Institute Of Refractories Engineers

Some Refractory Installations

Refractories Training Day
25th September 2008

Steve Wright

Institute Of Refractories Engineers

	Installation Issues Time, Access, Safety, Material Feed Installation Standards & Supervision Shuttering, centres, stop boards, Gunning – rebound Cool down & Heat up	

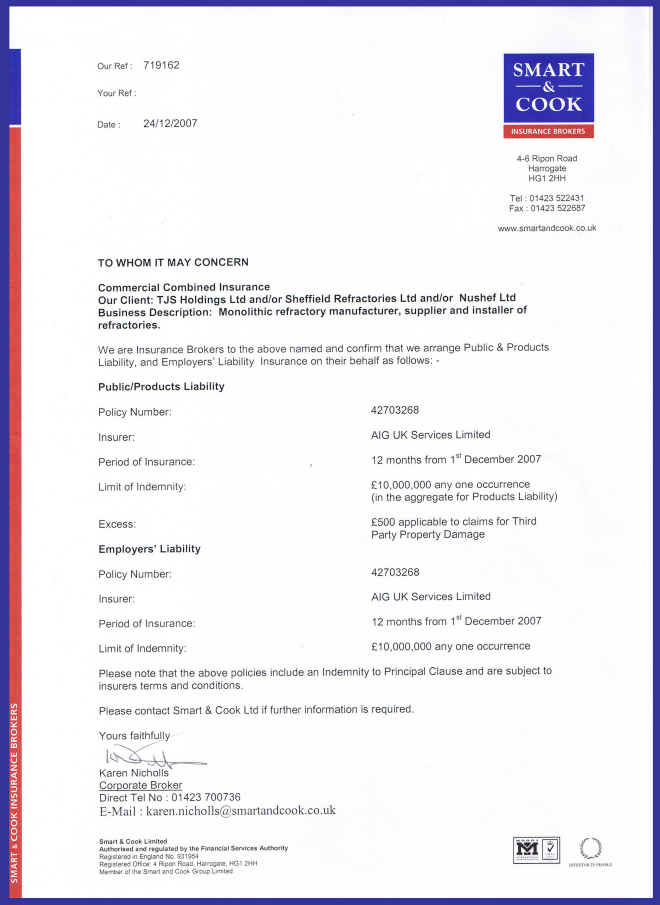
Refractory Installation

- Documentation, Legislation and Procedure and the Health Safety and Welfare of those installing and with whom they interact

- Carrying out the Installation

Refractory Installation

- Documentation, Legislation and Procedure and the Health Safety and Welfare of those installing and with whom they interact



Our Ref : 719162

Your Ref :

Date : 24/12/2007

SMART & COOK
INSURANCE BROKERS

4-6 Ripon Road
Harrogate
HG1 2HH

Tel : 01423 522431
Fax : 01423 522687

www.smartandcook.co.uk

TO WHOM IT MAY CONCERN

Commercial Combined Insurance
Our Client: TJS Holdings Ltd and/or Sheffield Refractories Ltd and/or Nushef Ltd
Business Description: Monolithic refractory manufacturer, supplier and installer of refractories.

We are Insurance Brokers to the above named and confirm that we arrange Public & Products Liability, and Employers' Liability Insurance on their behalf as follows: -

Public/Products Liability

Policy Number:	42703268
Insurer:	AIG UK Services Limited
Period of Insurance:	12 months from 1st December 2007
Limit of Indemnity:	£10,000,000 any one occurrence (in the aggregate for Products Liability)
Excess:	£500 applicable to claims for Third Party Property Damage

Employers' Liability

Policy Number:	42703268
Insurer:	AIG UK Services Limited
Period of Insurance:	12 months from 1st December 2007
Limit of Indemnity:	£10,000,000 any one occurrence

Please note that the above policies include an Indemnity to Principal Clause and are subject to insurers terms and conditions.

Please contact Smart & Cook Ltd if further information is required.

Yours faithfully

Karen Nicholls
Corporate Broker
Direct Tel No : 01423 700736
E-Mail : karen.nicholls@smartandcook.co.uk

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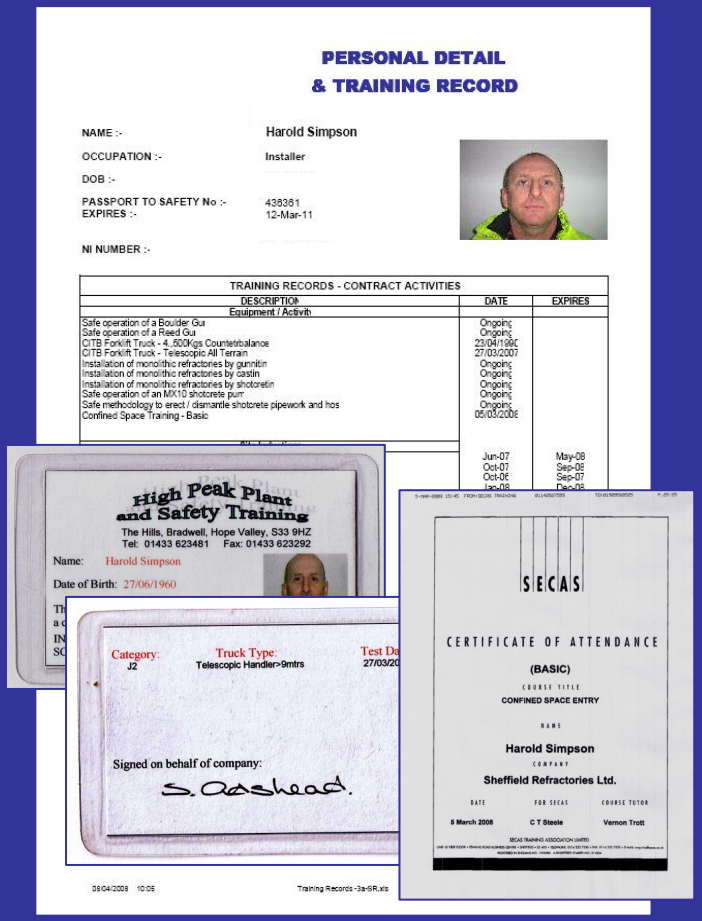
SMART & COOK INSURANCE BROKERS

