Extraction of Zinc from Secondary Sources

- Pilot Experiences from Swerea MEFOS

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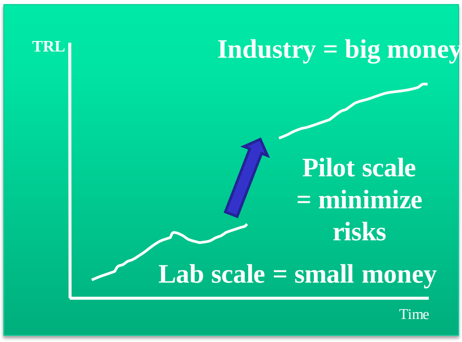
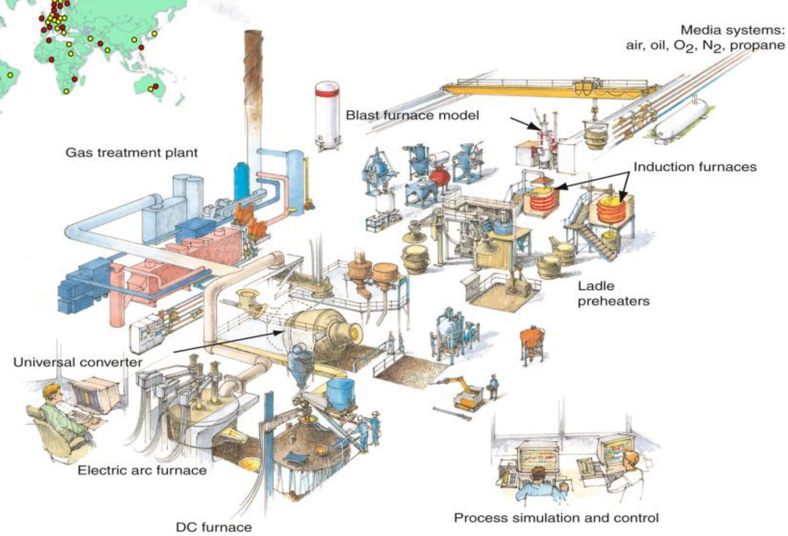
Minimizing the risk – testing in pilot scale

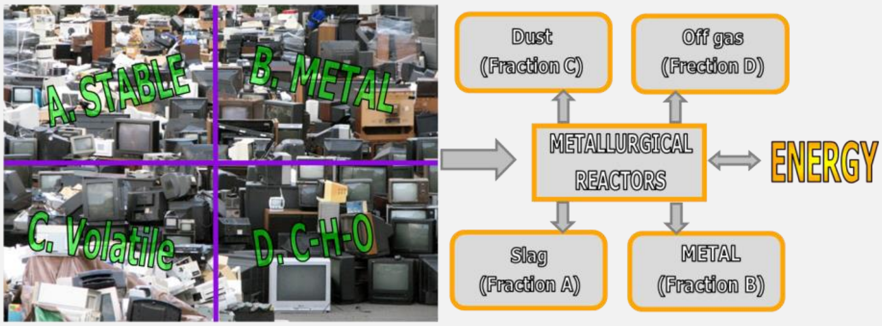


Pilot Plant

Clients from all over the world



Metallurgical principle for recycling?



A: CaO, SiO2, Al2O3, MgO

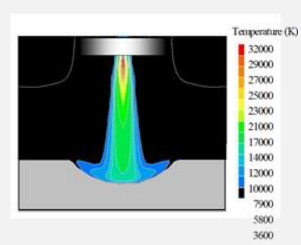
B: NiO, FeO, MnO, V2O3, Cr2O3, P2O5,Cu, Co, Mo

C: ZnO, PbO, Na, K, Cl, Cd, Hg

D: C-H-O, plastics/textile/fluff

Use of DC furnace technology

- Dust/sludge → Zn/Pb/Cd-product; Slag cement
- Steel slags → Fe, Mn/Fe,V, Mn, P/Fe, Ni, Cr; Slag cement
- Catalyst → Fe, Ni, Cu, Co; V-Slag for FeV
- Ashes → Na, K rich fume; Slag product for road construction — **ABB AshArc**
- Sludge → Syngas; Slag product
- Mn-Sludge → Zn, Na, K rich fraction; Mn-slag for FeMn/SiMn production

