HALOSEP PÅ VESTFORBRÆNDING, HVOR ER VI?

V/KIM CRILLESEN, I/S VESTFORBRÆNDING OG STENA

HaloSep fly ash treatment at WtE plants

- From Hazardous Waste to recycleable fractions -

https://vimeo.com/479770286

KIM CRILLESEN, VESTFORBRÆNDING; ERIK RASMUSSEN, STENA RECYCLING A/S

RAMBØLL SEPARATION FOR REUSE

VESTFORBRÆNDING

This project has received funding from European Union's LIFE Program under Grant Agreement LIFE15 ENV/SE/000265-HALOSEP

HaloSep

SEPARATION FOR REUSE

VESTFORBRÆNDING

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HaloSep

RAMBØLL
SEPARATION FOR REUSE

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HaloSep

AGENDA

1. HaloSep fly ash treatment
2. HaloSep fractions (WtE plant Vestforbrænding)
   - OS material (X-FGW > 1mm)
   - Treated fly ash (X-FGW)
   - Salt product
   - Metal product
3. LIFE HaloSep demonstration project
   - WtE plant Vestforbrænding, DK (14 kT/yr HaloSep plant)

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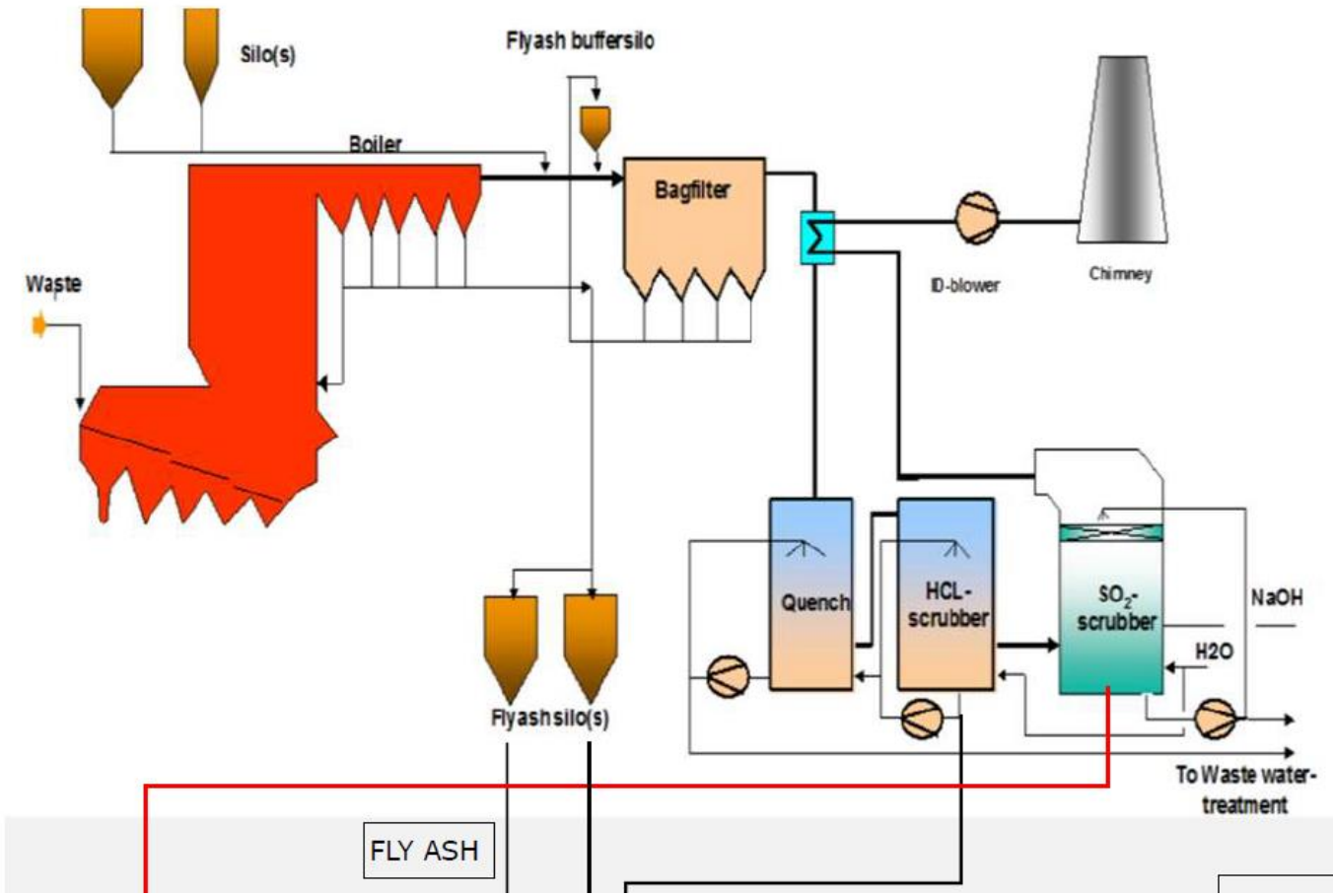
HaloSep full scale demonstration plant (Denmark)