Insurance
Of an appropriate type and level for the type of installation in which you are involved

Larger company groups will often stipulate The level of cover required to work on Their sites

Refractory Installation

- Documentation, Legislation and Procedure and the Health Safety and Welfare of those installing and with whom they interact



Competent /Qualified Responsible People and Supervision

Minimal is Passport to Safety
Additional to this is other training and certification which must Be gained and qualified to carry out certain Job tasks on site or to work in certain areas

Competencies of operating equipment, or Carrying out tasks such as
Fork truck / Telescopic truck licences
Crane operation, slinging, confined space training
First aid etc etc

Refractory Installation

- Documentation, Legislation and Procedure and the Health Safety and Welfare of those installing and with whom they interact

H&S Policy, Risk Assessments, Safe Working Procedures /Method Statements

On –site, people involved in site activities, have a duty of care to those around them and themselves

Refractory Installation

- Documentation, Legislation and Procedure and the Health Safety and Welfare of those installing and with whom they interact

Site Inductions and Procedures on Site

Specific to each site as it imparts important site specific information
And procedures including such as

- Emergency Procedure
- Evacuation /muster
- Raising Alarms
- Systems of Work- Site Permits and how they operate , Isolation Procedures
- Eg Locking On / Off
- Specific Hazards
- Safety and Welfare of Personnel

Refractory Installation

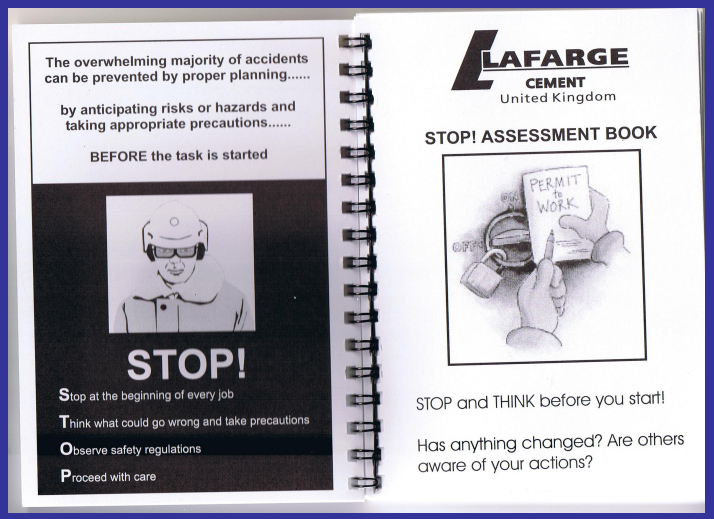
- Documentation, Legislation and Procedure and the Health Safety and Welfare of those installing and with whom they interact

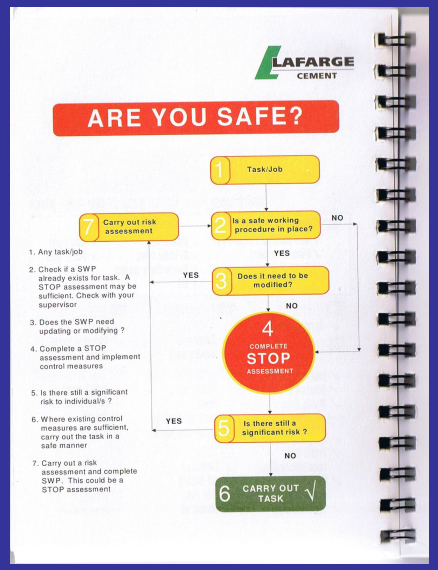
On Site Risk Assessments –Prior to Job start (daily)

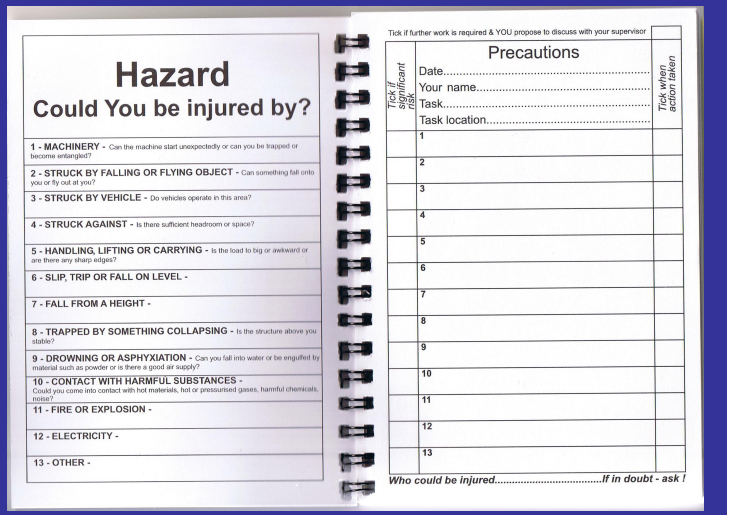
S T O P System as utilised in the Lafarge Group

