AGGLOMERATION
EYDE WASTE TO VALUE

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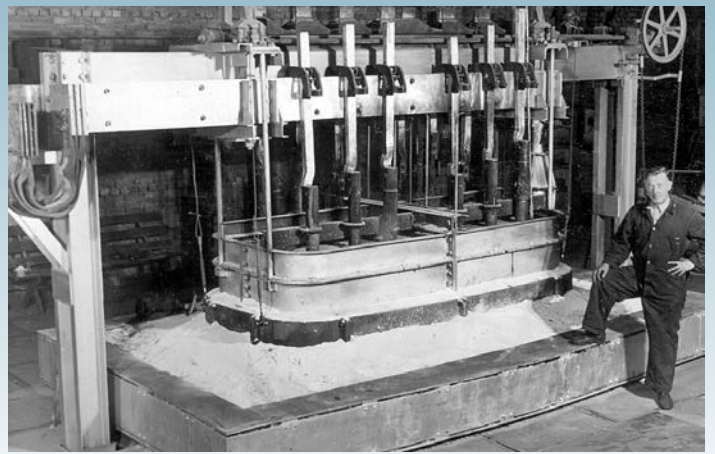
Elkem

Elkem Technology R&D technical centre – industrial R&D partner

Research and development for 78 years

- Pilot facility built in 1938 for research on aluminium production with Søderberg technology
- Developed further to a research centre for all materials in Elkem's portfolio
- The Pilot facility was a prerequisite for development and sale of Elkems process- and furnace technology world wide



Elkem R&D technical center:

FROM IDEA THROUGH TESTS INTO RESULTS

Elkem pilot plant

Facilities:

- Hydro-metallurgical lab
- Bench scale pyro-metallurgical lab
- Pilot skale pyro-metallurgical facility
- 10.000 m^2 area pilot facilities

Main projects:

- Pyro-metallurgical process development and verification
- «Waste to resources»
- Raw material testing and qualification
- Testing and verfication of process equipment
- Hydro-metallurgical treatment
- Product testing

EYDE-CLUSTER

Established 2007
14 core process companies
21 competence suppliers
24 bNOK (2,7b€) sales
7900 employees

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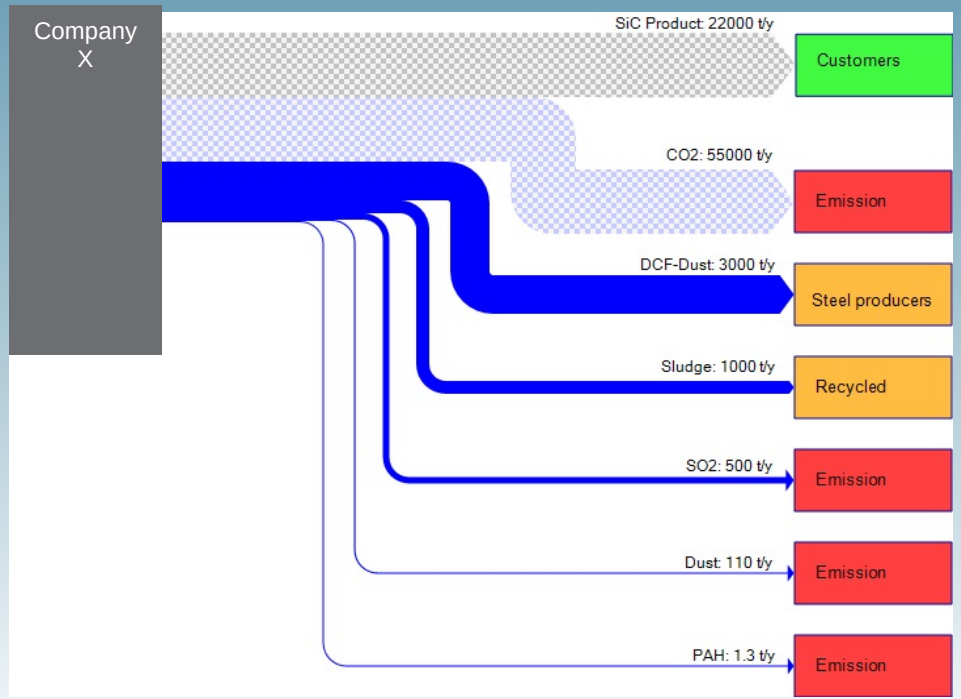
EYDE ZERO WASTE (2013) -
Mapping of all materials produced at seven Eyde-cluster core members