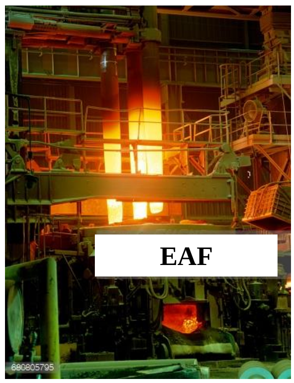


- **Spent alkaline batteries to zinc and Mn**
- **Ni-slag and Ni-dust**

Recovery of Zinc from EAF dust (EAFD)

	Zn	Fe	Pb	Hg	SiO2	CaO	MnO
Imatra	33	27	0.7	1.4ppm	3.4	2.92	4.19
Hofors	25	25	0.8	0.6ppm	2.65	14.6	3.84

EAF = Electric Arc Furnace for smelting of steel scrap



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What is the challenge of EAF dust?

Zn, Pb
€, $

-Fe
-ZnO*Fe2O3
Low yield
Leaching-Electrolysis

-Cl, F
Dross
Low yield
Pyro-process

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Two major projects on EAF dust

DC-furnace with hollow electrode (1992-1996)

- Zinc oxide for electrowinning
- Clean slag - efficient Zn-recovery
- Cl+F<100ppm and low dust carry-over control

The REZIN Project (2003-2006)

- Bypass filter method
- CaO-treatment
- Low temperature process

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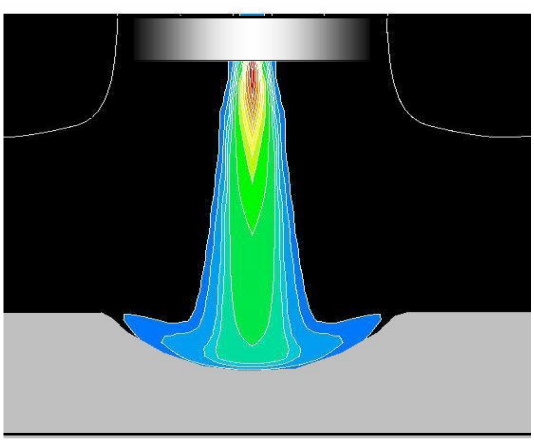
DC-furnace at MEFOS



3 MW DC
Hollow electrode
1-2 tons per hour
5 test campaigns, weeklong

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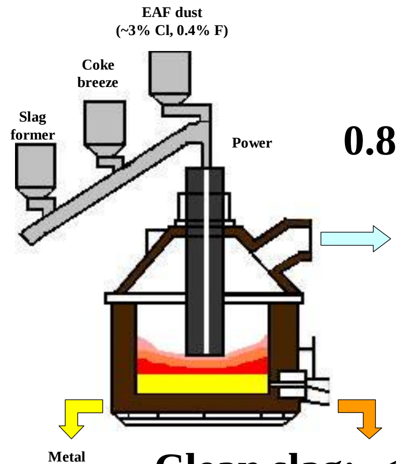
DC furnace- Summary



0.8-1.3MWh/ton

<u>Crude zinc oxide:</u>
72%Zn, 8%Pb, 1%FeO, 100 ppm Cl+F

Clean slag: <1%Zn, 50-200 ppm Pb

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Product quality

	Zn	Pb	Cl	F	FeO	
EAFD	**25**	**4**	**1.6**	**0.5**	**25**	
DC-Baghouse	**64**	**5.5**	**6**	**1.5**	**<1**	
Scrubber	**70**	**8**	**1.5**	**0.15**	**1**	
Washing I	**72**	**8**	**0.002**	**0.008**	**1.1**	
Washing II	**72**	**8**	**<u><0.002</u>**	**<u><0.008</u>**	**1.1**	

