Institute of Refractories Engineers

HEAT INSULATING REFRACTORIES

IRE Training Day
25 September 2008

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Heat Insulating Materials

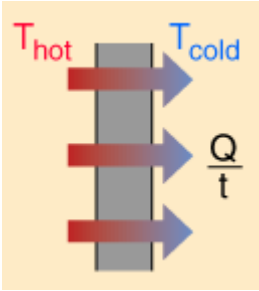
- WHY INSULATE
- HOW HEAT FLOWS
- HOW INSULATION WORKS
- TYPES OF INSULATION
- STEADY STATE AND TEMPERATURE CHANGE
- PROPERTIES
- EXAMPLES

Why Insulate?

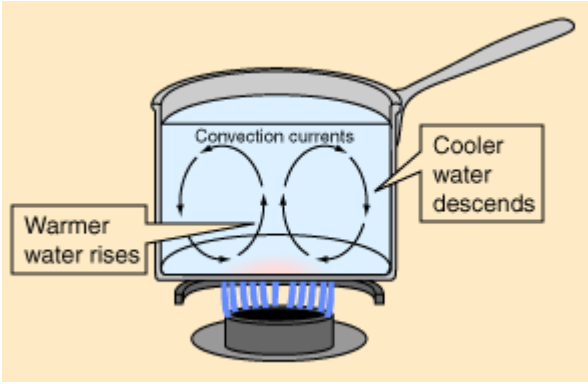
- Reduce Heat Flow to Shell/Outside
  - Acceptable Shell Temperature
  - Reduce Heat Loss – Fuel Saving
  - Control Cooling Rate
- Reduce Lining Weight
  - Less Energy To heat up Lining
    - Reduce Heat Up Energy Loss
    - Faster Heat Up/Cool Down
      - Cycle Time
      - Availability

How Heat Flows

Conduction



Convection



Radiation

How Insulation Works

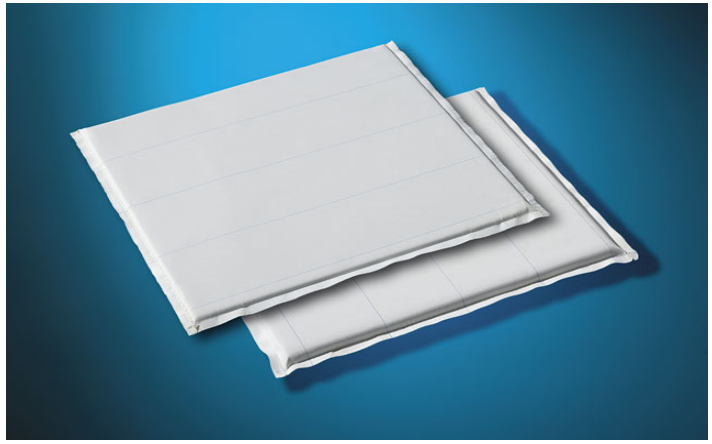
- High Porosity
  - Air is less conductive than solid refractory
- Small Pore Size
  - Small pores limit convection
  - Pore surfaces stop once-through radiation
  - Very small pores STOP radiation

Types of Insulation

Insulating Castable/Gunning

Fibre Insulation

Insulating Firebrick



Microporous Insulation

Insulating Castable/Gunning

COMPOSITION
Cement Binder
Lightweight Aggregate eg
Expanded Clay
Vermiculite

MAX TEMPERATURE 1300°C

WEIGHT
High – Density 1000-1500kg/m^3

INSULATION VALUE
Poor – Conductivity >0.5W/mK

PHYSICAL PROPERTIES
Good

COMMENT
Ease of Installation
Needs Anchorage

Insulating Firebrick

COMPOSITION
Refractory Grains
eg Chamotte
Combustible Particles
eg sawdust, EPS
Ceramic Bond

