

*European Workshop
15, 16 september 2003 - Brussels*

Thermal Treatment of Sewage Sludge for CHP Applications

ATHOS® WET AIR OXIDATION PROCESS. Case study : N-Brussels WWTP



M. BELKHODJA

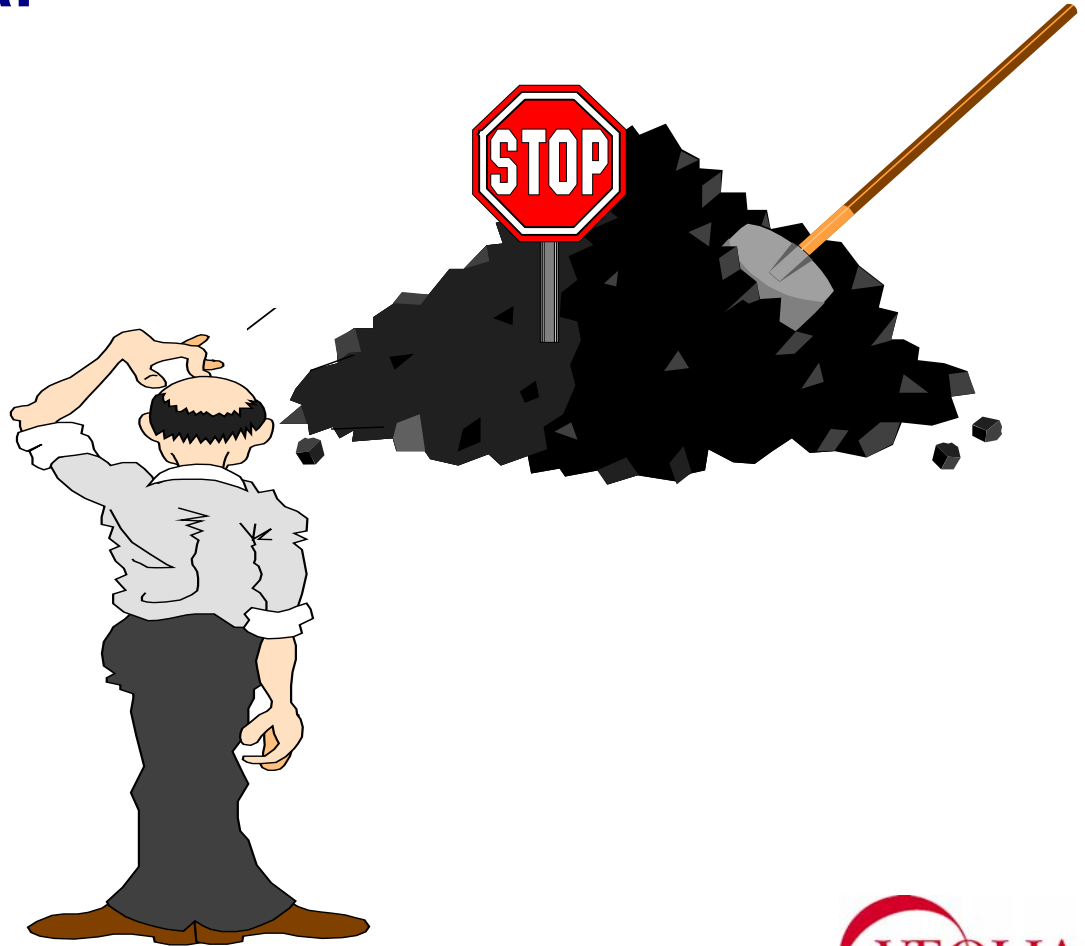
OTV SA- VEOLIA WATER SYSTEMS



SEWAGE SLUDGE : THE BIG ISSUE

⇒ **8.0 M Dry tons /year**
produced in the E.U.