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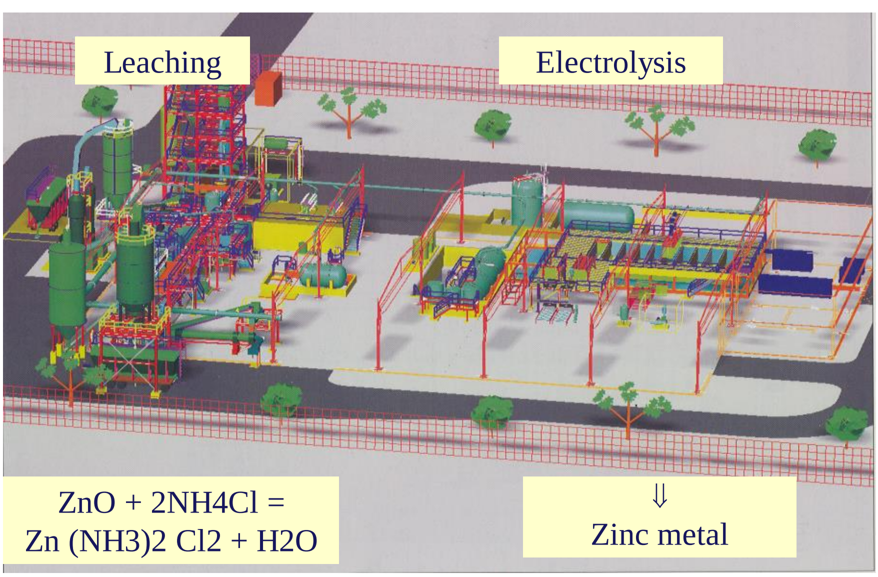
The REZIN project

- EU-research program (2002-2005)
- MEFOS-Engitec-Ferriere Nord –DDS-IVL
- **Elimination of zinc ferrite – 3 concepts**

1. Bypass filter concept
2. CaO-treatment
3. Selective reduction at low temperatures



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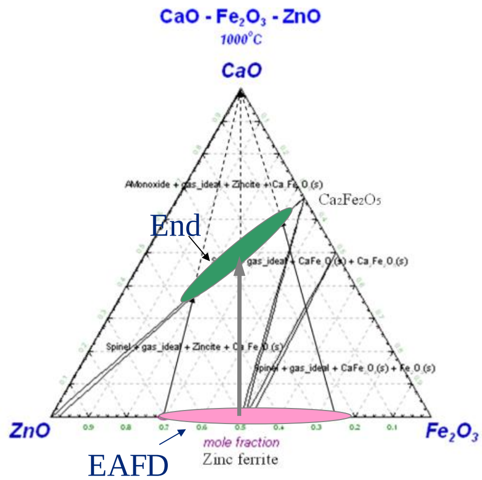
2. The CaO-treatment method



$$ZnFe_2O_4 + 2CaO = Ca_2Fe_2O_5 + ZnO_{free}$$

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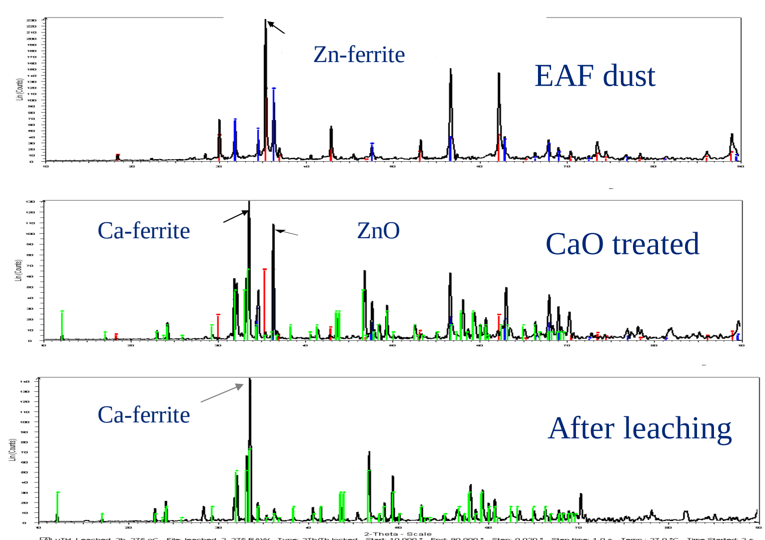
CaO-treatment results



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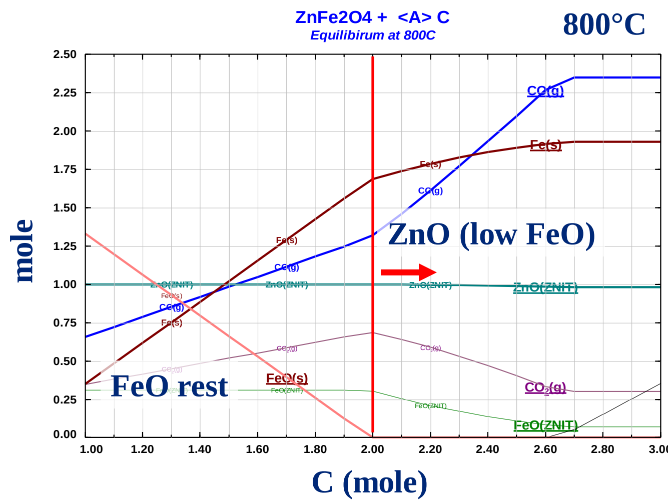
3. Selective reduction of Fe_2O_3