Halosep-anlæggets integrering i eksisterende vandbehandlingsanlæg



VESTFORBRÆNDING

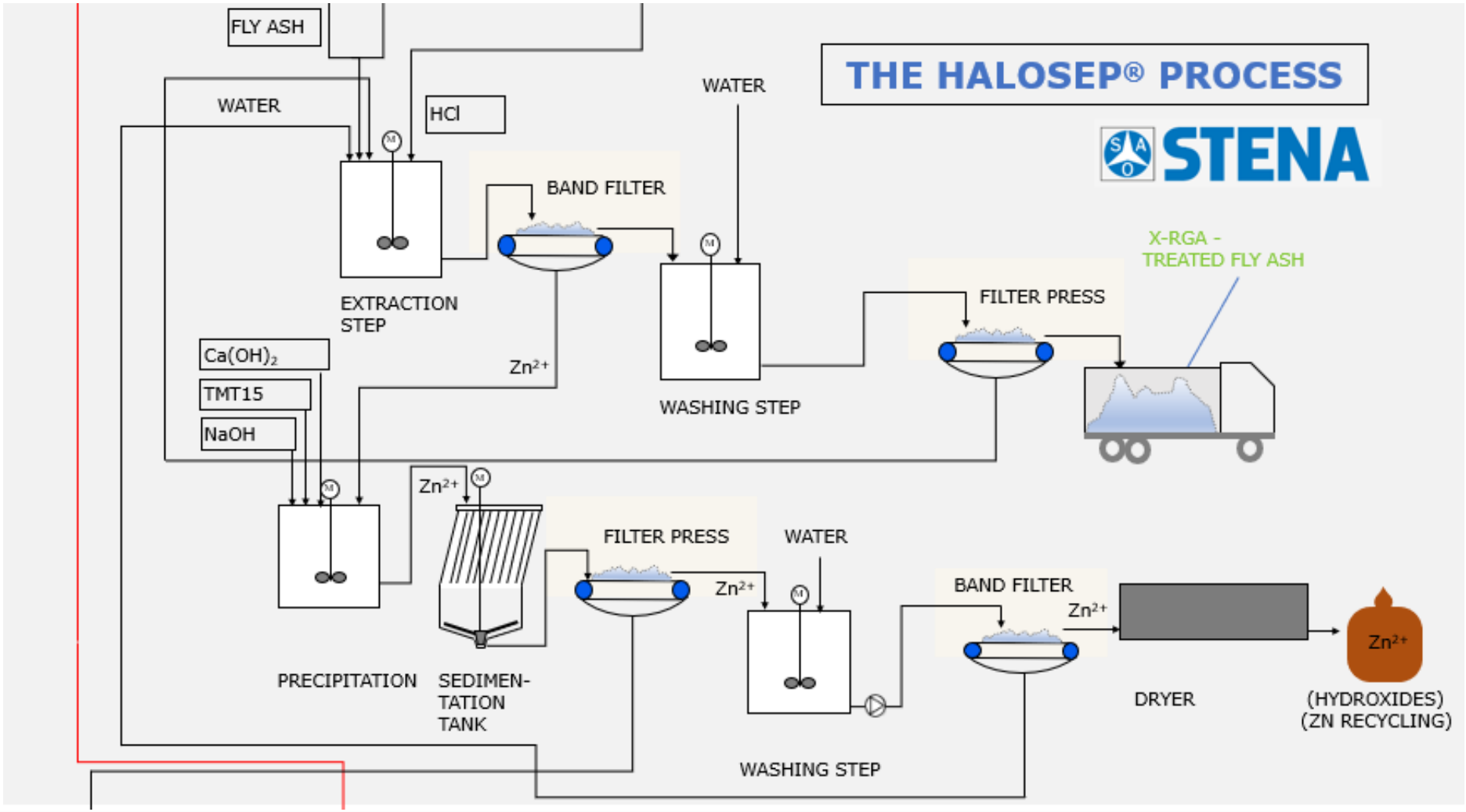
RØGGASGENSNINGSANLÆG

RAMBØLL VESTFORBRÆNDING

Life

HaloSep

HaloSep full scale demonstration plant (Denmark)

