Troubleshooting and process improvements at Zincor

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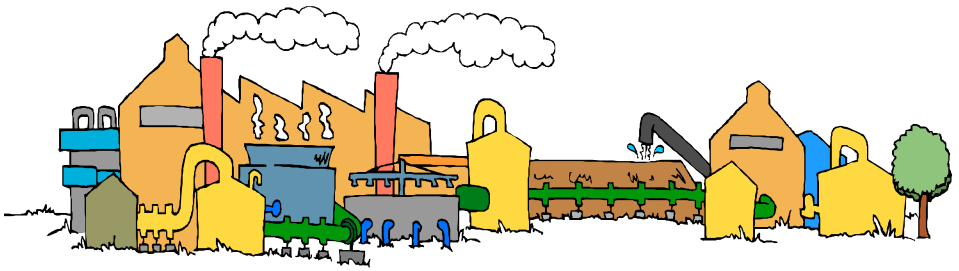
exxaro

ZINCOR | BASE METALS

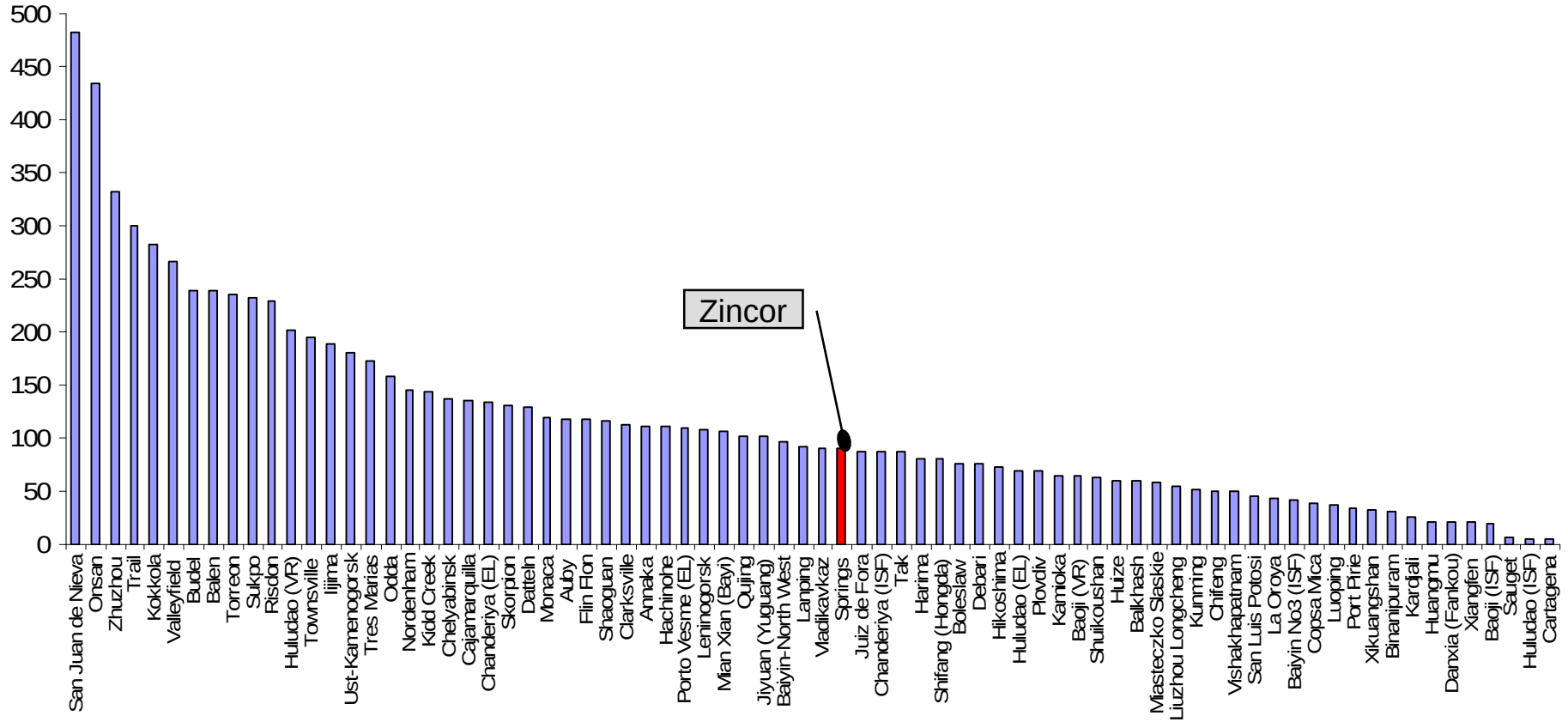


Contents

- Zincor’s position in the zinc industry
- Zincor’s history and its process
- Improvement projects/studies
  - TSL fuming
  - Recovery improvement with zinc oxide fume
  - Recovery from purification residues
- Troubleshooting at the roasters and acid plant
  - Breakthrough study
- Conclusion

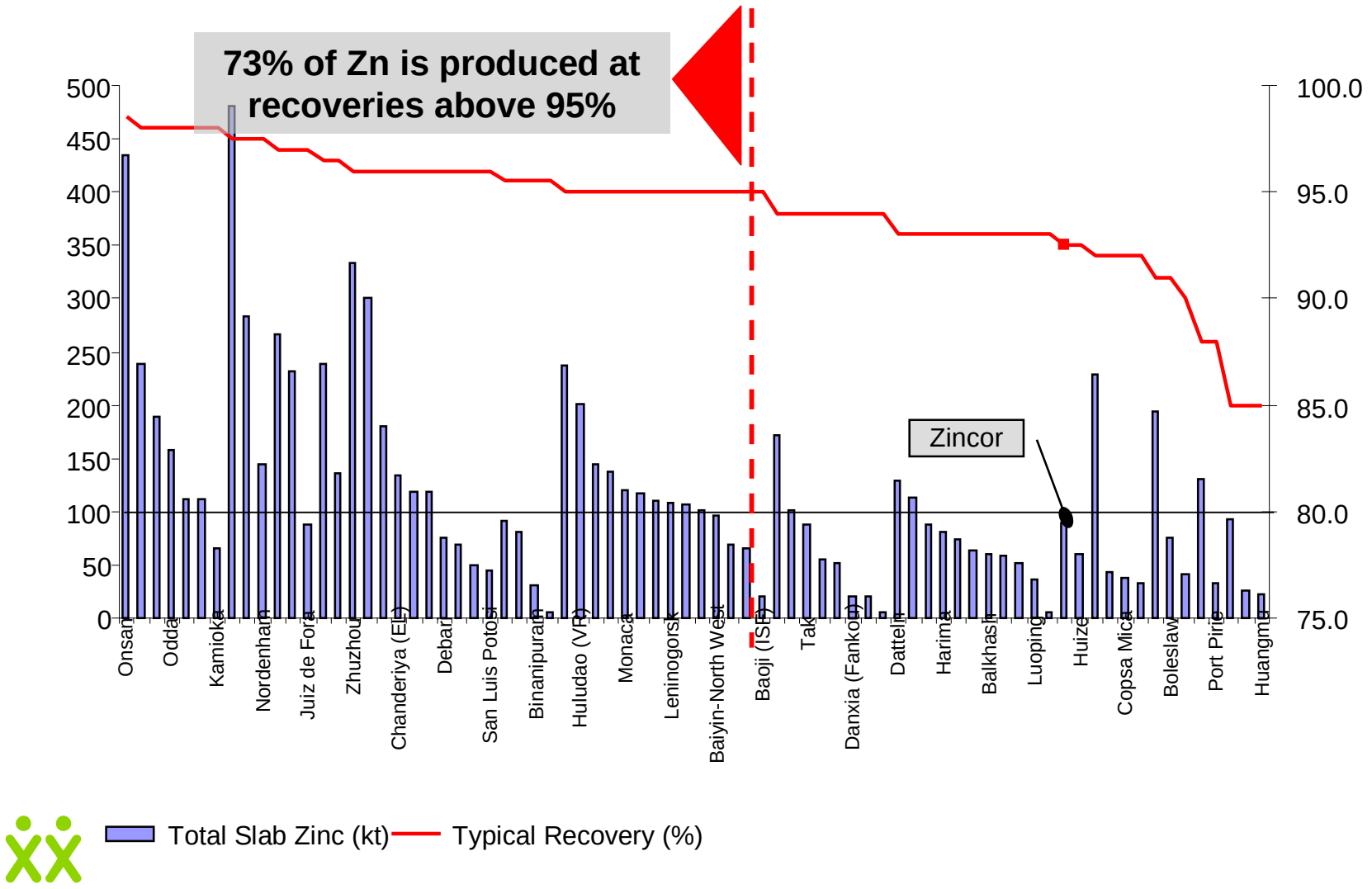
Contents

Global Smelter Slab Production (kt/a)



Source: Data from Brook Hunt :

Recovery vs slab production



Source: Data from Brook Hunt

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Zincor History

- **1965:** GFSA closes Vogelstruisbult Gold Mine in Springs. Facility is temporarily converted to process uranium
- **1967:** Zincor is established (65% GFSA; 35% Iscor)
- **1969, Apr:** First ingot cast
- **1999, Feb:** GFSA unbundles; Iscor acquires Zincor
- **2001, Nov:** Iscor unbundles; mining division of Iscor, including Zincor, is consolidated into a new entity – Kumba Resources
- **2002-2006:** Anglo American acquires controlling stake in Kumba Resources
- **2006, Nov:** Kumba Resources is unbundled; iron ore business is separated to form Kumba Iron Ore Company; remaining assets and Eyesizwe Coal are consolidated into a new entity - Exxaro Resources. Zincor is now a division of Exxaro Base Metals

Exxaro Base Metals: 100% Zincor, 26% Black Mt and Gamsberg; 50.1% of Rosh Pinah; minor shareholding in Chifeng Smelter in China

