

A close-up photograph of a black and white cow's head and upper body. The cow is looking slightly to the right. In the background, there is a large, modern-looking grey industrial building with a circular logo on its side. The foreground is a green field with some small plants.

HYDROTHERMAL CARBONIZATION OF PULP MILL WASTE-WATER SLUDGE

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BIOFIT Final Conference 2022-01-19

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DRY PYROLYSIS

Charcoal

- Charcoal (coke) is mainly used in the production of iron.



WET PYROLYSIS

HTC Biocoal (hydrochar)

- Wet pyrolysis or hydrothermal carbonization (HTC) was described by the German chemist Friedrich Bergius in 1913 (Nobel Prize 1931).





"WE DRY SLUDGE IN WATER"



By combining HTC with
wet oxidation

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COMPOSITION OF BIOSLUDGE

Water(70-80%)

C
P
N

Al
Ca
Fe
Mg
Si

Ag
As
Cd
Co
Cr
Cu

Hg
Mn
Ni
Pb
Zn

Odor
Patogens



Biosludge in Heinola

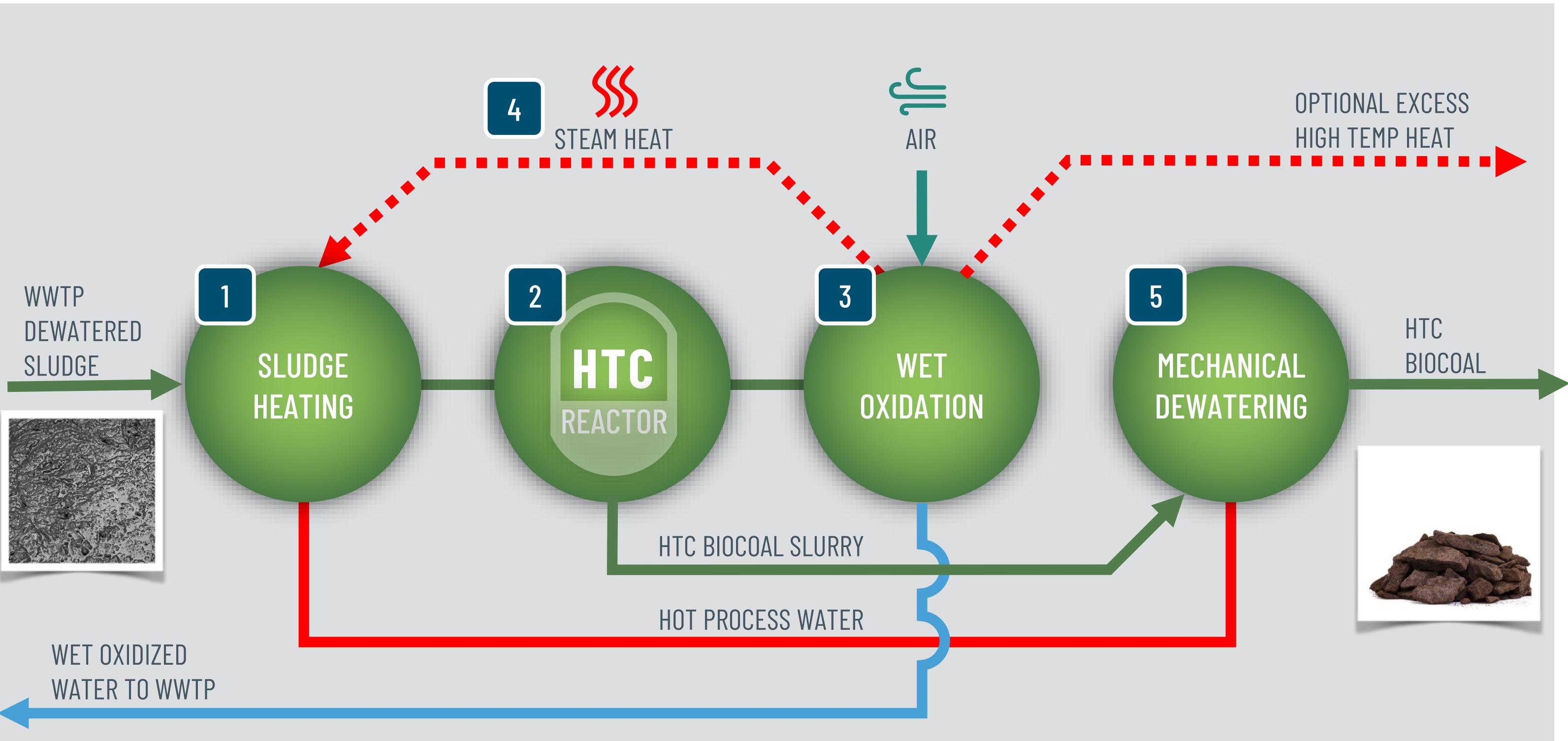
OXYPower HTC IN OPERATION AT HEINOLA NSSC MILL, FINLAND

