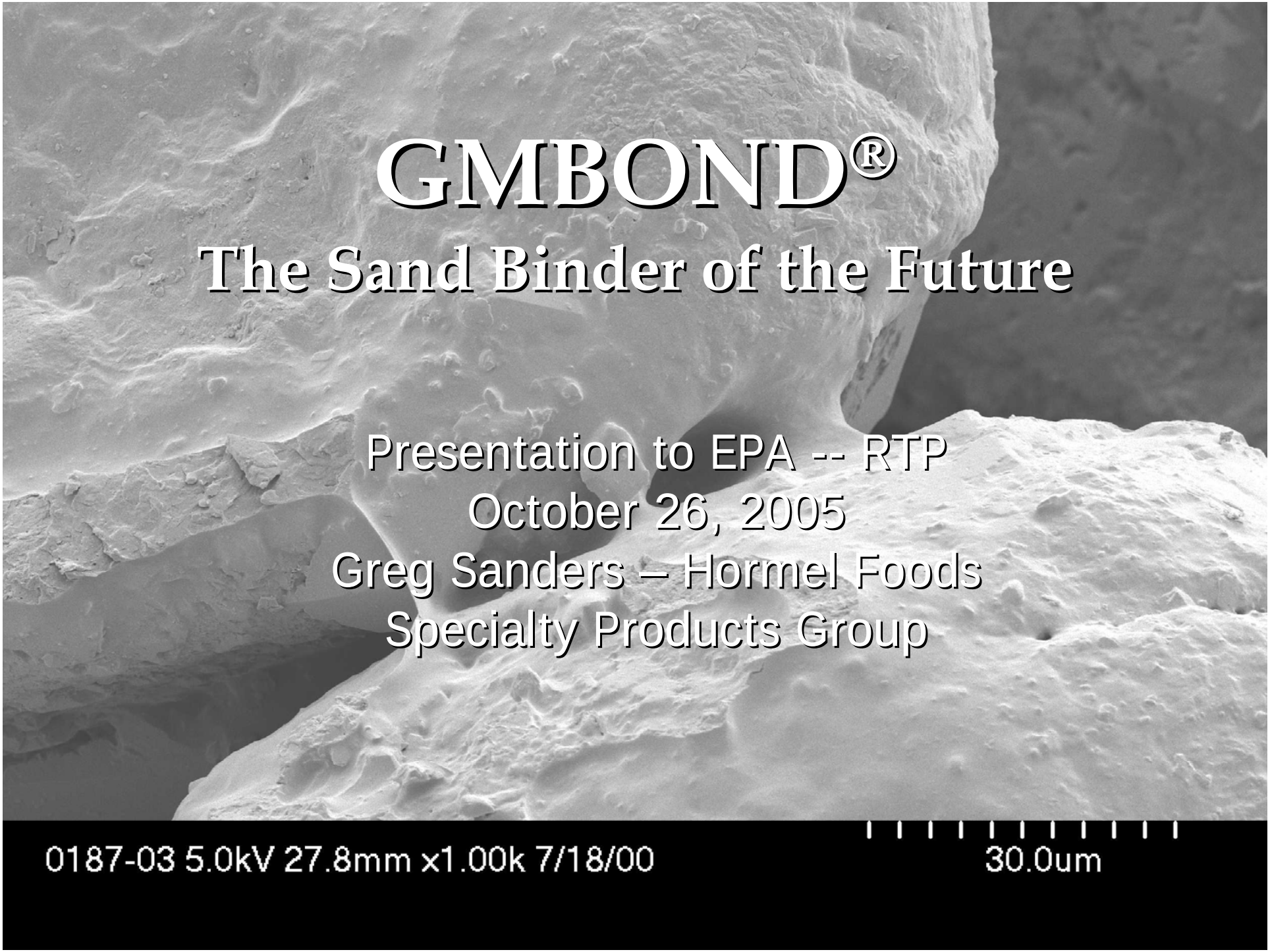
GMBOND®

The Sand Binder of the Future

Presentation to EPA -- RTP
October 26, 2005
Greg Sanders – Hormel Foods
Specialty Products Group



Why are we here?

Pollution Prevention and Reduction

- Pollution preventing technologies
  - "Ideal" binder systems, do they exist?
    - Inorganic technology
    - **Protein technology**
    - Other "natural" organic binders
- Pollution control technologies
    - Advanced Oxidation (A/O)

GMBOND® Sand Binder -- History

- GM Research and Development - began early 1990's
  - Patent awarded - 1994
    - Sand binder material identified
  - Patent awarded - 1996
    - Coremaking process established
- Hormel Granted Licensing – 1999
  - Hormel R&D expanded development to other alloys
- Hormel Annex Fully Equipped & Staffed – 2002
  - Sampling Initiated -- 2003
  - Customers -- 2005

GMBOND® Sand Binder

- Made up of two main ingredients
  - Protein
  - Catalyst
- Renewable resource
  - Water based
  - Non-toxic
- Environmentally friendly
  - Reduces employee chemical exposure
  - Lowers foundry emissions
  - Low odor (different)
  - Safe & easy to handle & store

GMBOND® Sand Binder

- Chemical Composition
  - Carbon - 50%
  - Nitrogen - 17%
  - Hydrogen - 7%
  - Oxygen - 25%
  - Trace minerals

GMBOND® Process

Sand

GMBOND

Water

Mix until Dry

Coated Sand

Cool < 70°F (20°C)