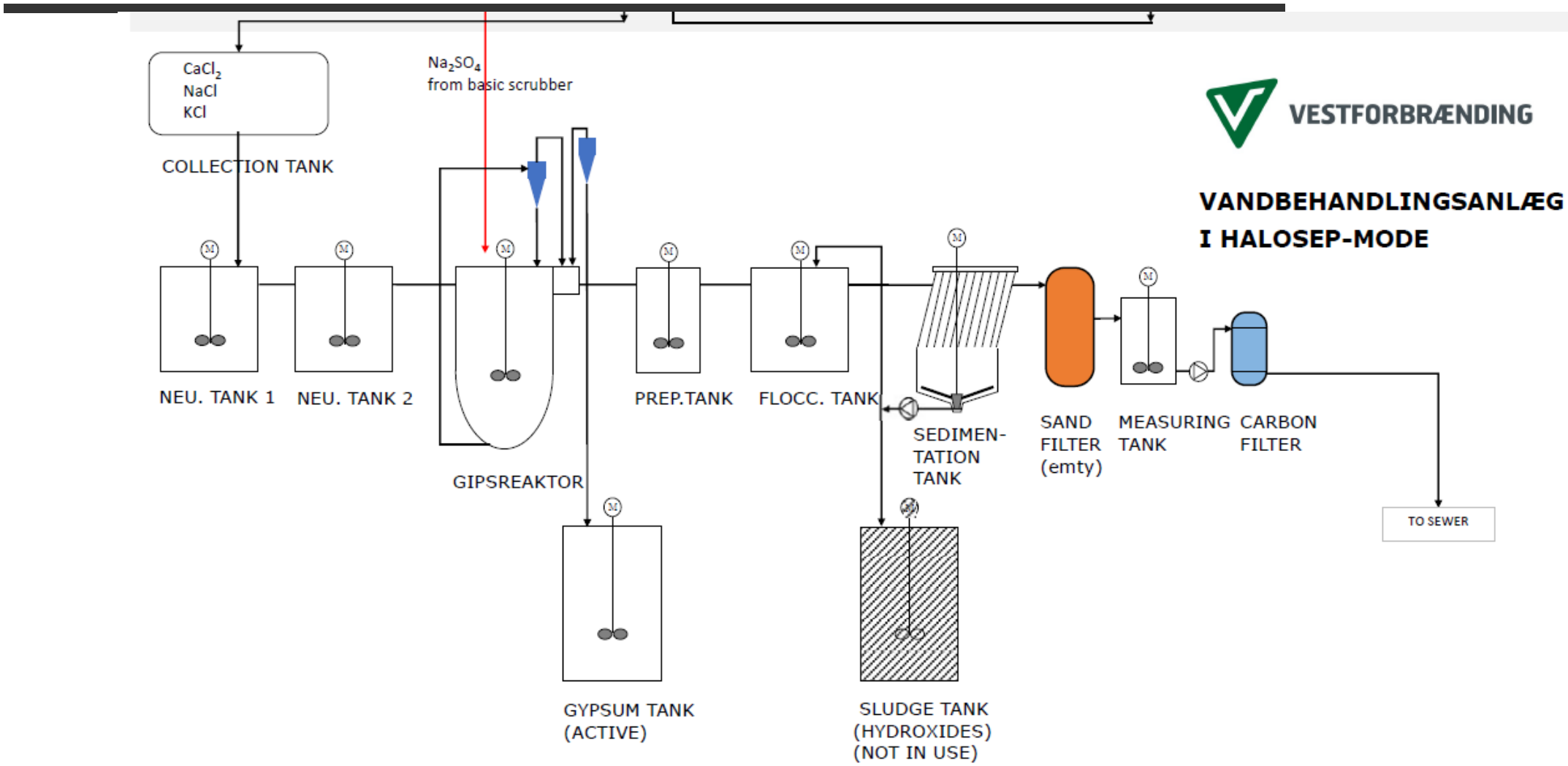


RAMVEL VESTFORBRÆNDING

Life

HaloSep

HaloSep full scale demonstration plant (Denmark)



RAMVEL VESTFORBRÆNDING

Life

HaloSep

FROM WtE PLANTS WITH WET OR SEMI-DRY FLUEGAS CLEANING

Fractions distribution	FLY ASH "wet flue gas treatment" (Ref. VESTFORBRÆNDING) in (w/w)%	FLY ASH "Semi-Dry flue gas treatment" (Ref. AMAGERFORBRÆNDING)
Treated fly ash (X-FGW)	60-61%	35-48%
Salt product	25-30%	42-55%
Metal product	~3%	~2%
X-FGW >1 mm (OS fraction)	~1%	~1%
H_2O and CO_2(g)	5-8%	8-12%

AGENDA

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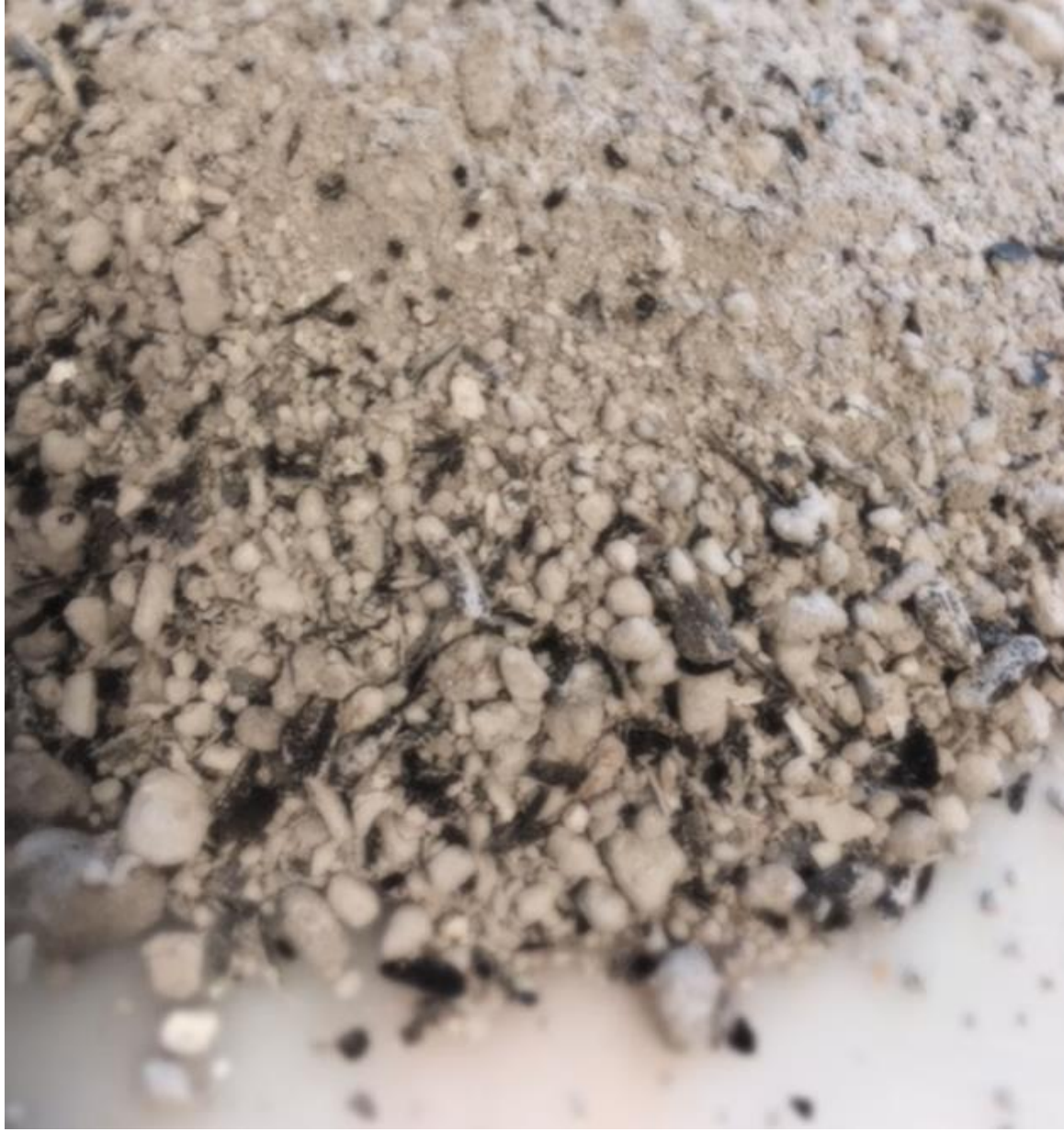
HaloSep fraction 1

X-APCR (OS) > 1 MM

Amount: < 1 %(w/w) of Fly ash (in)

