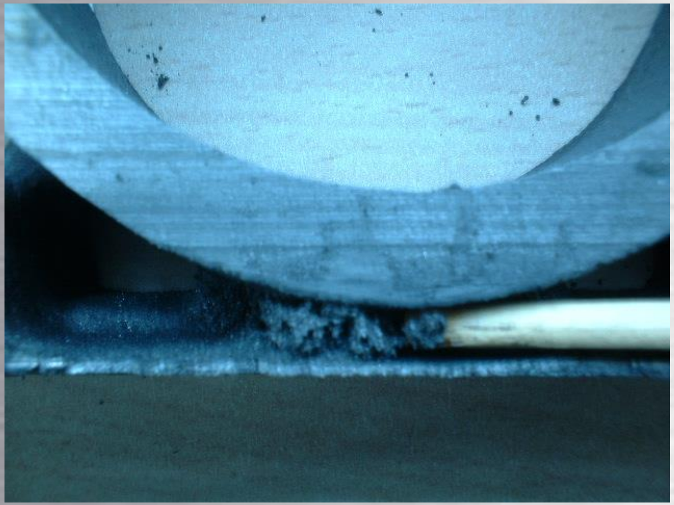
Manual and Robotic Dip Practice

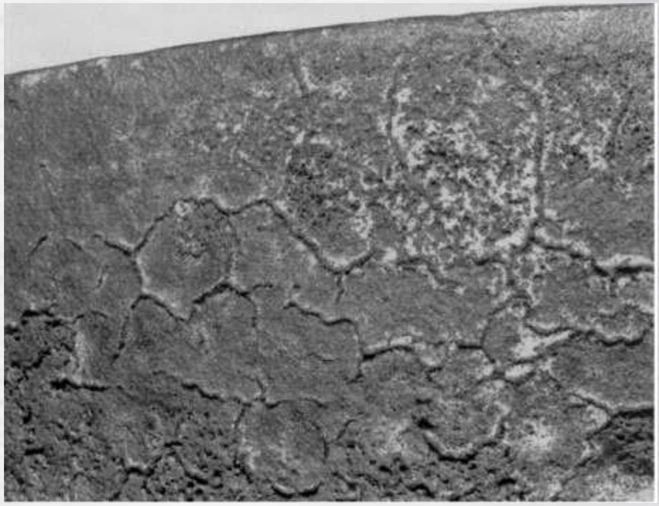
- Ensure compliance with handling regulations in local area. Extra personnel or cranes & robots may be needed for large cores.
- Dip method or program should be constant. This includes dip time, hold time and removal time.
- Ensure all core pockets are tilted & removed of excess coating.
- A uniform coating layer should be applied without runs or sagging.
- Coating should have matted out after turning the core and placing ready for drying
- Use a dip tank with pump recirculation ensuring homogenous & consistent application
- Ensure viscosity & thickness is rechecked and constant.
- Clean robot & dip tank of dried coating to avoid bacterial pick up.

Process Control

- Control coating layer film thickness
- Monitor Viscosity: flow time or baume. Consider HA automated control
- Ensure coating is homogenous following preparation
- Clean coating area, dip tanks, equipment regularly to avoid bacteria problems
- Control contamination from sand, filter etc.
- Ensure coating or working area is not subject to big variations in temperatures. This effects coating performance and consistency