Small booklets easily carried and used in a work area before the start

Of each shift to see if something has changed which may represent a Hazard







Courtesy of Lafarge

Refractory Installation

- Documentation, Legislation and Procedure and the Health Safety and Welfare of those installing and with whom they interact

Scope and Plan of Work

Time *eg Shifts*

Disciplines / Activities

	Area	Supplier
Kiln Stop	Kiln	LCUK
Kiln cool down period	Kiln	LCUK
Bridge in Kiln coating, brick, hearth, inlet and outlet nosering wrecking and clearing	Kiln Kiln	LCUK Simpsons
Graytons kiln turning	Kiln	Grayton
Instal steel nosering castings		
Kiln bricking 0-27m with 2 mortared sections	Kiln	Simpsons
Graytons kiln turning	Kiln	Grayton
Cast nosering	Kiln	SR
Kiln bricking 27-54m with 1 mortared sections	Kiln	Simpsons
Bridge out & firing pipe in. Permit off	Kiln	LCUK
FDS electrical test	Kiln	LCUK
Warm up to feed on	Kiln	LCUK
Cut beam doors on hearth	Riser	
Drop scaffold	Riser	
Brokk scaffold in bottom riser	Riser	High peak
Wreck low kiln hearth area	Riser	Simpsons
Lift brokk to upper kiln hearth area	Riser	Simpsons
Wreck upper kiln hearth area	Riser	Simpsons
Blaster positionning	Riser	LCUK
Anchoring in riser and panels	Riser	SR
Shotcreting in hearth & bottom riser	Riser	SR
Scaffolding	C3 to C2	High peak
Wrecking from C3 to C2	C3 to C3	Asbestos wrecker
Shotcreting from C3 to C2	C3 to C4	SR
C4 barrel wrecking and clearing (Big Brokk)	C4	Simpsons
Weld bricking ledge	C4	??
C4 bricking including seting bricks and bringing them	C4	Simpsons
Shotcrete/Gunning of side doors and dip tube surrounds	C4	SR
Cooler cooling off and clearing	Cooler	LCUK
Placing scaffold for Brokk 90 in cooler	Cooler	High peak
Lifting anvil plates	Cooler	??
Cooler throat scaffold mattress	Cooler	High peak
Wreck cooler refractory (side walls, arch)	Cooler	Simpsons
Cooler mechanical	Cooler	Grayton
Cooler arch bricking & scaffold alterations	Cooler	Simpsons
Cooler arch shotcreting	Cooler	SR
Cooler sidewall casting & joinery in/out	Cooler	SR
Cooler throat scaffolding	Cooler	High peak
Move samtl Brokk from cooler to drag	Cooler	Simpsons
Cooler drag sidewall	Cooler	Simpsons

Refractory Installation

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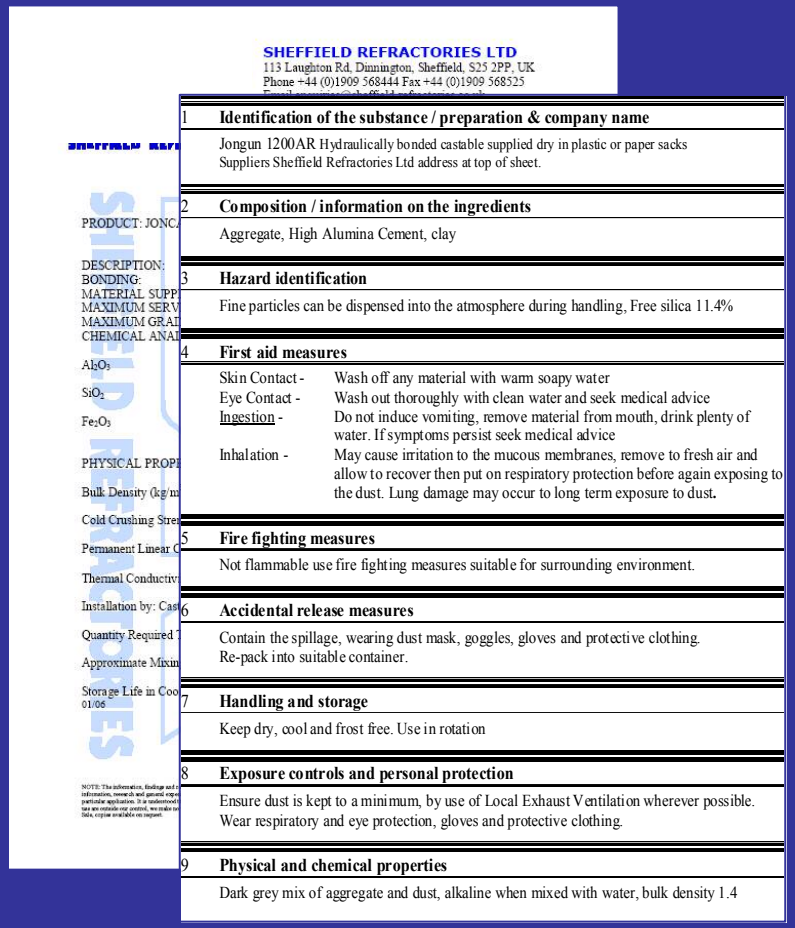


SHEFFIELD REFRACTORIES LTD
113 Laughton Rd. Dinnington, Sheffield, S25 2PP, UK
Phone +44 (0)1909 568444 Fax +44 (0)1909 568525