Water

Sand Into Core Box

Heat to Melt Binder

Remove Water to Harden

Core

Chemicals

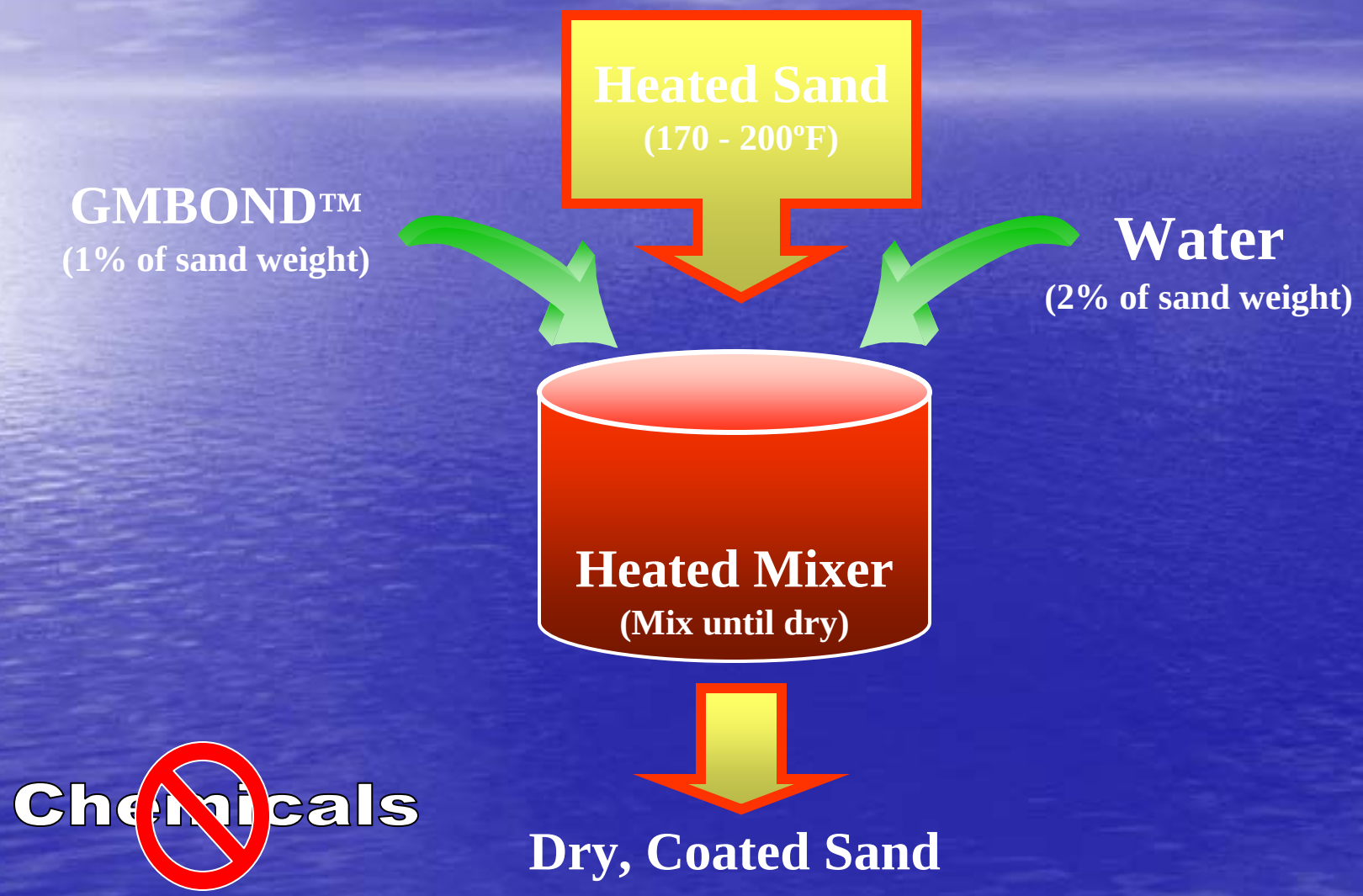
Add Water

Remove Water

Add Water

Remove Water

Coating Sand with GMBOND® Sand Binder

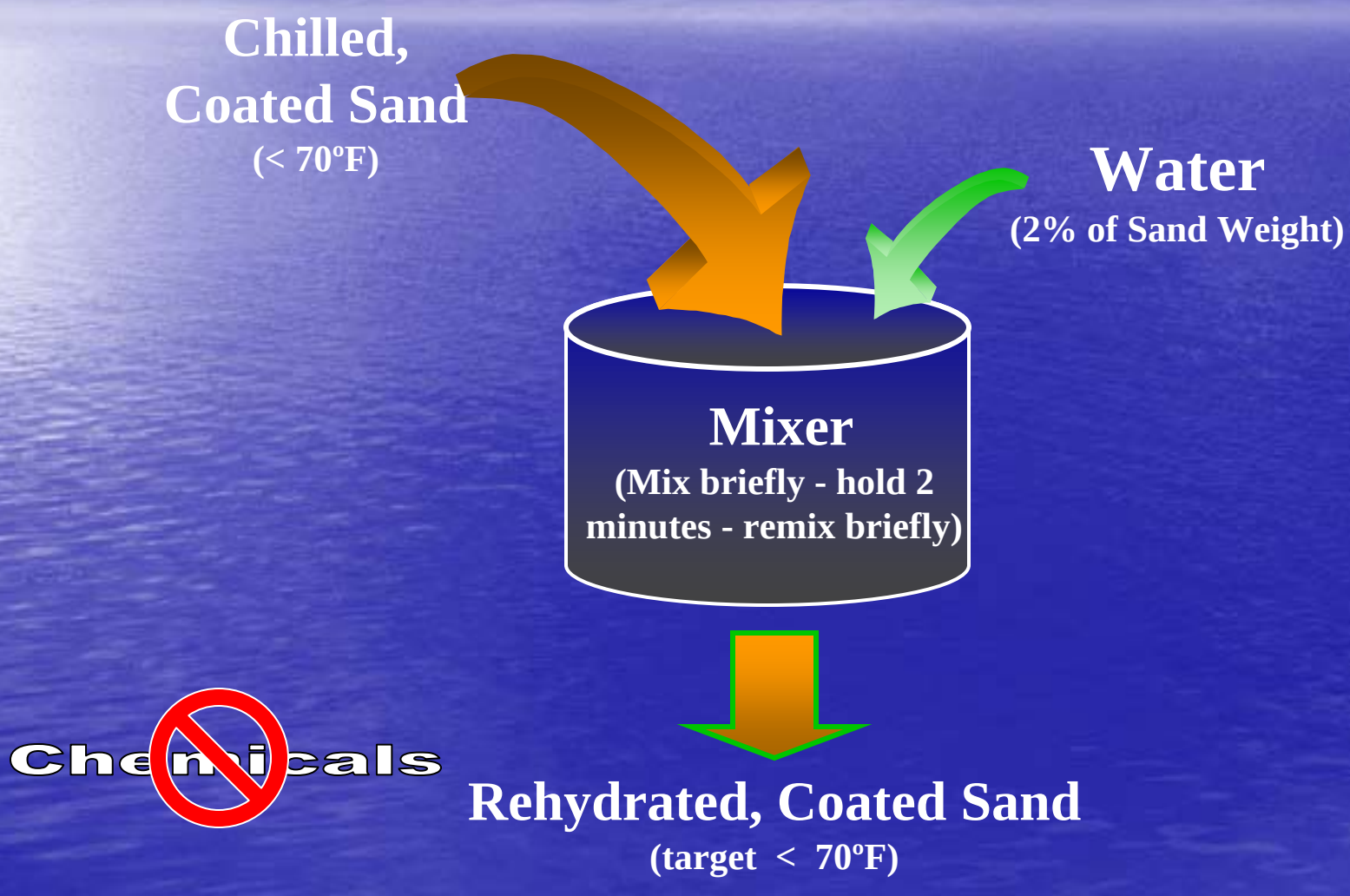


Chemicals

GMBOND® Process

- Conditioning - hydrating coated sand
  - Coated Sand
  - Water 2% BOS
- Mixture changes states
  - Water addition causes binder to gel
  - Cool conditioned sand - flowable for coremaking