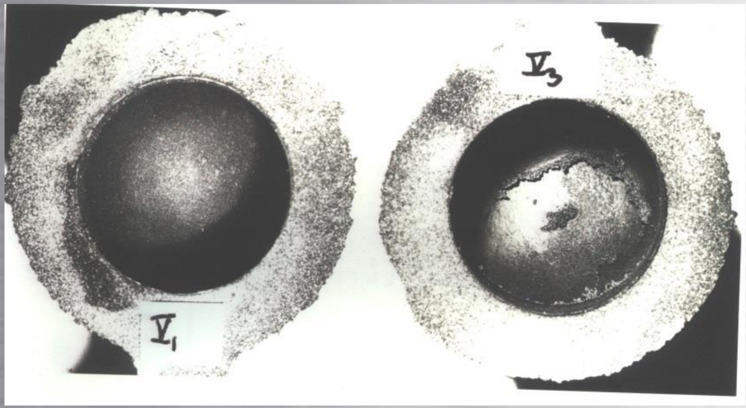
Coatings Applied Too Thin



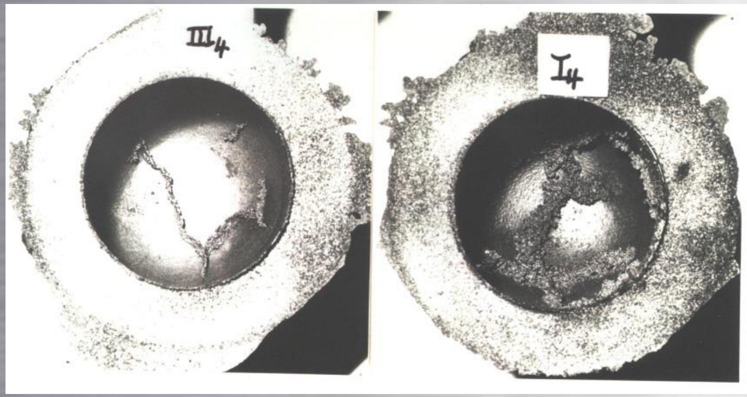


- Molten metal heat and abrasion from metal flow breaks down the thinner coating layer too easily allowing metal to penetrate into the sand
- Thin coating may not insulate the thermal expansion of the core sufficiently, resulting in stress cracks and relative veining

Veining - Effect of coating thickness



Test coat A - 300 microns   **Test coat A - 150 microns**



Test coat A - 200 microns   **Test coat B - 330 microns**

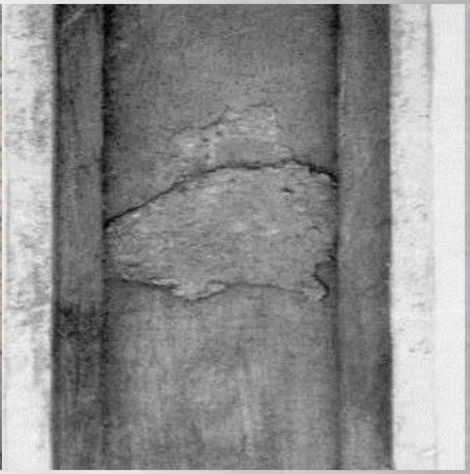
- The correct coating thickness can sometimes be the difference between veining defects and no defects at all – Test coatings A
- Incorrect coatings will not perform irrespective of the thickness – Test coating B
- Choice of coating at suitable thickness is the key to success

Coatings Applied Too Thick

Sagging & Run marks on the castings

Increased tendency for entrapped gas

Cracking of the coating layer

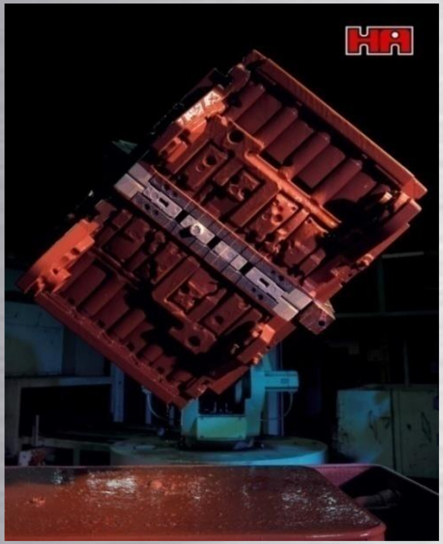


Coating abrades or lifts off to form scabs

Effect of inadequate process control

- Coating is applied too thin resulting in limited protection of the mould or core
- Coating is applied too thick making it brittle, crack, lift off and harder to dry
- Coating thickness needs very careful control !
- Failure to control will increase defect rates in the foundry

Coating preparation & auto-control plant



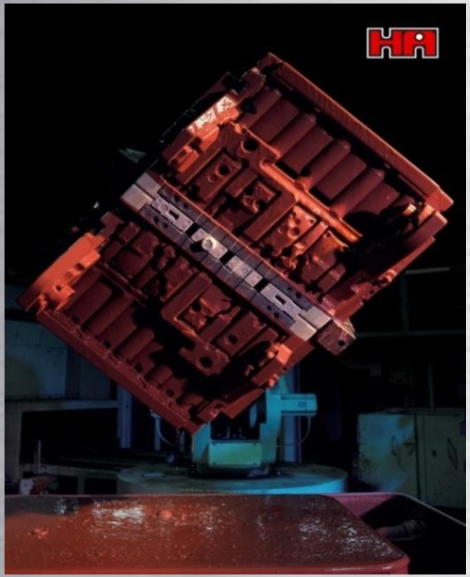
- Demands placed on coating of cores and moulds have increased.
- In order to achieve optimal casting results, the benefit of homogeneous, consistent and evenly distributed coating layers is of increased importance.
- HA in conjunction with OAS - AG have developed a series of systems ranging from smaller dipping tanks to complete automatic coating preparation plants.
- Flood basins, dip tanks as well as entire storage terminals can be custom developed to suit each application & customer requirements.