PRODUCT: JONG

DESCRIPTION:
BONDING:
MATERIAL SUPP
MAXIMUM SERV
MAXIMUM GRA
CHEMICAL ANA

Al_2O_3
SiO_2
Fe_2O_3

PHYSICAL PROP

Bulk Density (kg/m
Cold Crushing Stre
Permanent Linear C
Thermal Conductiv
Installation by: Cas
Quantity Required
Approximate Mixin
Storage Life in Coo

01/05

1	**Identification of the substance / preparation & company name**
	Jongun 1200AR Hydraulically bonded castable supplied dry in plastic or paper sacks Suppliers Sheffield Refractories Ltd address at top of sheet.
2	**Composition / information on the ingredients**
	Aggregate, High Alumina Cement, clay
3	**Hazard identification**
	Fine particles can be dispensed into the atmosphere during handling, Free silica 11.4%
4	**First aid measures**
	Skin Contact - Wash off any material with warm soapy water Eye Contact - Wash out thoroughly with clean water and seek medical advice Ingestion - Do not induce vomiting, remove material from mouth, drink plenty of water. If symptoms persist seek medical advice Inhalation - May cause irritation to the mucous membranes, remove to fresh air and allow to recover then put on respiratory protection before again exposing to the dust. Lung damage may occur to long term exposure to dust.
5	**Fire fighting measures**
	Not flammable use fire fighting measures suitable for surrounding environment.
6	**Accidental release measures**
	Contain the spillage, wearing dust mask, goggles, gloves and protective clothing. Re-pack into suitable container.
7	**Handling and storage**
	Keep dry, cool and frost free. Use in rotation
8	**Exposure controls and personal protection**
	Ensure dust is kept to a minimum, by use of Local Exhaust Ventilation wherever possible. Wear respiratory and eye protection, gloves and protective clothing.
9	**Physical and chemical properties**
	Dark grey mix of aggregate and dust, alkaline when mixed with water, bulk density 1.4

Product Data
H&S Data- MSDS

Refractory Installation

- Documentation, Legislation and Procedure and the Health Safety and Welfare of those installing and with whom they interact

QA - Sign Off

Quality and Scope of Work
Carried out April-08

For Refractory repair and replacement work carried out in the following areas

Preheater Tower
Kiln- Inlet
Cooler
Cooler Project Extension

We confirm that we are satisfied with the quality and scope of work carried out in the above areas during our April- 08 shutdown

For

For Sheffield Refractories Ltd

Steve Wright
Mob 07854 912207

Julian Gray
Mob 07854 911925

Quality Assurance Sign-Off
On installation

A document whereby both parties
Agree that the scope of work has been completed
In a timely manner and to standard that is
Acceptable to all parties

This document effectively hands over the
Finished installation to the client

Refractory Installation

Installation Of Refractories

- Carrying out the Installation

Refractory Installation

Installation Of Refractories

Personal Protective Equipment
A minimal level of PPE must be worn
on all sites, dependant on site
Activity
In dust environments appropriate
Filter masks should also be worn
Which may be the personal silicone type
With interchangable filters for prolonged
Exposure to dust / airborne particle
environments

-

Refractory Installation

Brick or Monolithic

Castable
Planning /Preparation
Anchoring
Shuttering
Homogenisation
Dosing
Mixing
Transport
Pouring
Vibration
Setting /Hardening
Curing
Drying
Heating-Up

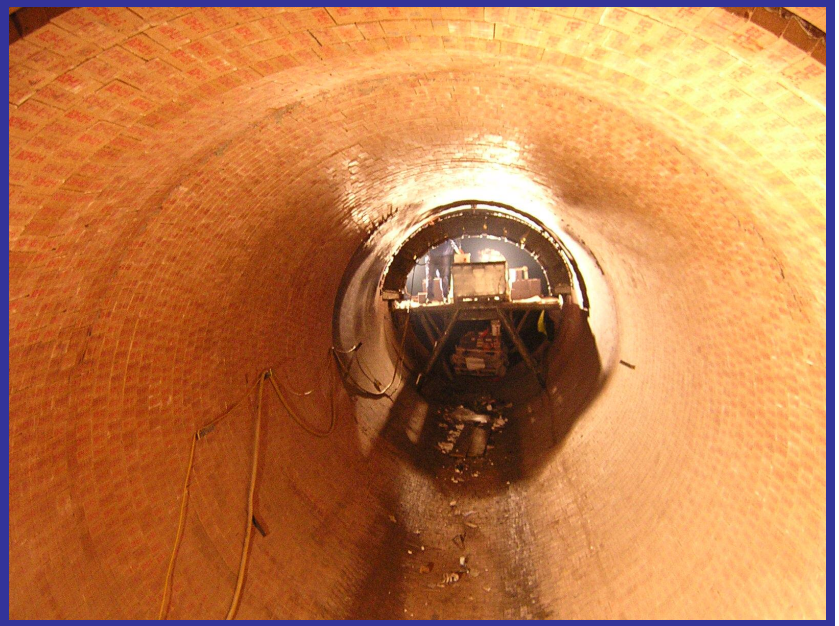
Brick
Planning /Preparation
Transport
Laying
Heating-Up

Refractory Installation

Brick Installations

Preformed quality assured shapes supplied on pallets direct from the factory
Fed to application area by forklift or conveyor
Laid by skilled masons
Supervision essential
No moisture to remove (unless combined with monos)
Quicker heat –up

Long lead times
Basic shapes – Squares / End Arch /Side Arch
Unusual emerging applications difficult



Refractory Installation

What is a monolithic and why is it used ?

