



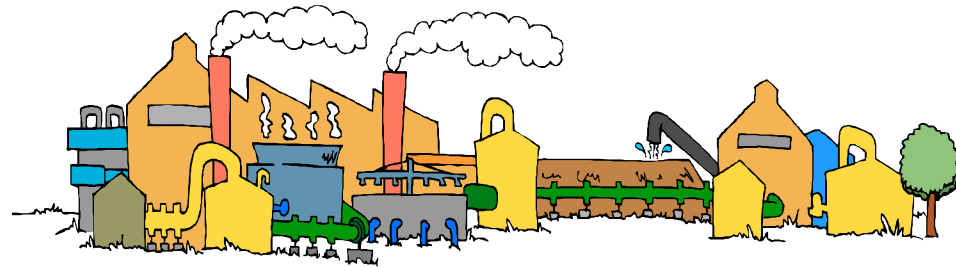
Troubleshooting and process improvements at Zincor

Jacolien Wyethe

Presented at Mintek 75, 4 June 2009

exxaro

ZINCOR | BASE METALS



Contents

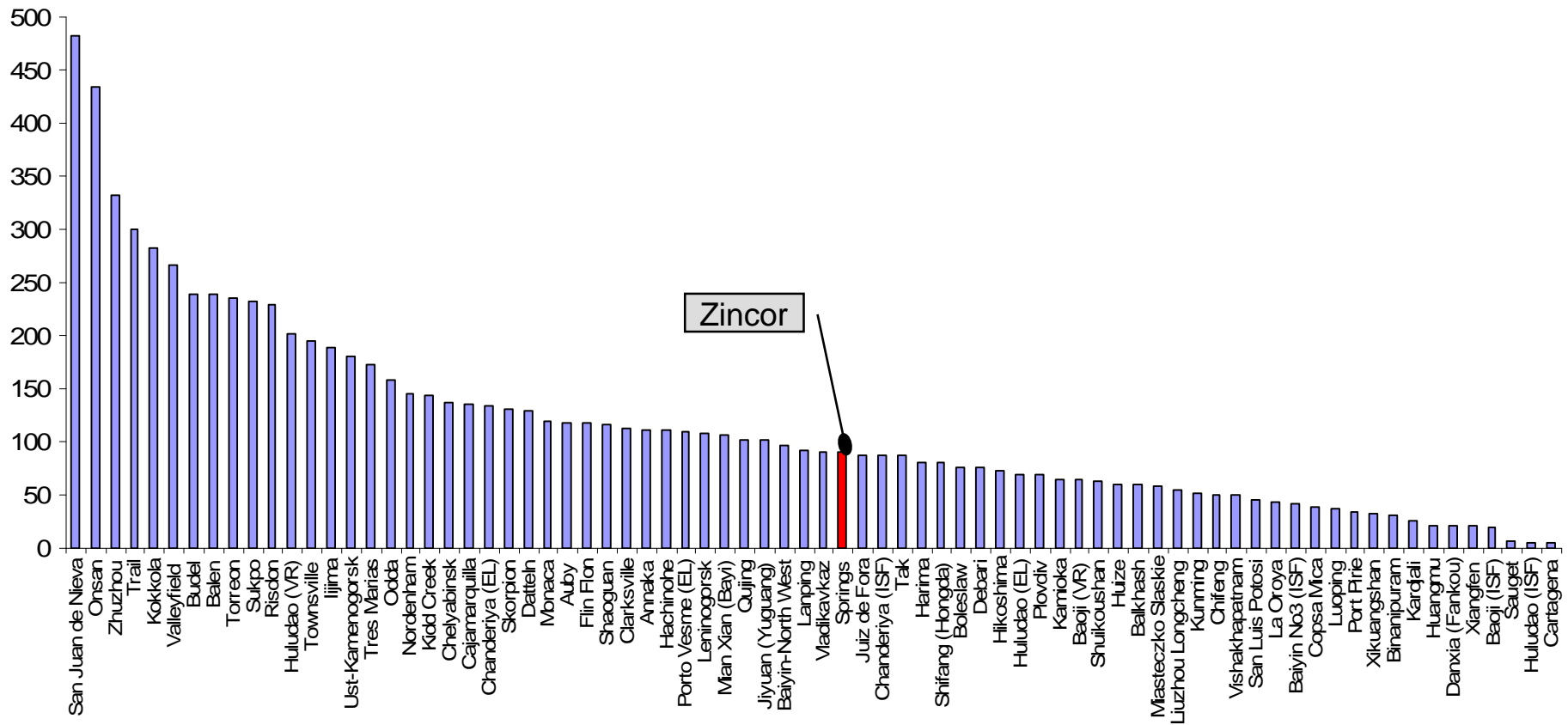
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- Zincor's history and its process
- Improvement projects/studies
 - TSL fuming
 - Recovery improvement with zinc oxide fume
 - Recovery from purification residues
- Troubleshooting at the roasters and acid plant
 - Breakthrough study
- Conclusion



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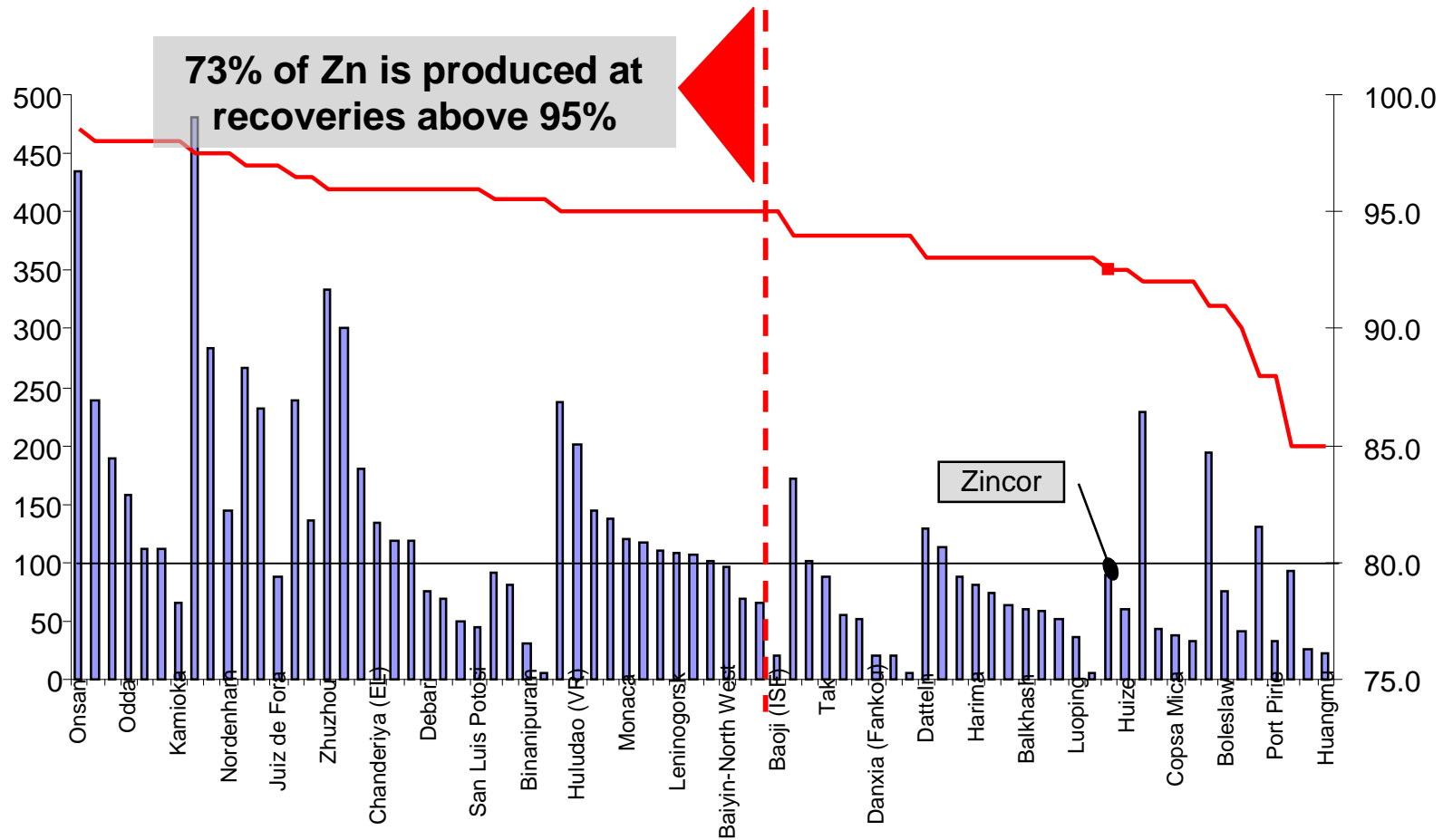
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Global Smelter Slab Production (kt/a)



Source: Data from Brook Hunt :

Recovery vs slab production



■ Total Slab Zinc (kt) — Typical Recovery (%)

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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