GFSA: Gold Fields of South Africa; *Iscor* : now ArcelorMittal South Africa

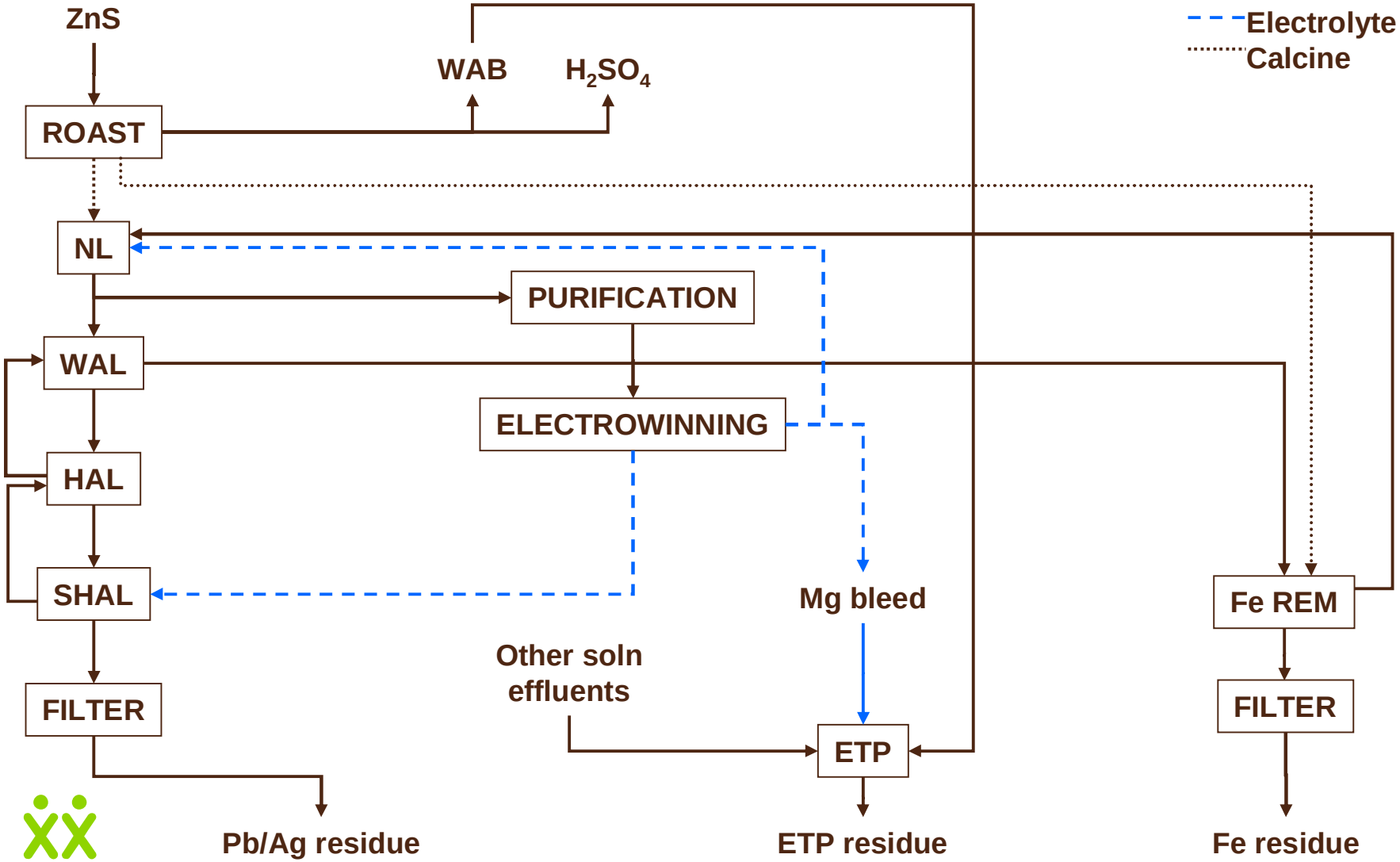
Zincor's role in South Africa

- Zincor is the only primary zinc producer in South Africa

- Slab zinc production of approximately 100 kt/a with inherent capacity up to 115 kt/a
    - Galvanising, alloy production, batteries and chemicals
    - Focus on customer requirement i.t.o. alloys and size

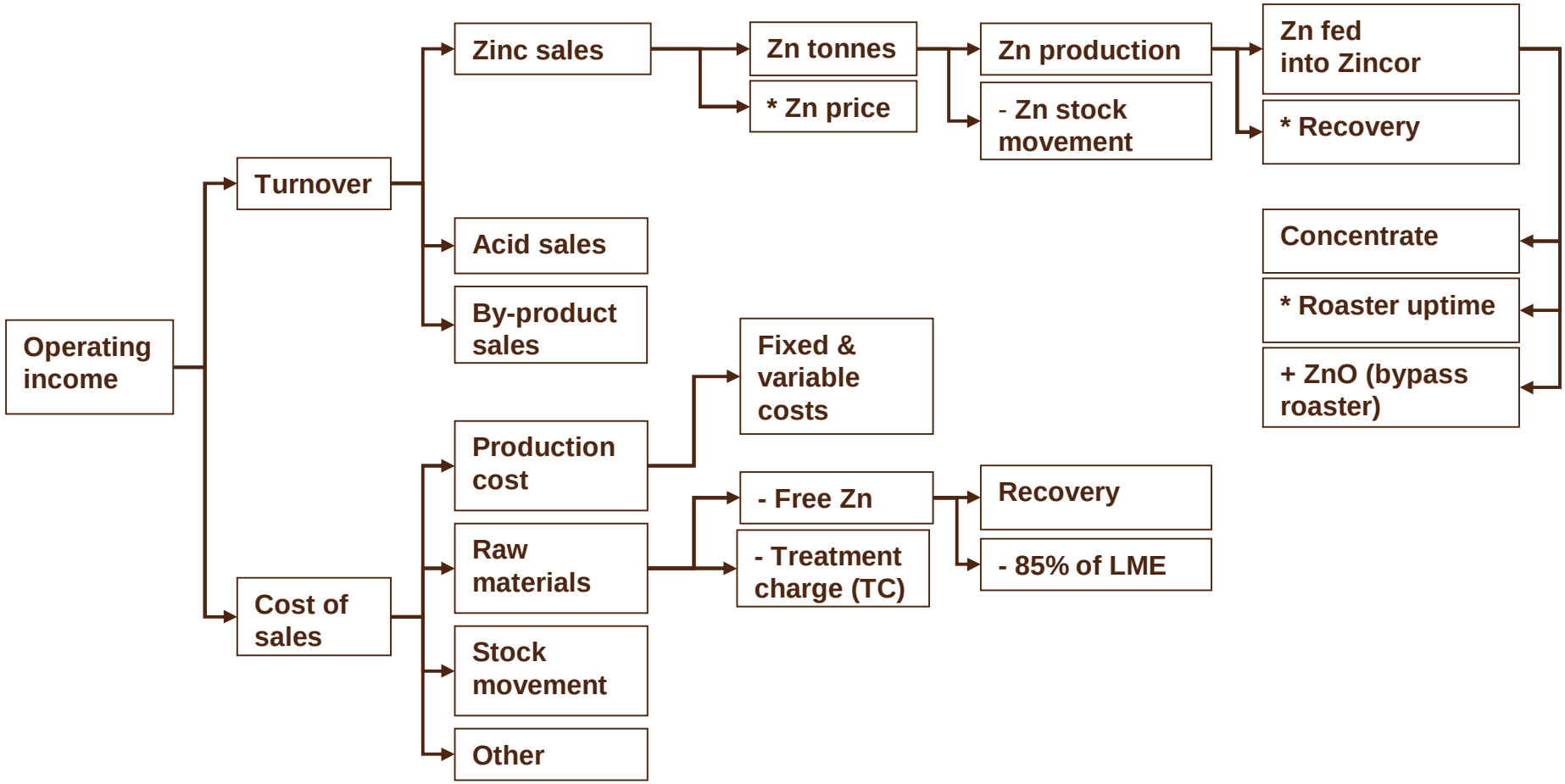
- Sulphuric acid production of approximately 170 kt/a.
    - Fertilizers, chemical processes

Zincor Process



Zincor Process

KPI – Bottleneck in roasters



Revenue = f((Recovery – 85%); Production cost; TC; Premiums)

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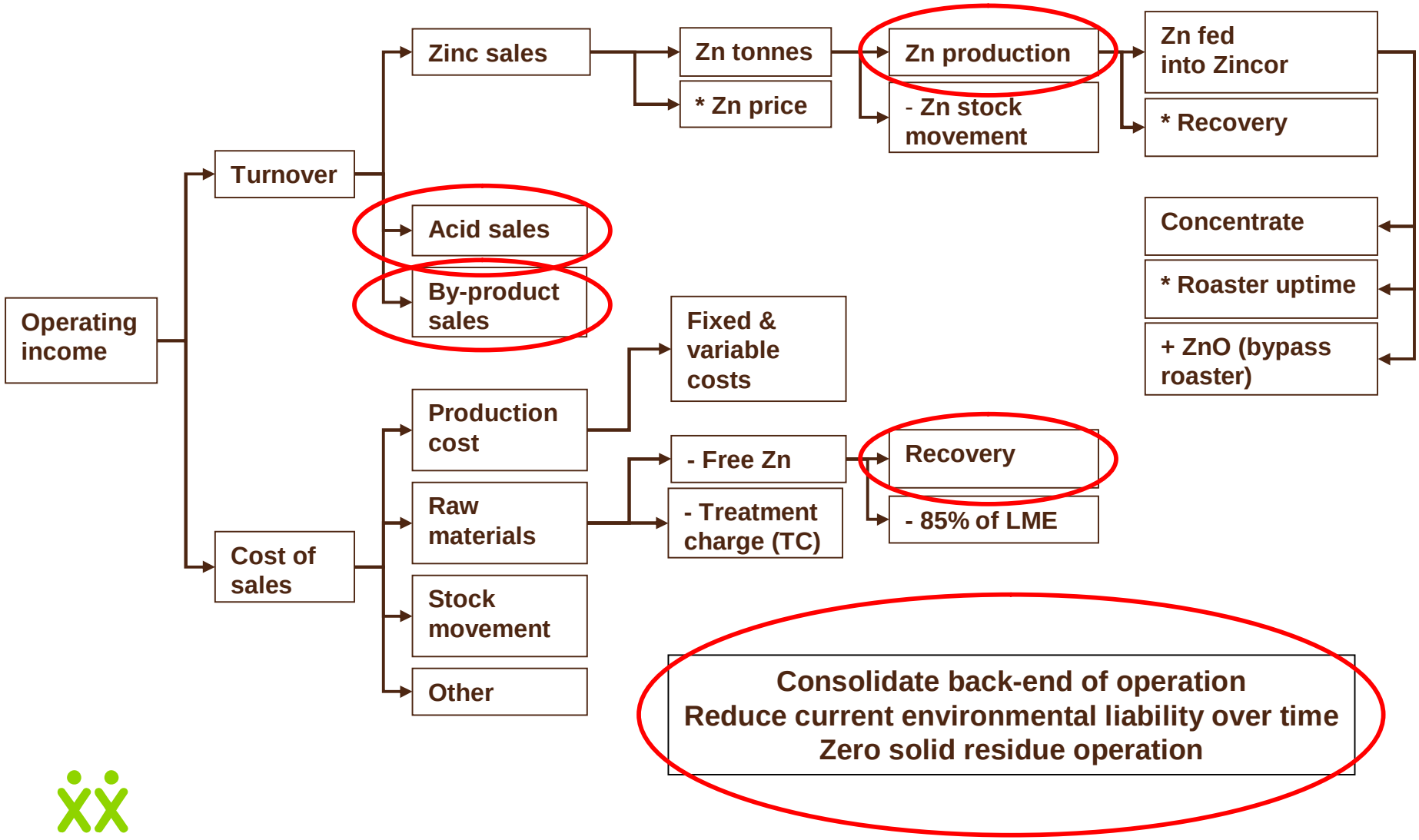
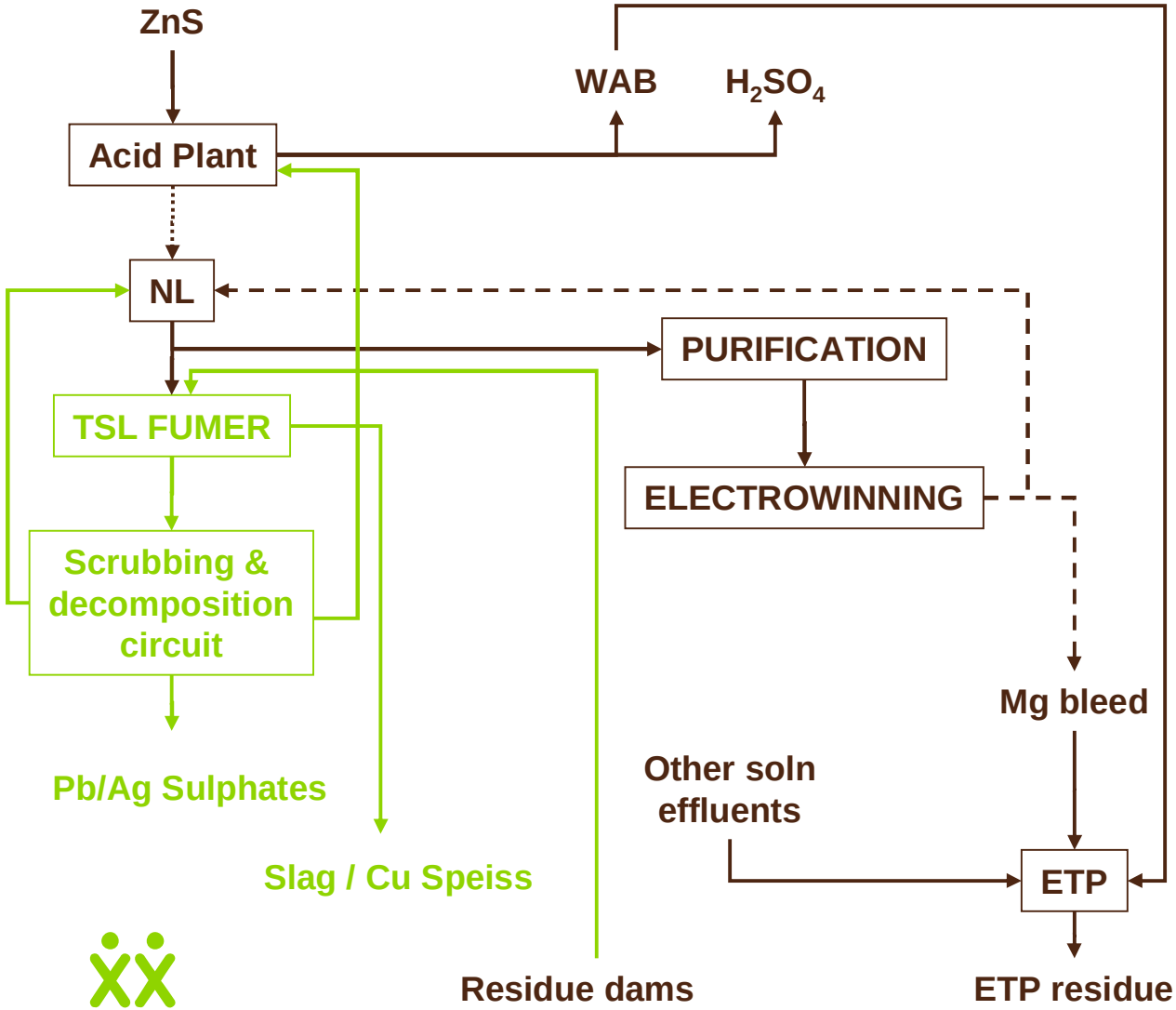
TSL fuming technology

