RECYCLING REFRACTORIES FROM AN ENDUSER´S VIEWPOINT
Introduction

Mass Balance of Refractories after Use

- Based on the original materials installed:
  - 35 % dissolved/consumed in within the process
  - 27 % is used in non refractory applications
  - 20 % can be recycled as secondary refractory material
  - 18 % is disposed as waste (mostly fines)

Market for Secondary Raw Materials - Worldwide

Refractory Market
- Steel & Iron: 78%
- Aluminum: 5%
- Cement & Lime: 8%
- Glass: 5%
- NFM: 1%

Market refractories: 23 Mio. t

Mass balance worldwide
- Total Dissolution: 49%
- Total Landfill: 36%
- Recyc. Non Refr. (Non-Refractories): 8%
- Sek. Raw Mat. (Secondary Raw Materials): 7%

Market sec. raw materials: 1.6 Mio. t
Industries using Products made of Secondary Raw Materials

Industries using RHI products:

- Stahl: 55%
- Cement/Lime: 18%
- Nonferrous metals: 6%
- Glass: 3%
- Environmental/Energy/Chemicals: 10%
- Raw materials: 3%

Industries using our products made of secondary raw material:

- Stahl: 79%
- Cement/Lime: 10%
- Nonferrous metals: 4%
- Glass: 4%
- Environmental/Energy/Chemicals: 3%
Why Recycle Refractories?

Motivation for Recycling

- Sustainable protection of natural resources
- Less exploitation, thus saving nature
- Lowering CO₂ emissions created by producing raw materials
- Reduce landfill volume
- Save landfill costs
- Reduce liability of land filled material (cradle to grave)

Effects of Recycling

- Save raw material costs
- Improve environmental balances and figures
- Introduce new products in new markets
- Closer cooperation between refractory supplier and customer
- Introduction of recycling specialists to improve treatment and distribution of recycled materials
- Stay ahead of ever changing EPA regulations on landfill materials.
Potential Industries for Recycling
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BOF Converters

- Desirable
  - MgO-Carbon
  - MgO

- Contaminant
  - Metal/Slag
  - Alumina refractory
  - Fines
Electric Arc Furnace

- Desirable
  MgO-Carbon
  MgO
  Electrodes

- Contaminant
  Metal/Slag
  Fines
RH/DH Degasser Units

- Desirable
  MgO
  MgO-Chrome

- Contaminants
  Alumina refractory
  Metal/Slag
  Fines
Ladles

- Desirable
  - MgO
  - MgO-Carbon
  - AMC
  - Slide Gates
  - Alumina

- Contaminants
  - Dolomite
  - Metal/slag
Example from Steel Industry

Breakout from steel industry before sorting

MgO-C scrap after sorting and cleaning
Close up of Unprocessed Bricks

Yield affected by:
- Steel
- Nozzles
- Fines
- Hydrated Brick
- Hi Alumina castable
- Bricks stuck together
Removing Metal and Slag
Grizzly

- Spacing @ 3” to separate the large pieces.
- Remove alumina and large pieces of brick stuck together.
- Fines separated.
- May elect to remove large pieces for recycling.
- May elect to crush large pieces for melt shop addition.
Example from Glass Industry

Breakout from glass industry before sorting

AZS after sorting and cleaning
Example from Foundry

Alumina Graphite from Foundry before sorting

After cleaning and sorting
Examples from Other Sources

High Alumina Precast Shapes

Porcelain Scrap
European waste management legislation uses following terminology for refractory breakout:

- Materials that have not been used or changed in chemical or mineralogical compositions during use. Can be used directly as secondary raw material.

- Materials that have been used and no changes in composition. Pose no environmental risk. Can be used as secondary raw material when processed according to the specification for their use as secondary raw material.

- Materials that have been used and pose some environmental risk. Only authorized or competent recycling companies are permitted to separate, clean and convert them into non-hazardous secondary raw materials.
Processing companies have become increasingly important.
Closer cooperation between production plant, the processor and the supplier is necessary to increase the consumption rate of secondary raw materials.
Recycled Materials vs Availability

Recycled Material

- Most Desirable
- Least Desirable

Availability

- Least Available
- Most Available

Reference: Mineralen Kollee
Minimising Refractory Waste

Demolition:

- Determine the classes of breakout materials.
- Select and segregate refractory types.
- Supervision during demolition.

Processing:

- Separation of fines, large pieces and debris from the desirable refractory.
- This increases purity of materials with higher value.
Maximising Waste Value

Production Plant

- Selective demolition of spent refractory
  - Increase purity of materials with higher value
- Supervision during demolition
  - Determine the classes of breakout materials

Recycling Partner

- Improve separation techniques
  - Remove infiltration zones to increase the degree of purity
- Improve sorting techniques
  - Introducing technical equipment to sort the different refractory types
- Find alternative applications for materials that cannot be reused in refractory
Conclusion

A financially and environmentally productive recycling program requires cooperation by all three partners.

This is accomplished by:

- Determining what can be recycled.
- How can the refractory be removed, segregated and stored.
- Establish Standard Operating Parameters (SOP’s) throughout the process.
- Maintain communication among all three partners.
Conclusion

Recycling of refractories is one of RHI’s main focuses in regard of raw material availability and cost savings.

Recycling concepts are put in place.

New products based on secondary materials are introduced.

Cooperations with recycling partners allows us to increase the amount of high purity materials.

Advantages include saving natural resources, reduce carbon emissions, reduce landfill, save landfill costs and provide cost savings to our customers.

The refractory industry and it’s partners have made immense progress in improved usage, reuse, recovery, recycling and waste minimization. The achievements to date prove a solid basis for further progress and for improved sustainability.
Conclusion

- Every recycling program is unique but our common goals and the commitment to succeed will overcome any obstacle.

- It is easy to send spent refractory to landfill but rising taxes along with environmental fees and increased pressure on our natural resources will leave us with no option but to utilize this vital secondary raw material.
Questions

Thank You

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