- **TOC-content 4-10% (w/w)**

➢ **X-APCR (OS) >1mm will be returned to the incinerator furnaces**



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HaloSep fraction 2

TREATED FLY ASH (X-APCR)

- **X-APCR/Fly ash-ratio (in): 60-61 %(w/w)**
- **Inorganic substances:**

Agent	Halosep product 2015 mg/kg ts	Halosep product 2017 mg/kg ts	Limit values Forordning 2017/997 af 8. juni 2017 (HP14) mg/kg ts
Cr(VI)	190		1.000
Cd	60		1.000
Cu	1.400		2.500
Hg	30		2.500
Pb	6.500	2.400-2.700	2.500
Zn	20.000	13.300	2.500

- **Organic substances:**

Agent	Halosep product mg/kg ts	Limit values Landfil Directive 2018/850, June 14, 2018 (Inert Waste) mg/kg ts	Limit values Counsil Regulation (POP) 2019/1021 June 20, 2019 Existing ELV (POP) ng/kg	Coming updated list of waste Proposal 1 ng/kg	Coming updated list of waste Proposal 2 ng/kg
TOC	0,4-0,8%	3%			
PCB (7 Indic.)	<0,002	1			
PCDD/PCDF	<125 ng/kg	-	15.000 ng/kg	1.000 ng/kg	50 ng/kg
Aromatics (BTEX)	0,2	6,0			
Sum Benz-C40	20-200	150			
PAH (15) (HMP)	<0,03	4			

➢ **No single substance content is believed to cause inherent Hazardous Waste properties of the treated fly ash (X-APCR) from MSWI (VF)**

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HaloSep fraction 2

TREATED FLY ASH (X-APCR)

Classification of "X-APCR":

- **X-APCR "not relevant Hazardous Properties": HP1, HP2, HP3, HP9, HP12**
- **X-APCR to be classified as NHW (non hazardous waste) for: HP4, HP5, HP6, HP7, HP8, HP10, HP11, HP13**
- **Ecotoxic HP14/N/H410: Worst Case classification of X-APCR based on maximum leaching values for Pb,Cu and Zn at L:S=10 is NHW. We also expect NHW classification of X-APCR when biotests will be used for HP14**

➢ **NHW classification of X-APCR makes it possible for the X-APCR to be used for other applications. Applications (use as a construction material) will be evaluated and tested in the operational period of the LIFE Halosep project**

➢ **Classification of X-APCR will be performed during the four operational test periods of the LIFE Halosep project starting Oct.12th. 2020**

➢ **Temporary disposal of the X-APCR. Leaching tests will determine whether X-APCR should go to a disposal site class IA1, MA1 or FA1 according to EU directive 2033/33**

HaloSep fraction 2

TREATED FLY ASH (X-APCR) COLUMN LEACHING DATA

Temporary disposal of X-APCR (EU directive 2033/33):

Inert waste (IA1)

Non hazardous waste (mineral waste) (MA1)

Hazardous waste (FA1)

Data from 2018-tests (Sb leaching optimization)

- A process technical solution to ”Sb-leaching” has been developed in order to fullfil the MA1 leaching limit value for Antimony
- X-APCR (right column): The Antimony (Sb) leaching value at L:S=10 is below the MA1 limit value (0,7 mg/kg)
- All other leaching values are compliant with current limit values for disposal at local landfill class MA1

	Measured leaching values "incl. color coding for waste disposal" IA1 (green), MA1 (yellow), FA1 (brown)		
	L:S 0,1	L:S 2	L:S 10
	C0 mg/l	mg/kg	mg/kg
pH	> 6	> 6	> 6
DOC, dis..org.carbon	0,37	13	<5
Antimony (Sb), dis.	<0,0002	<0,0008	0,33
Arsenic (As), dis .	0,000024	<0,0003	<0,002
Barium (Ba), dis.	0,01	0,083	0,34
Lead (Pb), dis.	0,00091	0,075	<0,003
Cadmium (Cd), dis.	0,000015	0,00052	0,00041
Chloride, filtered	57	250	26
Chromium (Cr), dis.	0,0067	0,026	0,037
Fluoride, filtered	0,016	3,1	23
Copper (Cu), dis.	0,0014	0,024	<0,005
Mercury (Hg), dis.	<0,0001	0,00016	0,0015
Molybdenum (Mo), dis.	0,11	2,1	1,8
Nickel (Ni), dis.	0,00011	0,00091	<0,005
Selen (Se), dis.	0,0024	0,059	0,0092
Sulphate, filtered	53	1600	7100
Zinc (Zn), dis.	0,0024	0,019	<0,03

HaloSep fraction 3

SALT PRODUCT ”RECYCLING OR DISCHARGE”

Salt product

- amount is 25-50 %(w/w) of fly ash (in)

Trace metals

- Middle coloumn: Max. Limit values for trace metals in De-Icing agents are shown in table 4.4
- Right coloumn: Trace metals in Saltproduct SP2 from Vestforbrænding are shown in table 4.4
- SP2 Salt quality (DS) is OK according to EUSALT CEN TC337 ”Standard for De-Icing agents”

Conclusion

➢ Use of the salt product for road deicing will be validated in the operational period of the LIFE Halosep demonstration project

EUSALT Standard of De-Icing agents: CEN TC337 FOR DE-ICING AGENTS (TABLE 4.4)		SALTPRODUCT SP2-VF
Soluble Heavy metals	**Max Limit mg/kg DS**	**mg/kg DS**
Al	50	0,03
As	2,5	0,01-0,05
Cd	2	0,03-0,9
Cr	5	0,02-0,03
Cu	5	< 0,01
Hg	0,5	< 0,01
Ni	5	< 0,01
Pb	5	0,01
Zn	20	0,1-0,3
Co	2	0,02
Hydrocarbons	100	< 20 (DOC)
Sulfate Type 1	Max. 1,5%	0,5-1% (w/w)*

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HaloSep fraction 4

METAL PRODUCT (HMP)

Metal product

- Amount approx. 3% (w/w) of fly ash (in)

