STUDY ON RECYCLING OF USED MAG-CARBON BRICK IN PRODUCTION OF MAG-CARBON BRICKS

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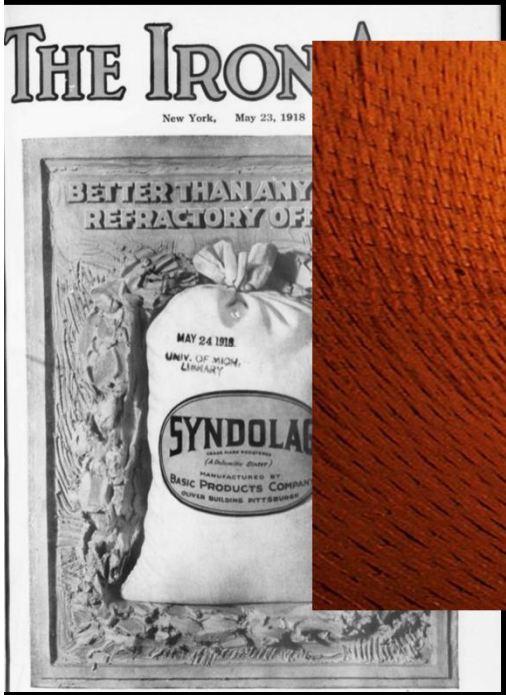
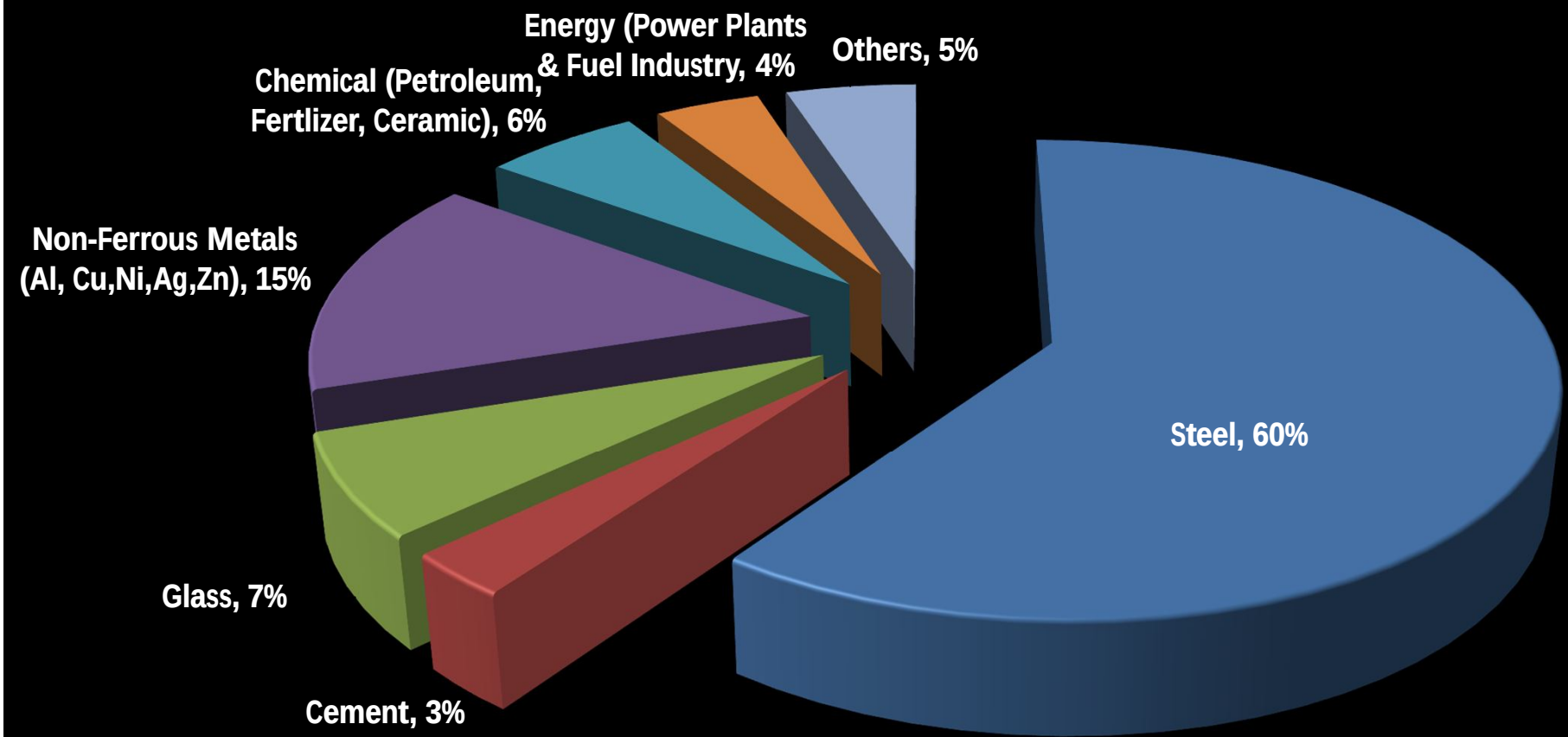
How old is Refractory..