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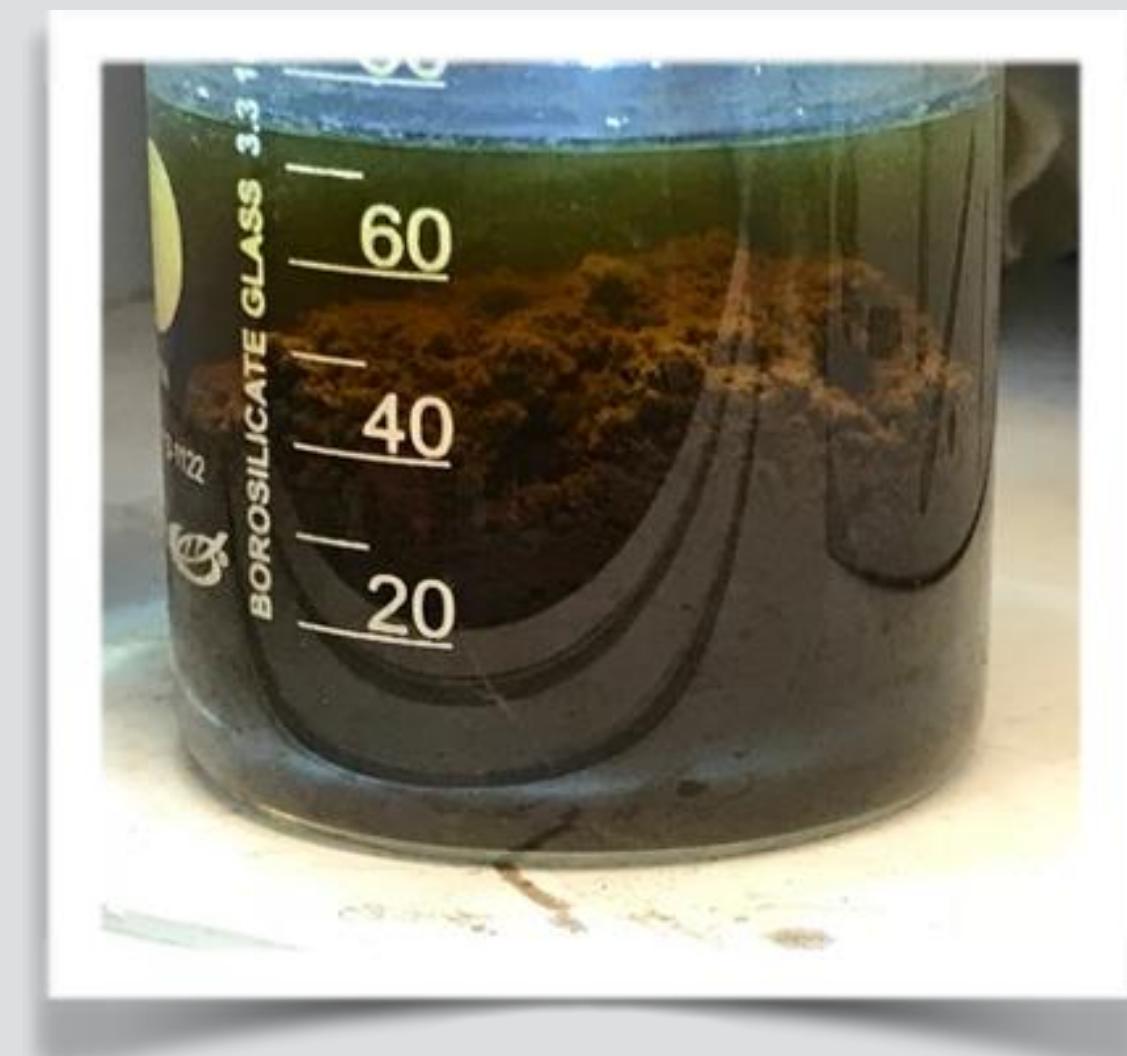
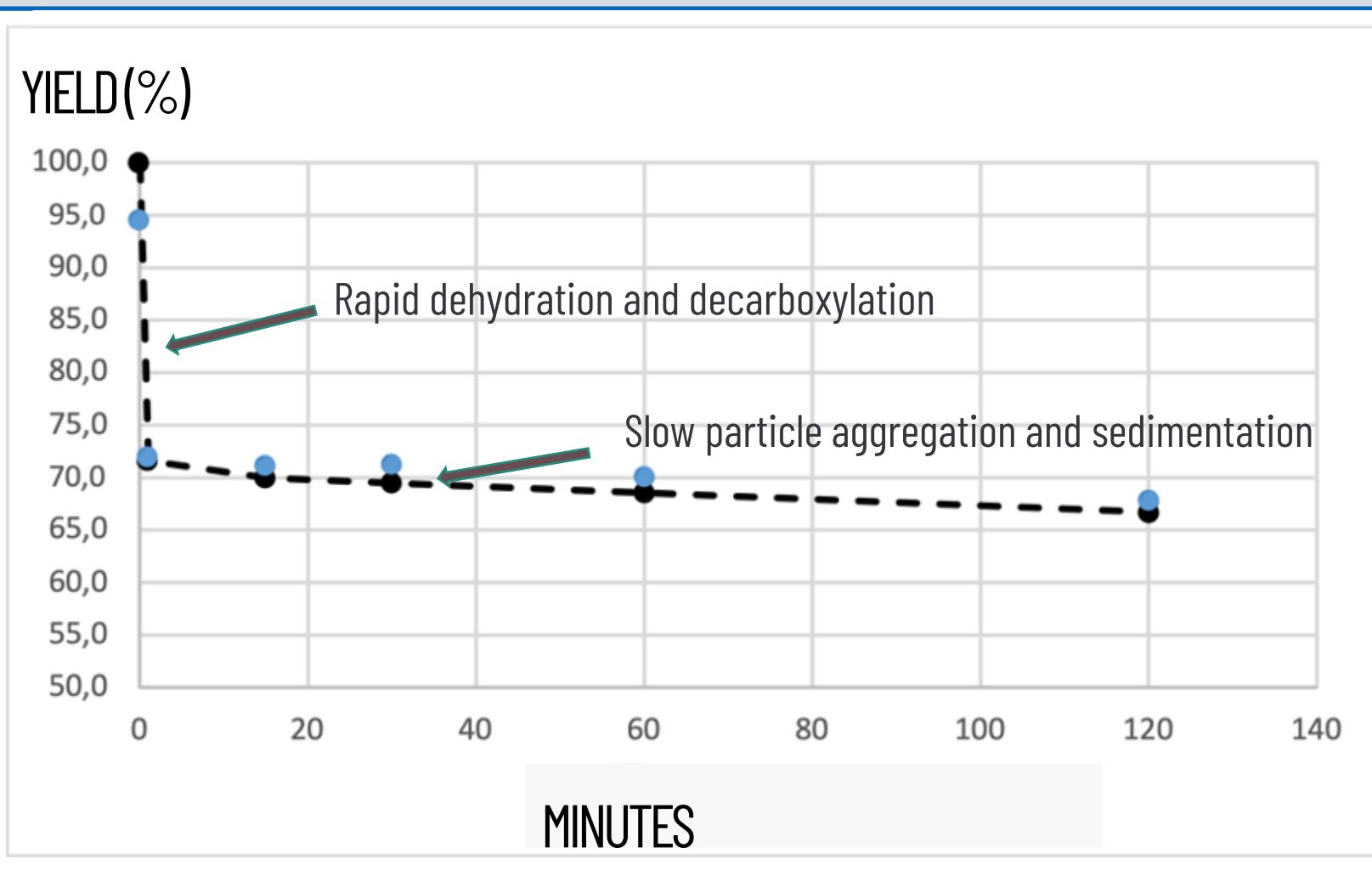