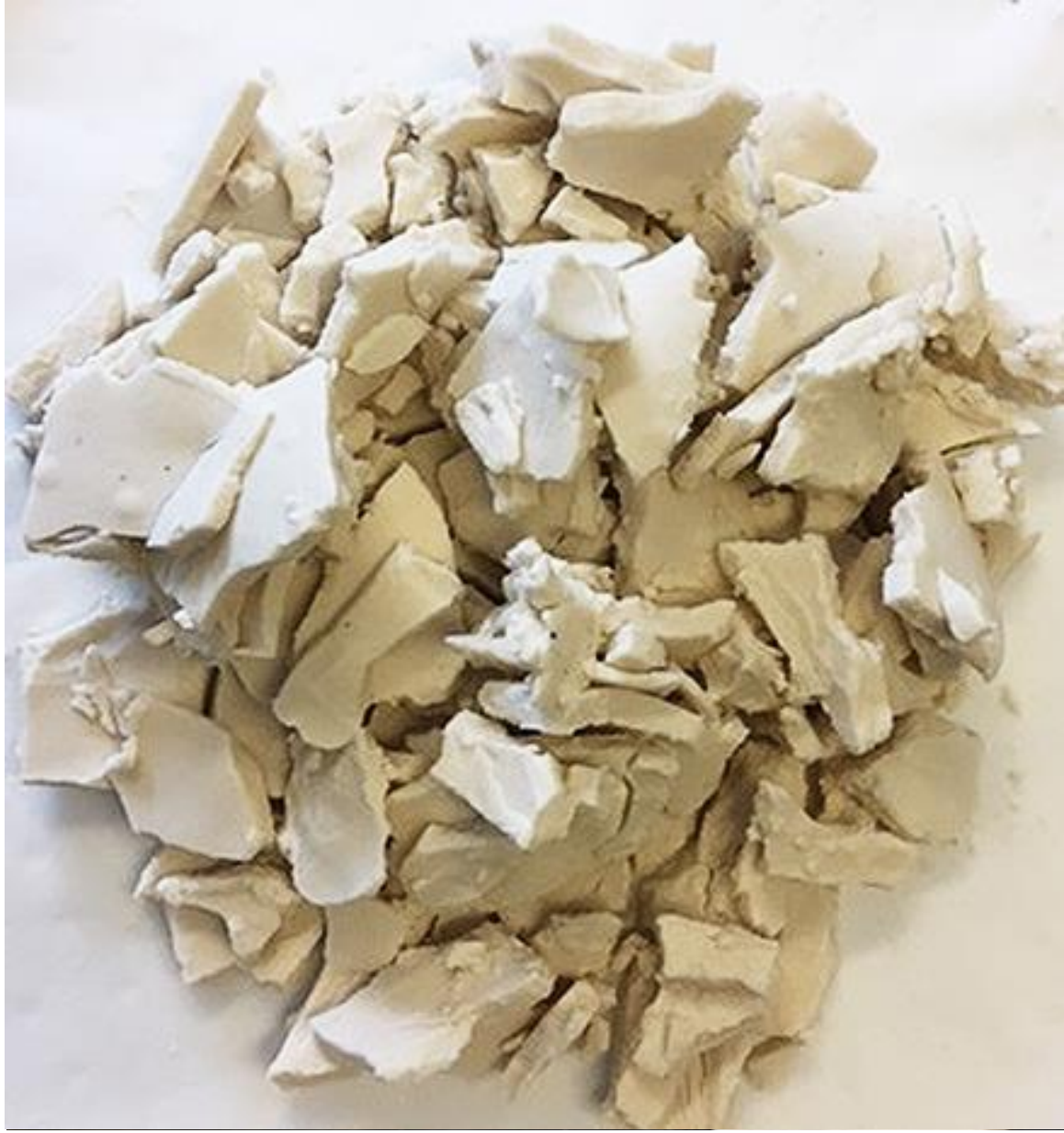
Composition

- Zinc content 37-45 % (w/w) (56-68% zinc hydroxide)
- Lead content 0,4-3,0% (w/w)
- Cadmium content 0,3-1,0 % (w/w)
- Other Mg, Ca, Si, Cl, S, Al

Conclusion

- Metal product to Zinc recycling for Zinc recovery

➢ Optimization of the zinc yield and concentration will be further developed in the operational period of the LIFE Halosep demonstration project



RAMBØLL SEPARATION FOR REUSE

VESTFORBRÆNDING

Life

HaloSep

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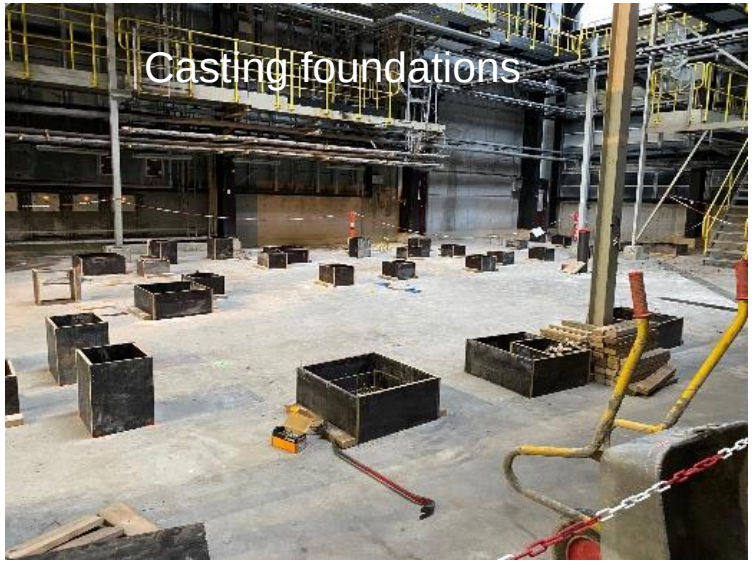
LIFE HALOSEP - PLANT STATUS

Halosep plant status (Vestforbrænding)

- ✓ All equipment in place and mounted
- ✓ All pipes, valves, instruments, power cables and signal cables mounted
- ✓ All connections to the existing WtE plant completed
- ✓ Spilage pits, ventilation system completed
- ✓ Control, regulation and monitoring programmed (signals to VF central control room)
- ✓ Cold tests completed
- ➢ Commissioning of filters started sept. 15th.
- ➢ ”Hot test” (with fly ash and scrubber liquids) started nov. 1 st.