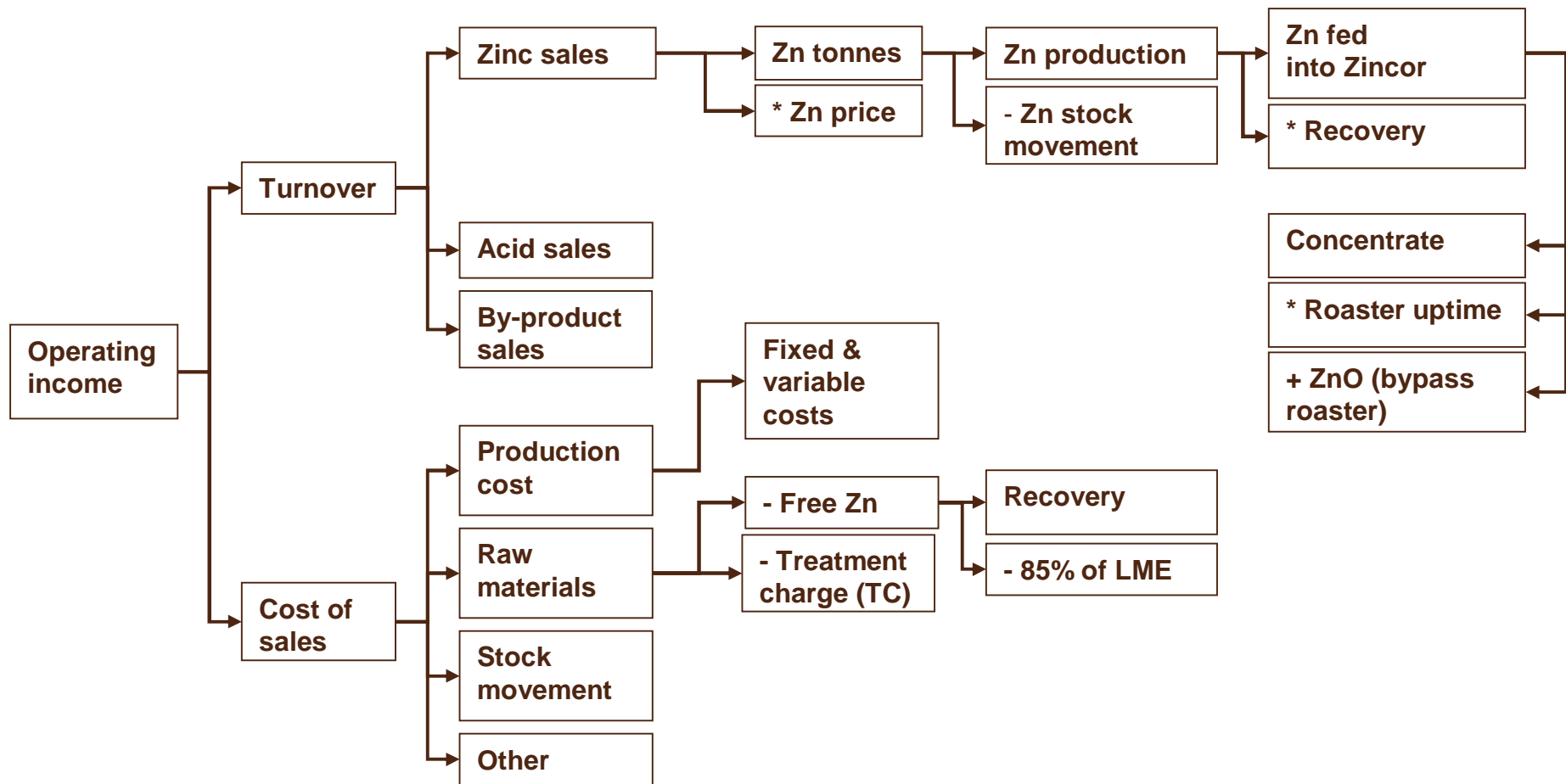
Zincor's role in South Africa

- 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

KPI – Bottleneck in roasters



$$\text{Revenue} = f((\text{Recovery} - 85\%); \text{Production cost}; \text{TC}; \text{Premiums})$$

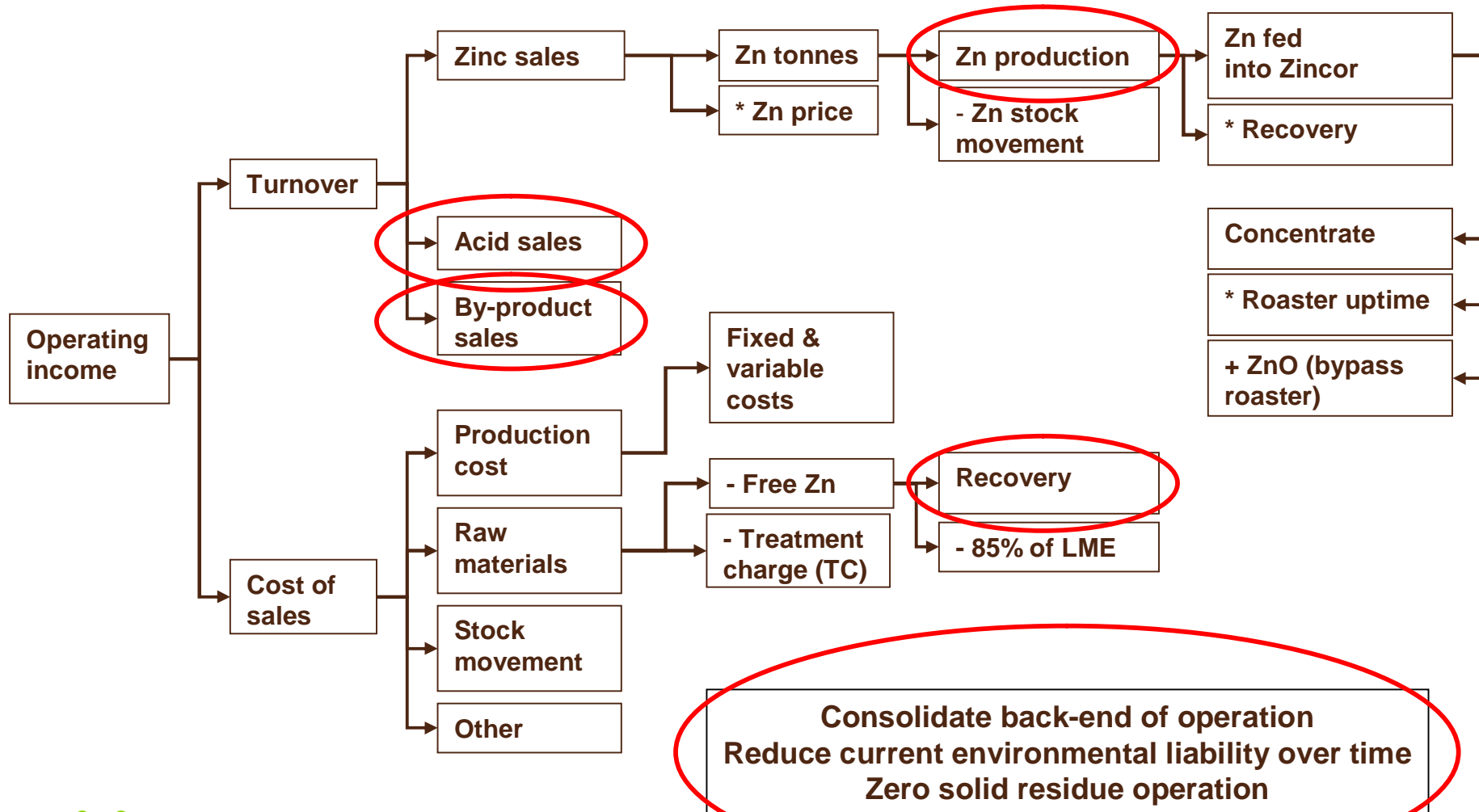
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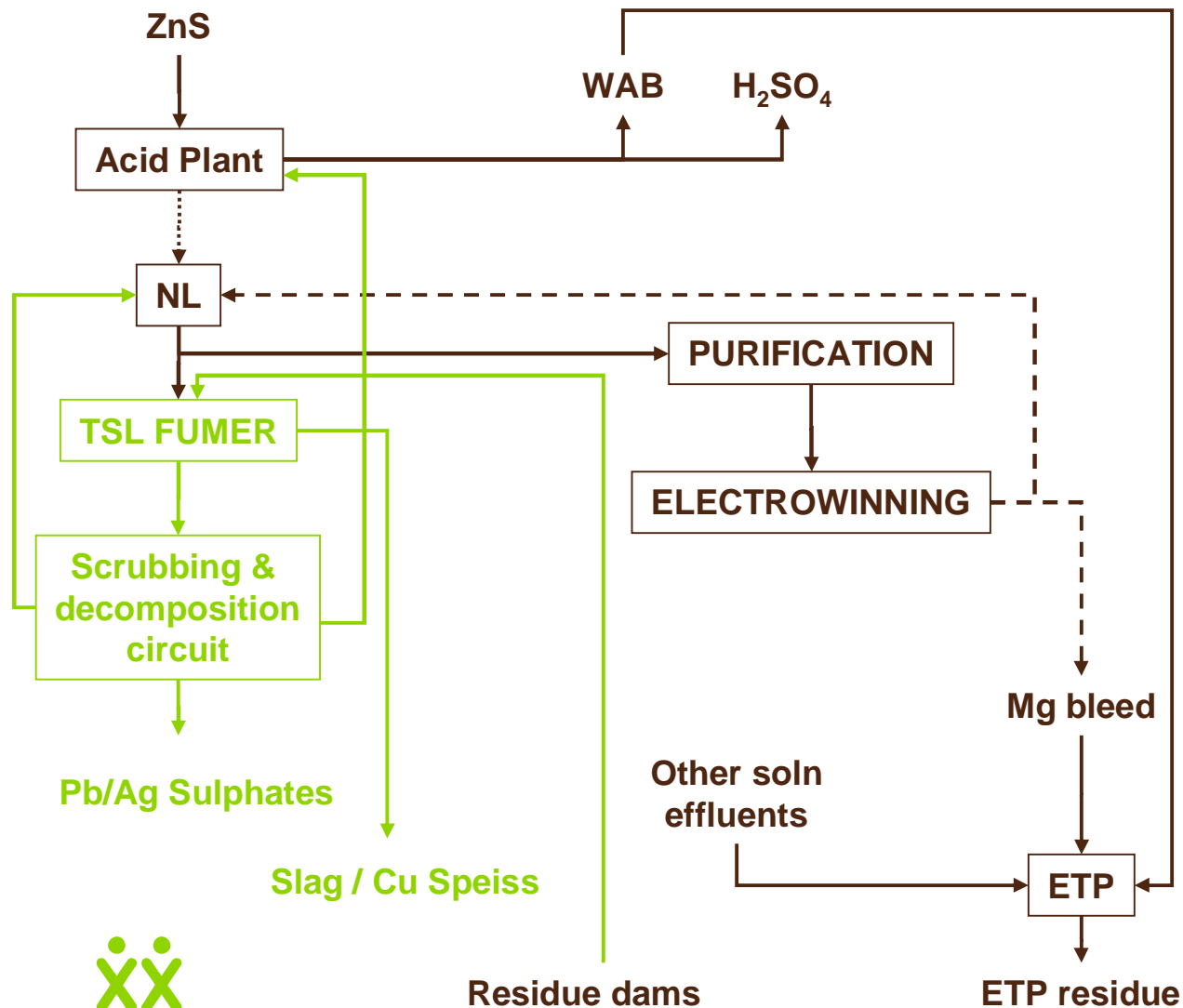
TSL fuming technology