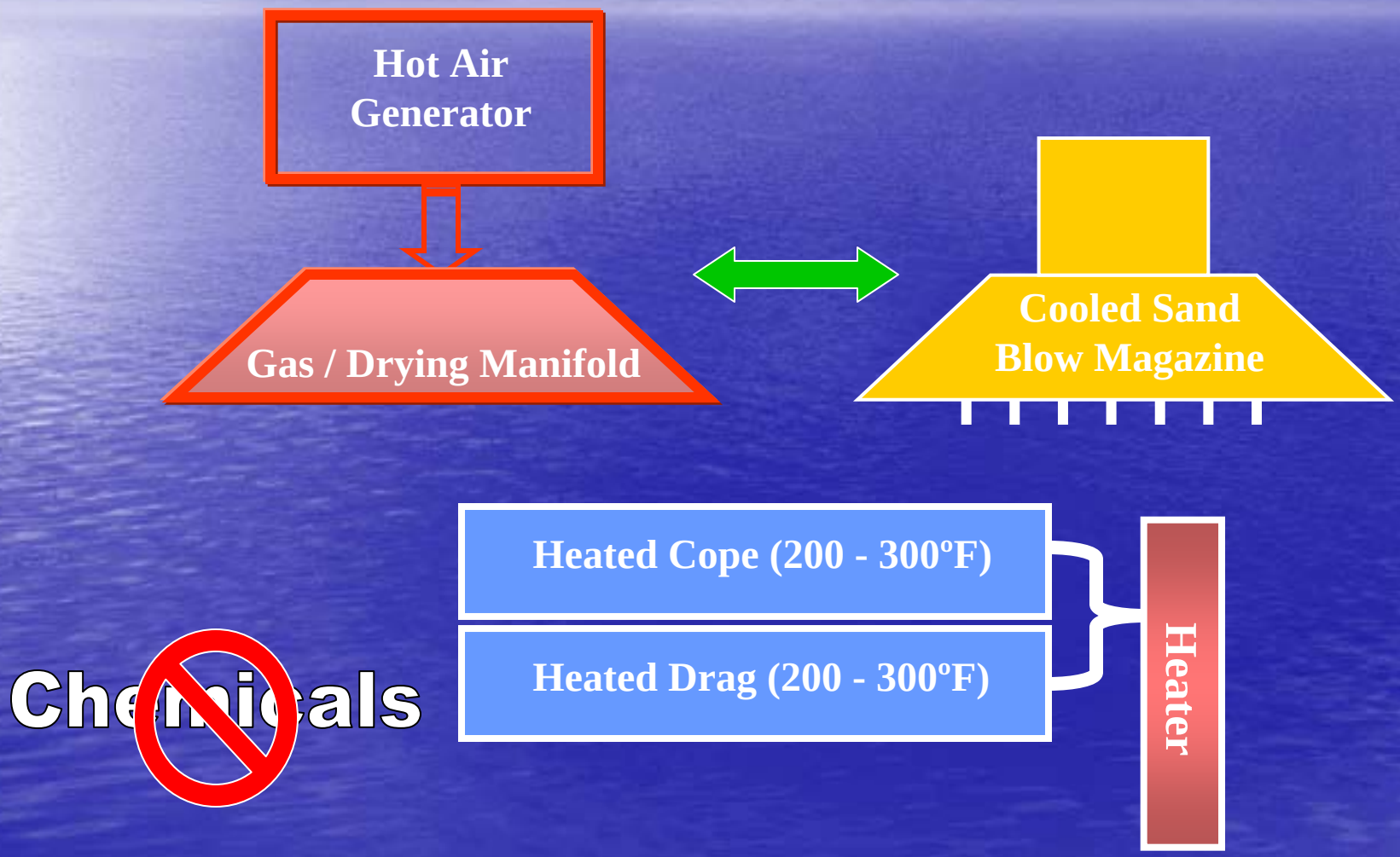
Rehydrating GMBOND® Coated Sand



GMBOND® Process

- Coremaking Equipment - combination of hotbox and coldbox technology
  - Core Machine
    - Cooled Sand Magazine
    - Purge Head
    - Air Heater
  - Tooling
    - Cooled Blow Plate and Blow tubes
    - Heated Metal Tooling with vents

Equipment -- Making Cores with GMBOND®



Blowing Cores with GMBOND®

1) Rehydrated, Coated Sand (target < 70ºF)

2) Blow with ~60 psi air

Chemicals

Activating GMBOND®

Dwell Time for Activation
(~10 seconds)

Hot Air
Generator

Gas / Drying Manifold

Cooled Sand
Blow Magazine

Heated Cope (200 - 300ºF)

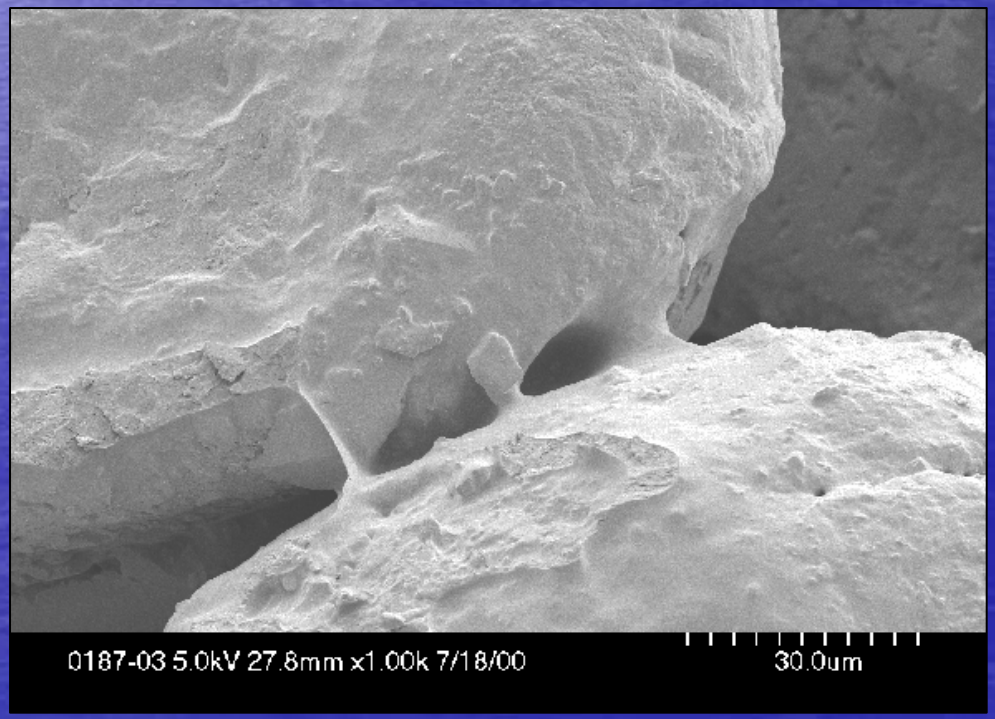
Heated Drag (200 - 300ºF)