Halosep fly ash treatment

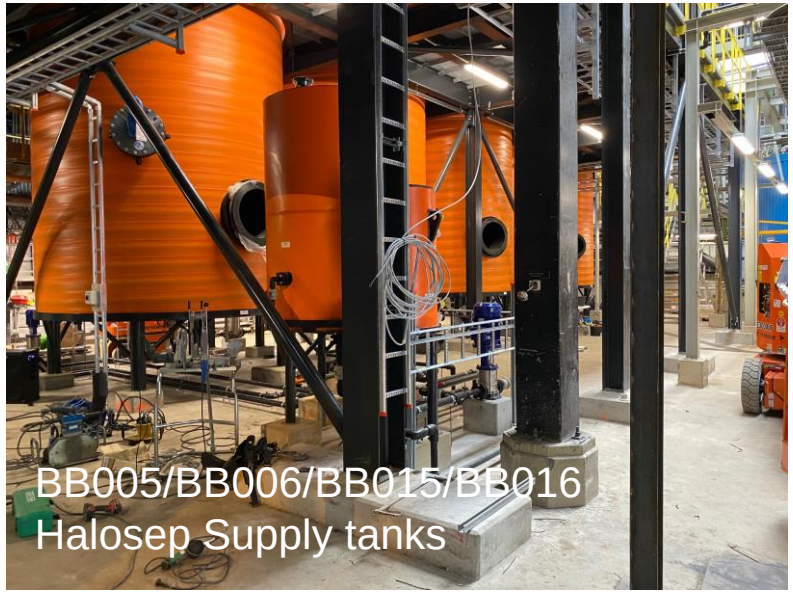
Construction of the mezzanine incl. machine foundations in the existing FGT building



Halosep fly ash treatment

Installation of HaloSep process equipment (1)


BB002 Ash receiver


BB005/BB006/BB015/BB016
Halosep Supply tanks


BB003/BB004 Halosep reaction tanks

RAMBØLL VESTFORBRÆNDING

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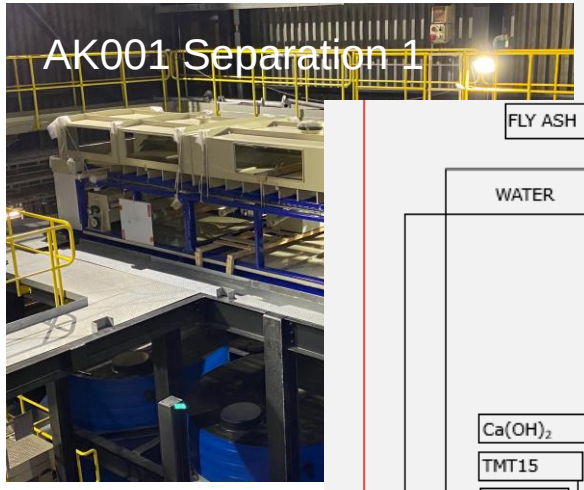
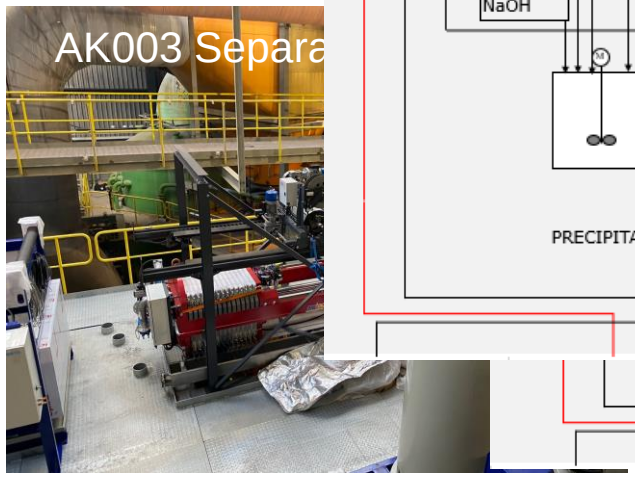
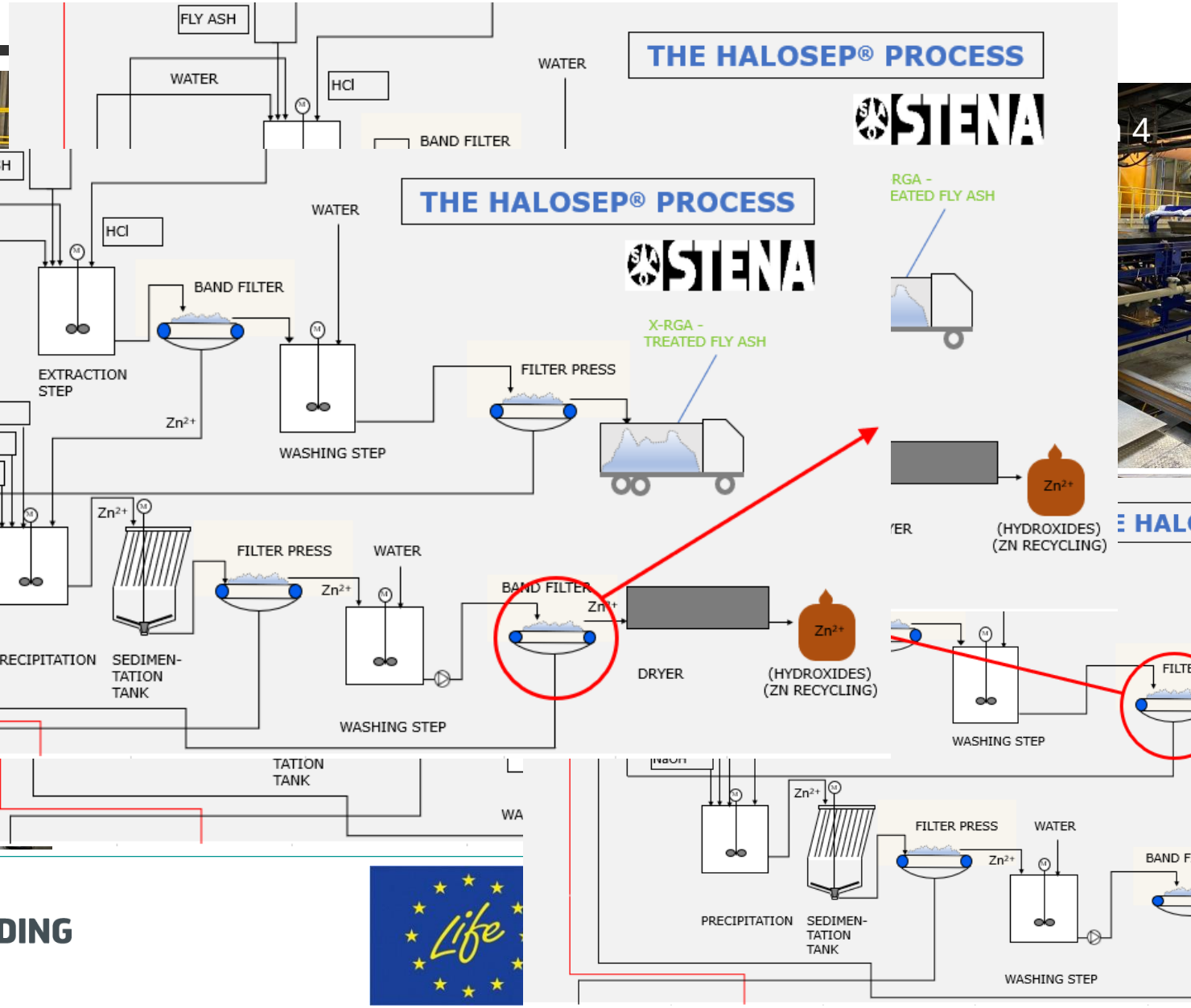
Halosep fly ash treatmentInstallation of HaloSep process equipment (2)







