



Institute of Refractories Engineers

Insulation Applications

Sheffield
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Classification Temperature

Insulation Firebrick to EN1094-2

The temperature (in 50°C steps) at which the PLC is $\leq 2\%$.

	PLC at 1250°C	PLC at 1300°C
A	0.6%	2.1%
B	1.9%	3.5%

Both would be classed as 1250°C materials
This is in a 12h test



Classification Temperature

Long term behaviour??

CLASSIFICATION TEMP IS **NOT** MAX SERVICE TEMP

What is Average temperature in the product?

Cold face may not shrink

Can Exceed Classification Temp for SHORT times



Cost

Approx Relative Cost of different insulation types.

Material	Per Tonne	Per Volume	Per R Value
Castable	50-100	300-400	100-150
Brick	100-150	600-1,200	100-500
Fibre	300-1000	300-1,000	30-300
Microporous	10,000-20,000	20,000-50,000	1,000-1,500



Intermittent Process

Energy required to heat and cool furnace

Low mass = energy saving

Heating rates – process efficiency



Thermal Conductivity

Thermal Conductivity determines how thick a lining can be

- Thinner linings allow a larger process volume
 - Greater throughput



Installation

Ease of installation

- Equipment already on site
- Need for Anchors
- Access and material feed



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Furnace Atmosphere

Acid gases

- Condense on cold areas
- Corrosion of casing and refractory

Hydrogen

- Common in petrochemical process
- Conductivity of insulation is much higher in hydrogen atmospheres
 - Increased heat loss and shell temperatures

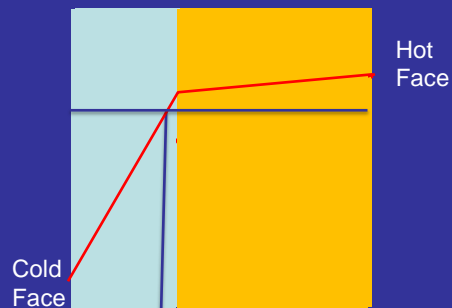


Freeze Line

If liquid penetration of a lining can occur, the liquid will penetrate to a freeze-line where it solidifies.

Increasing the amount of insulation will move change the thermal profile.

This will change the position of the freeze line.





Freeze Line

Example Steel Ladle

- Insulation needed to reduce heat loss during processing
- Attack in some cases due to slag attack of zone where slag has penetrated
- Need to balance heat loss versus refractory wear



Too Much Insulation

Can you have too much insulation

- Increased lining thickness and cost
- Reduced cool down time for maintenance stops
- Accelerated hot face wear
- Acid gas condensation



Mechanical Properties

Lower strength than dense (hot face) products

- Castables usually have higher strength than other forms
- Ambient strength required for
 - Handling during installation
 - Load from refractories above
- Hot Strength Required for
 - Load from refractories at temperature
 - Load from furnace charge
 - Vibration
 - Abrasion from solids and dusts



Application - Example

Refinery Fired Heater

- Large fired heater, Heats oil for subsequent processing
- Radiant section is lined with insulation
 - Keep casing cool
 - Reduce heat losses
- Major energy cost in a refinery





Process Requirements

Hot face temperature in Radiant Zone	~1000-1100°C
Tube temperature	~500°C
Skin Temperature	<100°C
Service Life	3-5 years between stops
Fuel	A range of gas and liquid fuels



Installation Factors

- New units are often transported ready lined
- During stops, repair is quicker than full replacement
- Distortion of casing leads to hot spots
- Local climate and labour availability can affect material choice



Material Selection - Brick

- | | |
|---|---|
| ✓ Ease of installation | ✗ Shell distortion likely to lead to gas tracking |
| ✓ Local Repair Possible | ✗ Transport of lined unit is difficult |
| ✓ Erosion resistant lining | ✗ Risk of Collapse |
| ✓ Can work with no hot face
(except dirties fuels) | |



Material Selection - Castable

- | | |
|-----------------------------|---|
| ✓ Shop Installation Easy | ✗ Risk of Anchor Corrosion |
| ✓ Local Repair Possible | ✗ Low Insulating Value (Thicker Lining) |
| ✓ Erosion resistant lining | ✗ Higher Density |
| ✓ Can work with no hot face | ✗ Heavier lining |
| | ✗ Installation difficult in v hot condition |



Material Selection - Fibre

- ✓ Good Insulating Value
- ✓ Light Weight
- ✓ Shop Lining is possible (Modules)
- ✗ Problems from build up of ash or coking
- ✗ Anchor corrosion can occur
- ✗ Abrasion from dirtier fuels



Material Selection - Summary

And the normally supplied lining material is.....

ALL TYPES ARE COMMONLY USED



EXERCISE