Heater

Chemicals

GMBOND® Process

- Strength Profile - bridge formation during Activation as surface tension changes



Hardening GMBOND® Cores

Blow Heated Air through Cores to Remove Moisture

Hot Air Generator

Cooled Sand Blow Magazine

Gas / Drying Manifold

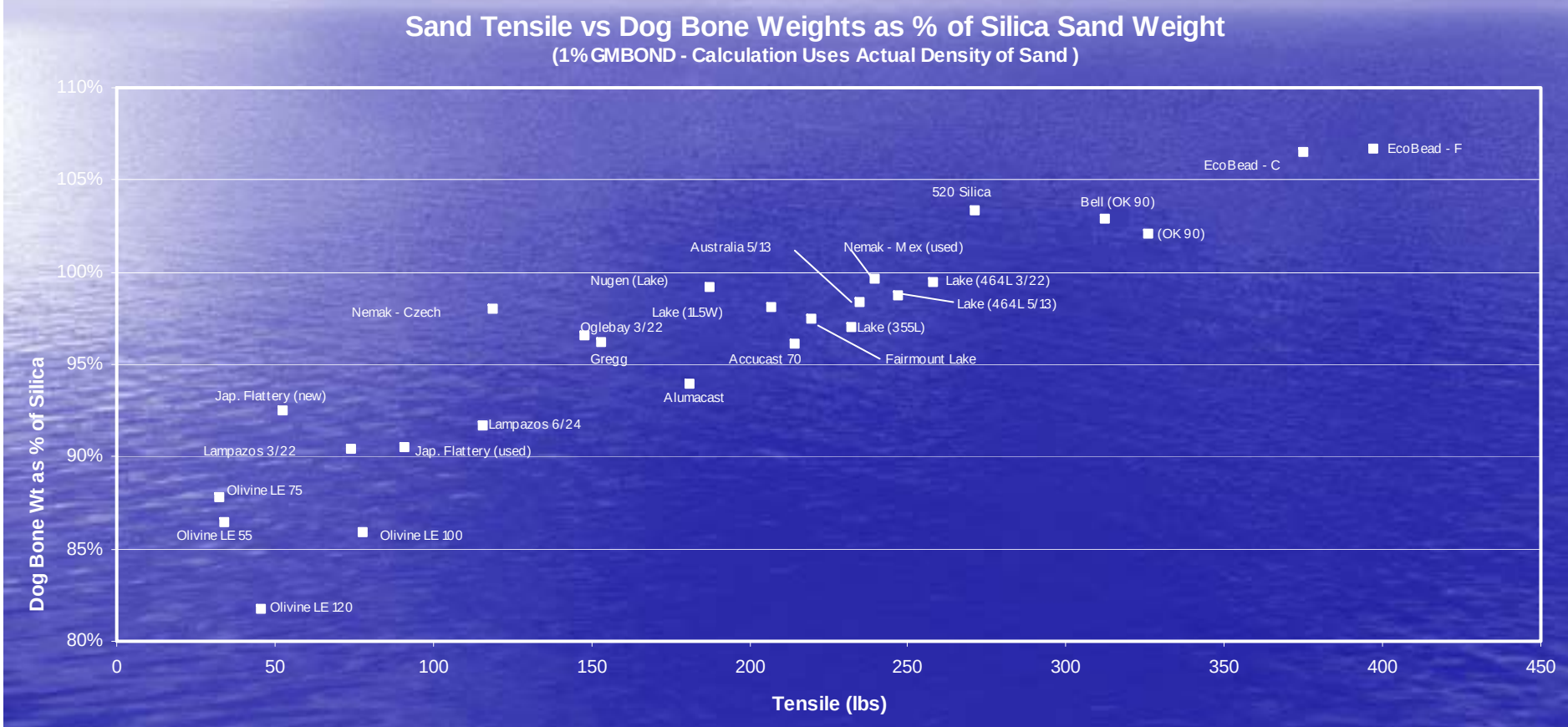
Heated Cope (200 - 300ºF)

Heated Drag (200 - 300ºF)