KPI focus



TSL fuming technology

Integration in the Zincor circuit



Capex ~R1.9B
Neg. business case

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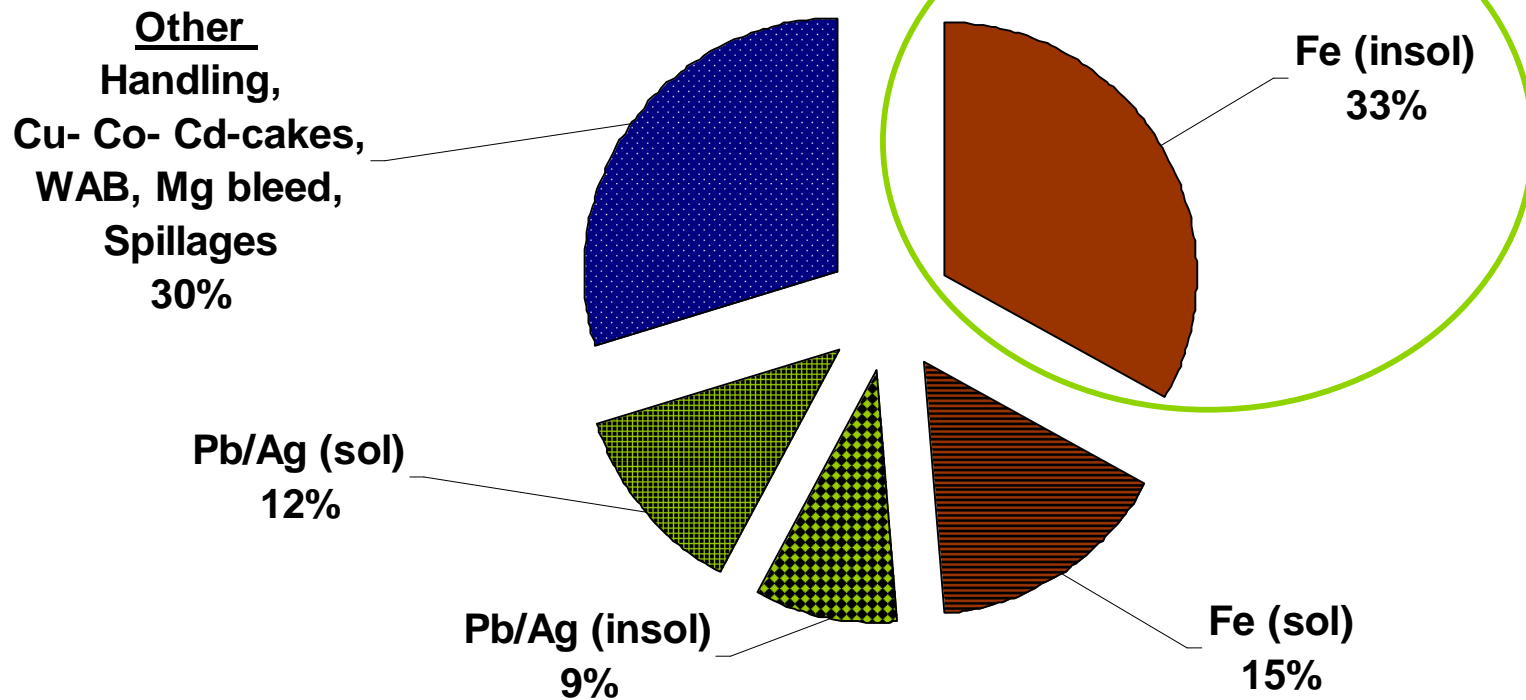


Zinc recovery

Focus

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



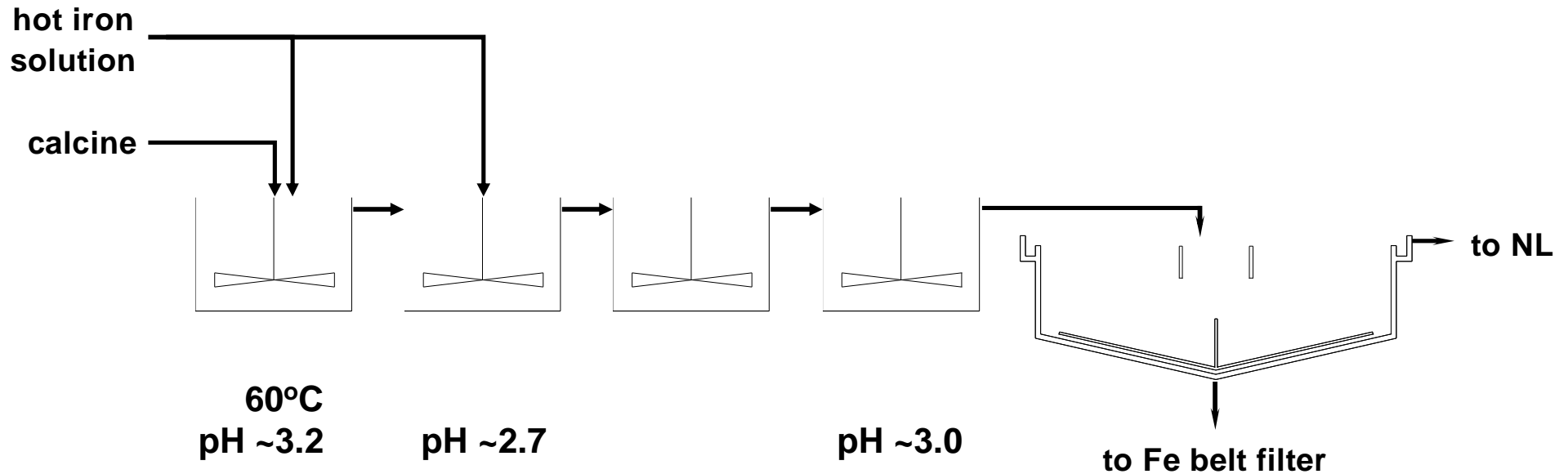
Jan-06 to May-07



Zinc recovery

Fe removal circuit

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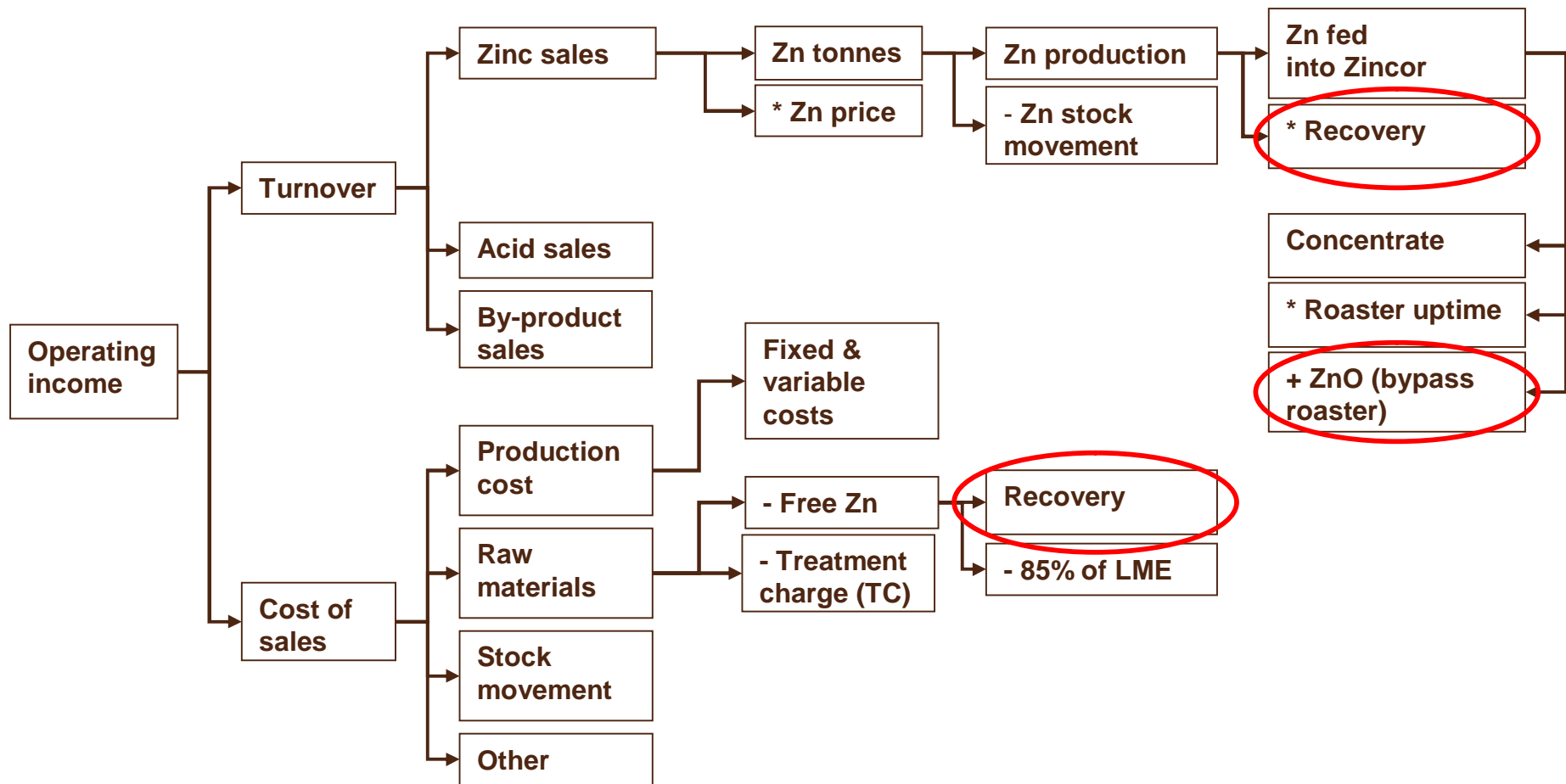


- Residue - jarosite, schwertmannite & ferrihydrite
- Residue typically contains around 35% Fe and 10 - 11% Zn



Zinc oxide

KPI focus



Zinc oxide

Fumed ZnO for Fe removal

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Fumed zinc oxide for iron removal stage.