KPI focus



TSL fuming technology

Integration in the Zincor circuit



Capex ~R1.9B

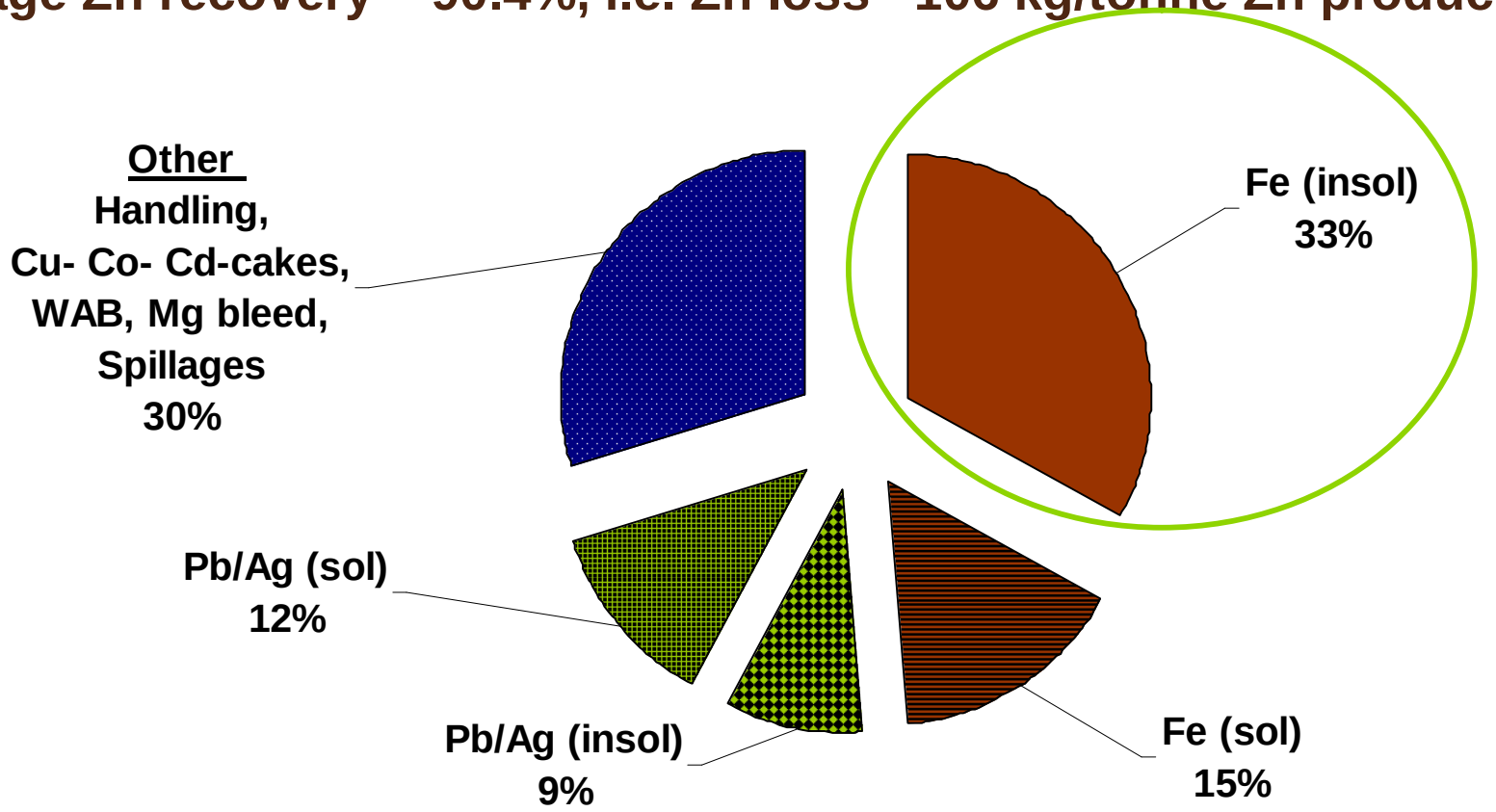
Neg. business case

Contents

Zinc recovery

Focus

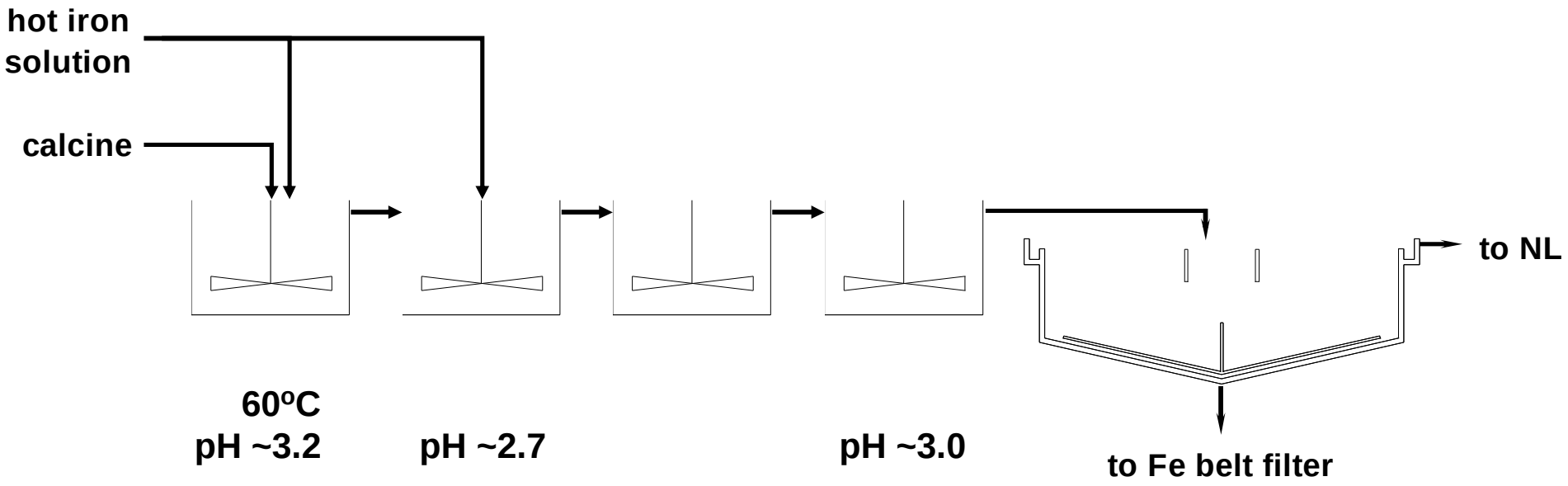
Average Zn recovery ~ 90.4%, i.e. Zn loss ~106 kg/tonne Zn produced