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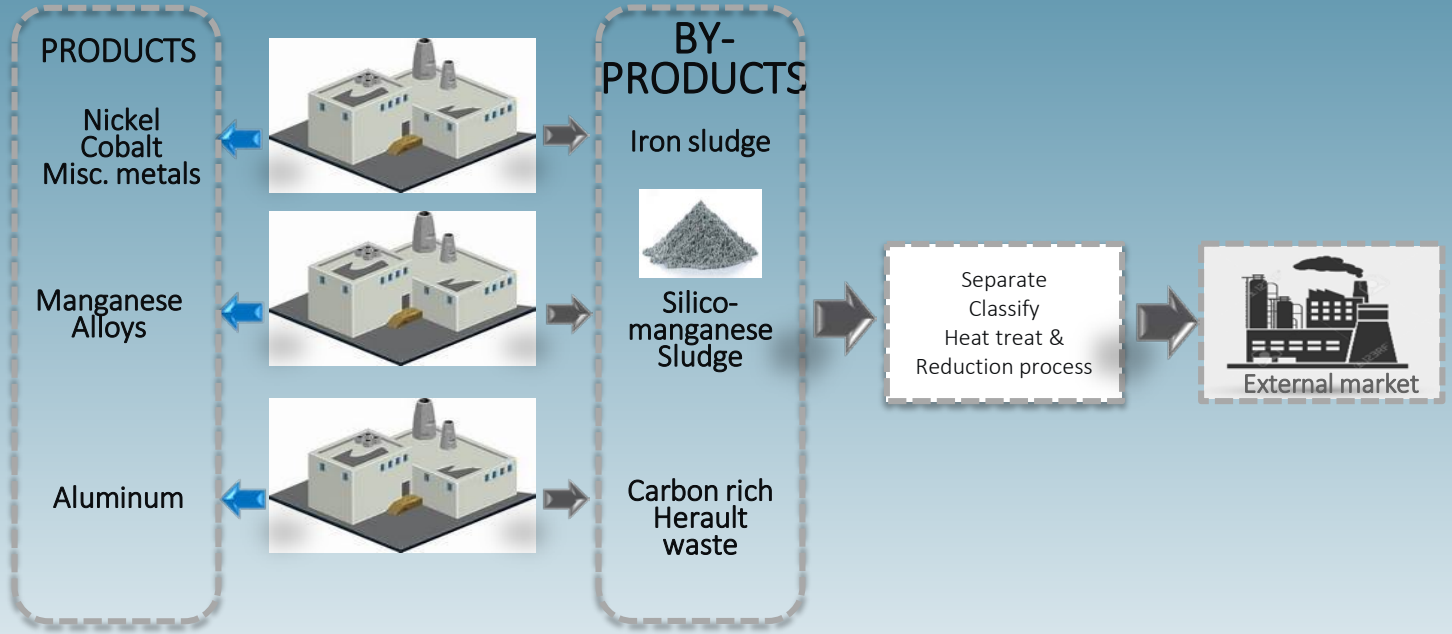
Waste to value