- land application : 40%
- landfill : 40%
- incineration : 10%
- other : 10%



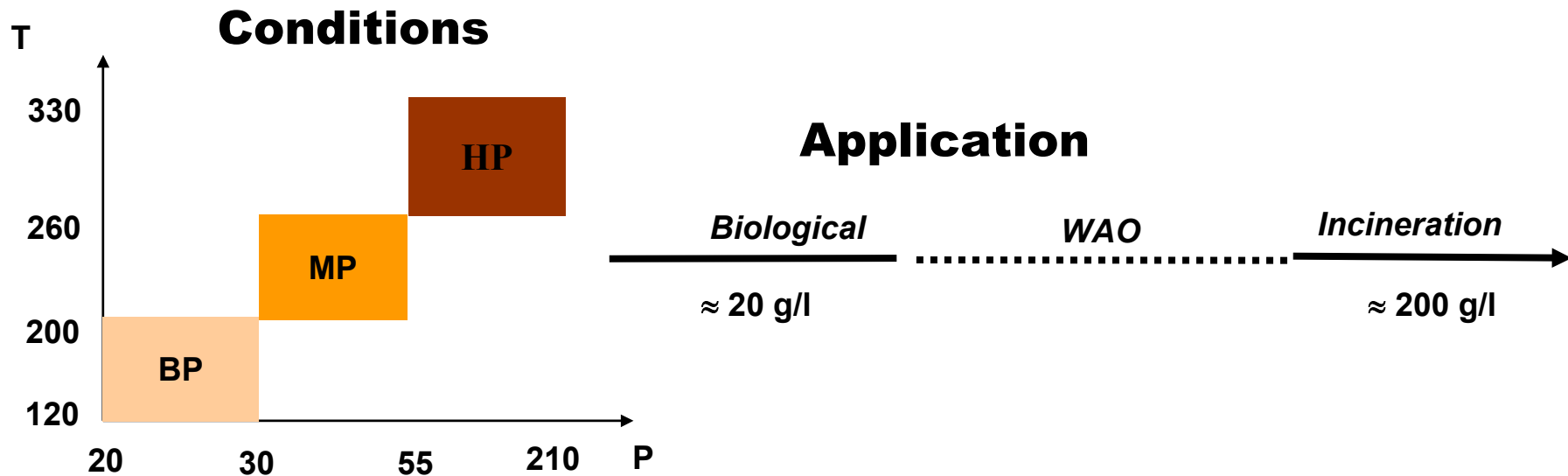
VEOLIA WATER SYSTEMS

Sludge Thermal Processes

<i>Process</i>	<i>Treatment Description</i>	<i>Sludge concentration needed</i>
PYROFLUID® (OTV)	Incineration	25 - 30%
PYROFLUID S® (OTV)	Incineration for Small capacities	18-22%
PYROMIX® (OTV)	Co-Incineration with MSW	18 – 25%
ATHOS® (OTV)	Wet Air Oxidation	4- 8%
THELYS® (OTV)	Thermal Hydrolysis	12 - 18%
BIOTHELYS® (OTV)	Sludge production reduction	4%
BIOCON® (KRUGER)	Drying	15-30%
J-VAP® (US-FILTER)	Dewatering-drying device	-