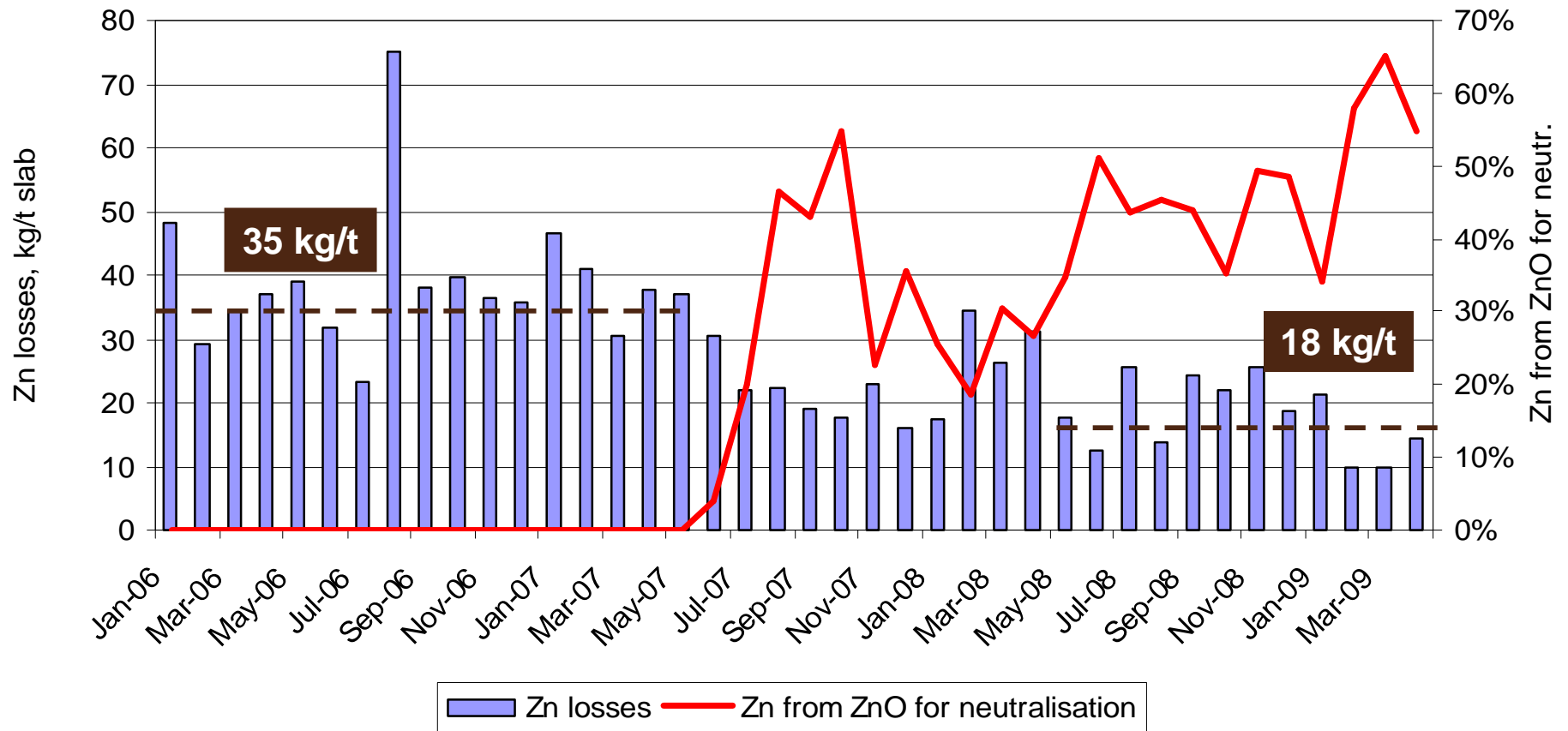
Element	Unit	Calcine	DRC ZnO*
Zn	% (w/w)	57	69
Pb	% (w/w)	2.8	9.3
Fe	% (w/w)	6.2	0.4
Cl	g/t	<10	280
F	g/t	<100	370

* Fumed oxides from Democratic Republic of Congo



Zinc recovery

Fumed ZnO for Fe removal

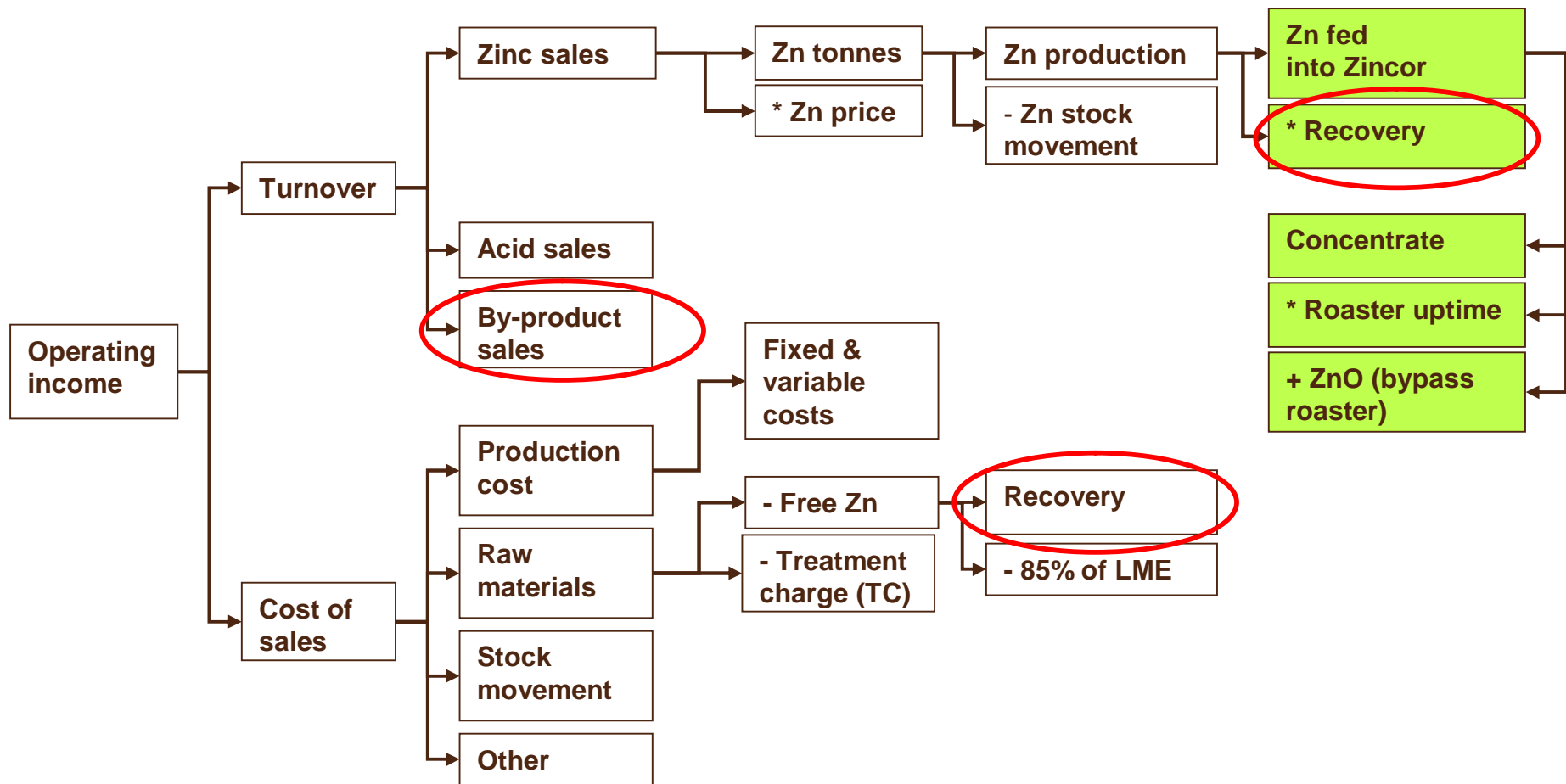


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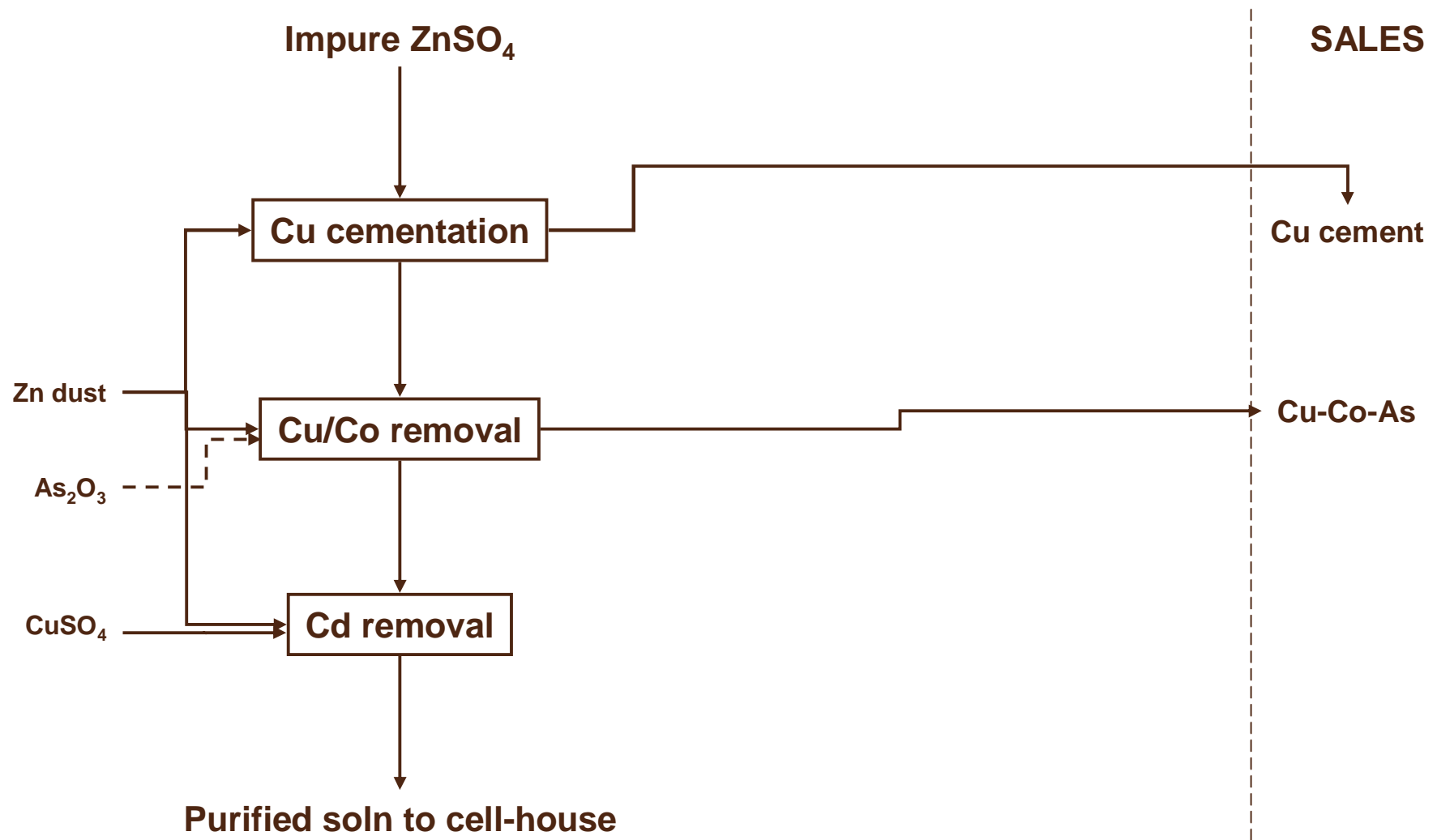
Recovery from Purification residues