De Re Metallica



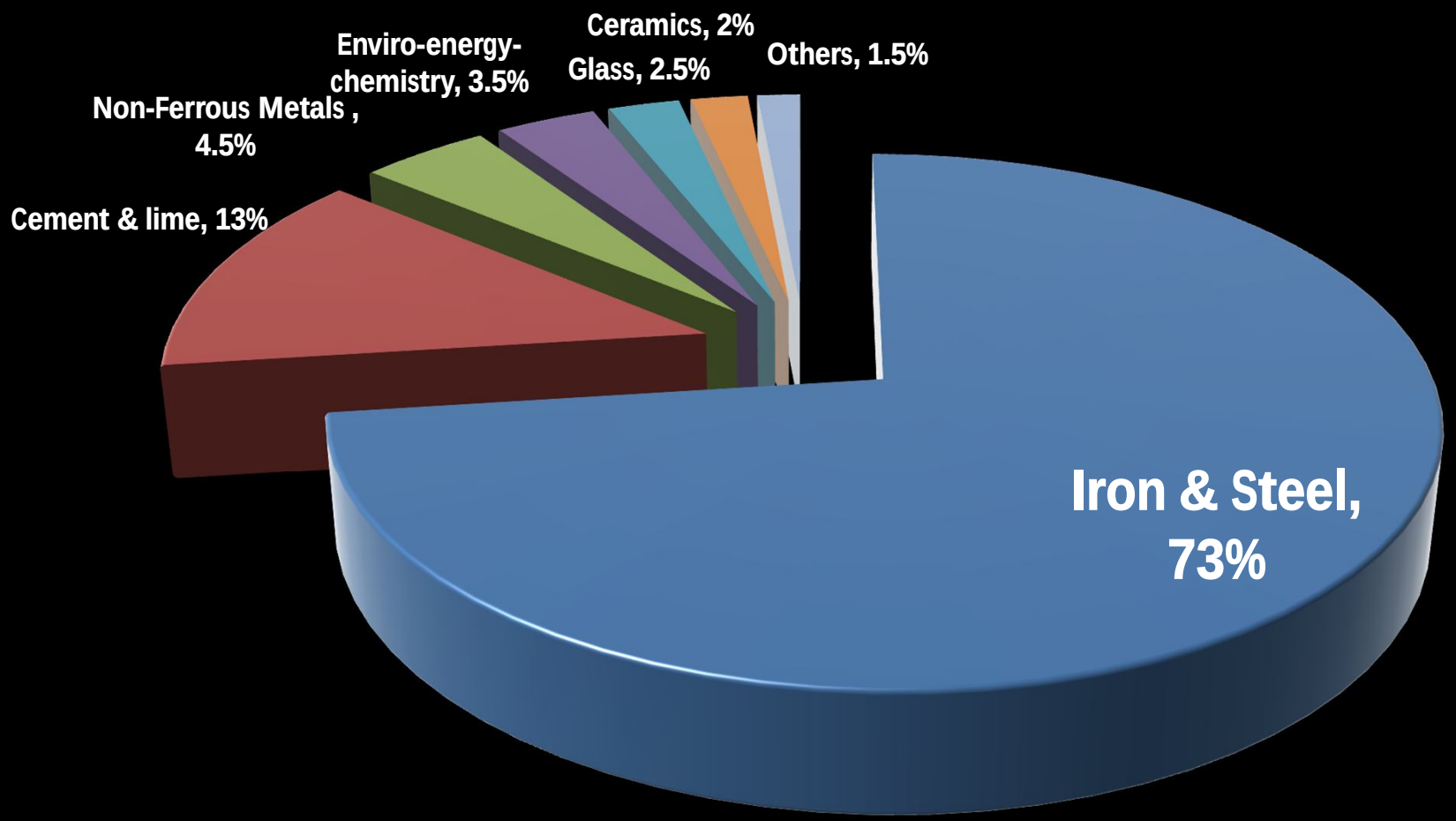
Characteristics of Refractories:

Global Refractory consumption Pattern: Sector Wise



Source – Roskill Information Services

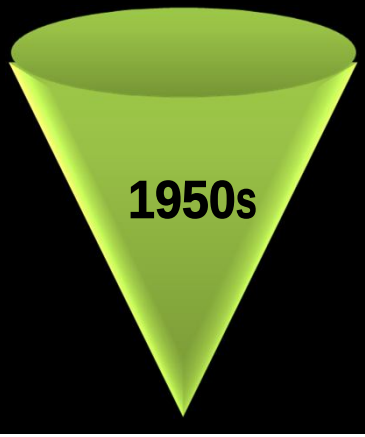
Indian Refractory consumption Pattern: Sector Wise



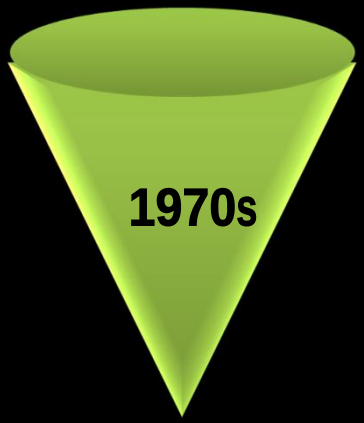
Source – Roskill Information Services

Evolution of Mag Carbon Brick

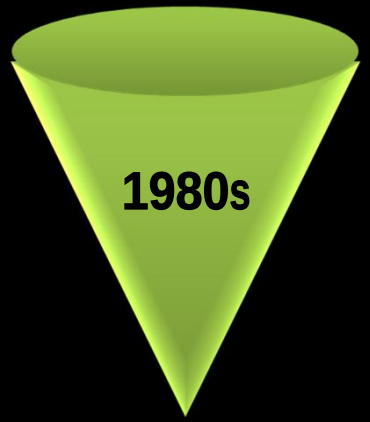
Magnesia + Carbon + Pitch Bonded Dolomite



Burned & impregnated magnesia brick with finite pore size



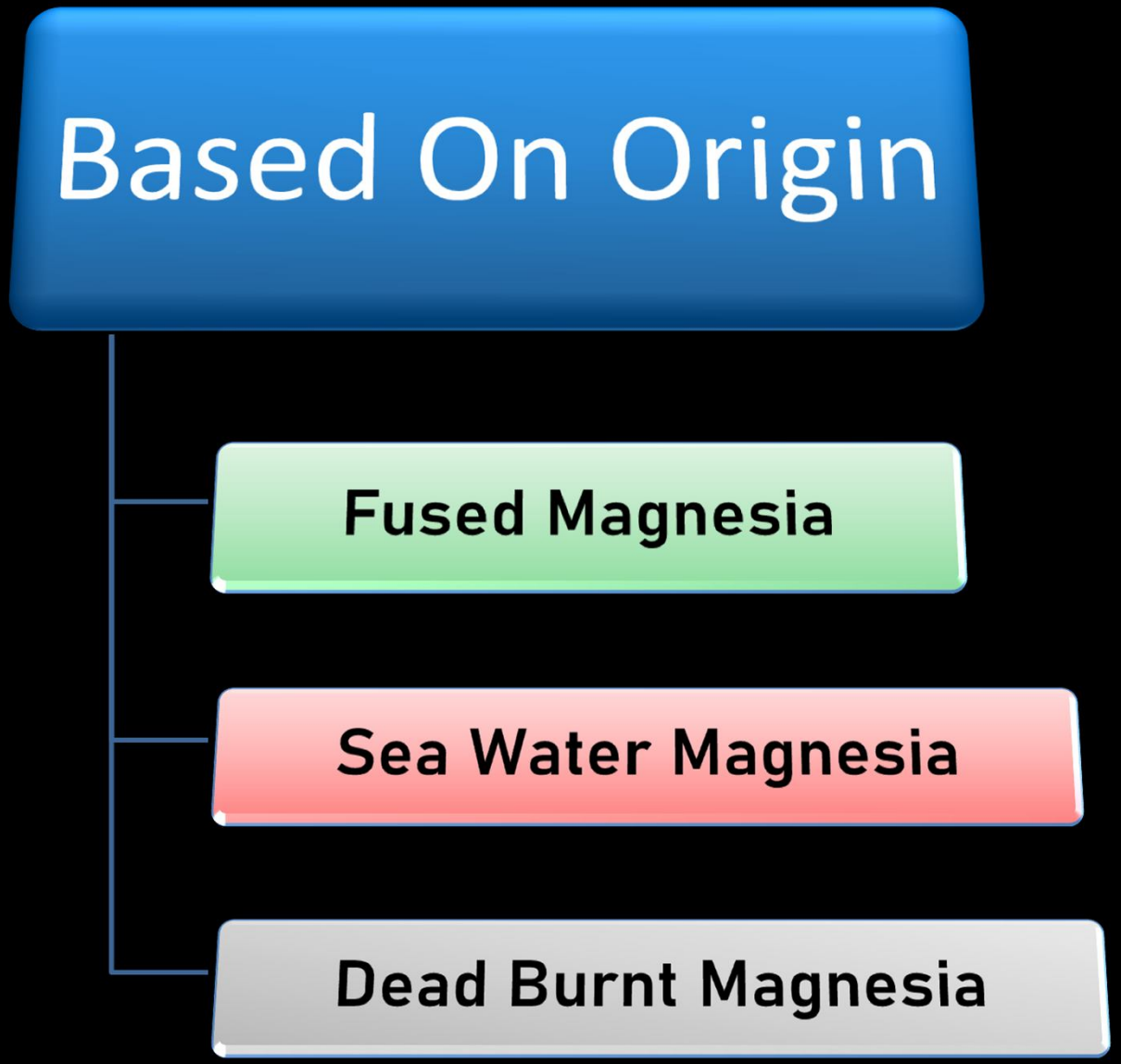
Resin bonded magnesia-graphite + Antioxidants