Jan-06 to May-07

Zinc recovery

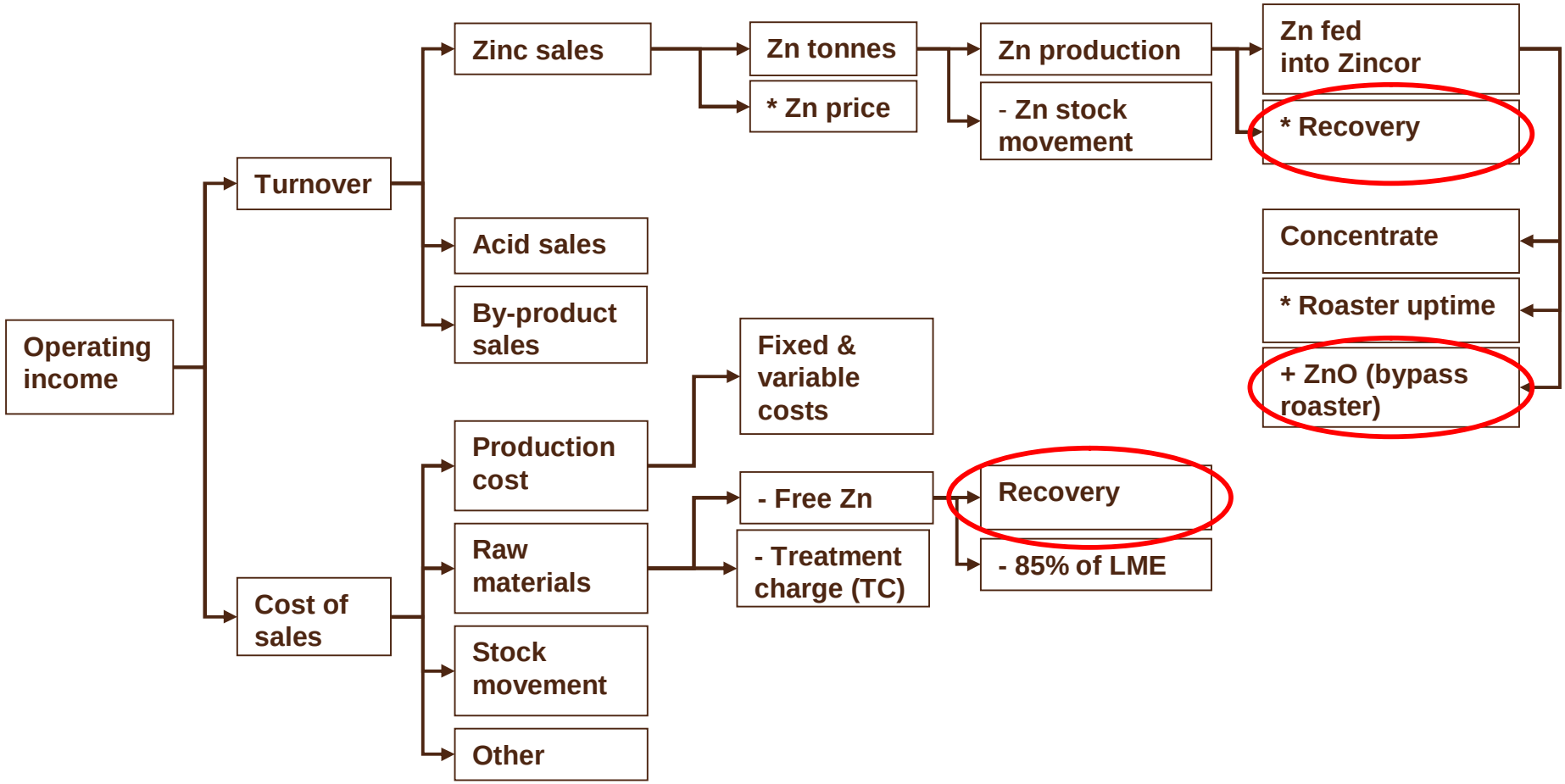
Fe removal circuit



- Residue - jarosite, schwertmannite & ferrihydrite
- Residue typically contains around 35% Fe and 10 - 11% Zn

Zinc oxide

KPI focus



Zinc oxide

Fumed ZnO for Fe removal

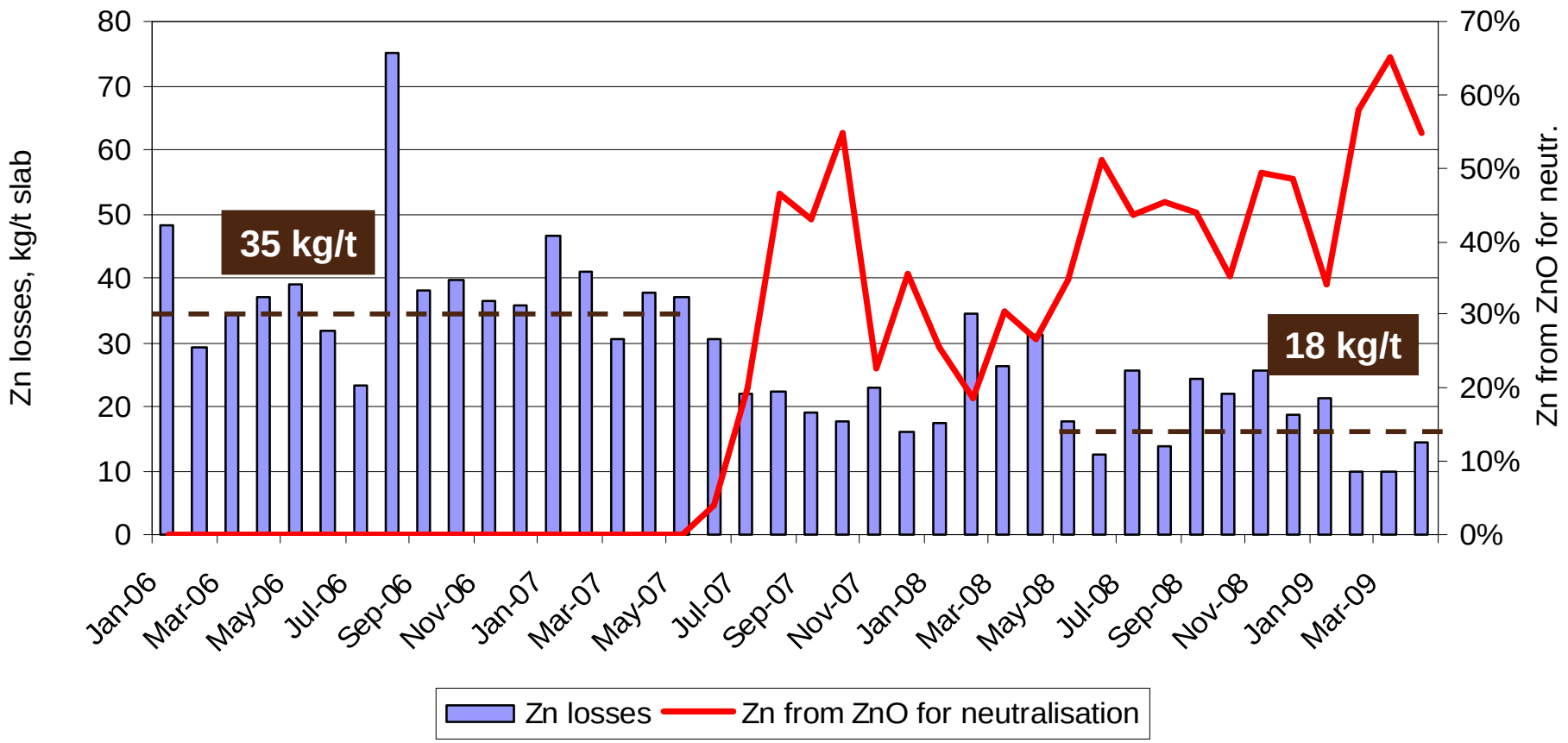
Fumed zinc oxide for iron removal stage.

Element	Unit	Calcine	DRC ZnO*
Zn	% (w/w)	57	69
Pb	% (w/w)	2.8	9.3
Fe	% (w/w)	6.2	0.4
Cl	g/t	<10	280
F	g/t	<100	370

*** Fumed oxides from Democratic Republic of Congo**

Zinc recovery

Fumed ZnO for Fe removal



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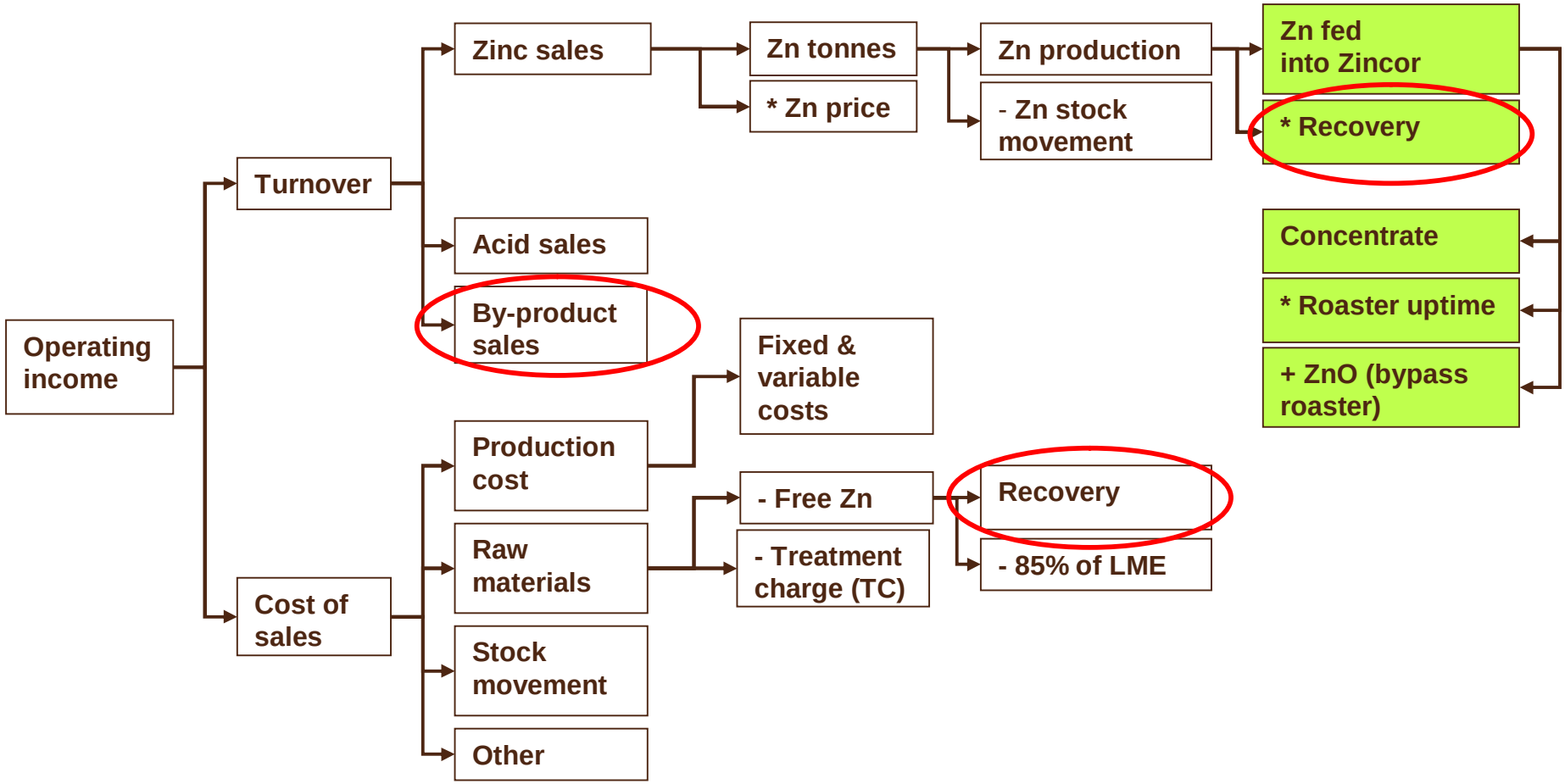
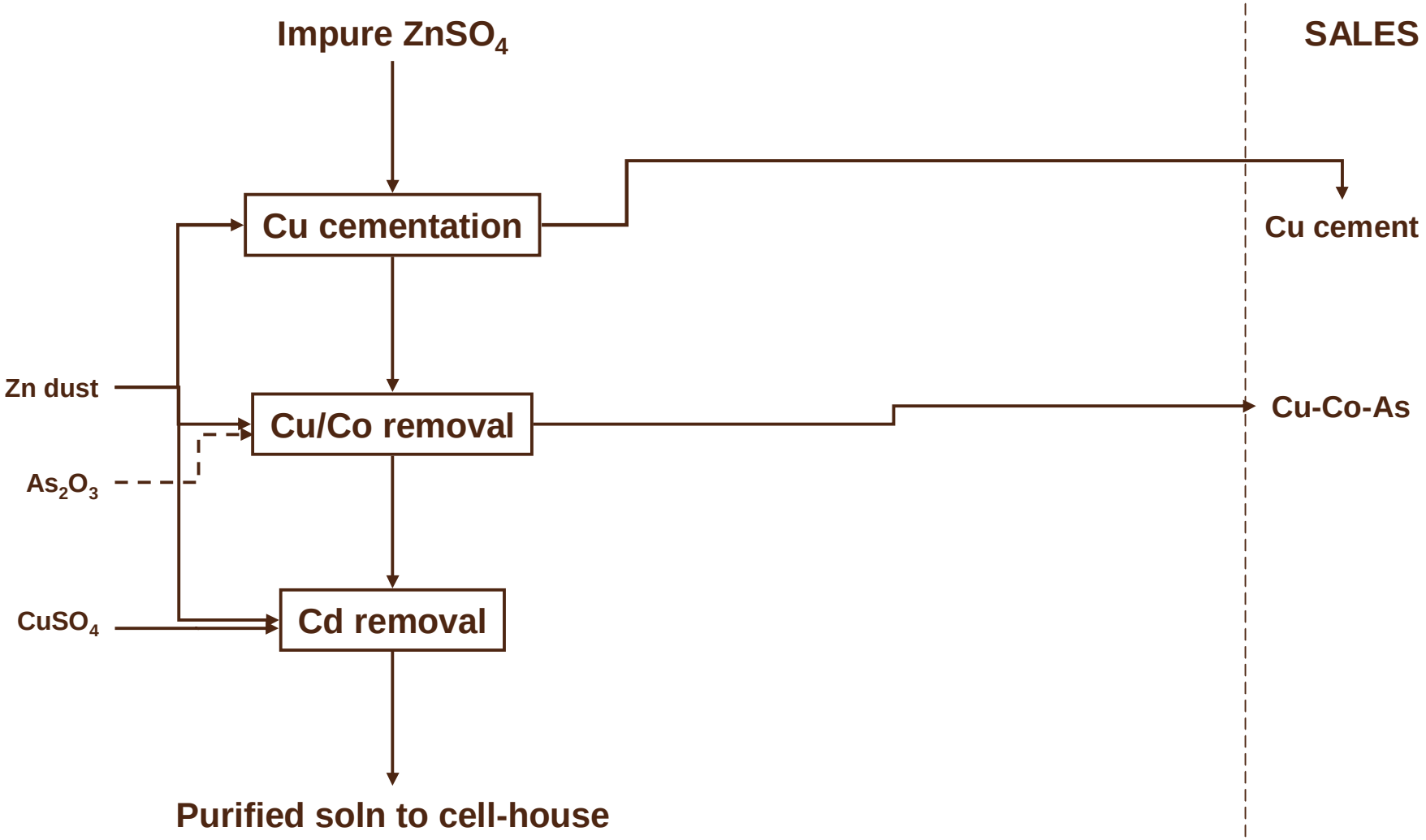
Recovery from Purification residues