KPI focus



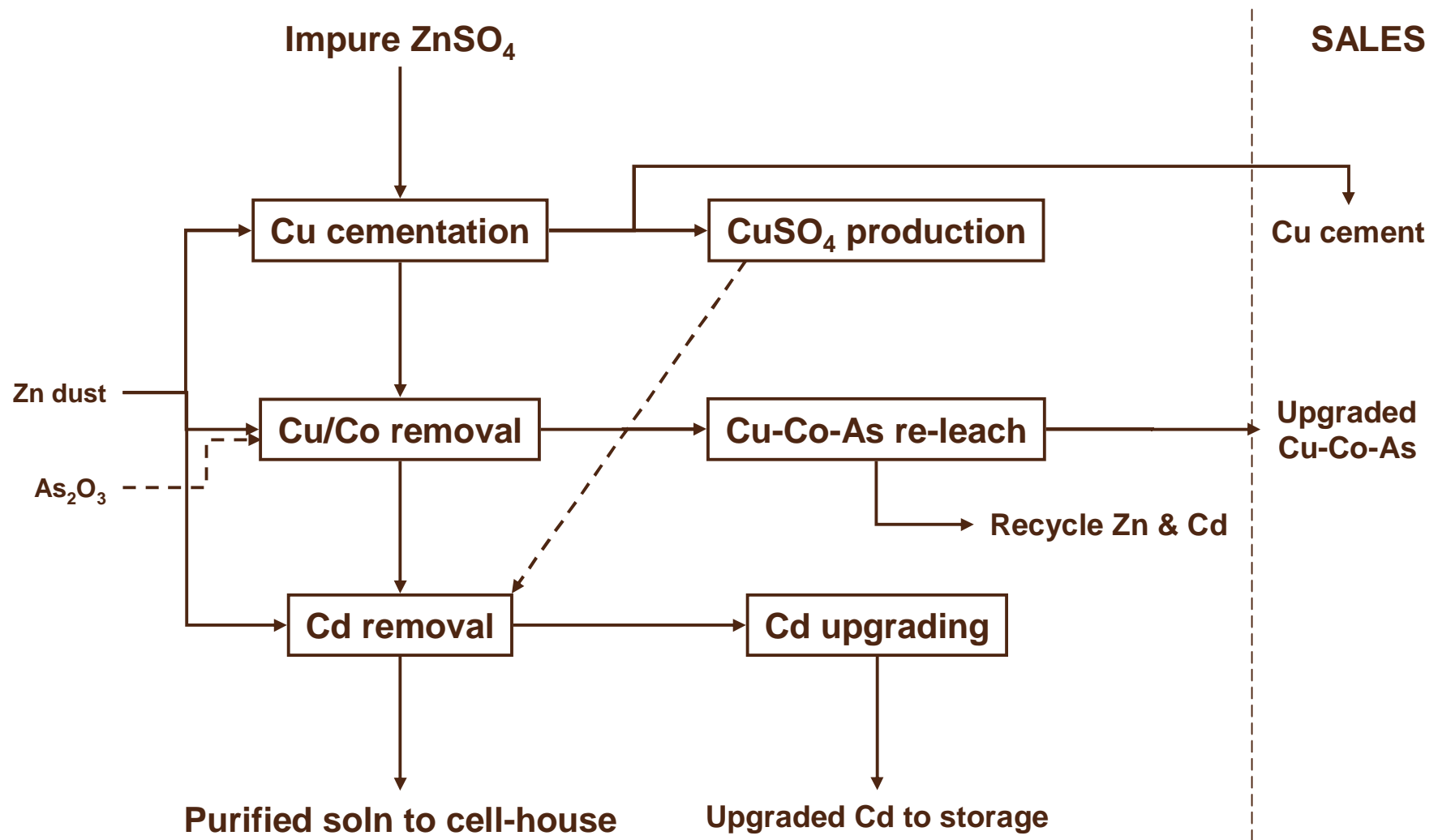
Recovery from Purification residues

Purification and byproduct circuits



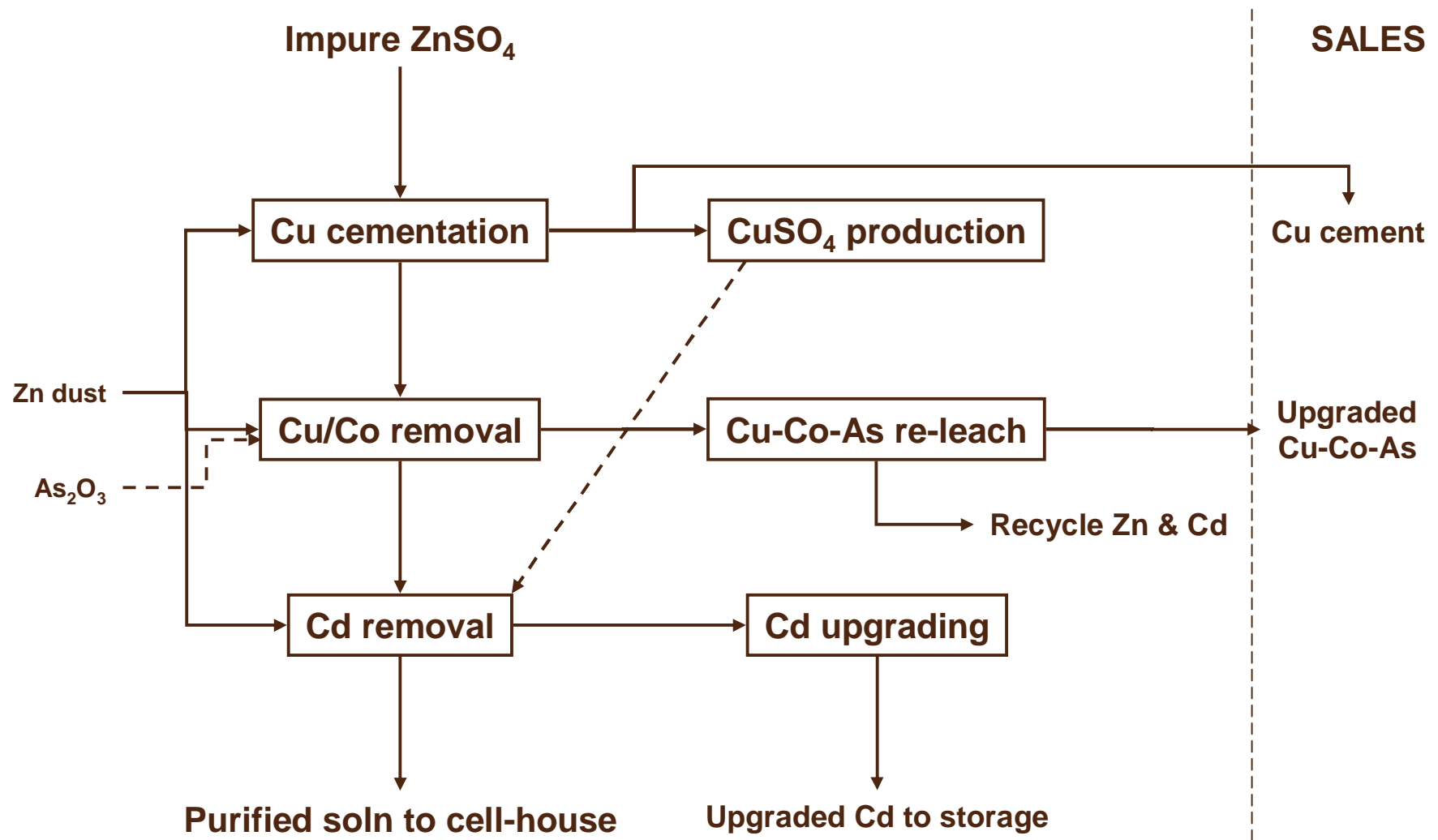
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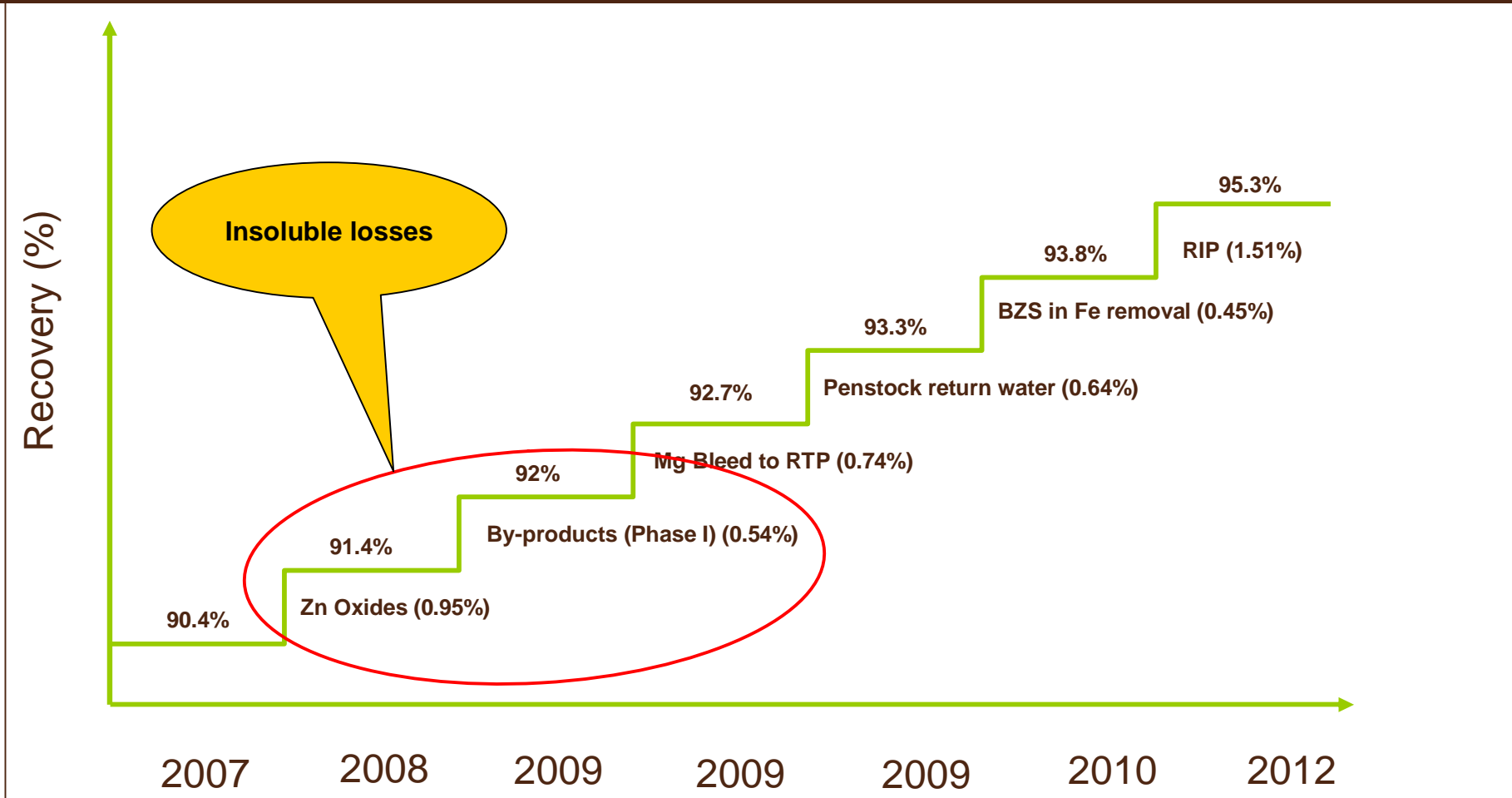