Monolithics - Can give exceptional performance in difficult to install areas

Advantages of monolithic

High strength
Tailored to meet specific requirements –eg chemical, strength, light weight, etc
Dry / minimal joints
Easy to repair
Large high quality and relatively fast installations with such as shotcrete
Special requirements eg Precast shapes, blasters , shrouds etc

Disadvantages

Difficult to
Setup / install
Dry
Demolish

Refractory Installation

Example; **Low Cement Castable**

1. Accurate water measurement

2 Timing mix in “Hi-Shear” mixer

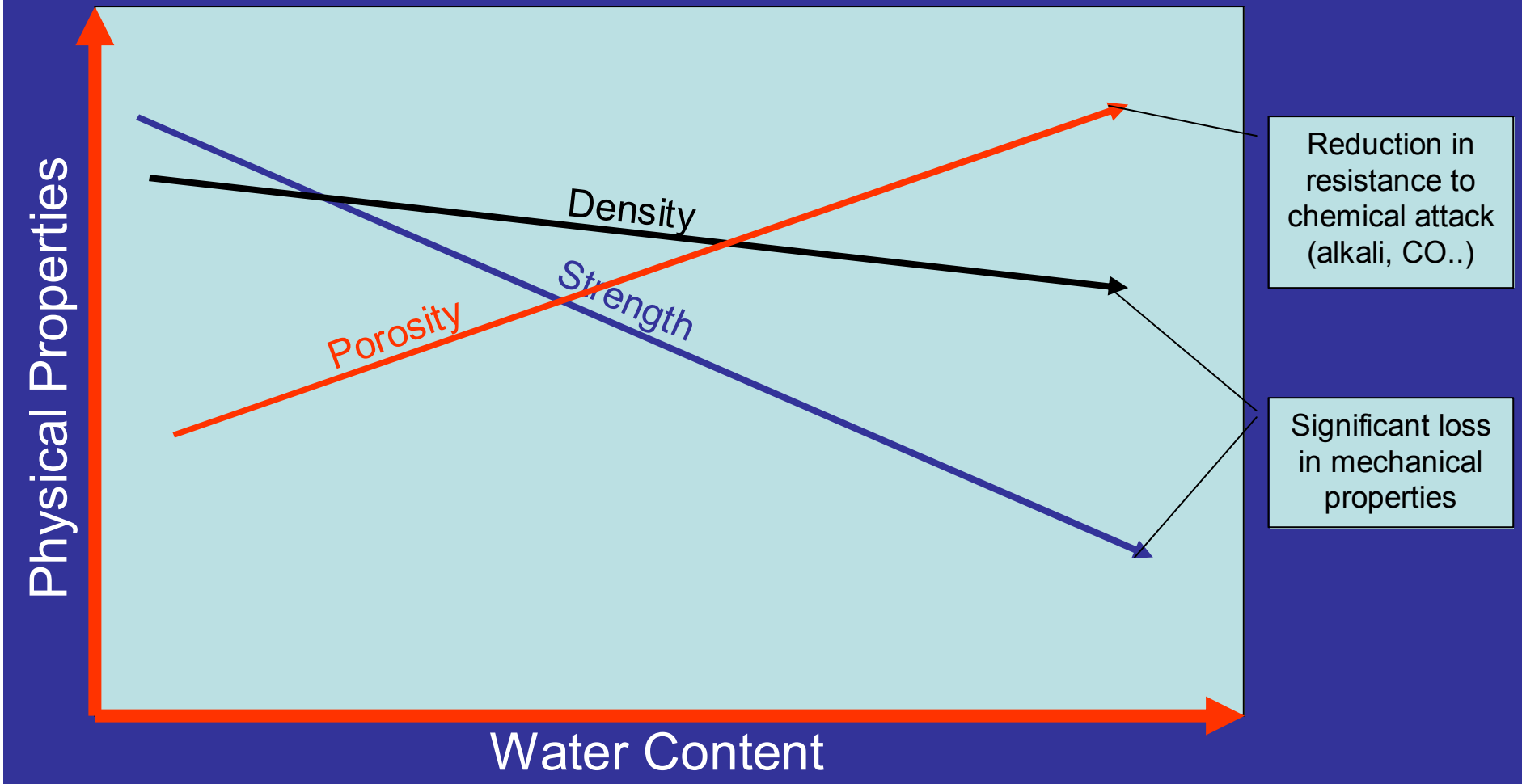
3. Castable “stiff” as applied

4. Apply high frequency poker

5. Material flows with vibration

6.Partially completed lining

Castable Properties



Refractory Installation

•Technical Castables such as Low Cement, Freeflow Pumpable etc

These type of products are quite complex and have several fine additive Additions which are crucial to the optimal performance

Increased water additions have a dramatic effect by decreasing properties

On –site installation is therefore very important to get the best properties and Performance in services.