KPI focus



Recovery from Purification residues

Purification and byproduct circuits



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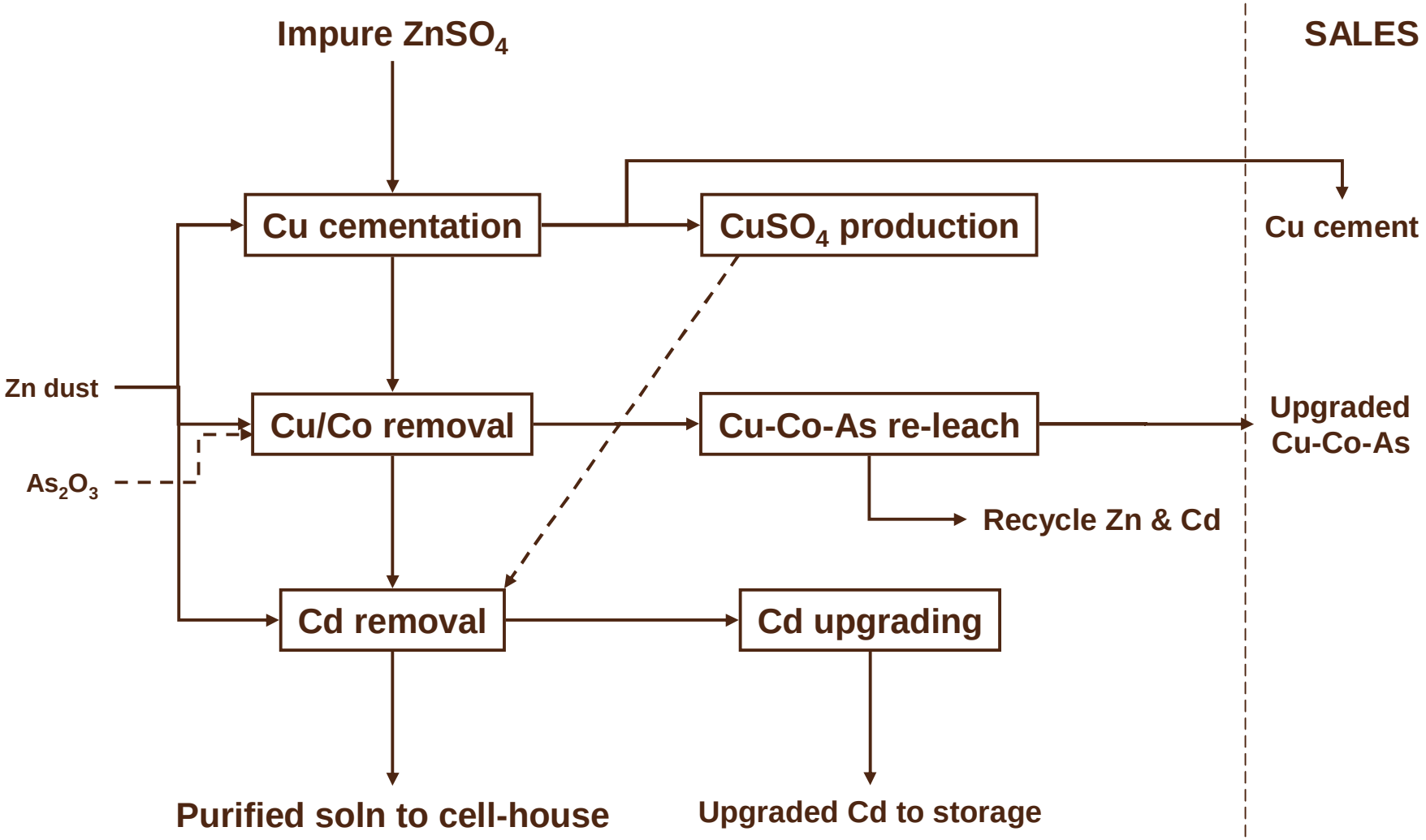

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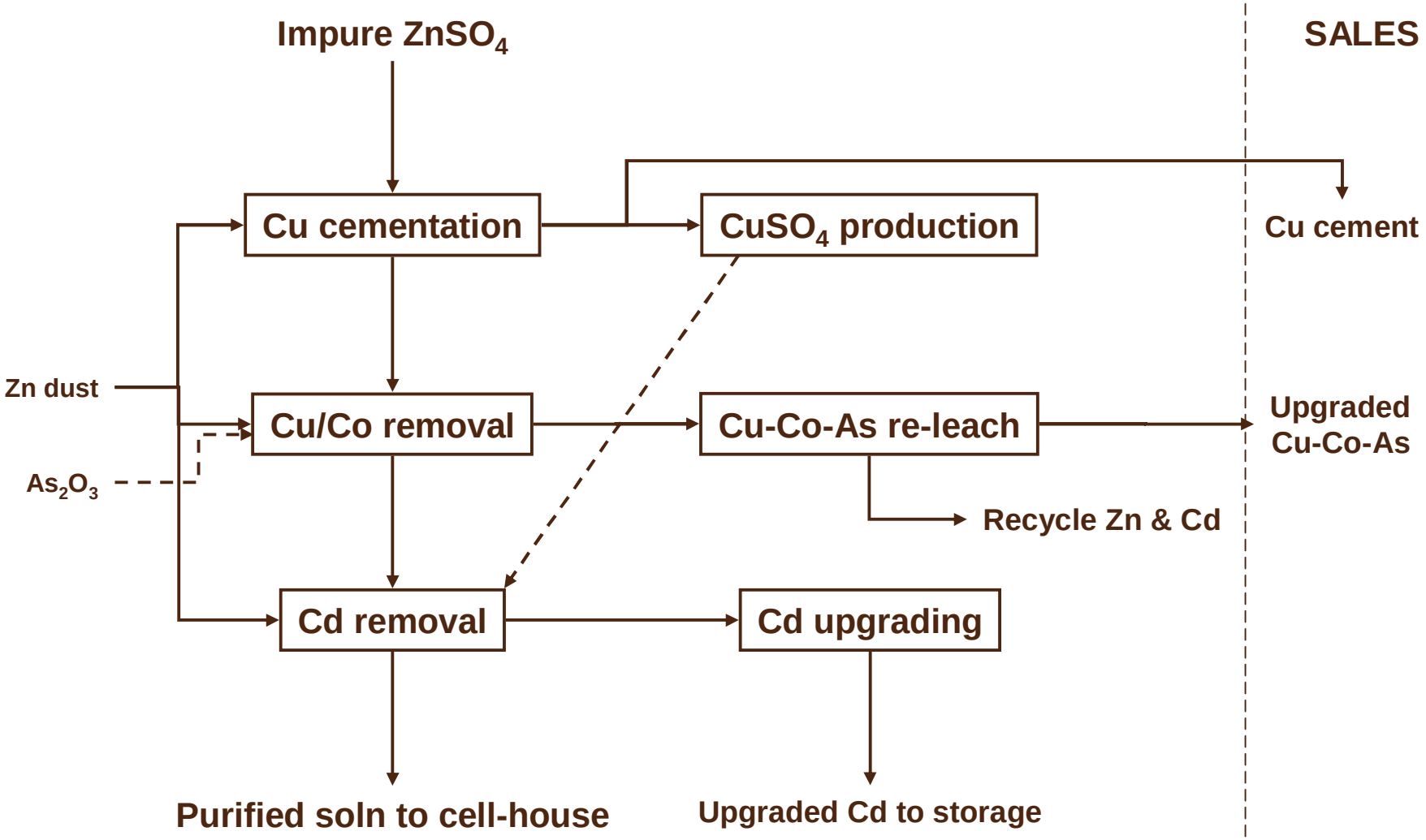
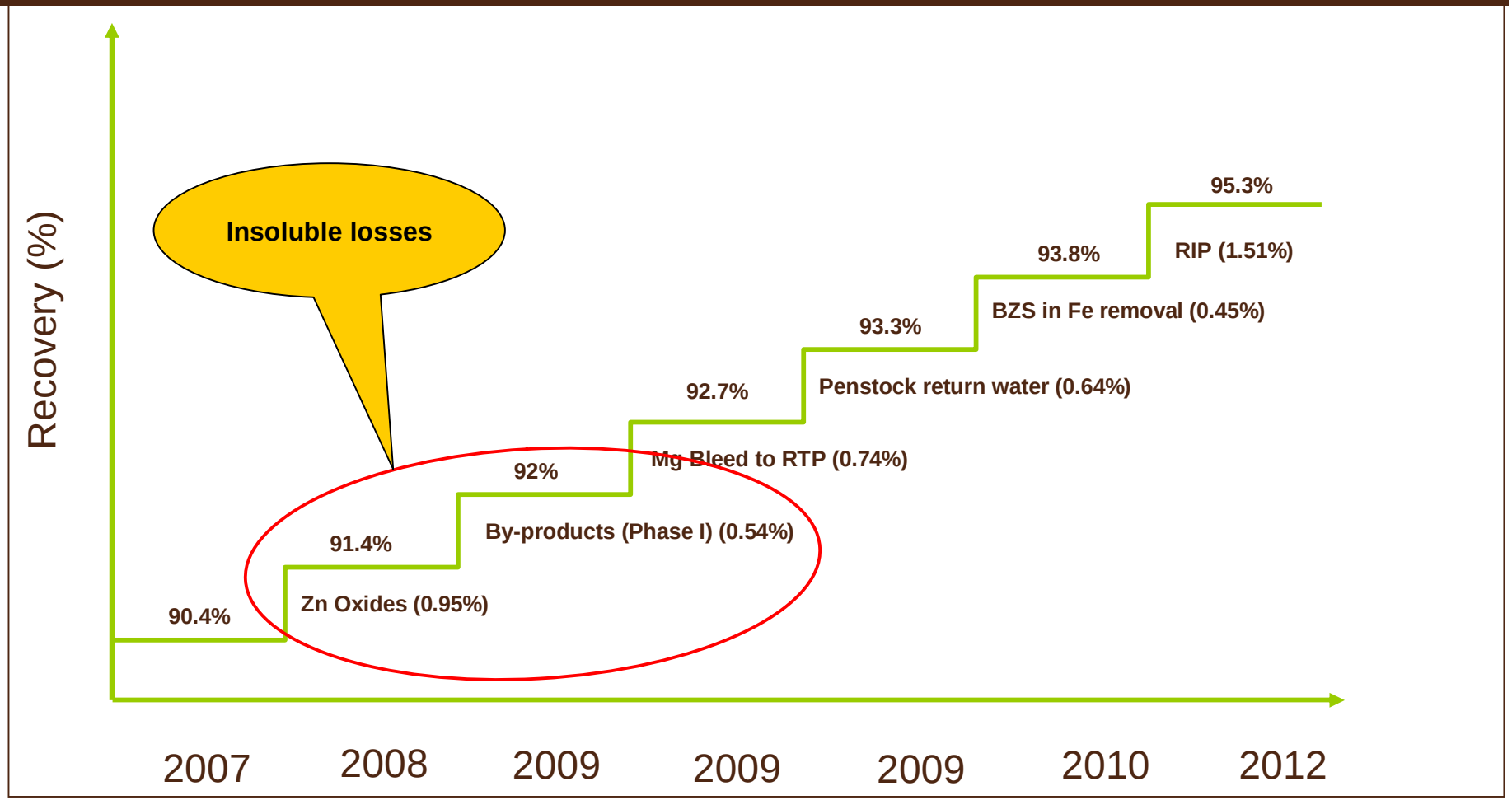