Ingredients at a Glance..

- Magnesia
- Carbon
- Resin
- Additives

Classification of Magnesia..



More About Magnesia..

	MgO%	CaO%	Fe_2O_3%	Al_2O_3%	SiO_2%	B_2O_3%	BD (in gm/cc)	Crystal size (in Micron)	CaO/SiO_2
Fused Magnesia	98	1	0.25	0.15	0.5		3.5	400	2
Synthetic Magnesia	98.35	0.83	0.57	0.12	0.2	0.02	3.4	60	4
Dead Burnt Magnesia (Australian origin)	96	2.7	0.5	0.2	0.8	0.002	3.4	100	>2.5
Sea Water Magnesia	97	2.4	0.25	0.12	0.35	0.03	3.4	110	>5
Dead Burnt Magnesia(Brazilian origin)	98.33	0.87	0.39	0.07	0.25	negligible	3.31	122	3.5

Fused Magnesia

- Fused Magnesia is produced by fusion of Raw Magnesite or Calcined magnesia by means of electric arcing and cooled down to crystallization.

- It has advantages of high purity and large crystal size.
- Thermal shock resistance is very poor for this material.

Sea Water Magnesia

- Sea Water Magnesia is produced by extraction of Magnesium Chloride salt from sea water followed by beneficiation, calcination and high temperature firing.

- This material is very pure with cryptocrystalline structure and has high $CaO:SiO_2$ ratio.

Dead Burnt Magnesia

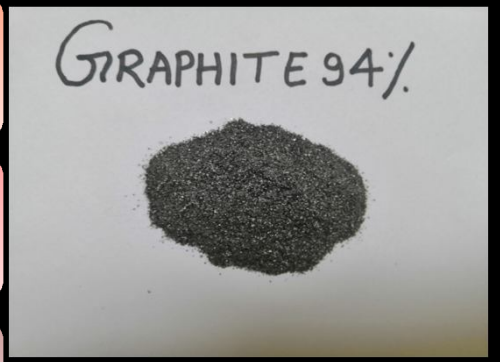
- Natural deposit of Raw Magnesite($MgCO_3$) is first beneficiated then calcined, followed by high temperature firing, to produce Dead Burnt Magnesia.