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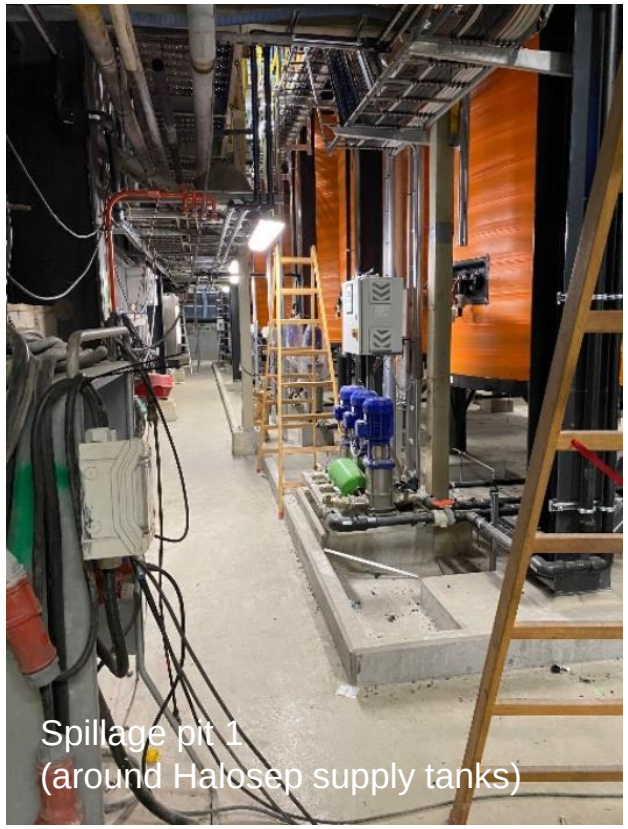
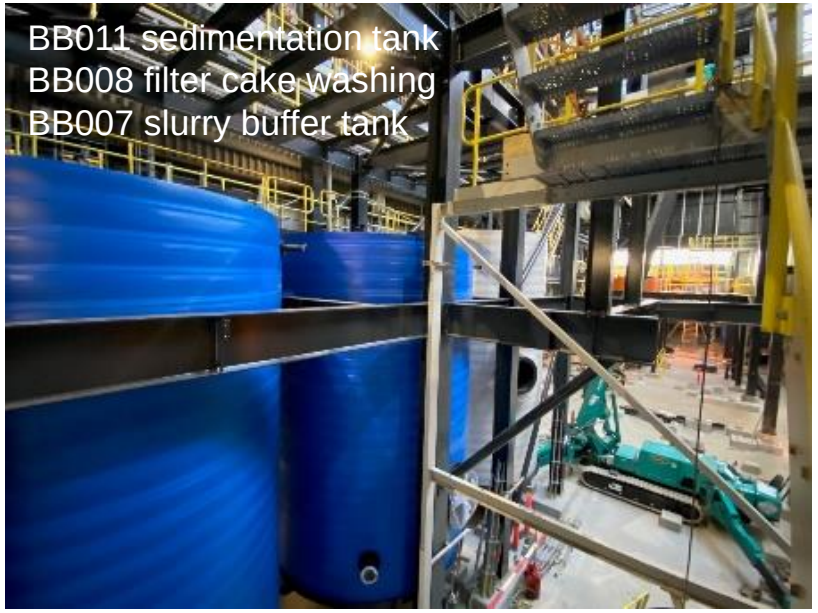
Halosep fly ash treatment
Installation of HaloSep process equipment (3)