Heater

Chemicals

GMBOND® Tensile Data – Core Strength

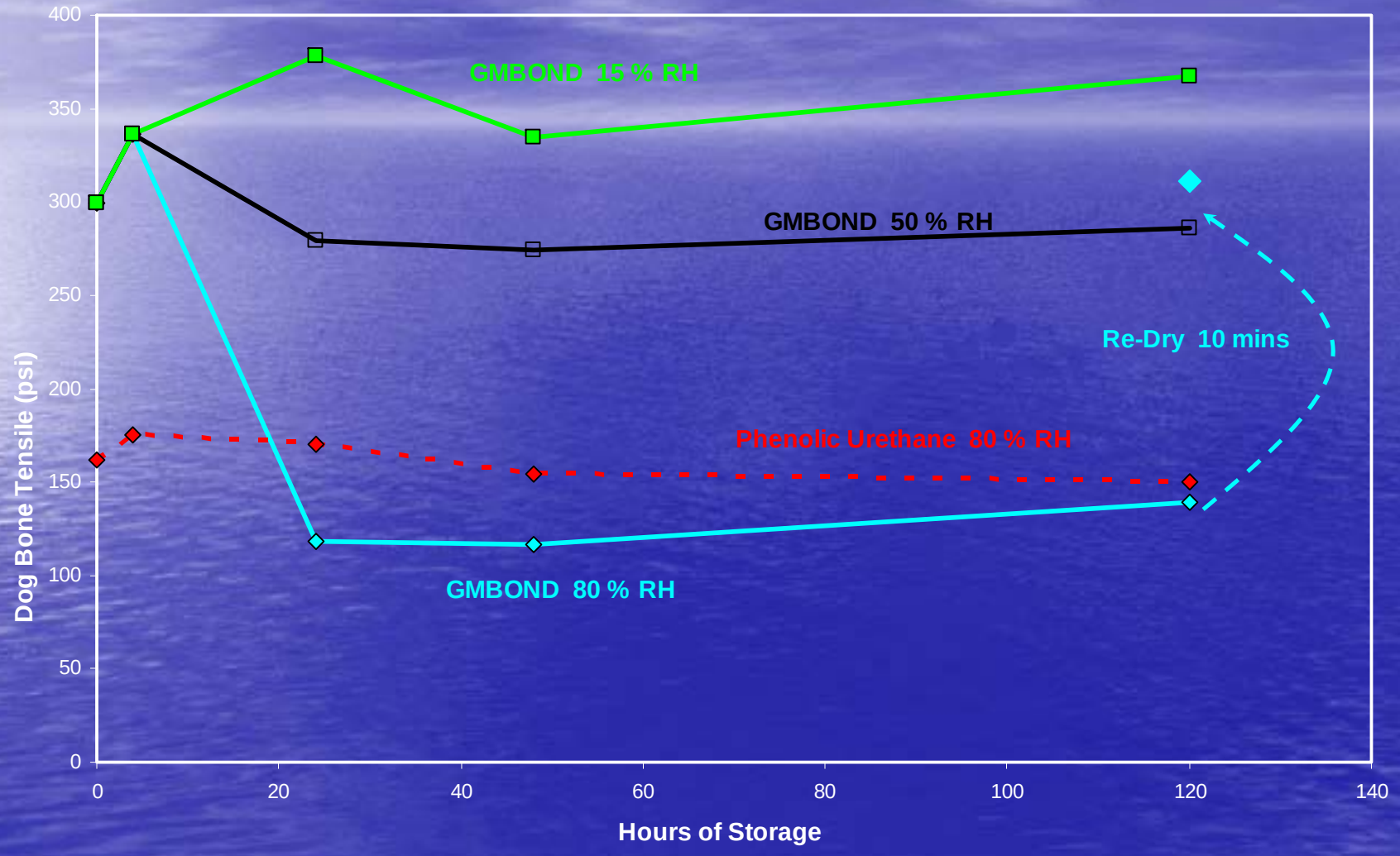


GMBOND® -- Core Strength

- Shelf Life
  - Tensile strength affected by humidity
  - Cores can regain full strength if dried
  - No detrimental effects on casting quality
  - Satisfactory handling strength
  - Cores do not become friable

Effect of Storage Humidity on Tensile Strength

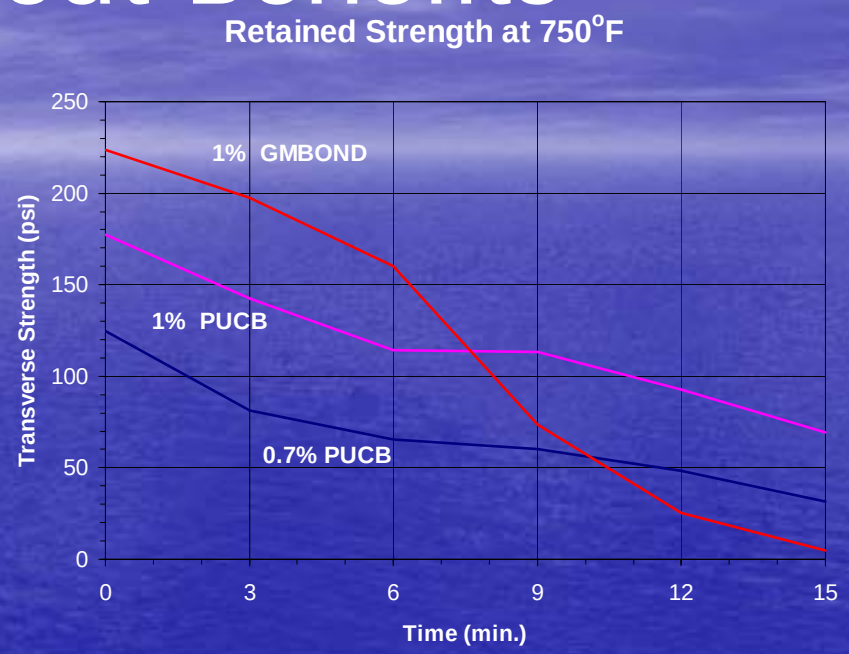
1% GMBOND - Silica Sand - 70 F

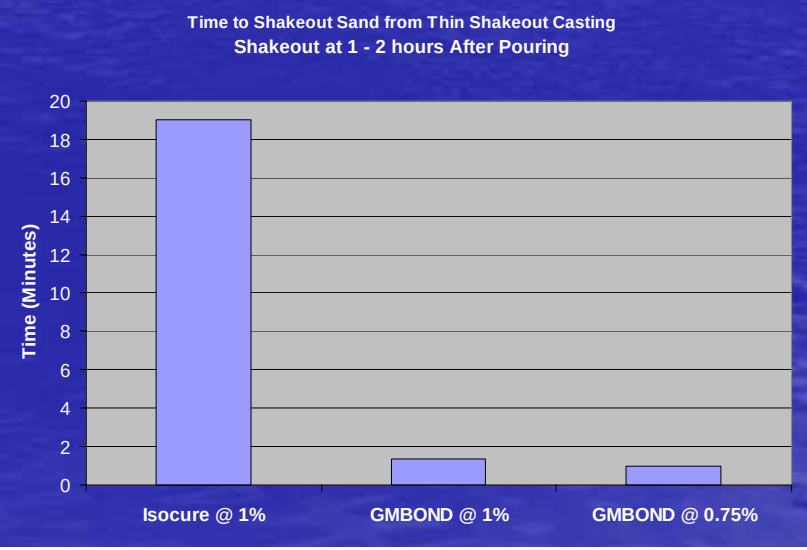


Data provided by UNI

GMBOND® Shakeout Benefits

- GMBOND® holds it strength and then collapses (rapid decomposition) after 6 minutes at 750ºF
- Shakeout times reduced