Recovery Improvement Projects - Summary



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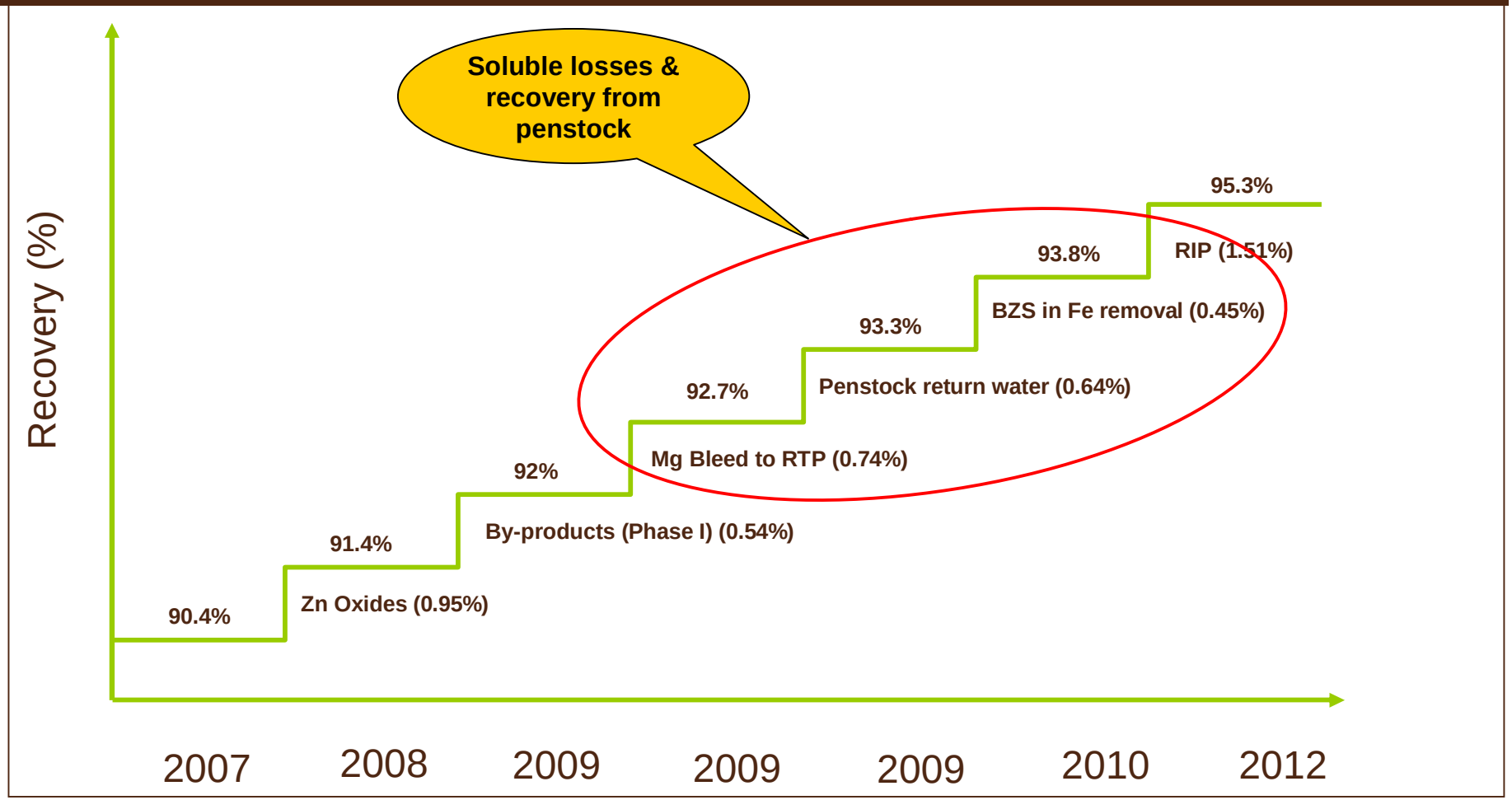

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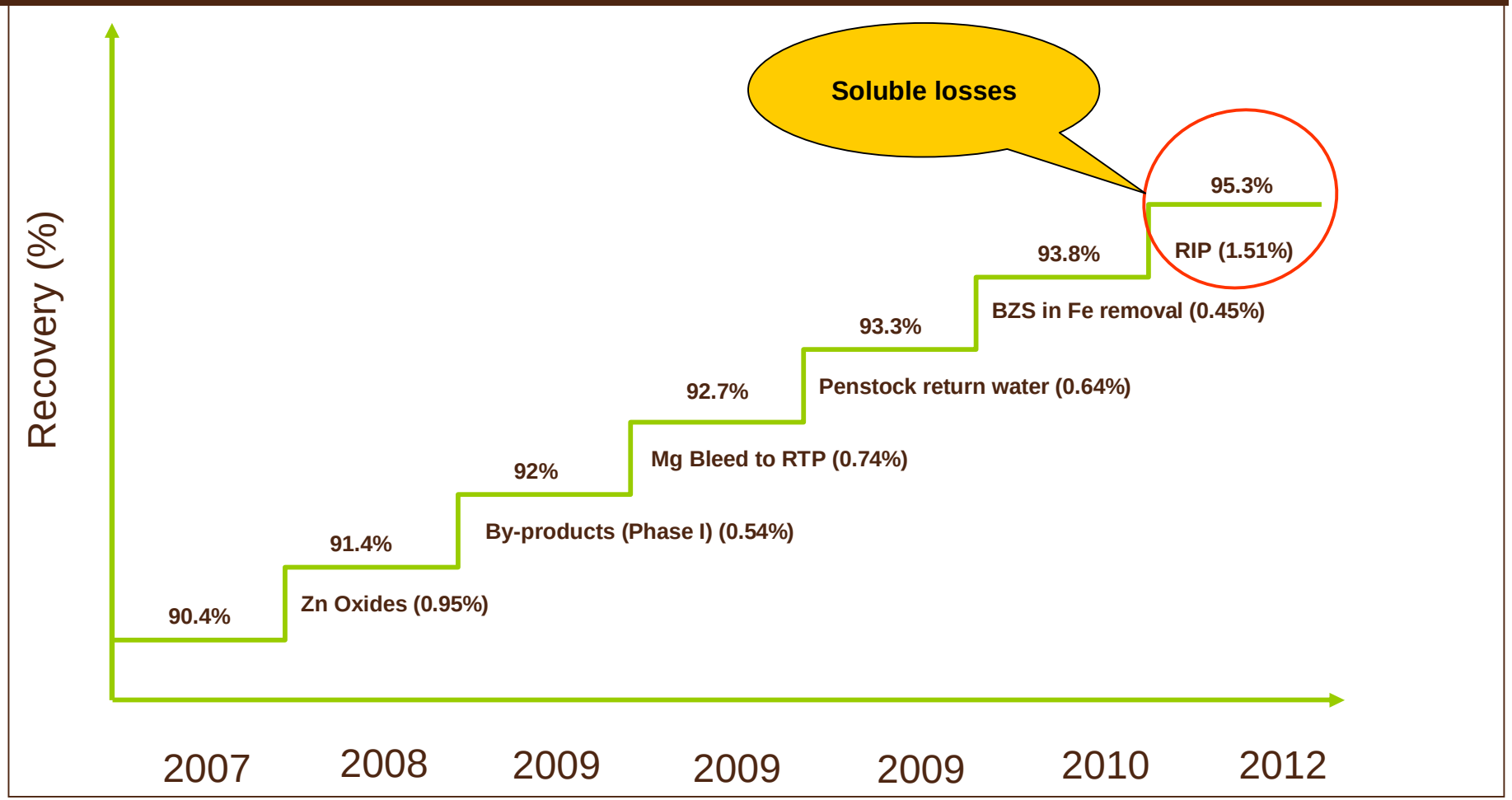
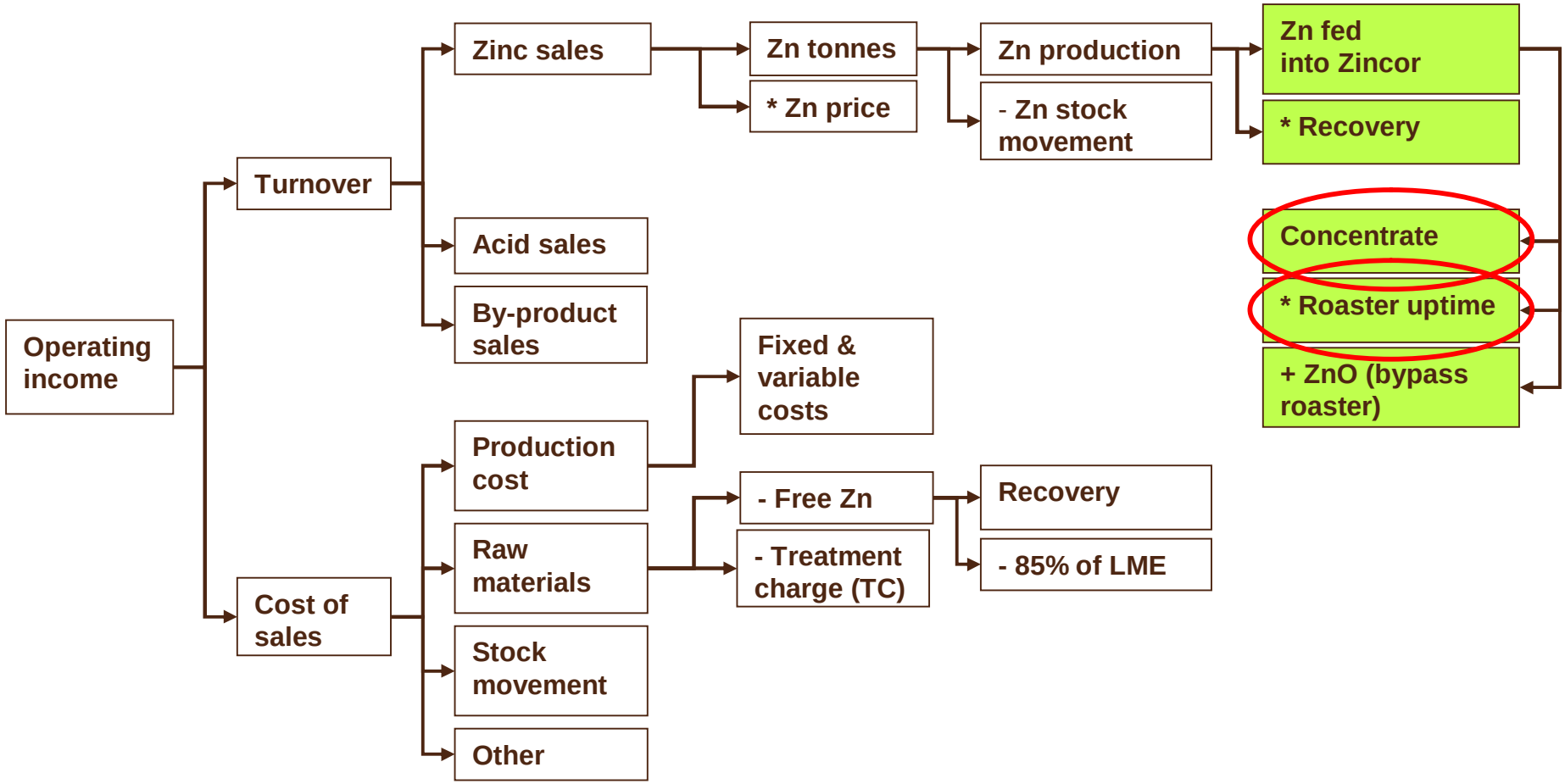