Mixing must be with the use of a high shear mixer with a positive mixing action

Mixing time with this kind of equipment is generally

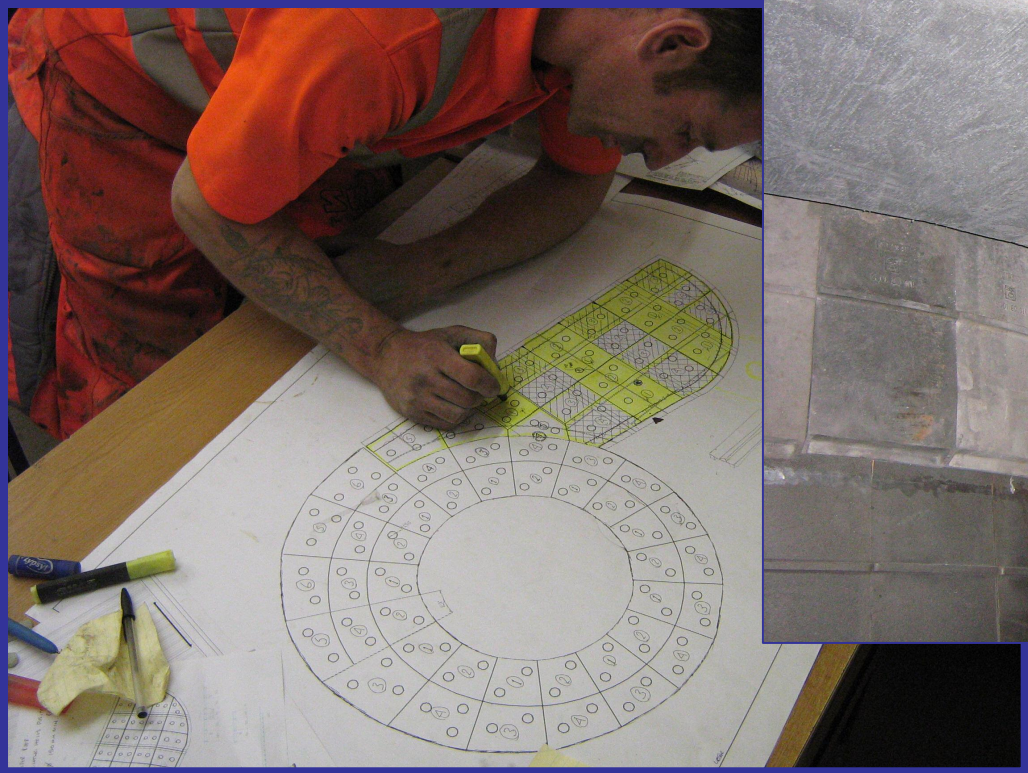
4 -6 minutes per batch

At the recommended water content (usually 5-7% for LC types)

Large High Shear Mixer
with measured water being added

Refractory Installation

- Installing Low Cement Castables In a roof

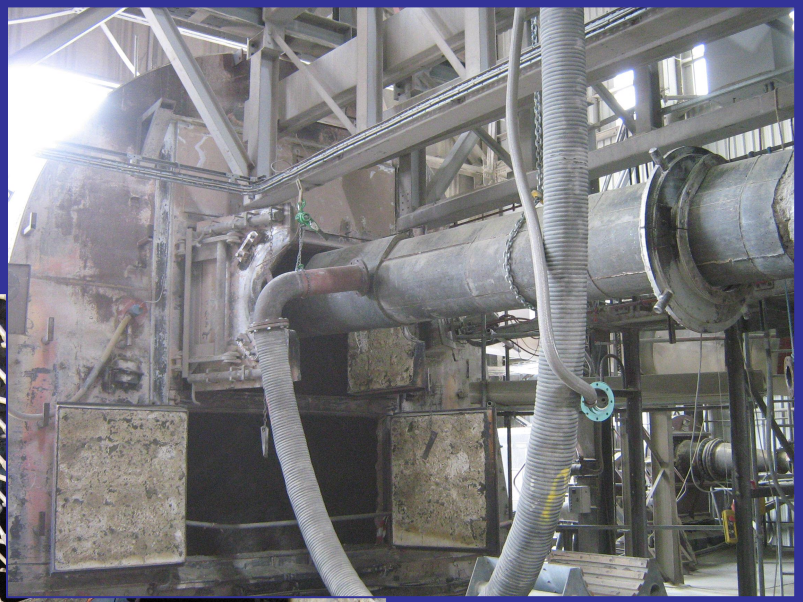


Refractory Installation

- Precast Shapes
- Can be small or large

Refractory Installation

- Installing Low Cement Castables
  Thin section using limpet vibrators



Refractory Installation

What is a monolithic and why is it used ?

- Refractory monolithics can be
- Gunning grades

Loading gun with 25Kg bags
Dry refractory transported to application

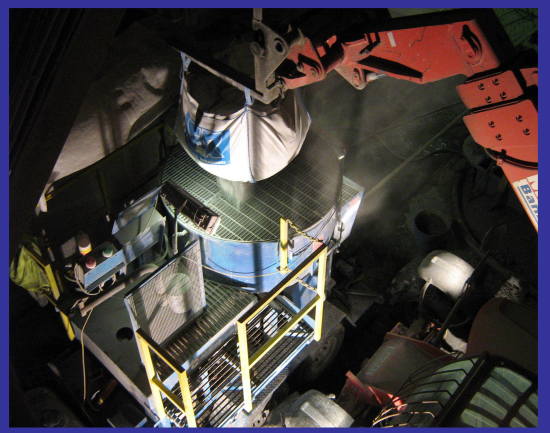
Good water injection and elongated nozzle
Ensure good mixing and minimal rebound

Refractory Installation

- Example –Full Wet Low Cement Shotcrete

1. Readying materials to start

2 Specialised equipment & team



3. Lines ready, process starts

4. Special nozzle with air & accr

5. Applied in panels, quick setting (no slumping), clean environment

Refractory Installation

What is a monolithic and why is it used ?