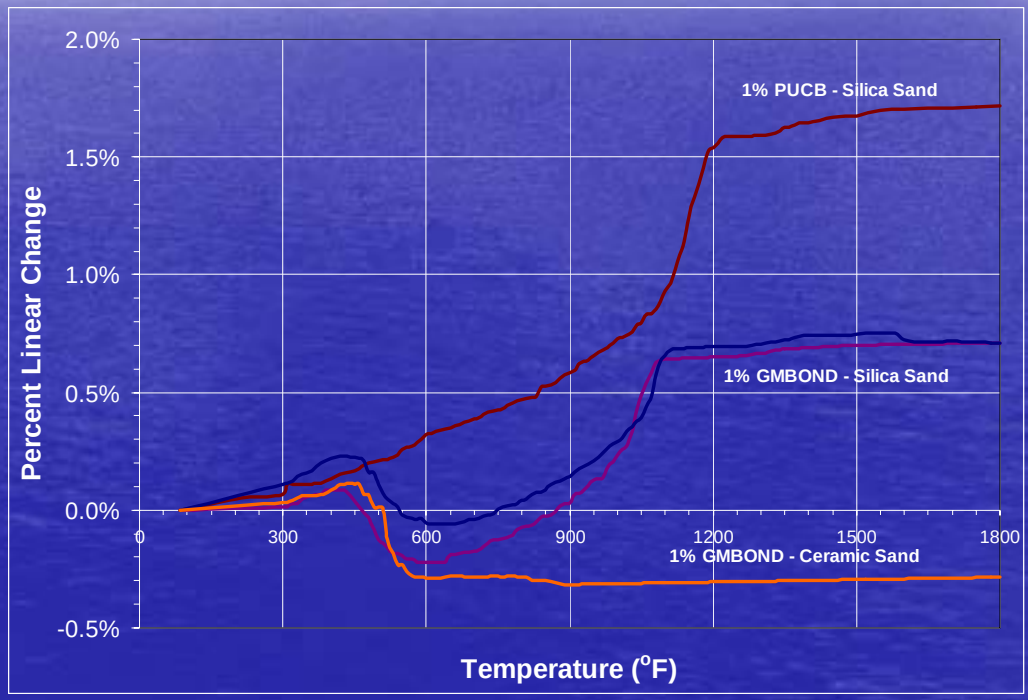
Data provided by UNI

GMBOND® Shakeout Benefits

- Collapsibility - enhanced by catalyst
  - Very small additions of metallic oxide catalyst increase thermal degradation at low casting temperatures
  - Do not have to sacrifice collapsibility or surface finish for handling strength
  - Mechanical bonds in binder require little energy to break

GMBOND® Dimensional Stability

- Thermal expansion mainly due to silica
  - Binder effect negligible
- Expansion approx. 0.5% in Aluminum pouring range



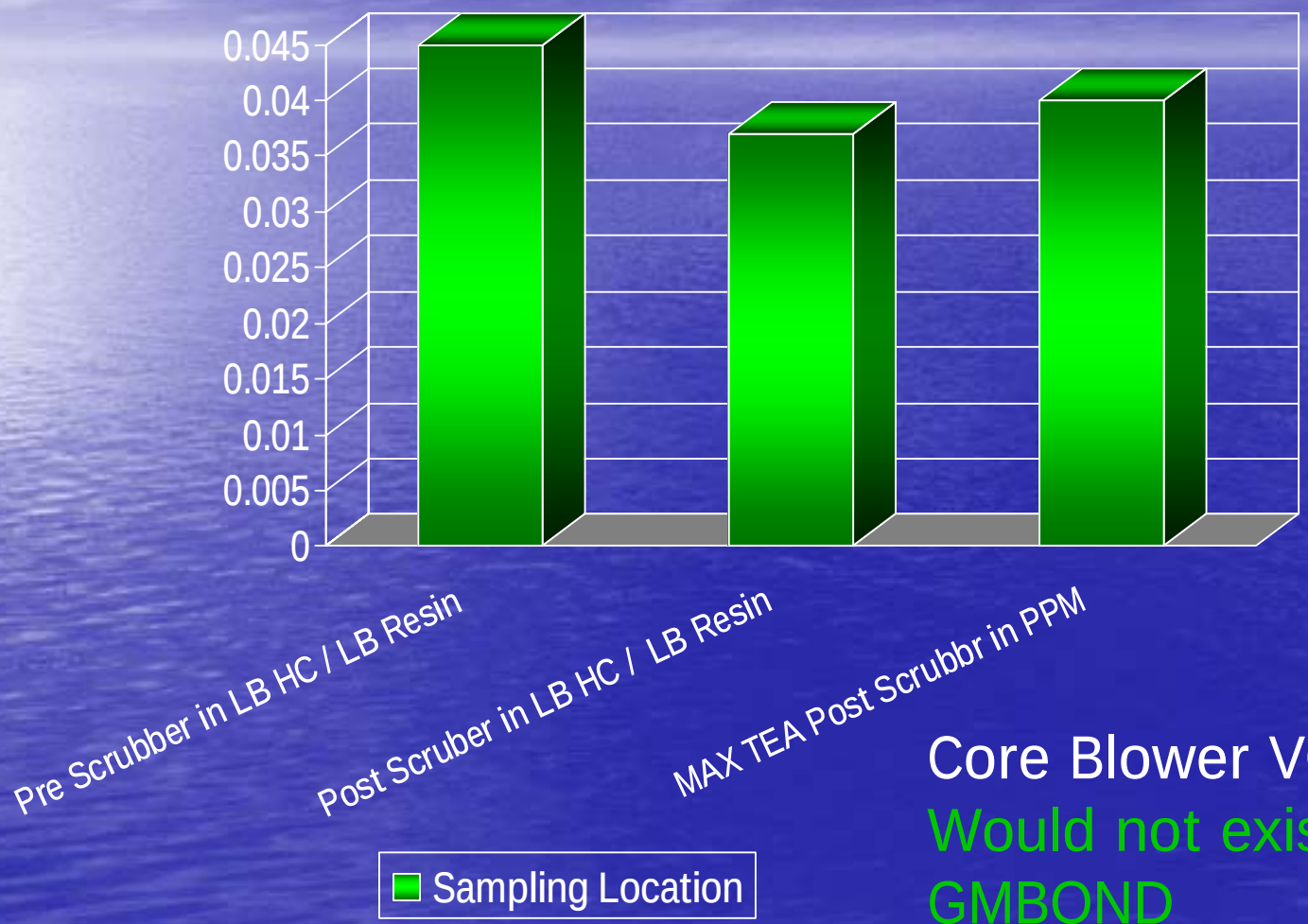
High Temperature Expansion

Data provided by UNI

GMBOND® Environmental Benefits

- Equipment Cleanup and Storage
  - Non-flammable
  - Non-reactive
  - Mild soap and water based cleaner
- Air Emissions
  - Dramatic reductions in air emissions
- Recycling and Reuse
  - Reuse core butts and scrap cores
  - Disposal reduced and non-toxic