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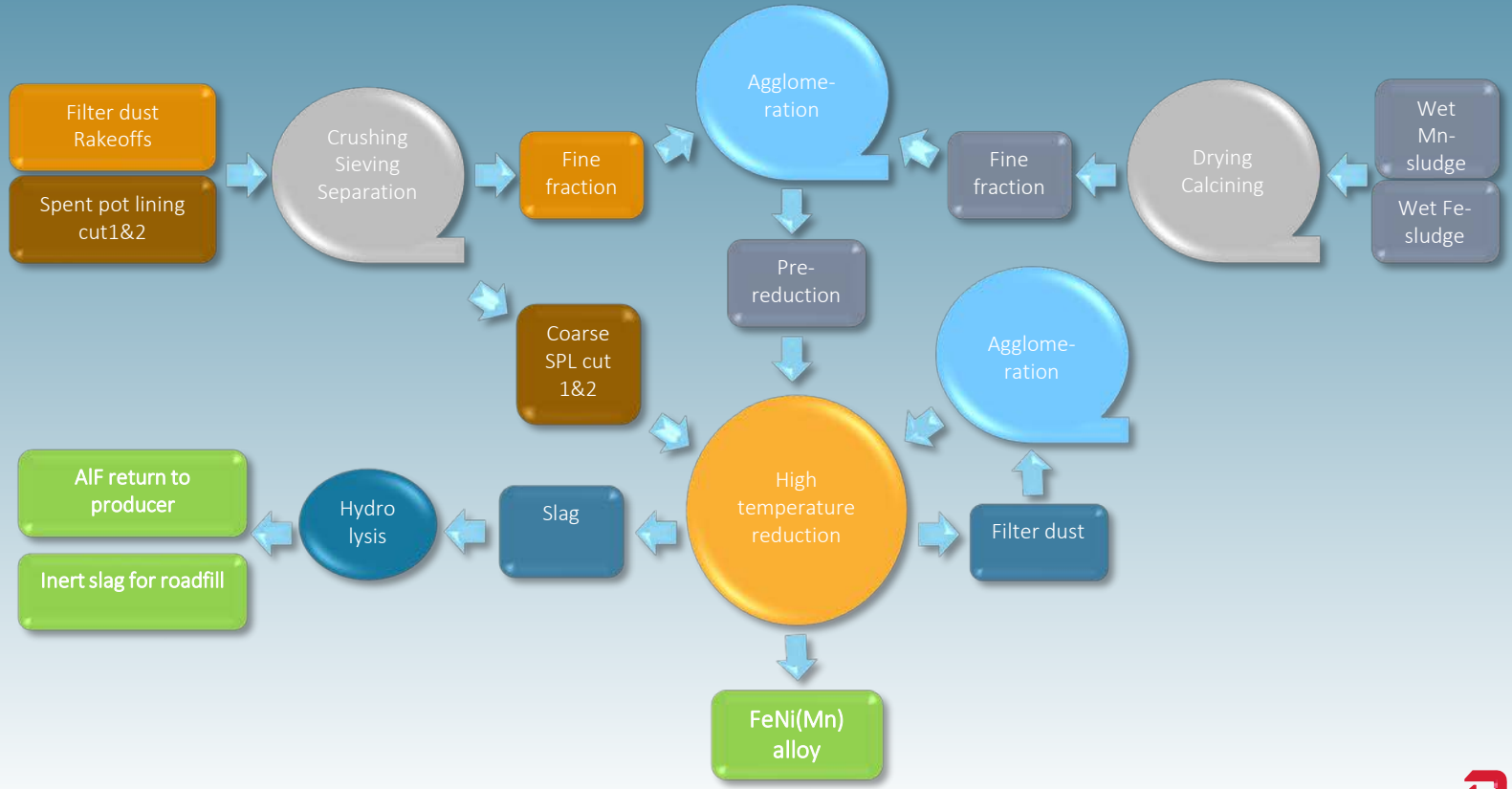
Eyde Waste 2 Value- Process

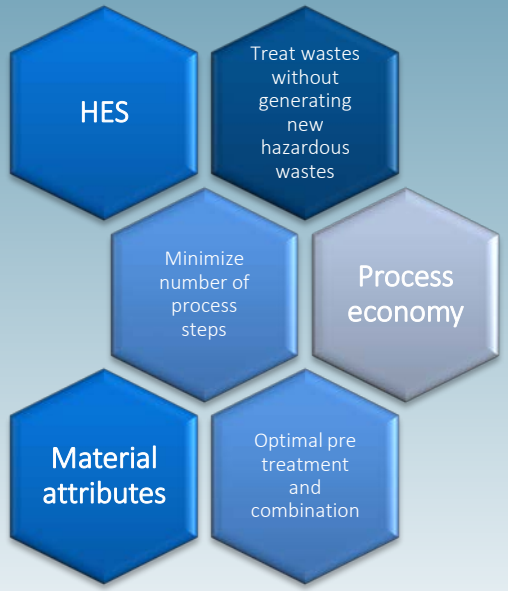


Eyde Waste 2 Value- Materials

MATERIALS

Mn- sludge	•High water content •Contains heavy metals, halogens and alkalis •Highly tixotropic
Fe- sludge	•High water content (free and ionic bound) •Contains heavy metals, halogens and alkalis •Very low viscosity
ESP-dust	•High carbon content •Contains heavy metals, halogens and alkalis
Rakeoffs	•High carbon content •Un-even distribution of carbon in the bath •Powder and lumps
Spent pot lining	•High carbon content •High F content Mer •Mix of refractories, bath and carbon