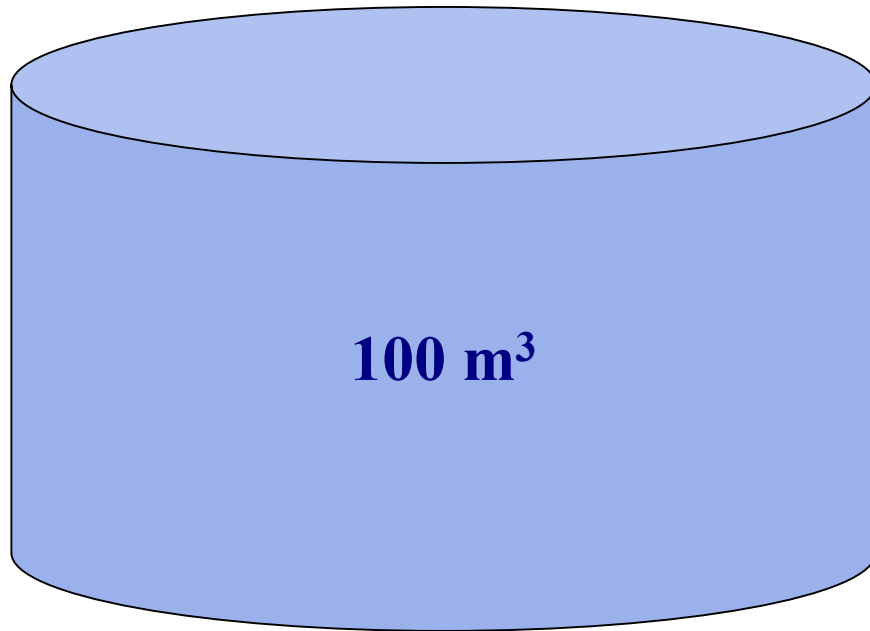
Principle

Thermal oxidation in liquid phase using molecular oxygen

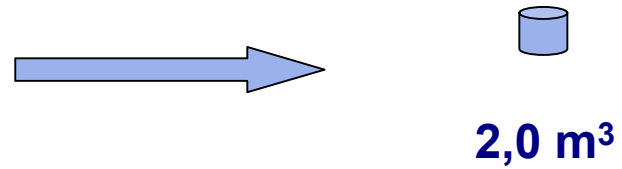


Sludge Volume reduction

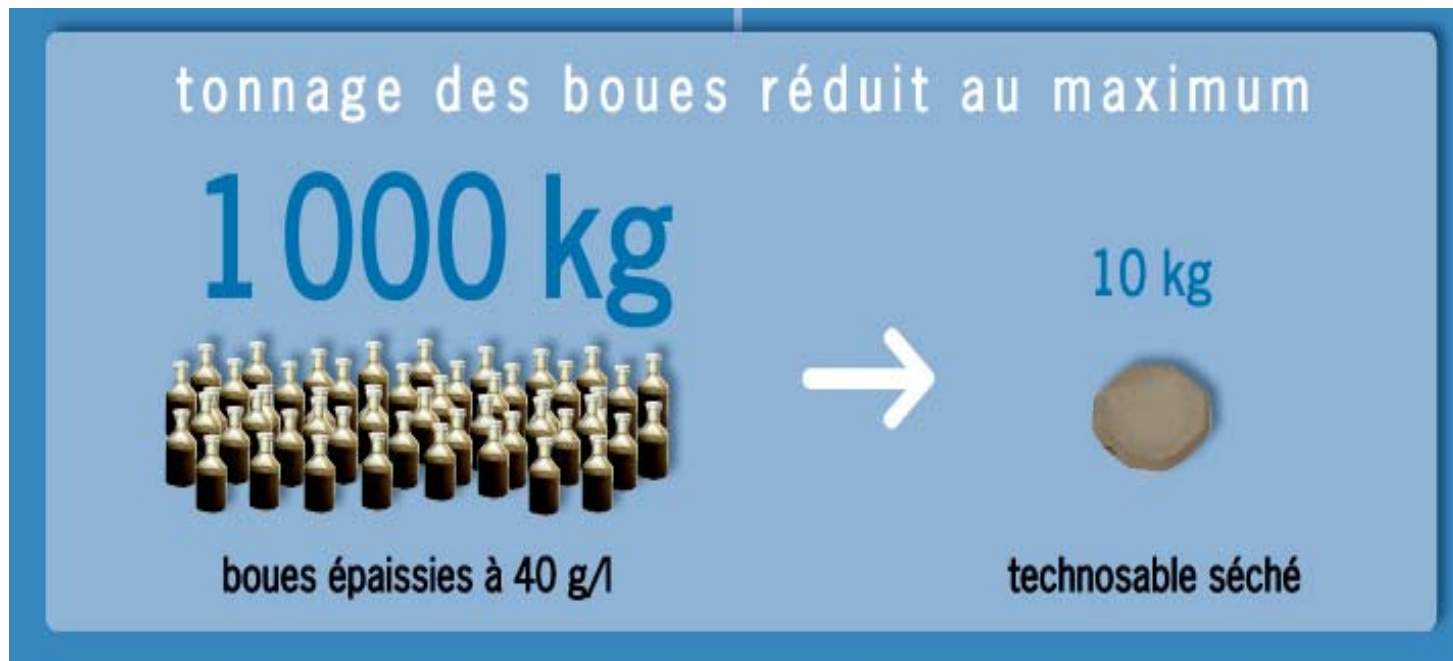
Liquid sludge @ 4%



Final mineral solid
@ 50% MS



Sludge Weight Reduction



WAO – Incineration Comparison

⇒ Incineration

Thickening

Dewatering

Incinération



⇒ WET AIR OXIDATION

Thickening

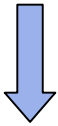
WAO



ATHOS® HISTORY

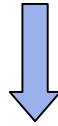
1992

First tests on tubular plug flow reactor



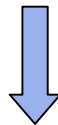
1993

Autoclave tests



1995

Continuous pilot plant (25 L/h - 300 PE)



1998

Start up of ATHOS Toulouse (3 m³/h – 50 000 PE)