GMBOND® Environmental Benefits



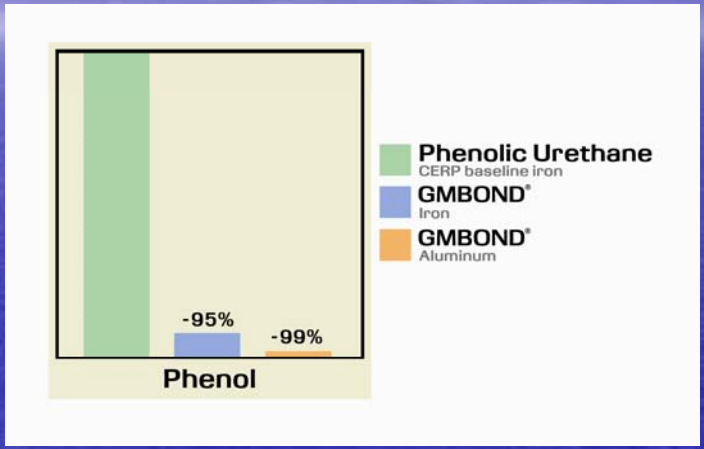
Core Blower VOC Emissions

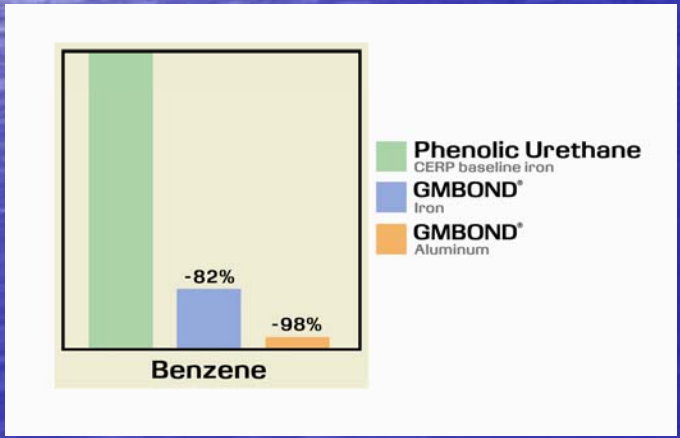
Would not exist with GMBOND

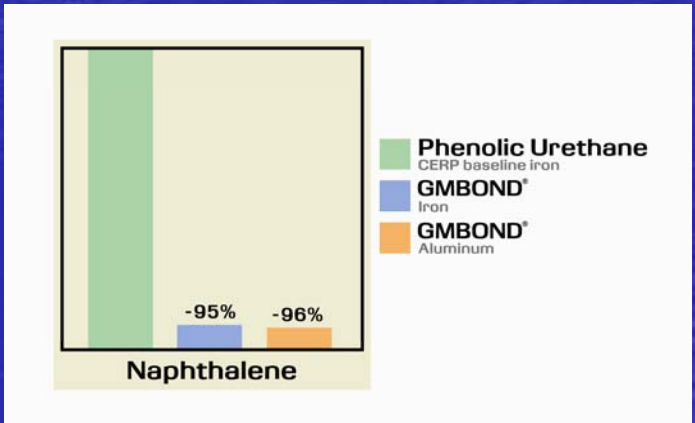
Data provided by CERP

GMBOND® Environmental Benefits

- Significant reductions in Benzene, phenol, and napthalene emissions



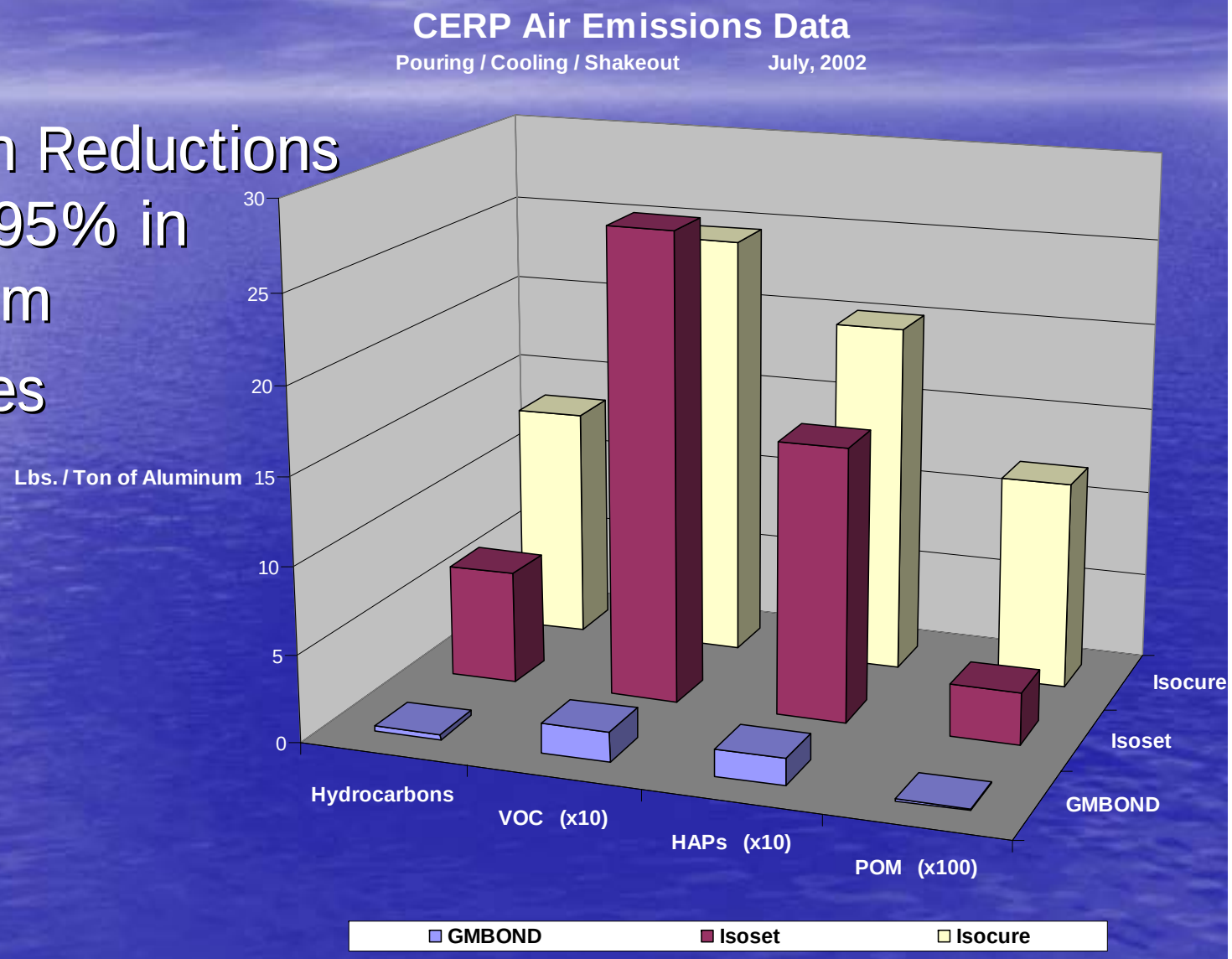




Data provided by CERP

GMBOND® Environmental Benefits

- Emission Reductions of over 95% in Aluminum Foundries



Data provided by CERP

GMBOND® Environmental Benefits

- Reuse and Recyclability
  - Core Removal
    - Remove Core butts from core package
  - Crush Core butts & Scrap Cores
    - Break down into individual sand grains
    - Transport back into process at Sand Conditioning