$$ZnFe_2O_4 + 2C = Fe + ZnO_{free} + CO/CO_2$$

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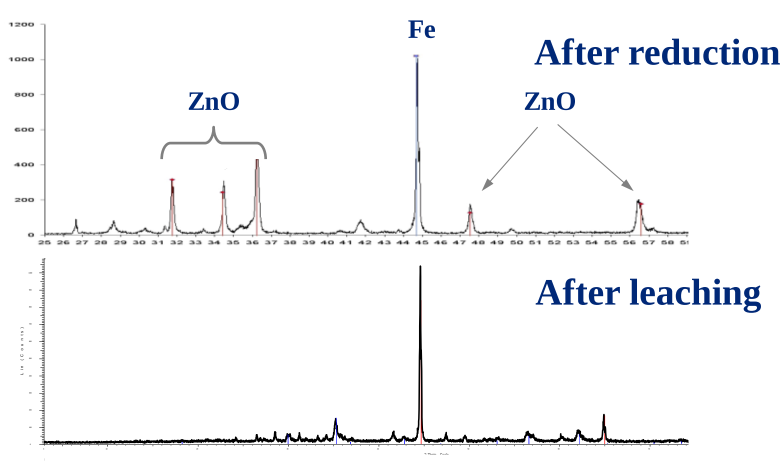
Pilot results, selective reduction



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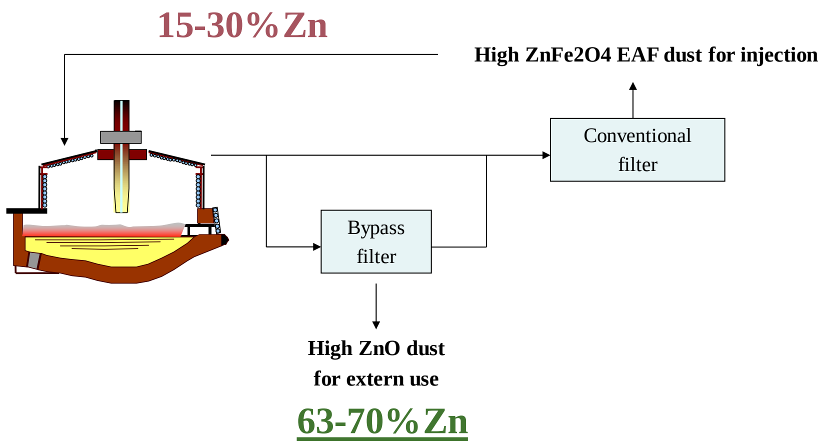
1. The bypass filter concept



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Some typical pilot results

	Zn	Fe	Hg	Si, Ca, Mn-oxides
Plant 1 EAFD in	33	27	1.4ppm	10.5
Test1: ZnO-out	62	6.7	0.2ppm	1.35
Test2: ZnO-out	64	6.4	0.1ppm	1.98
Plant 2 EAFD in	25	25	0.6ppm	21.1
Test3: ZnO-out	70	2.5	0.2ppm	0.88

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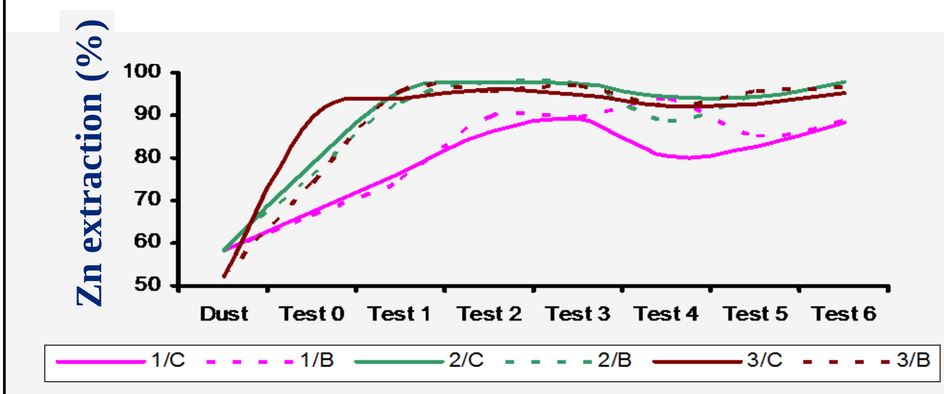
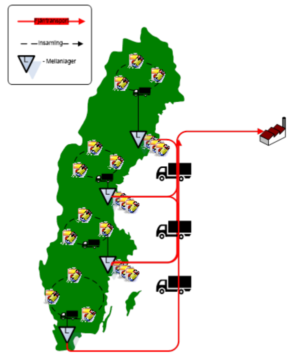
Leaching of by-pass filter dust