Coating preparation & auto-control plant

- An optimum coating process is achieved with a system custom suited to the particular foundry application.

- Coatings can be dipped robotically or manually and any adjustments to the coating are made automatically to ensure that a consistent coating application is made each time.

Coating preparation & auto-control plant

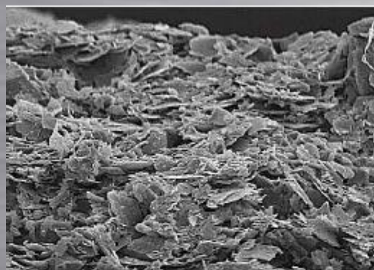


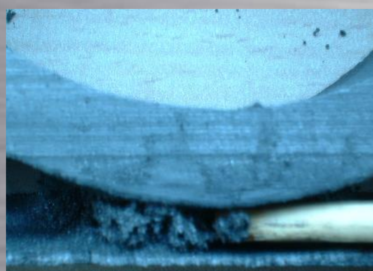
- Viscosity & density measurements are adjusted automatically using a dosing system that feeds coating or liquid carrier at a consistency that coating is applied at stable and desired thicknesses
- Levels of coating in the application area are automatically refilled
- The entire testing equipment is installed outside the tank to prevent contamination of the sensors by the coating as well as wear and tear by the abrasive materials.
- The system includes a washing cycle for the sensor system internally & the disposal of the flushing agent is therefore not needed.

Coating preparation & auto-control plant

- The design of the plant with sealed components reduces any evaporation of the product during use, avoiding need for modification of the coating due to water or alcohol evaporation.
- Equipment can be delivered as a complete system for central processing of the coating or installed at an individual station or dip tank. The plant technology used is tailored to suit varied types of coating.
- The extensive range auto control systems can be adjusted and optimized to all coating application processes in various fields of the foundry industry.
- Good quality coating control ensures a more consistent production of castings with improved levels of overall cast quality.

Critical Properties During Casting





- Must achieve suitable surface finish
- Adequate permeability to release any gases. HA ensures coating permeability suits the application by coating structure
- Suitable refractoriness & thermal stability of coatings are needed
- Good bond strength & resistance to abrasion by metal.
- Adequate ‘keying in’ and coating penetration to prevent mould or core erosion
- Suitable coating release or peel-back needed so that no residue is left internally in the casting

Carrier types used Worldwide

- Solvent - Isopropanol (IPA)

  Ethanol

  Methanol

  Chlorinated Solvents

  Reclaimed solvents

- Water - Purity varies including pH

  These changes effect the coating!

Solvent carrier considerations

- Reasons for choice is mainly price driven globally
- Performances vary due to heat of combustion, boil point and flash point. Different solvents effect the coating performance

Isopropanol HC-30.4 MJ/Kg , Bp = 82 C, Flash point = 12 C

Higher heat of combustion (burns hotter), Lower rate of evaporation (Bp 82C)

Easy ignition, Very low tendency for filler separation & allows longer brushability with most gel systems

Ethanol HC-28.9 MJ/Kg, Bp= 78 C, Flash point = 13 C

Fairly high heat of combustion, med evaporation rate, ***Least easy***

Ignition *(often has 5% water, lowering further)*. Low tendency for filler separation.

Methanol HC-19.9 MJ/Kg, Bp= 65 C, Flash point = 11 C

Lower heat of combustion (burns cooler)*. *High evaporation rate, Easiest ignition, Higher tendency for filler separation, shorter brushability. Is a Toxic solvent and should be used with care.

Reclaimed solvents

Ensure good consistency, not recommended due to variability

Efficient application summary

- Correct coating applications will reduce casting defects
- Correct coating choices are needed for each application
- Solvents for dilution effect coating performances
- Coating thickness and even application is very important
- Process control should be monitored carefully in the foundry
- Operator training (manual) / or correct settings (robot) are vital to ensure consistent application.
- New automated coating control systems are now available to improve consistency in our modern foundries

Thank you for your attention