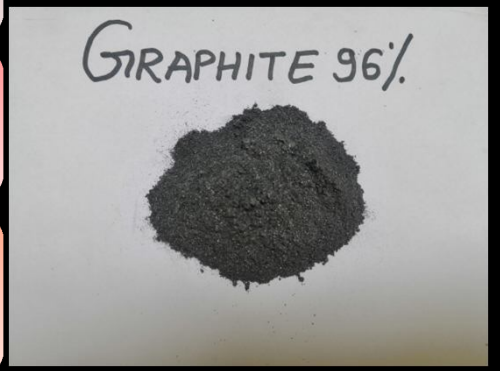
- This material contains negligible amount of Boron with high lime silica ratio.

Carbon in the form of Graphite

Flaky graphite is mainly used because of its excellent physical properties such as:

1. **The non wettability of the slag**
2. **High thermal conductivity**
3. **Low thermal expansibility**
4. **In addition, graphite do not fuse with refractories at high temperature.**
5. **The purity and the flake size of graphite has a great influence on the performance of magnesia carbon bricks**





Resin as Binder..

- It contains high quantity of fixed carbon which gives strong bonding property,
- It possesses high dry strength because of its thermosetting nature,
- It produces less hazardous gas than tar / pitch,
- At curing temperature (around 200^{O}C), it polymerizes which gives isotropic interlocking structure, and
- Cold crushing strength (CCS) increases with the increase of resin content.

Other Additives..

Carbon components contained in MgO-C bricks are oxidized by oxygen in the atmosphere or by iron oxide in the slag.

Antioxidants such as metallic powders are added mainly to suppress this oxidation.

Magnesia in Indian Refractories

Almora

High Iron

Salem

High Silica


ALASKA (USA)
GREENLAND (DENMARK)
CANADA
RUSSIA
ICELAND
SWEDEN
FINLAND
NORWAY
ESTONIA
LATVIA
LITHUANIA
BELARUS
UNITED KINGDOM
GERMANY
POLAND
UKRAINE
KAZAKHSTAN
MONGOLIA
FRANCE
MOLDOVA
ROMANIA
UZBEKISTAN
UNITED STATES OF AMERICA
SPAIN
ITALY
GREECE
TURKEY
TURKMENISTAN
CHINA
SYRIA
IRAQ
IRAN
AFGHANISTAN
PAKISTAN
MOROCCO
ALGERIA
LIBYA
EGYPT
SAUDI ARABIA
OMAN
INDIA
MEXICO
MALI
NIGER
CHAD
SUDAN
ERITREA
YEMEN
THAILAND
GUINEA
NIGERIA
CENTRAL AFRICAN REPUBLIC
ETHIOPIA
VENEZUELA
COLOMBIA
UGANDA
KENYA
SOMALIA
DEMOCRATIC REPUBLIC OF THE CONGO
INDONESIA
PERU
BRAZIL
TANZANIA
ANGOLA
ZAMBIA
BOLIVIA
NAMIBIA
BOTSWANA
AUSTRALIA
SOUTH AFRICA
ARGENTINA
NEW ZEALAND

Challenged Faced globally

High cost of Natural gas, coal, oil and electricity

Geo Political Issues- Russia invasion of Ukraine

Chaos in Global Magnesia production

Economic slowdown due to outbreak of Covid pandemic in 2020

Major cities in China under lockdown

Magnesia production stopped

Volatility in Freight Rates

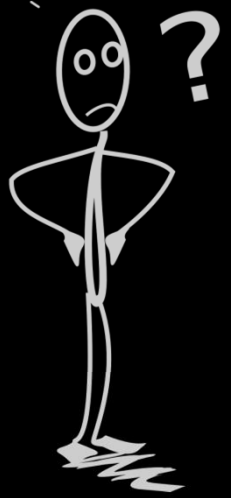
Potential Price hike upto 50%

Gaseous pollutants causes global warming and acidification

Environment & Carbon emission

Magnesia production is an energy intensive process

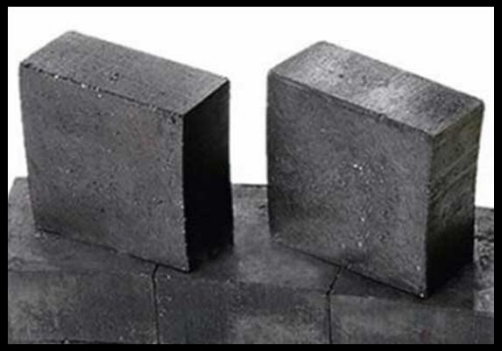
Challenges faced by Indian Refractories



- Increase in Lead Time
- Uncertainty in availability
- Affecting cost of production

Need of the hour

Depletion of natural deposits



Bricks made are consumables

Used Bricks , with no value

Why we need to reuse the Refractories..