GMBOND® Environmental Benefits

- Reuse and Recyclability
  - Thermal Sand Reclamation
    - Less material to reclaim
    - Ability to reclaim at lower temperatures
    - No affect of ADV on core properties after reclamation
    - Supplies Sand Coating Process with hot sand
      - no extra energy needed for sand coating

GMBOND® Sand Binder Cost Comparison

- GMBOND is a push with Phenolic Urethane binder when used with green sand and a savings when used in an all cored package.
- Today, GMBOND binder itself costs more than Phenolic Urethane but the amount used is less, effectively eliminating the difference.
- GMBOND price is stable (not affected by petroleum market)
- GMBOND eliminates need for scrubbers, respirators, etc.

Phenolic Urethane vs GMBOND®

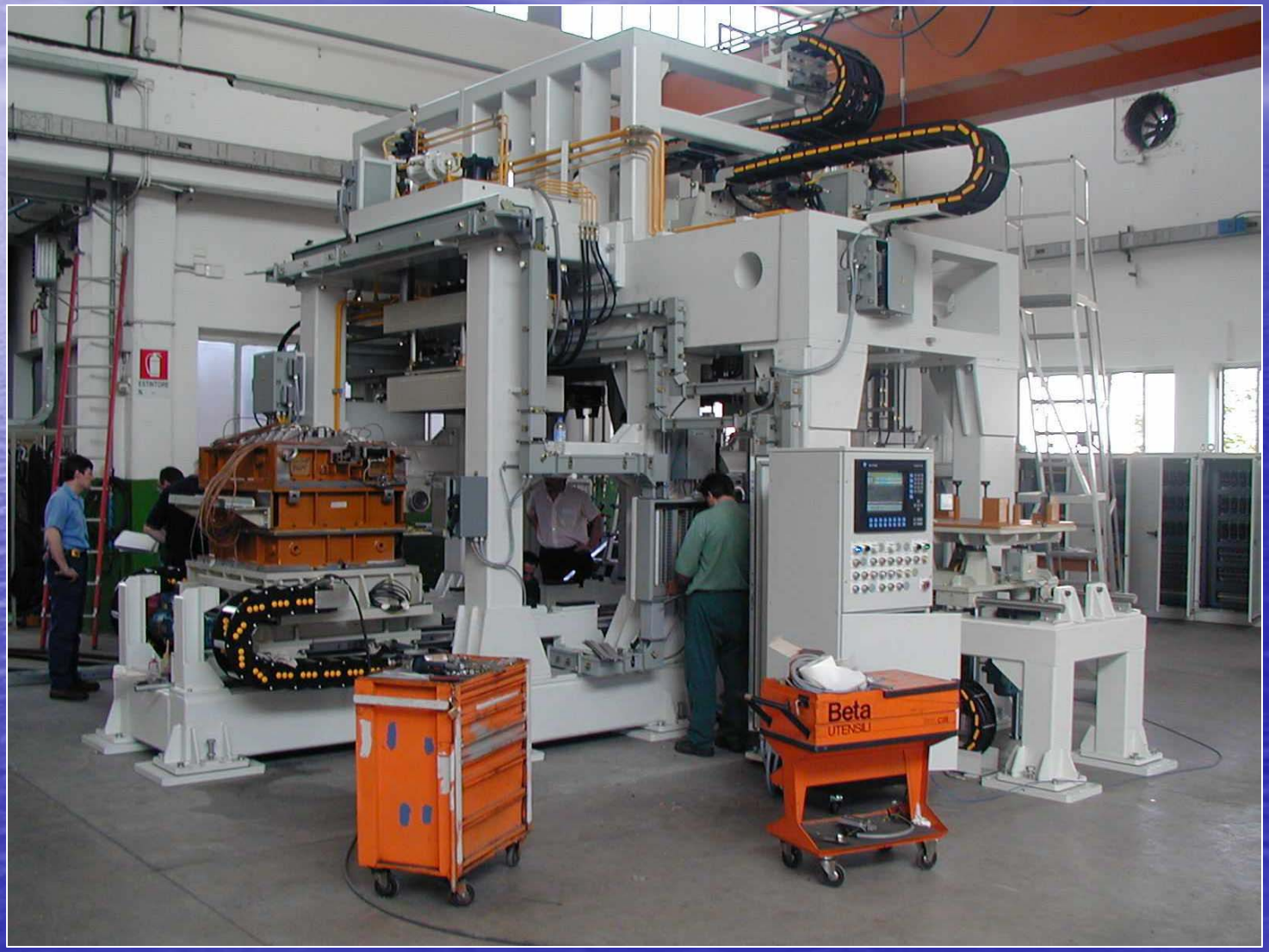
Phenolic Urethane

- Proven Productivity
- Higher Air Emissions
- SARA Reporting Requirements (TEA, MDI)
- Requires Heat for Sand Reclamation – 925 F +
- Waste Stream for scrap cores

GMBOND®

- Production Methods proven
- Low Air Emissions
- **NO CORE ROOM EMISSIONS**
- No SARA requirements
- Reclaims with water
- Low waste generation – scrap sand can be reused, resin recovered from water and reused

GMBOND® Coremachine Demonstration - GM Foundry



GMBOND® Core Applications

GMBOND® Environmental Benefits

#1 Water-soluble & non-toxic

#2 Natural renewable material

#3 No special handling or storage

#4 Eliminates scrap cores & waste

#5 Easier sand reclamation

#6 No hazardous chemicals used

#7 Lowers emissions

GMBOND® Casting Benefits

#1 Improved shakeout effectiveness

#2 Excellent hot strength

#3 Excellent surface finish

#4 High temperature alloys

#5 Water based core washes

#6 No thermoplastic deformation

#7 Easy to use

GMBOND® Sand BINDER

H_2O IN → H_2O OUT

~~Chemicals~~