Recovery from Purification residues

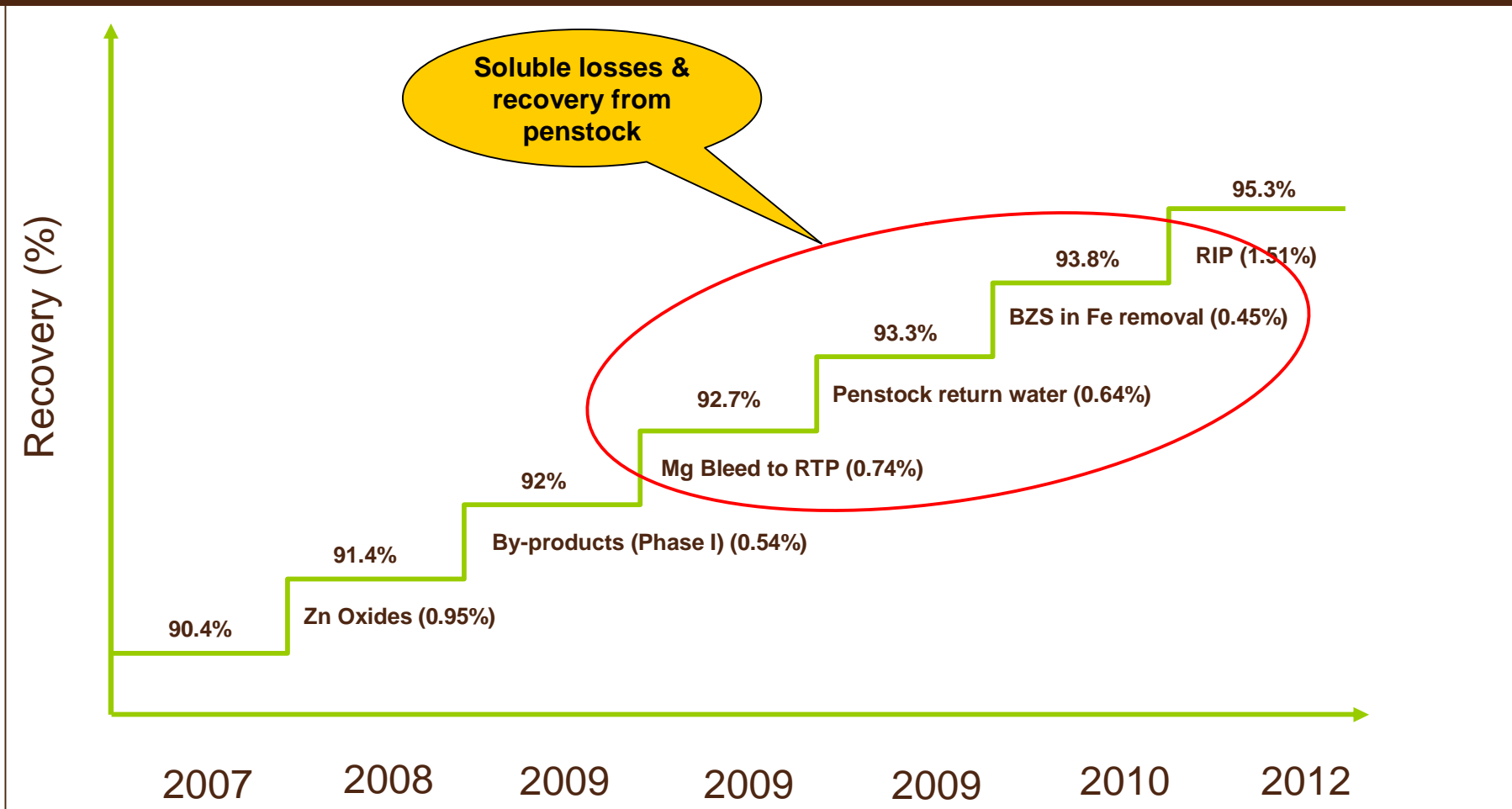
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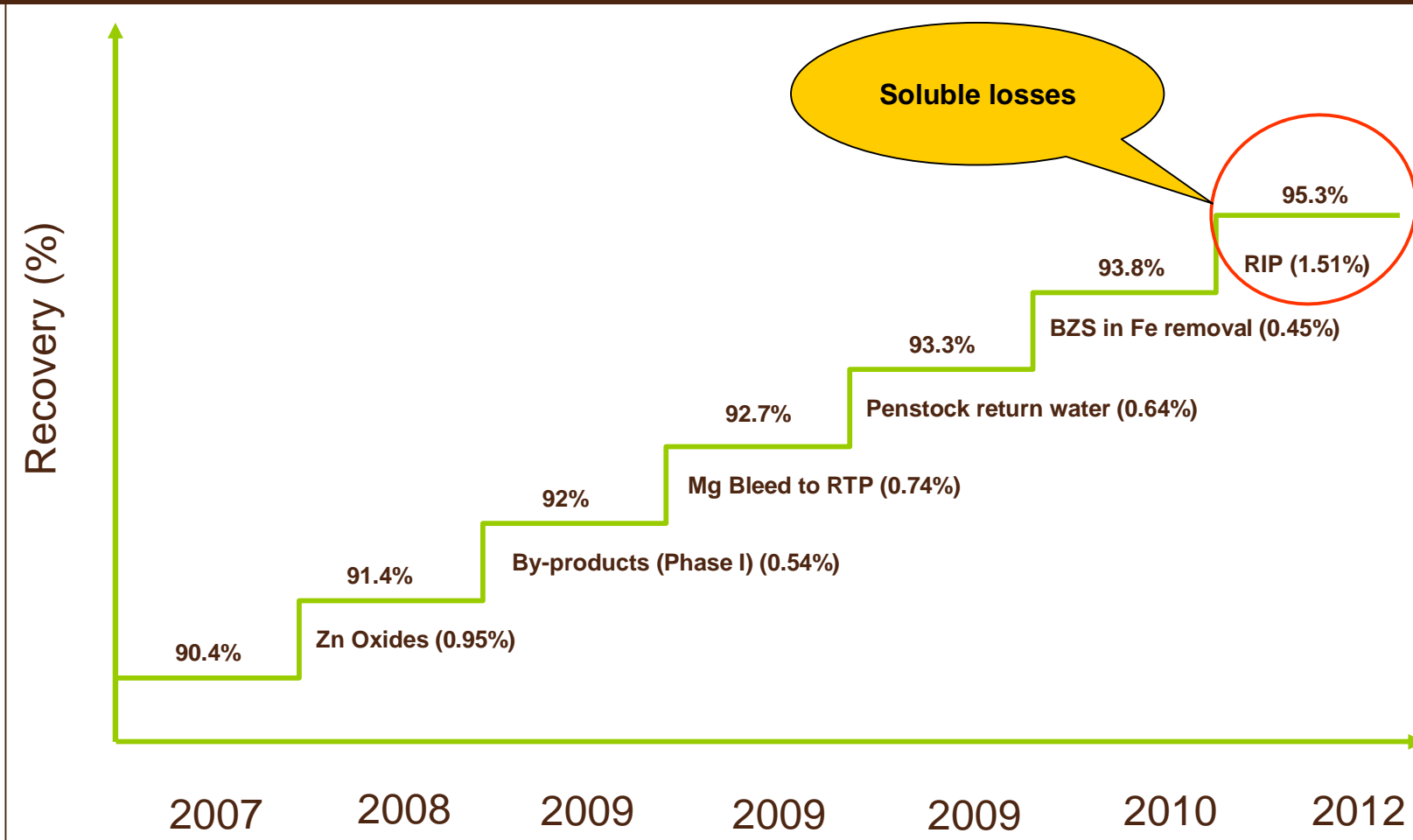
Recovery Improvement Projects - Summary