Contents

Acid Plant Breakthrough

KPI focus

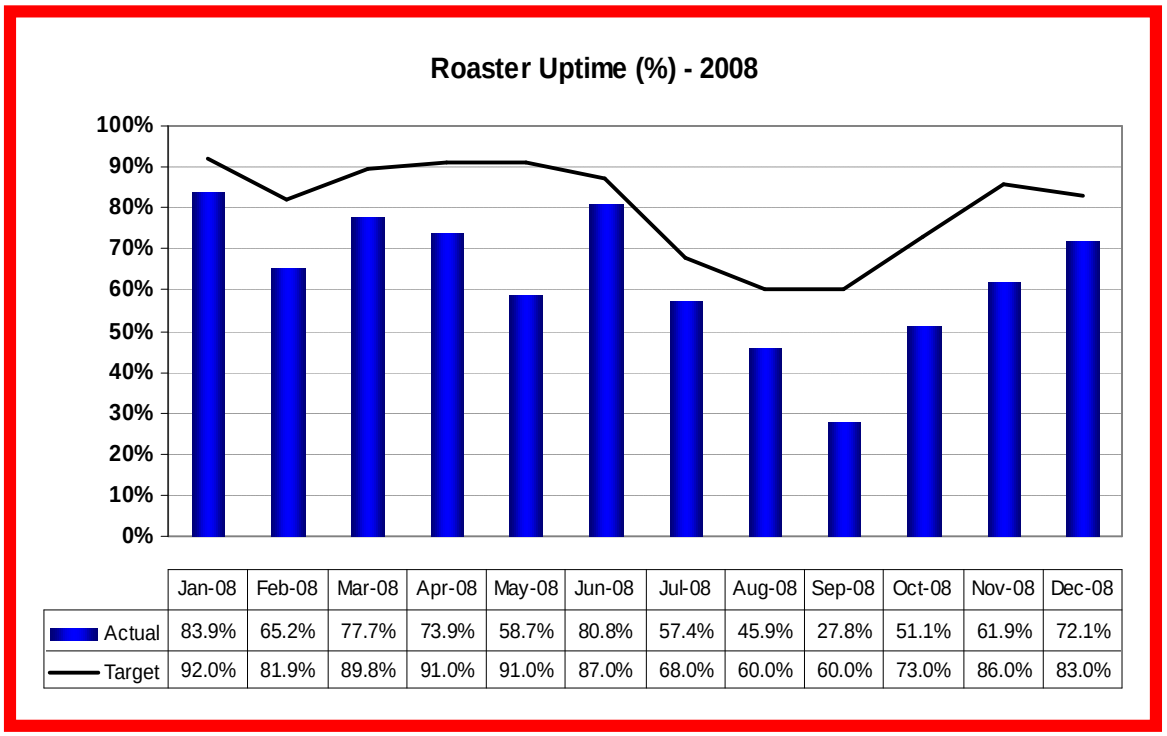


Acid Plant Breakthrough

Case for change

- Roaster throughput below the required target.

- Issues:
Equipment availability
Frozen beds



	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08
Actual	83.9%	65.2%	77.7%	73.9%	58.7%	80.8%	57.4%	45.9%	27.8%	51.1%	61.9%	72.1%
Target	92.0%	81.9%	89.8%	91.0%	91.0%	87.0%	68.0%	60.0%	60.0%	73.0%	86.0%	83.0%

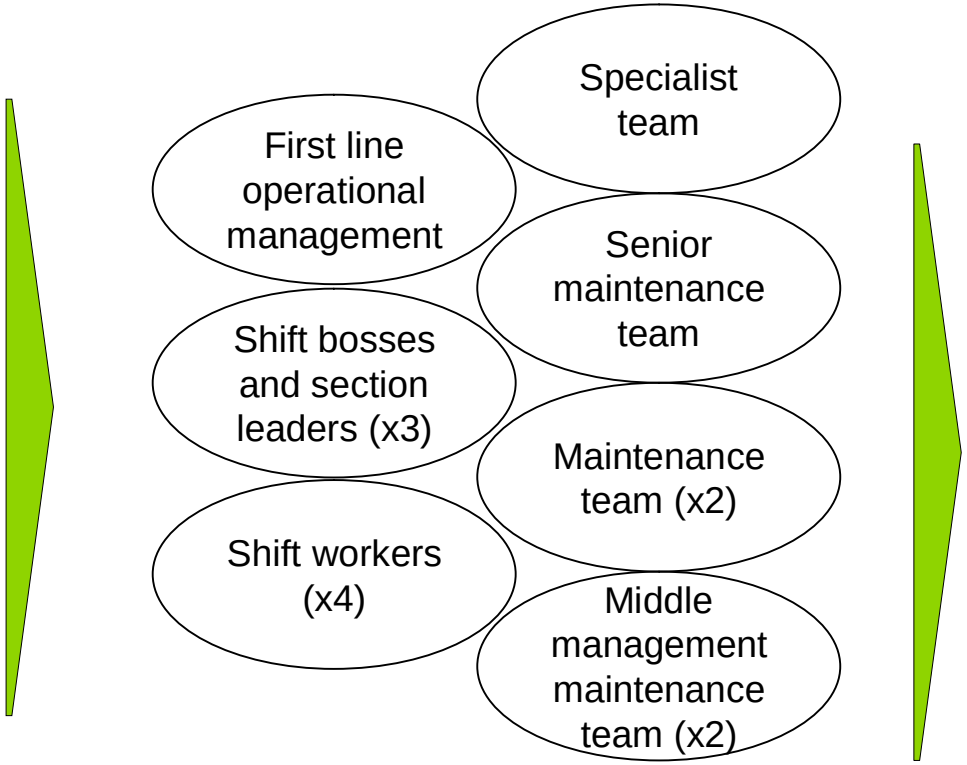
Acid Plant Breakthrough

Roaster bed failure

Acid Plant Breakthrough

Harvest and generate ideas

120+ ideas captured during various brainstorming sessions



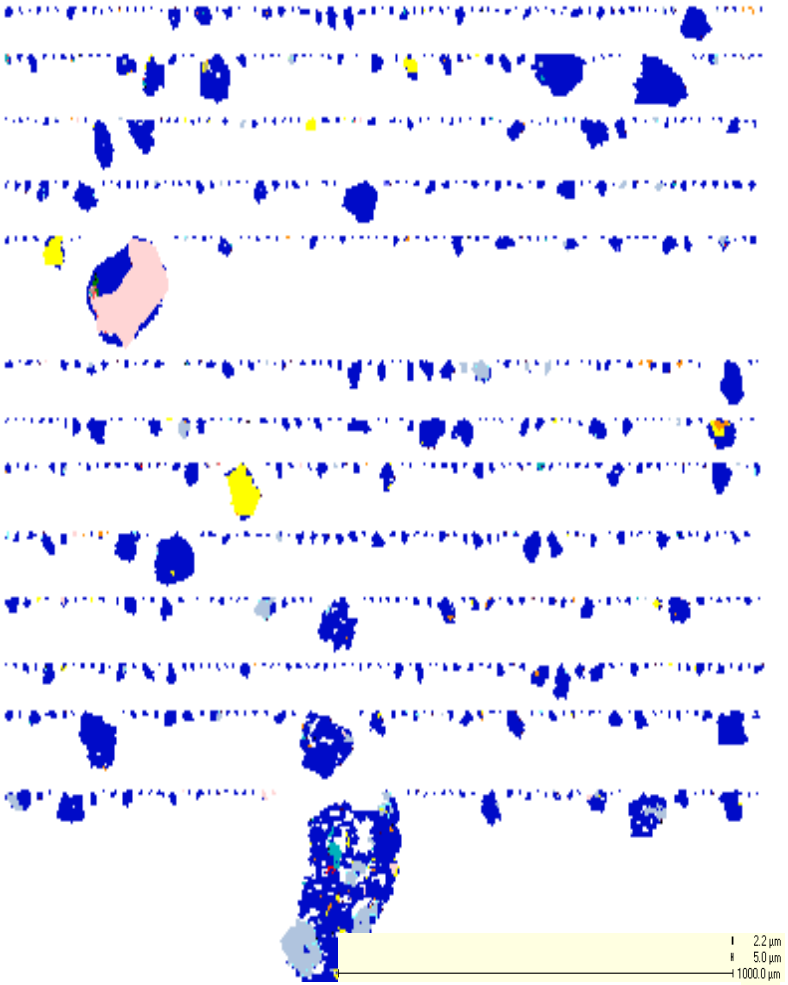
Fundamentals of operation

Plant uptime
- Maintenance
- Capital projects
- Critical spares

People related matters

Fundamentals of operation

QEMSCAN of concentrate



Mineral Name	
Background	0.00
Sphalerite	87.60
Zincite	0.08
Galena	0.29
Alabandite(MnS+MnS2))	0.04
Pyrite	2.87
Pyrrhotite	0.04
Chalcopyrite	1.23
Rutile/Leucox	0.01
Arsenopyrite	0.01
Alunite	0.03
'Sulphosalts'	0.01
Other sulphides	0.00
Barite	0.73
Quartz	0.69
Celsian(Ba-feldspar)	0.05
K-feldspar	0.16
Ba-K-feldspar	0.47
Muscovite	0.02
Ba-Mica (Phlogopite)	0.00
Chlorite	0.00
Mica	0.10
Dolomite	4.66
Calcite	0.55
Apatite	0.08
Ba-Ca-carbonate	0.02
Ba-carbonate(Witherite_Norsethi	0.06
Anhydrite/Gypsum	0.00
Other carbonates	0.10
Fe-oxides/hydroxides	0.04
Others	0.08
Amphibole-2-Rim	0.00