MAX TEMPERATURE 1500°C

WEIGHT
Medium – Density 600-1000kg/m^3

INSULATION VALUE
Low – Conductivity >0.2-0.5W/mK

PHYSICAL PROPERTIES
Medium

Insulating Firebrick - Production

Batch and Mix

Extrude - Oversize

Dry

Fire

Machine to Size

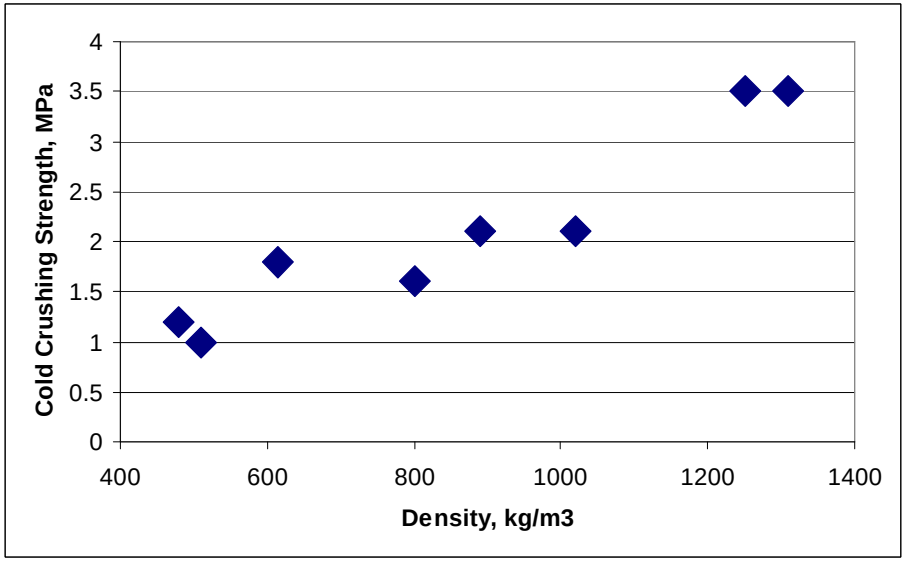
Insulating Firebrick - Properties

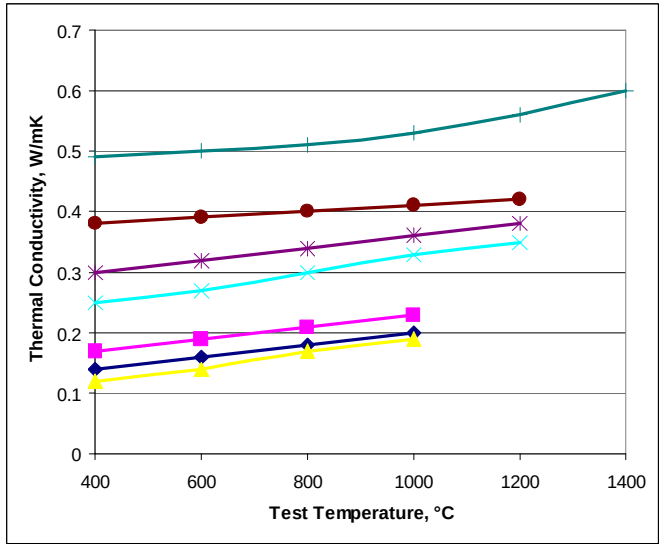
An INCREASE in Density ….

- Decrease in Insulation Value
- Increase in Strength
- Increase in Max Temp

CLASSIFICATION TEMPERATURE

- Defined by Shrinkage.
- **<u>NOT</u> Maximum Service Temperature**





Fibre Products

RCF vs BODY SOLUBLE

- Health Issue
  - Substitution
  - Exposure Avoidance
  - Monitoring
  - Labelling
- Maximum Temperature