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Recovery Improvement Projects - Summary



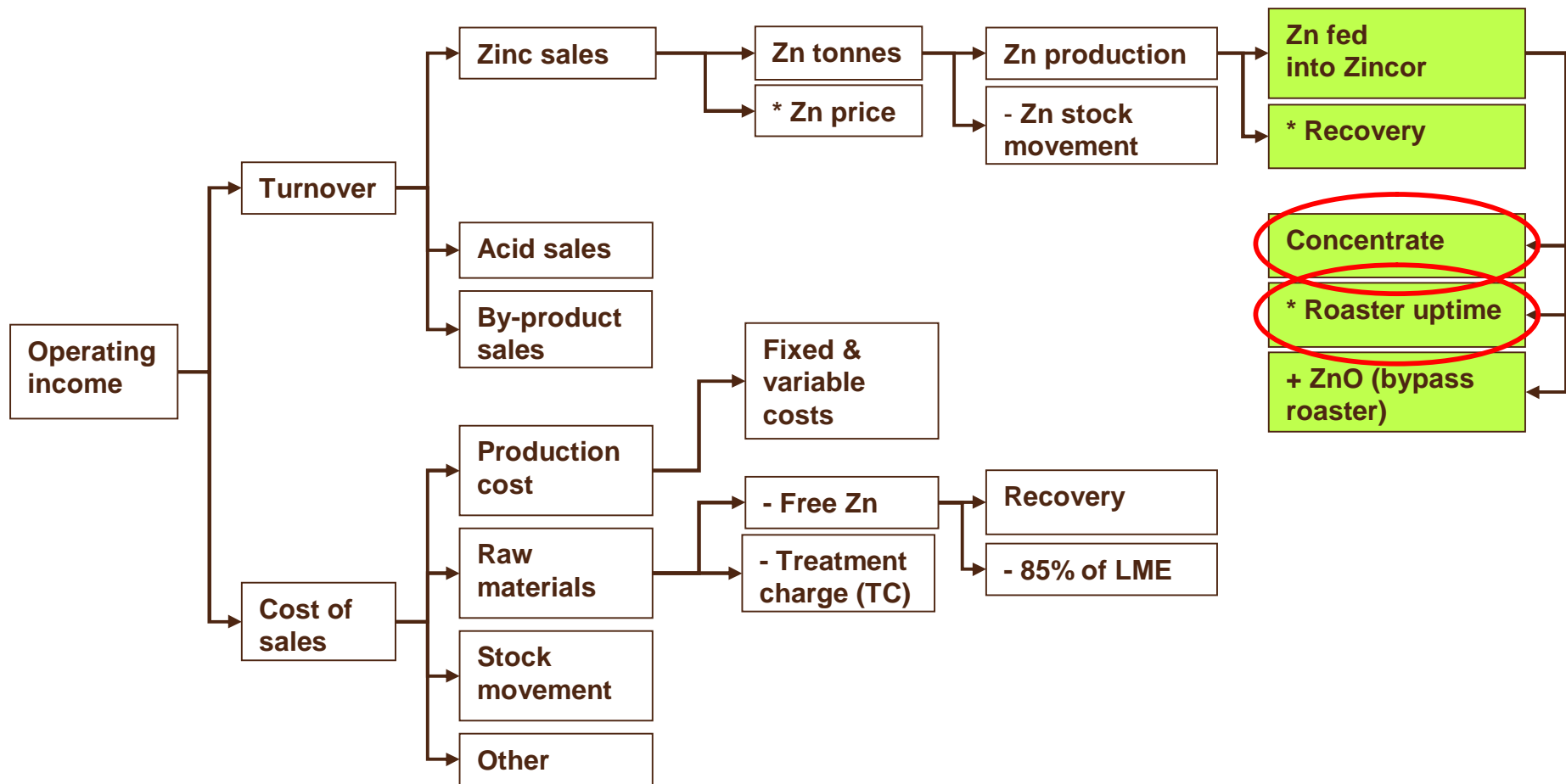
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Acid Plant Breakthrough

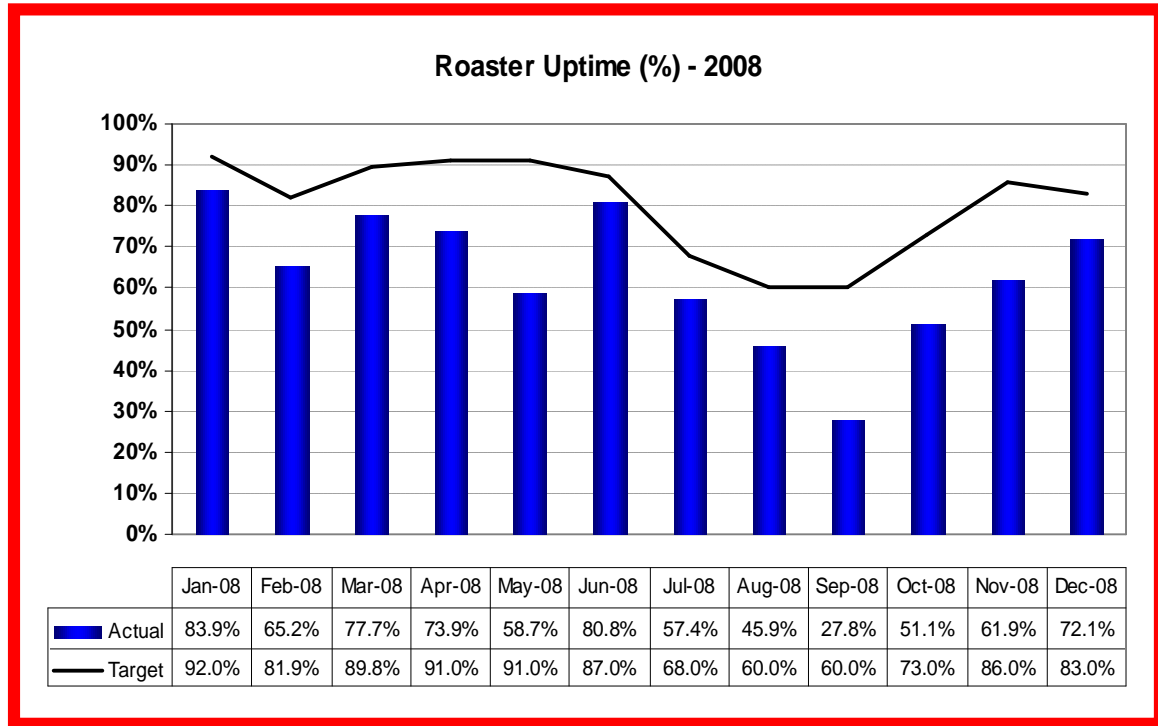
KPI focus



Acid Plant Breakthrough

Case for change

- Roaster throughput below the required target.
- Issues:
Equipment availability
Frozen beds



Acid Plant Breakthrough

Roaster bed failure

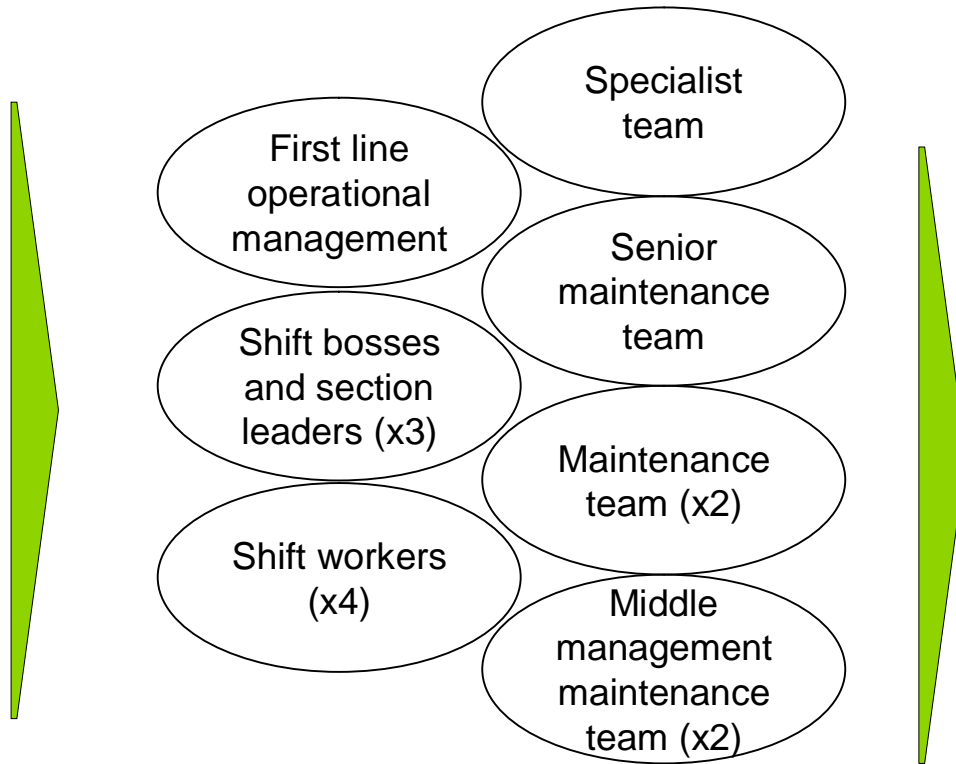
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Acid Plant Breakthrough