Fundamentals of operation

Hypothesis – growth of roaster bed particles

790°C $CaMg(CO_3)_2 \longrightarrow CaCO_3 + MgO + CO_2$

>940°C $CaCO_3 \longrightarrow CaO + CO_2$

$CaO + SO_3 \longrightarrow CaSO_4$

$ZnO + CaSO_4 + SiO_2 \longrightarrow Ca_2ZnSi_2O_7$

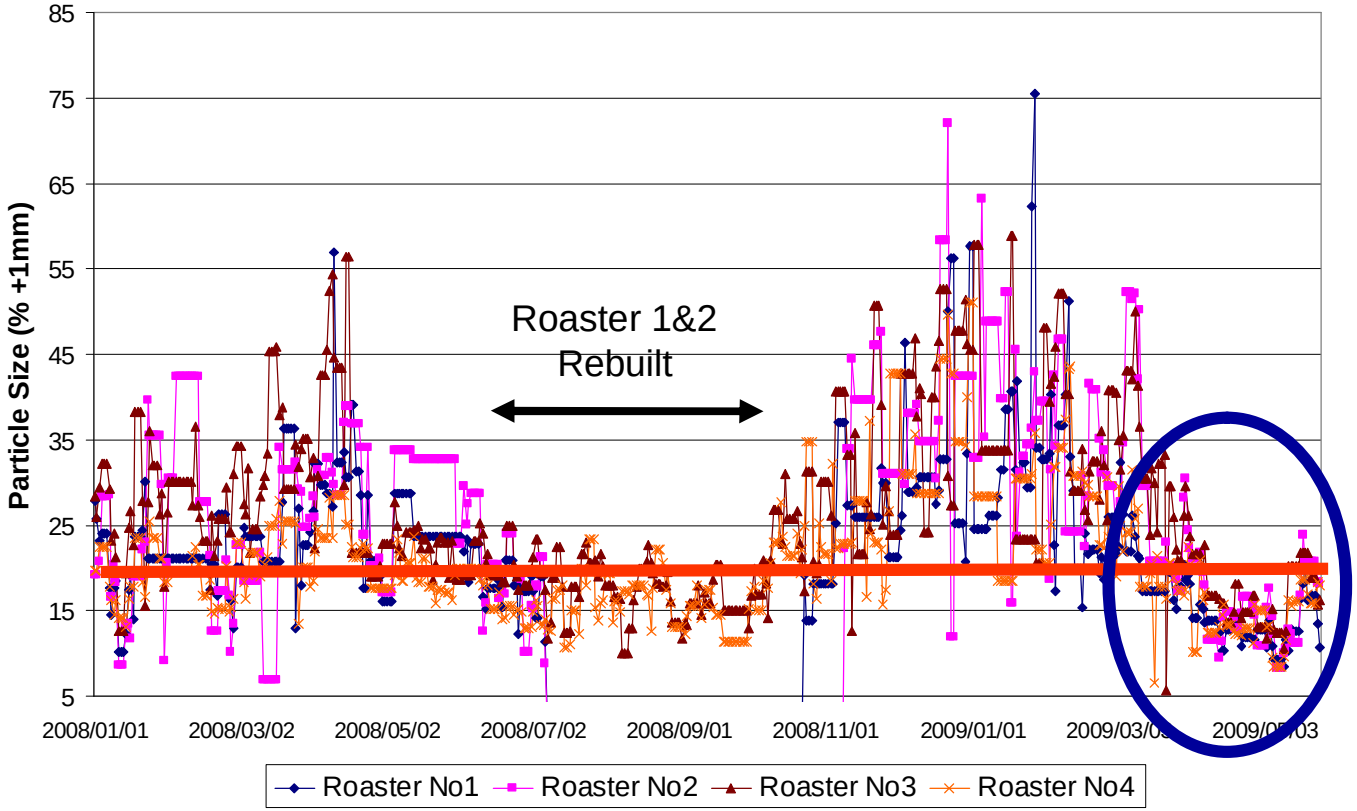
Hypothesis to prevent formation of $Ca_2ZnSi_2O_7$:

- **Prevent $CaSO_4$ and CaO from forming by maintaining operating temperature below 940°C**

Fundamentals of operation

Evaluation of hypothesis

Control operating temperature between 890 and 910°C

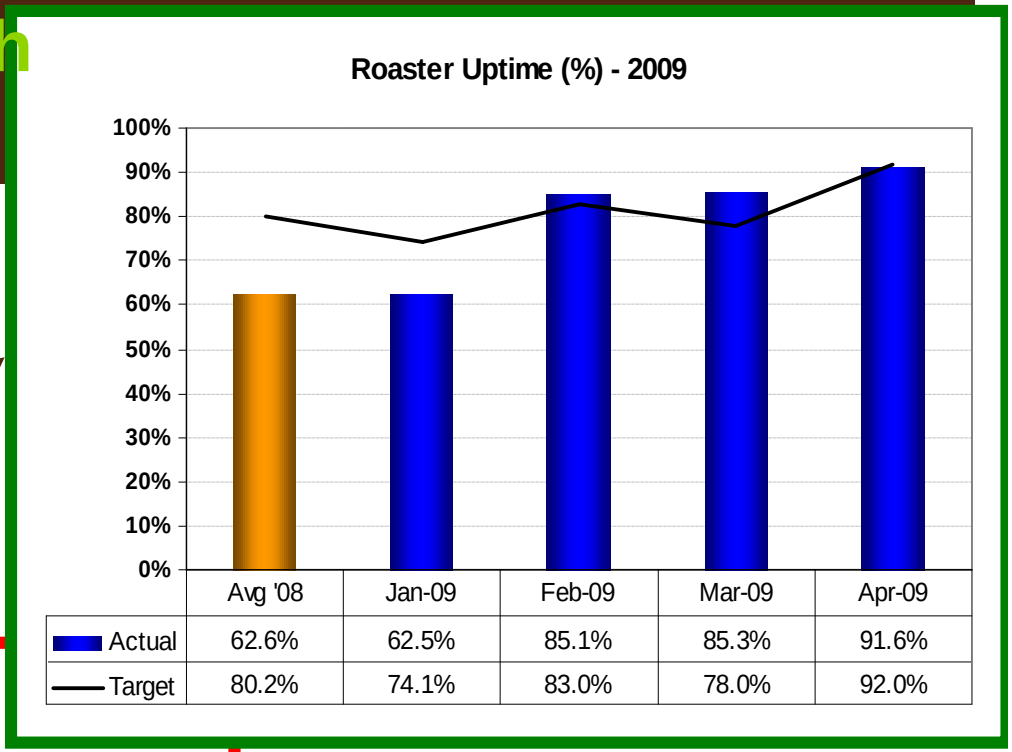


Improved bed gradings without affecting roasting efficiency

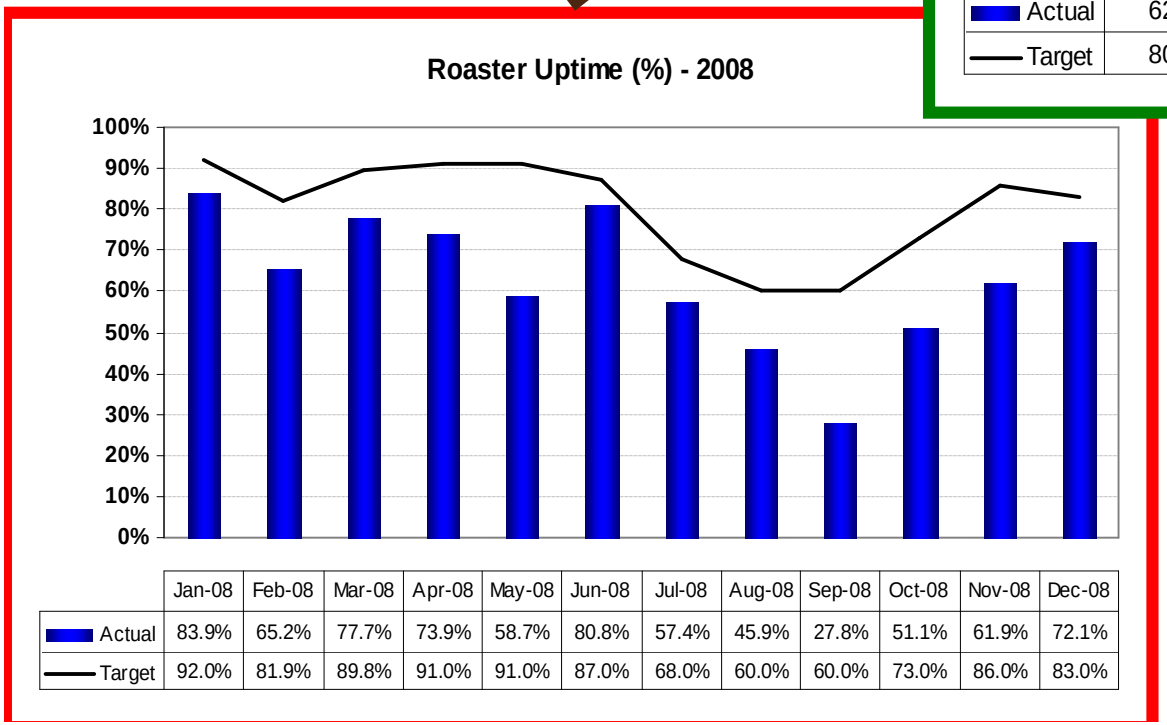
Acid Plant Breakthrough

The Proof…

Fundamentals
Maintenance
People management



	Avg '08	Jan-09	Feb-09	Mar-09	Apr-09
Actual	62.6%	62.5%	85.1%	85.3%	91.6%
Target	80.2%	74.1%	83.0%	78.0%	92.0%



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Conclusions

Acid plant breakthrough

- Breakthrough process focuses attention - improvements are often the result of increased focus.
- Ongoing tracking is critical to ensure implementation of ideas to eliminate risks and ensure sustainable results.

Process Improvements

- Zincor retain focus on customer requirements i.t.o. capacity and product mix
- Increase recovery to >95% at relatively low capital cost:
  - Neutralising agent for Fe removal
  - Zn recovery from purification residues
  - Recovery of soluble Zn from the existing circuit and Zn returned from slimes dams
- Increase revenue from by-product sales by increasing Cu and Co content in purification cementation products

Acknowledgements

- Zincor management and personnel
- Fumer project team
- Exxaro R&D
- Acid Plant breakthrough team

QUESTIONS?