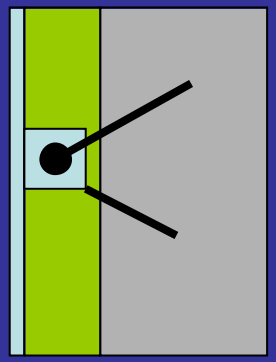
- Refractory monolithics can be
- Shotcretes

Special pumpable LC castable
Is charged in bulk bags, then mixed
and pumped to application

At the nozzle, material combines
With compressed air stream and
Accelerator to project and stay
On the wall

Refractory Installation

Lining Configuration, Anchorage, Panelisation and Expansion Allowance



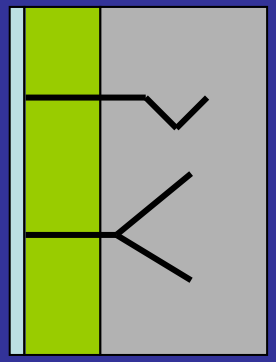
1/3 2/3

Perceived typical

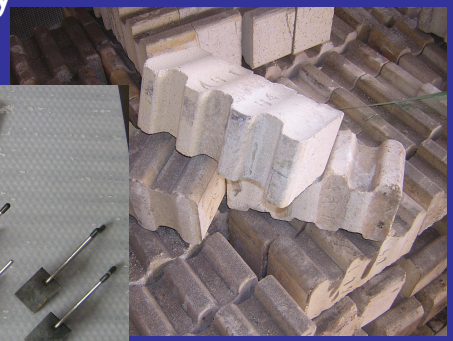
But can vary by application

Lining configuration
Determined by
Local conditions such as :
Heat Retention
Chemical and Abrasion Resistance

Anchorage and panelisation/ expansion
Determined on case by case basis
Taking into consideration, environment, history, and safety



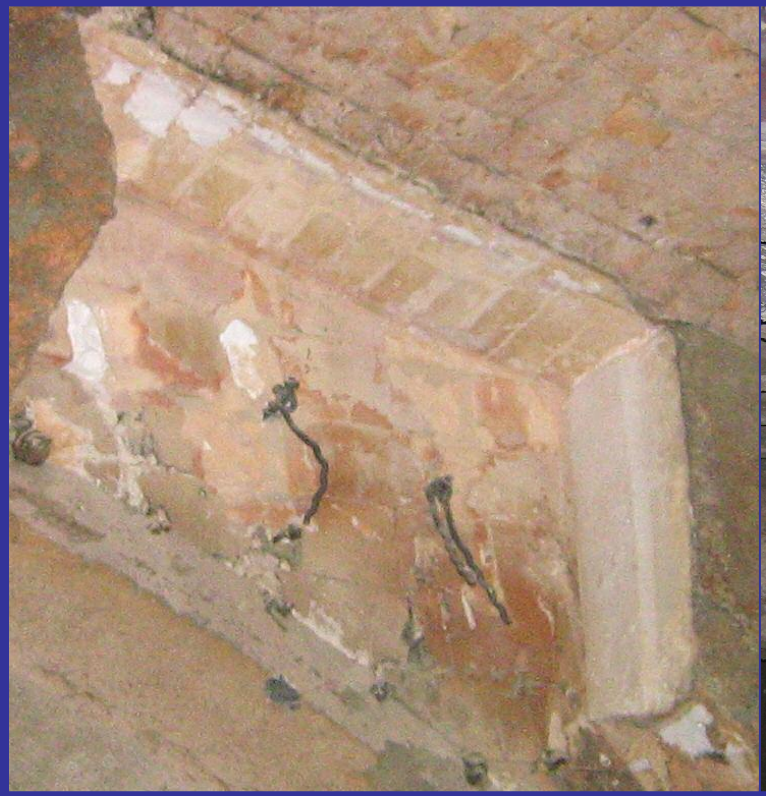
IC9 Med Wt
Safety &Security



Metallic and Ceramic anchors

Refractory Installation

Lining Configuration, Anchorage, Panelisation and Expansion Allowance



If anchors fail for whatever reason..it can be very dangerous
as refractory can fall out unexpectedly