Harvest and generate ideas

120+ ideas captured during various brainstorming sessions



Fundamentals of operation

Plant uptime

- Maintenance
- Capital projects
- Critical spares

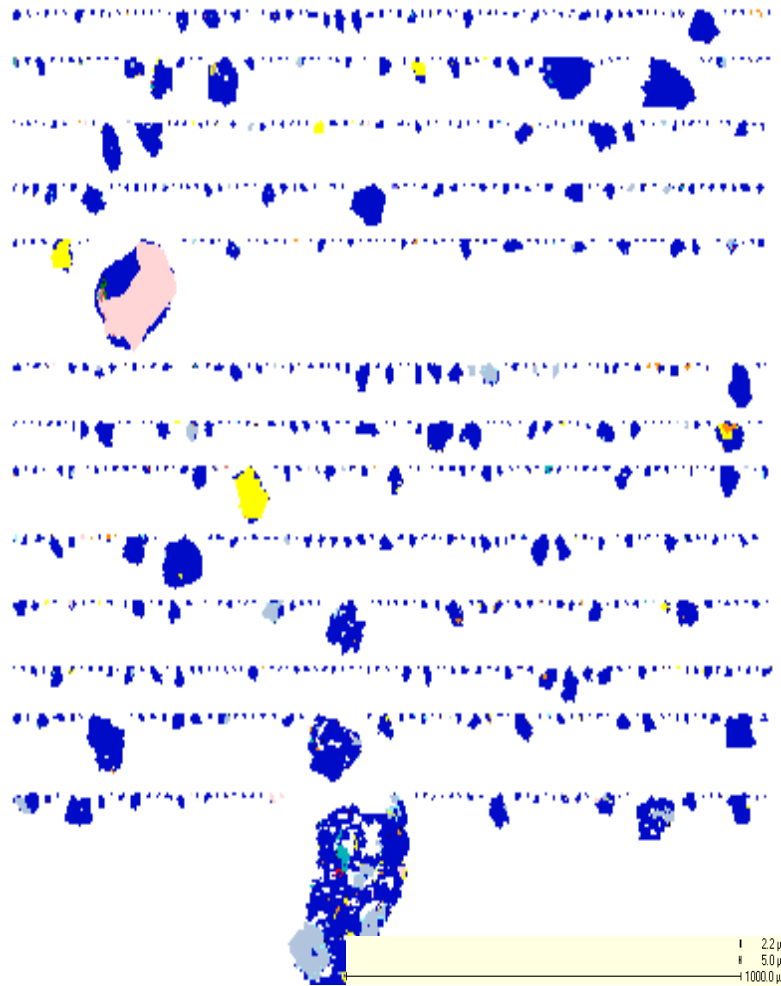
People related matters



Fundamentals of operation

QEMSCAN of concentrate

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Mineral Name	Percentage
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

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Hypothesis – growth of roaster bed particles



Hypothesis to prevent formation of $\text{Ca}_2\text{ZnSi}_2\text{O}_7$:

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

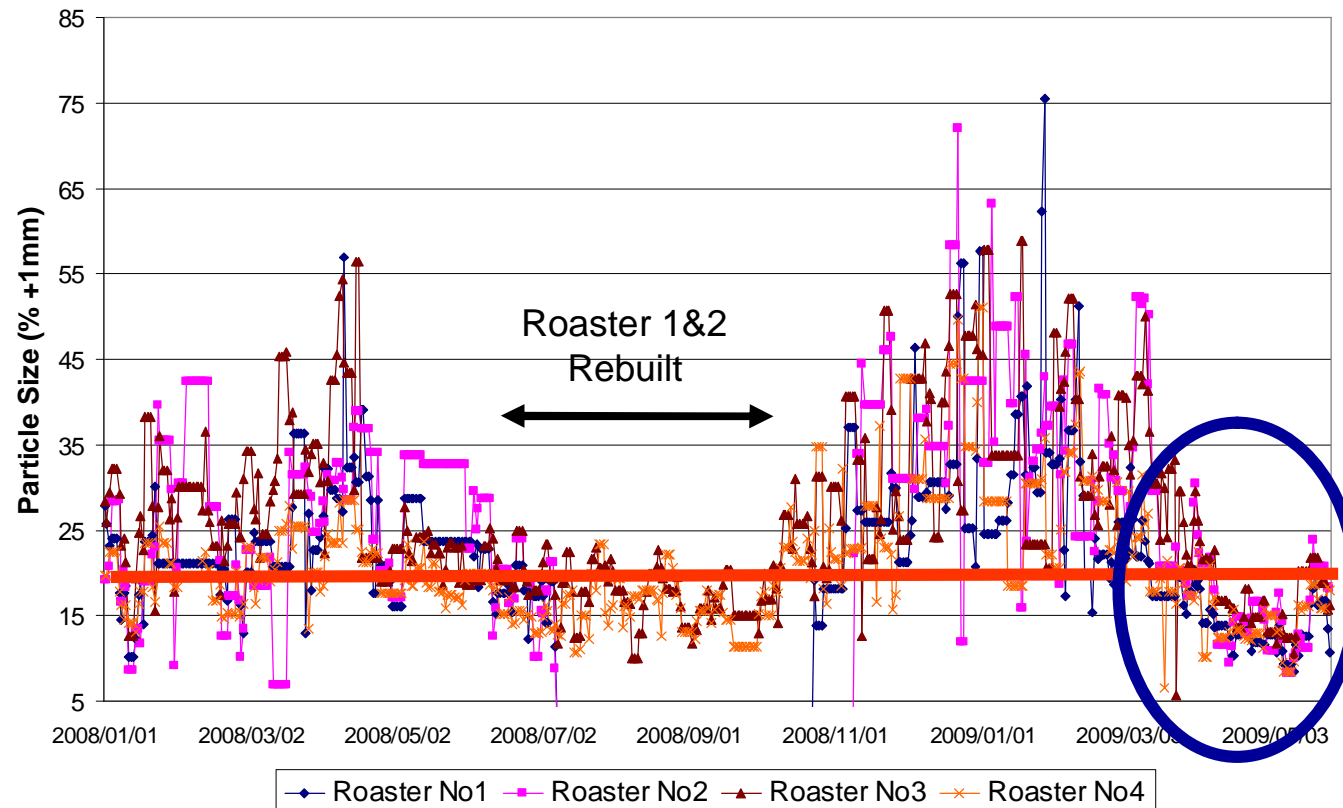


Fundamentals of operation

Evaluation of hypothesis

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Control operating temperature between 890 and 910°C



Improved bed gradings without affecting roasting efficiency



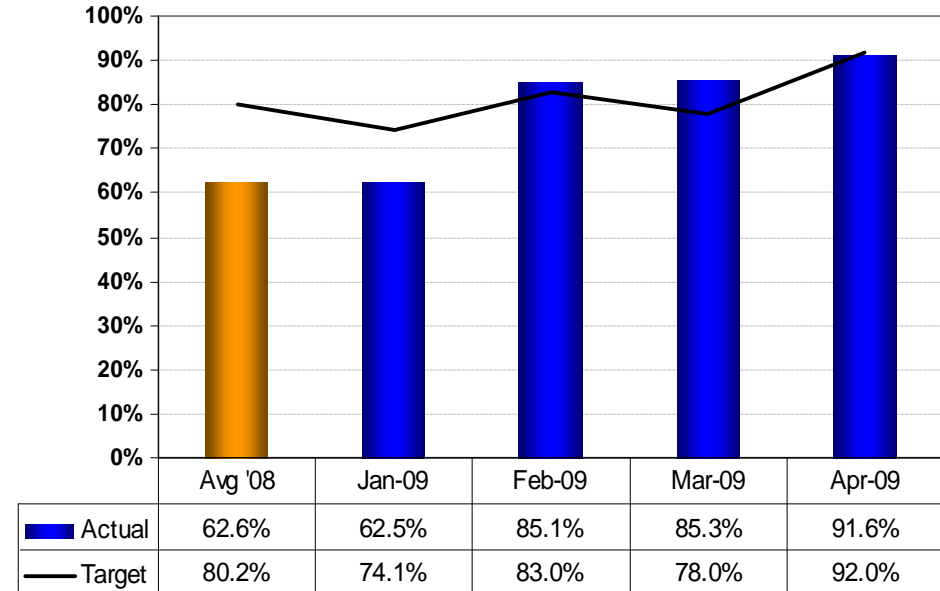
Acid Plant Breakthrough

The Proof...

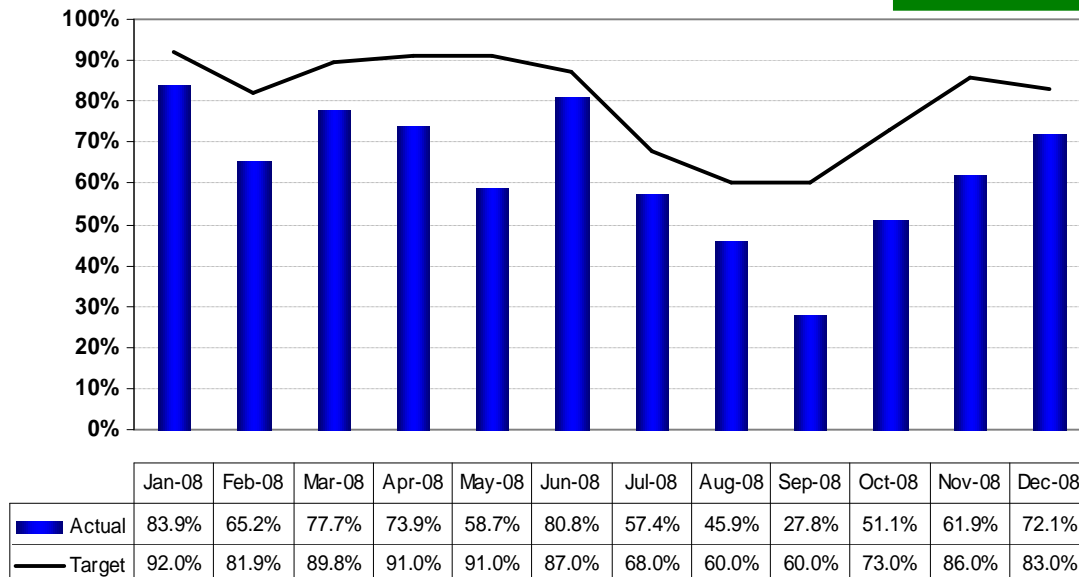
Fundamentals
Maintenance
People management



Roaster Uptime (%) - 2009



Roaster Uptime (%) - 2008



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?