Thought Process

Resistance of graphite increases upto 3000^{O}C. Hence the Carbon present in the leftover thickness should be unused.

Melting point of magnesia is also high, hence the MgO present in the left over thickness remains untapped.

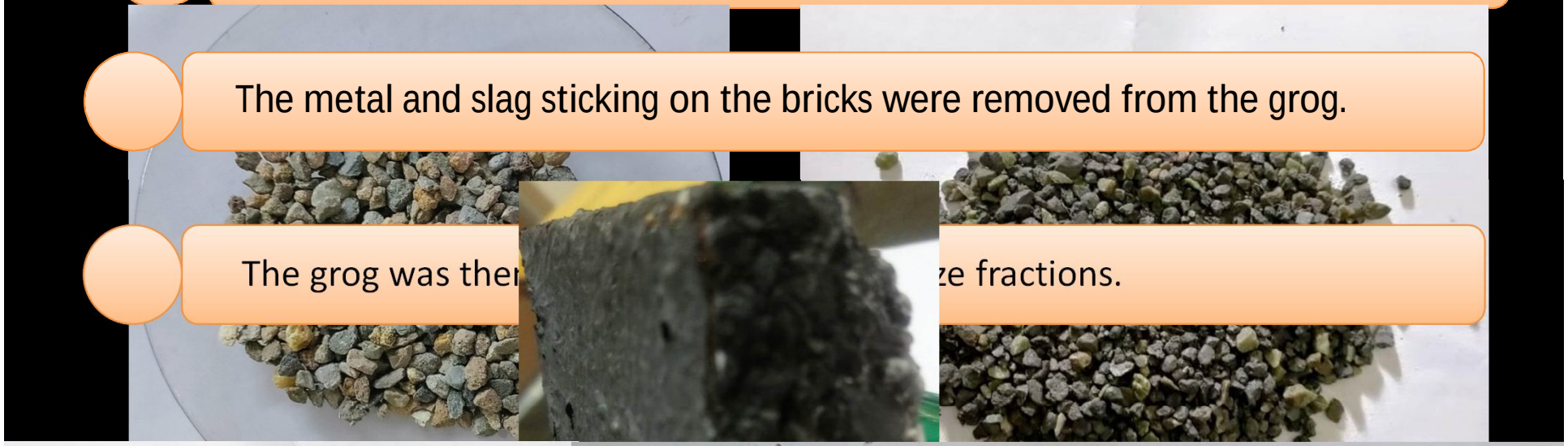
However the impurities such as Fe_2O_3, CaO, SiO_2 increases due to the interaction with slag and metal

Al_2O_3 from Aluminium powder combines with MgO at higher temperature to form Magnesium Aluminate spinel $MgAl_2O_4$.

Hence the presence of this spinel in grog may help us in getting better refractory properties.

Sample Preparation

- Two types of grog were taken for the study.
- The metal and slag sticking on the bricks were removed from the grog.
- The grog was ther ze fractions.



Experimentation

Chemical analysis of the grog was done at the laboratory mainly for the constituent's viz. %C and %MgO.

Type of grog	%C	%MgO
Normal Grog	8-10	80-85
Calcined Grog	0.5-1	89-93

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Experimentation

Trial	AP	BD	CCS	COKE AP	COKE BD	COKE CCS	HMOR
C1	4.2	2.95	415	12.1	2.85	212.9	43.3
C2	4.3	2.92	350	13.7	2.98	237.1	65.4
C3	4.25	2.95	360	12.5	2.92	186.7	37.5
C4	4.3	2.93	315	12.1	2.88	220	58
C5	4.05	2.99	422	10.9	2.93	179.4	48.3
C6	4.35	2.94	322	10.4	2.91	187.3	61.9
C7	4.25	2.95	410	11.5	2.95	181.7	47.2
C8	4.05	3.0	387	11.4	2.85	205.2	78.7

Conclusion

Used MgO-C brick, can be a partial substitute of virgin raw material for manufacturing of MgO-C bricks

Recycling of bricks has partially reduced our dependency on imported magnesia.

Improved the environmental sustainability which is the burning topic today.

Conclusion

This research work has enabled SRU Bhilai to successfully save 10% of its virgin raw material cost in FY2021-22.

Thank You