Fibre Products

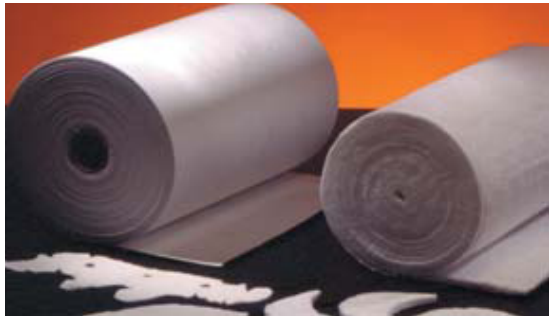
Bulk

Board

Blanket

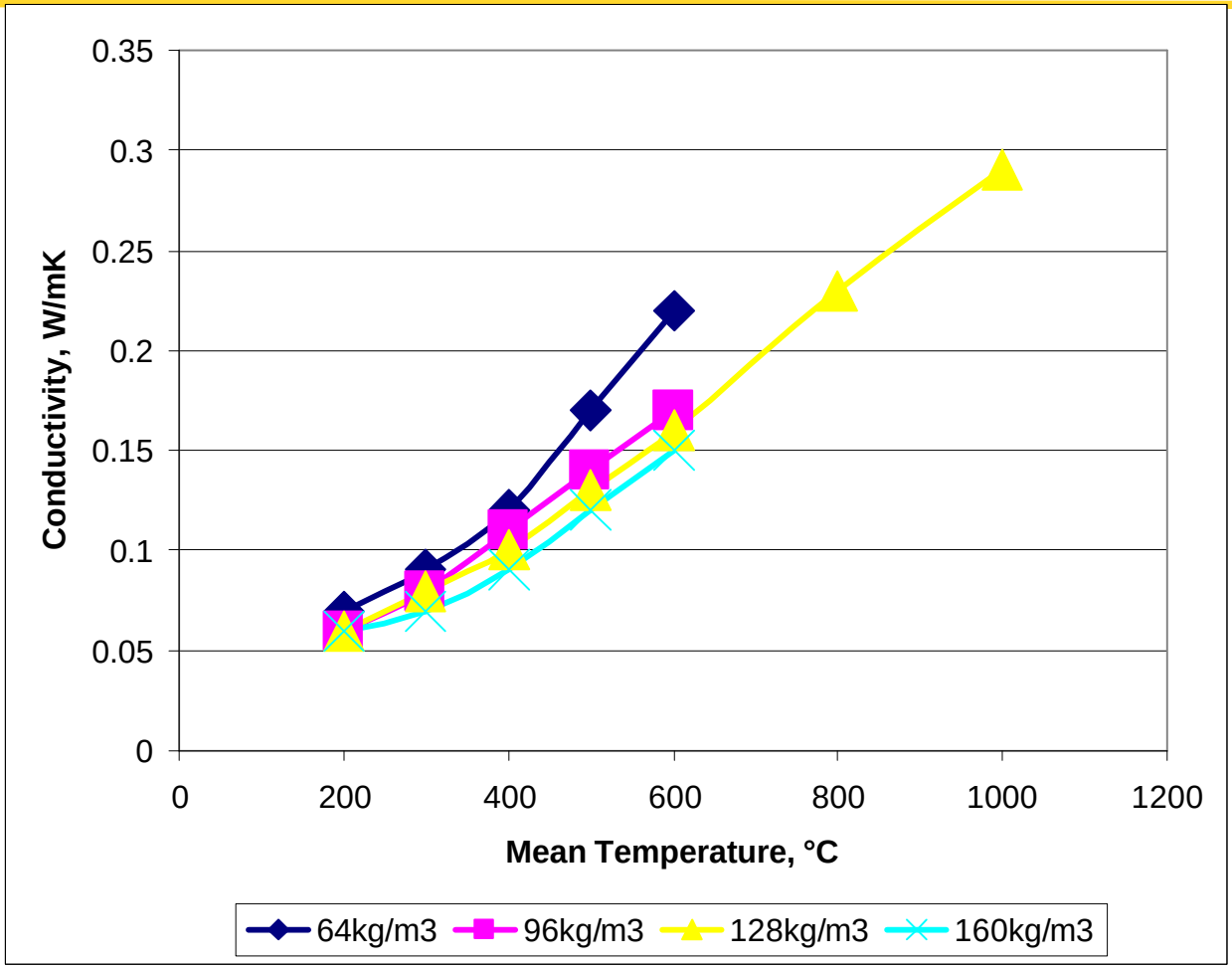
Vacuum Formed

Modules

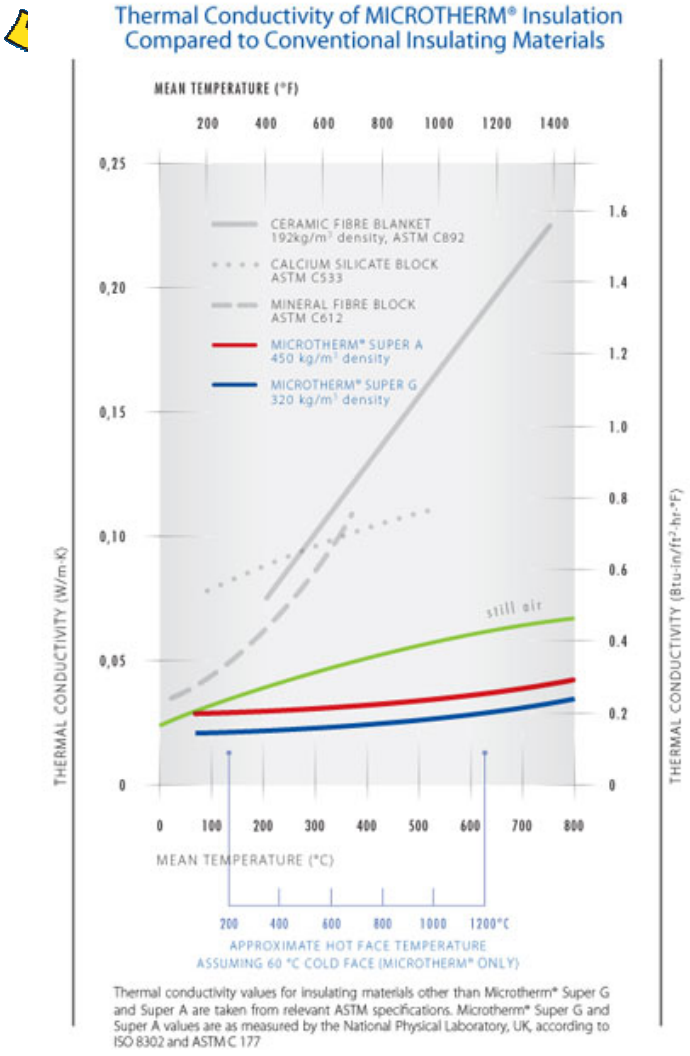


Paper

Fibre Products



Microporous Materials



- Temperature vs Thermal Conductivity
- Installation
  - Bending & Cutting, Water

Heat Flow Calculation

General Comments

- Consider Maximum Temperature
- Thermal Conductivity Value at Temperature
- Available Thickness
- Strength Requirements
- Chemical Attack – Hydrogen, Alkali

Thank You For Your Attention