PROCESS CHALLENGES



Eyde Waste 2 Value- Agglomeration of sludges

One step drying and milling of sludges

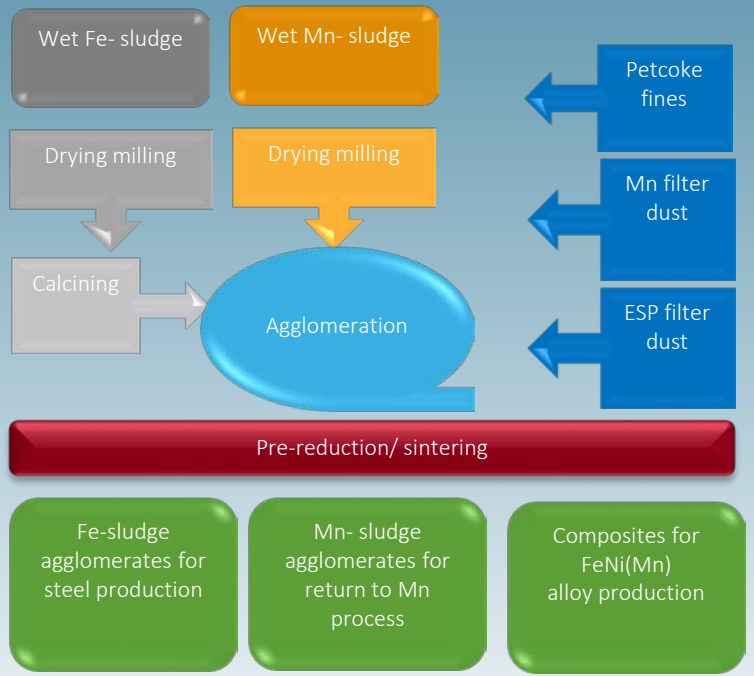
- 0,2- 0,6 kWh/kg
- Adjustable outcome moisture

Agglomeration program

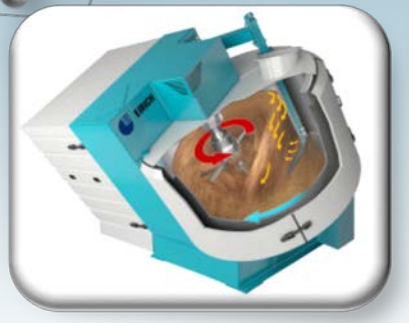
- Detect optimal agglomeration technologies
- No commercial binders
- Agglomerates for both FeNi(Mn) production and alternative uses

Agglomerate pre reduction program

- Determine optimal time, temperature and atmosphere conditions
- Thermodynamic modelling



Eyde Waste 2 Value- Agglomeration of sludges



PRE TREATMENT PROCESS

Drying/ milling
- Semi dry powder production in Vortair separator
- Milling of rakeoffs in Vortair separator

Fe- sludge calcining
- Removal of Cl and bonded water from Fe- sludge to reduce sinter porosity

Agglomeration
- One step dry/ wet mixing and pelletization of monolithic and composite recipies in Eirichmixer, or
- Mixing in Eirich mixer followed by briquetting

Sintering
- Sintering and pre-reduction of unwanted elements
- Reduce Zn, Cl, Pb, S, P, As

Case - Pelletizing campaign week 45 2016

Agglomeration

Campaign focus

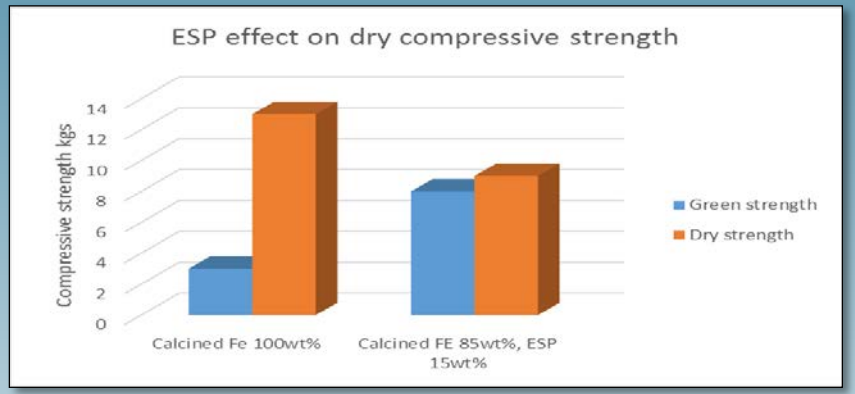
- Optimize pelletizing technique in Eirich mixer without commercial binders
- Focus on pellet growth and dry strength
- Compare dry compressive strength on calc Fe vs calc Fe + ESP pellets

Background

- Weak dry strength on Calcined Fe pellets from earlier tests due to narrow size distribution
- ESP-dust increase strength/ reduce shrinkage in sintered Fe- agglomerates

Test matrix

- Experimental impeller RPM programs for mixing, nucleation and pellet growth
- Varying moisture level
- Varying ESP content



Campaign results

- 300 % strength increase on dry Calc Fe pellets
- Controlable pellet size
- Both qualities compare favorably to briquettes regarding strength

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ADVANCED MATERIALS
SHAPING THE FUTURE