Refractory Installation

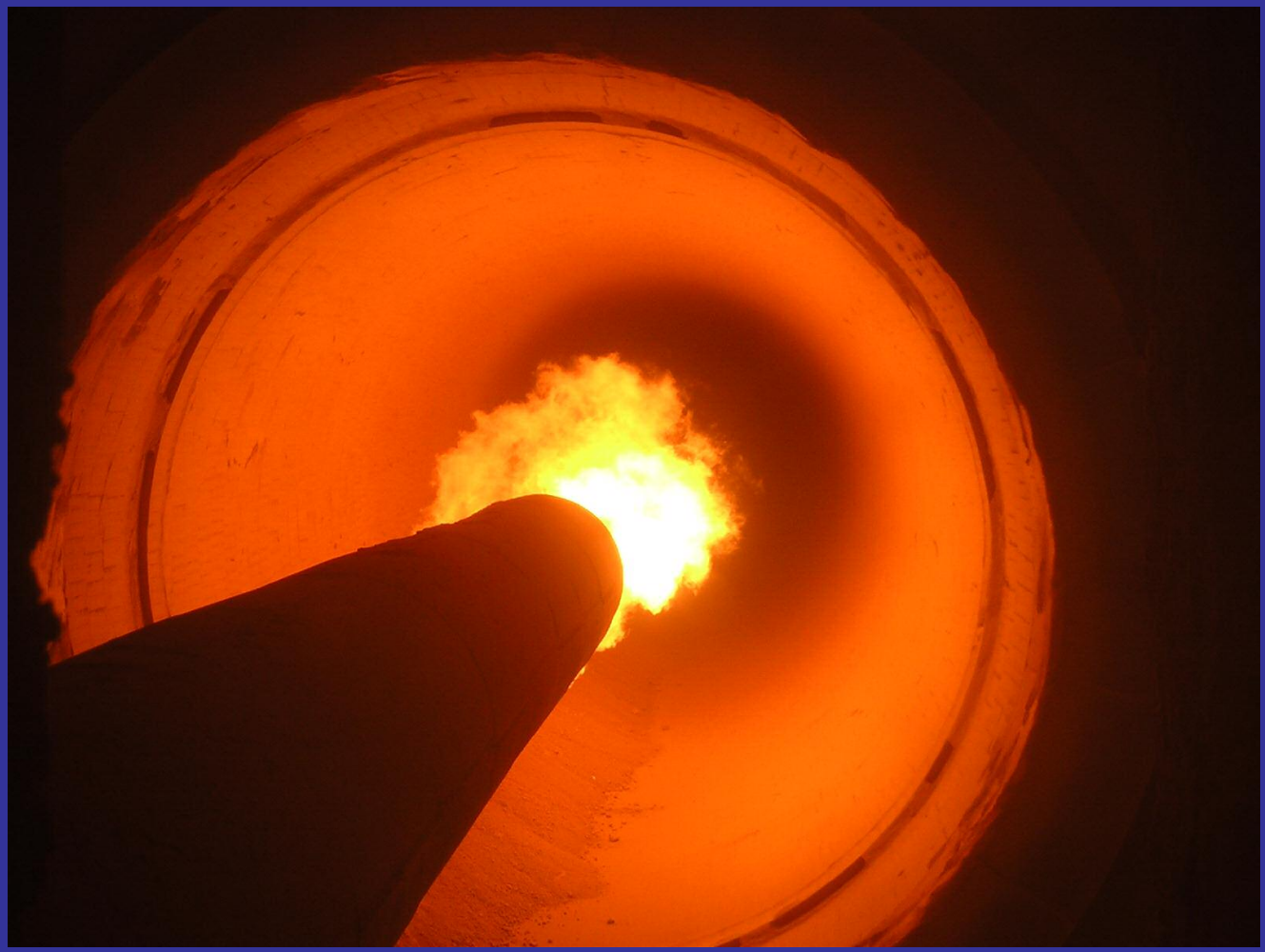
Lining Configuration, Anchorage, Panelisation and Expansion Allowance

Refractory Installation

Lining Configuration, Anchorage, Panelisation and Expansion Allowance

Refractory Installation

Setting, Curing and Preheating



Monolithics
Manufacture and Installation

Setting, Curing and Preheating

Setting is determined by the type of product and the ambient temperatures

At a **typical 20C** an initial set would be expected in 4-6 hours

In **hotter climates** setting time can be dramatically reduced due to the heat accelerating the bond. This can have consequences for the installation and retarders should be considered to be added at the suppliers factory with a minimal fine tune on site or wholly on-site under careful supervision

Conversely in **colder climes** the opposite is true.
The more technical low cement products can exhibit very long set times, even 1 -2 shifts
Which can have serious consequences for the installation programme
In these circumstances, retarder at the factory should be cut back and consideration should be given to the supply of accelerants for site addition

With extremes of temperature, site materials should be kept in controlled temperature Warehouses and site water temperatue controlled

Monolithics
Manufacture and Installation

Setting, Curing and Preheating

Curing should be at least 12 hours and air drying similar
Theoretically castables should not be allowed to prematurely dry out in the first 12 hours and the surafce should be kept moist.
See manufacturers data sheets

This is best practice but with the exception of floors, it rarely happens on site

Thicker section jobs should be planned early in repair to allow maximum curing /air drying time

Where and when practicable, shells should be drilled and monolithic vented during installation. Organic fibres are added which also aid moisture removal.

Very dense monolithics give good performance but are the most difficult to dry out (Low porosity / permeability)

Monolithics
Manufacture and Installation

Preheating

No Preheating curve is given as generally this follows custom and practice
Or is discussed and agreed on a case by case basis

Different schools of thought exist for drying out and Preheating monolithics

1 **Traditional**
Where possible, preheating should be done to an agreed regime and allowing good air movement across the face
Preheating regimes will vary but should consist of slow ramping- 20-25C/hr and holds at 110 and 350 visibly monitoring for high steam pressure and if so hold until it subsides

2 **Modern**
Ramping at a constant temperature from ambient, theoretically building heat up slowly at the hot face and driving moisture back through at a constant rate with no holds

Monolithics
Manufacture and Installation

Preheating

In either Preheating situation it is extremely important to visually monitor the application and if excessive steaming or plumes are noted then the regime should be held until it subsides and then progressed with caution

Installations can be long and costly affairs taking place over long periods of time and consequently heating up should not be rushed.

Specialised companies are available for preheating on site for small or large project applications

Generally, > 80% of moisture is removed by 400C equilibrium.

Cooling of Linings
Unless being wrecked for replacement, refractory linings should not be force cooled
And certainly water should never be used to cool down a lining

Monolithics
Manufacture and Installation

Storage

See manufacturers instructions

Generally supplied products should be kept under cover in a clean, dry
Well ventilated storage area

Manufacturers can modify the packaging spec liasing with the customer, especially for international destinations, however normally, such as25Kg valve packed bags of monolithic stored in the above, can have a life of 6-12 months duration dependant on type

Refractory Installation

And Finally……

Thank You for your time
And consideration