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THIS HAPPENS DURING HTC AT 200 °C



WET OXIDATION



- Temperature increase from ~200°C to ~230°C
- COD reduced up to 70%
- Dramatic reduction of color and odor
- Organic N converted to NH₄⁺



- One hour at 200 C for 1h
- No external heat needed
- Solid HTC- biocoal @ 50-70% DS
- 80 -90 % water removed
- HTC-biocoal @ 4-11GJ/t, sterile, odorless

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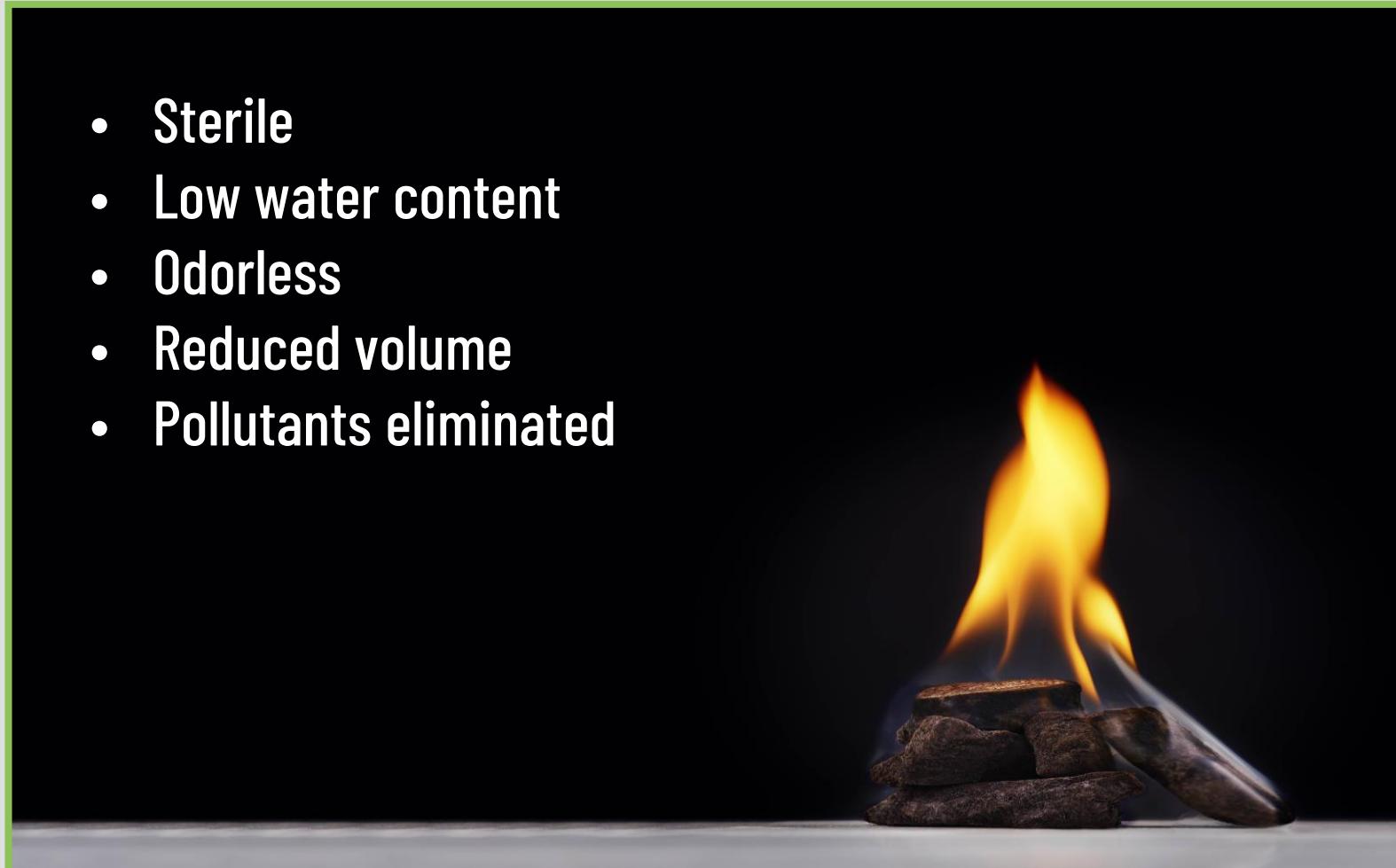


OXYPOWER HTC IN OPERATION IN HEINOLA



Biofuel

- Sterile
- Low water content
- Odorless
- Reduced volume
- Pollutants eliminated