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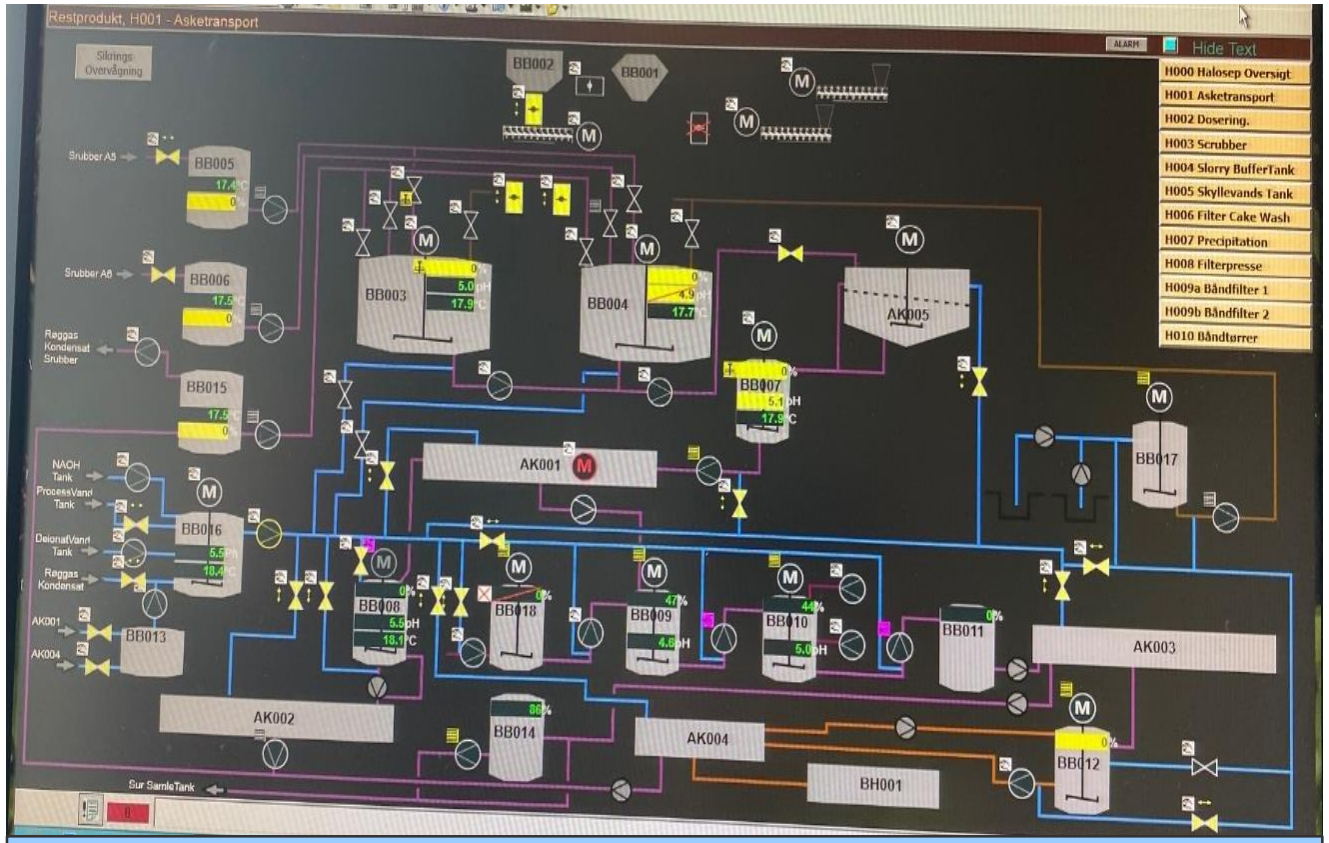
HaloSep fly ash treatment

INSTALLATION OF PROCESS EQUIPMENT 4

Frequency converters 1 for the Halosep plant

Frequency converters 2 for the Halosep plant



SRO screen picture of the Halosep plant in the VF main control room

HaloSep full scale demonstration plant (Denmark)

LIFE HaloSep – consumption of Auxiliaries

Consumables / Ressources	unit	Existing treatment	HALOSEP®
Electricity	Mwh/year	300	600
District heating water	MWh/tear	0	310
Water (sec.ground-, FGC)	tonne/year	0	3.000
$CaCO_3$	tonne/year	1940	0
$Ca(OH)_2$	tonne/year	153	80
NaOH (50%)	tonne/year	0	26
TMT15	tonne/year	14	8
Floculant	tonne/year	0,5	0

HaloSep full scale demonstration plant (Denmark)

LIFE HaloSep - expected results

- ✓ Build an approx.13-14 kton/year HaloSep plant in an existing Flue gas cleaning building at VF
- ✓ Integrate the HaloSep plant with the existing Flue Gas cleaning plant and the existing WWTP
- ➢ Total costs for treatment of fly ash (incl. scrubber liquid) to be reduced by approx. 20%
- ➢ Chemicals consumption to be reduced by > 80%
- ✓ Treated Fly ash amounts (DM) 60-62% of Fly ash input, i.e. the reduction in DM will be 38-40%

LIFE HaloSep - full scale tests 2020-21

Full scale “warm tests” started in October 2020

1. Test period 1 “Low salt”. Use of the treated Fly ash (X-APCR) as a construction material or as an additive in concrete or cement will be tested and evaluated during this test period
2. Test period 2 “High salt”. Show that the salt product can be recycled as a brine with about 10% salt content. It will be evaluated during this test period if up to 2.000 tons salt can be used as road salt during the winter period
3. Test period 3: Zinc optimization. Metal product (HMP) will be upgraded to about 45% zinc content. The zinc yield will be optimized during this test period
4. Test period 4: Treatment of Fly ash from other (external) WtE plants (for example ARC) will be tested during this test period

THANK YOU FOR YOUR ATTENTION

CUSTOMER CONTACT INFORMATION:

HaloSep AB

- Staffan Svensson [Phone +46 104452188]

Stena Recycling DK

- Erik Rasmussen [Phone +45 21488211]
- Kim Crillesen, Vestforbrænding [Phone +45 29171347]

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