Summary - REZIN

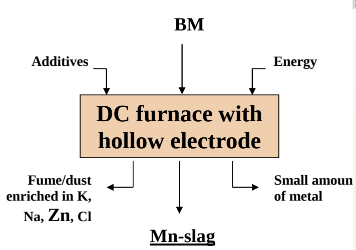
- Possible to recover Zn from EAF dust without ZnO-reduction
- Possible to recover Zn and metallic Fe by only reduction of Fe_2O_3 in EAFD

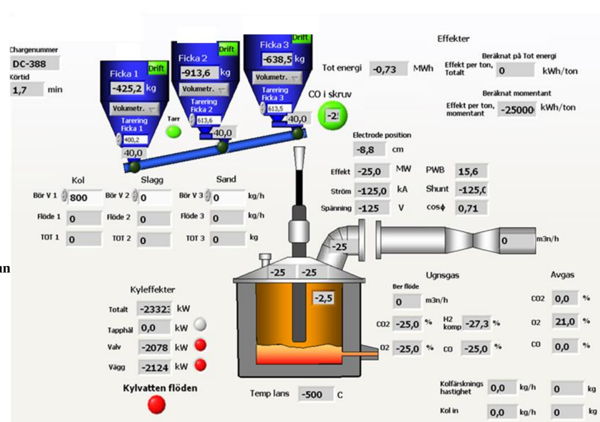
Recovery of Valuables from Alkaline and other Mn-Zn rich residues



	Zn	Mn	C	KOH	Cl	NH_4	Fe	Ni+Cd	Hg
Before	20	18		3	1.6		16	0.2	0.1
After*	25	30	8	5	4	0.5	1.5	0.6	

The Process Concept and Set-up





The major test results

	Energy	Energy	Feed rate	Temp tap	B2	K2O-sl	ZnO-sl	Mn-sl	K2O-d	ZnO-d	Mn-d
Heat no	**kwh/ton BM**	**kwh/ton feed**	**ton/h**	**°C**		**wt.-%**	**wt.-%**	**wt.-%**	**wt.-%**	**wt.-%**	**wt.-%**
DC627	1118	806	1.0	1703	1.09	1.19	0.03	19.70	9.87	71.40	7.08
DC628	1053	786	1.0	1636	1.08	1.46	0.08	25.72	8.31	79.60	4.38
DC629	1022	893	0.9	1662	1.09	1.22	0.04	30.36	8.98	74.20	7.47
DC630	913	766	1.0	1673	1.25	1.27	0.03	32.74	15.80	64.40	6.29
DC631	893	750	1.0	1600	0.51	1.37	0.07	36.43	6.69	67.80	12.78
DC632	1219	1150	0.9	1621	0.45	1.71	0.04	39.94	8.27	77.90	6.04
DC633	1191	1136	0.8	1651	0.40	1.71	0.03	42.29	8.82	76.20	7.09
Avg	**1058**	**898**	**0.9**	**1649**	**0.84**	**1.42**	**0.05**	**32.46**	**9.53**	**73.07**	**7.30**

Conclusions

- The ZnO content in the slag could be reduced to below 0.1 % meaning a zinc recovery close to 100 %, the amount of the produced secondary zinc feed is about 375 kg/ton BM. A ZnO product with up to 79 % ZnO has been achieved.
- A cleaned MnO-slag with 45-55 %MnO, less than 0.1 %ZnO and <1.5 %K2O has been achieved. The low Zn and K content make it possible to be used as MnO-feed for Mn-alloy production. The produced MnO-slag is on average about 530 kg/ton BM.

Thank you for the attention