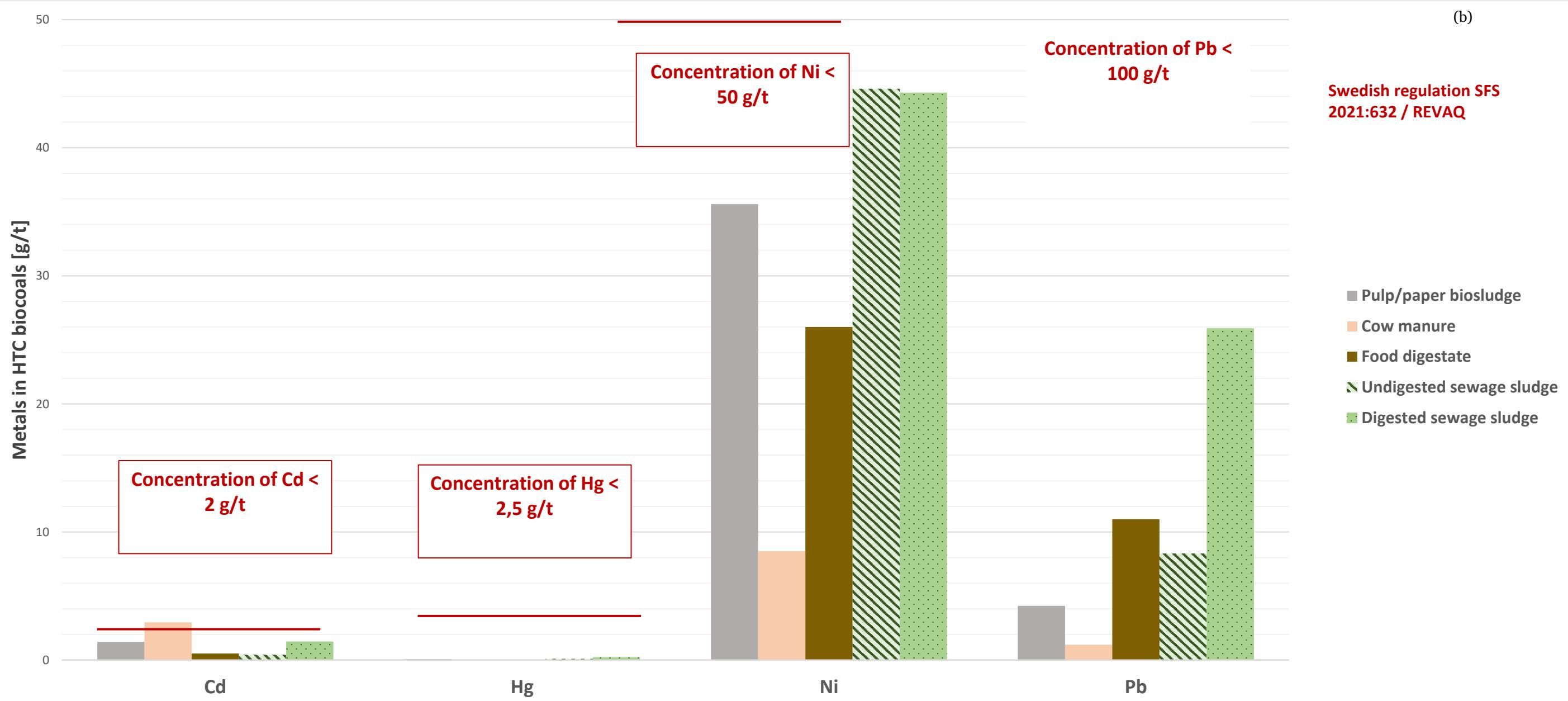


Soil applications



- adding and retaining nutrients
- enhancing soil aggregation and water retention
- reducing soil acidity
- sequestering atmospheric C
- improving soil microbial activity

HEAVY METALS IN HTC-BIOCOAL



TOTAL AMOUNT AND PLANT NUTRIENT AVAILABILITY

Leachable amount (available for plants) based on lactate based leaching tests at SLU (Swedish Agricultural University)

Type	C-org	C:N	P	K	Ca	Mg	Na	Plant availability
	% of TS	Total amount/leachable amount in kg/t TS						
Pulp/paper biosludge	49,9	11,8	19/0,78	1,1/ 0,45	19,9/8,28	2,2/0,91	1,2/0,64	High except P
Food digestate	41,2	10,1	24/8,5	2,0/0,75	78/46	2,0/1,16	1,0/0,34	High
Undigested sewage sludge	41,1	28,3	28/0,62	2,2/0,07	18,4/2,7	2,0/0,11	0,9/0,02	Low

PAK CHOI AND BASILIKÅ

Pak choi



Foto: Helene Larsson Jönsson, SLU

Basilika



Foto: Helene Larsson Jönsson, SLU

C-GREEN'S HTC PILOT

On route to Roslagsvatten Sept 2021



Installed at Roslagsvatten Sept 2021



SUMMARY

- HTC and wet oxidation is a new and powerful combination
- Any organic sludge can be converted to odor free and sterile HTC biocoal
- HTC biocoal applications - biofuel, soil improvement and potentially as activated carbon



THANK YOU FOR YOUR ATTENTION!
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