Anjou Recherche R&D WAO Reactors



Autoclave reactor



25 l/h pilot unit

ATHOS® REFERENCES

	<i>Toulouse (France)</i>	<i>Trucazzanno (Italy)</i>	<i>N-Brussels (Belgium)</i>	<i>Epernay (France)</i>
WWTP capacity:	550 000 PE	300 000 PE	1 100 000 PE	150 000 PE
ATHOS capacity :	1 100 TDS/y	5 100 TDS/y	15 000 TDS/y	2 200 TDS/y
ATHOS capacity :	3 000 kg DS/d	15 000 kg DS/d	45 000 kg DS/d	7 300 kg DS/d
Flowrate :	3 m ³ /h	8 m ³ /h	24 m ³ /h	4 m ³ /h
Devices :	1	1	2	1
Sludge quality :	mixed	digested	TH + digested	digested
Sludge conc. :	4.5%	8.0%	7.7%	7.6%
Volatile fraction :	80%	53%	53%	56%
Operating hours:	8 000 h/y	8 000 h/y	8 000 h/y	7 800 h/y
Start-Up :	1998	2005	2006	2005

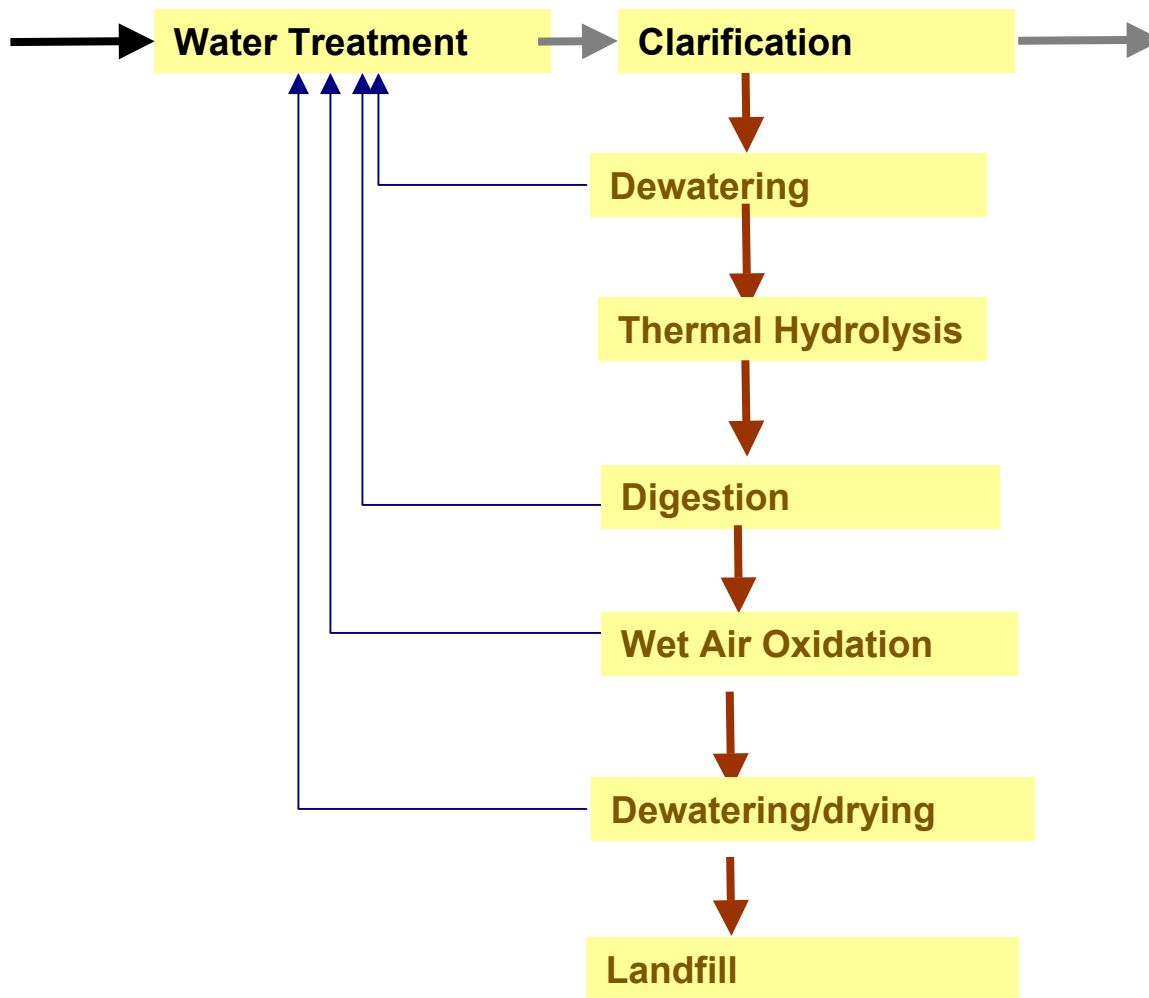
ATHOS TOULOUSE INDUSTRIAL UNIT



ATHOS TOULOUSE INDUSTRIAL UNIT



N-Brussels WTPP Sludge Treatment



***Incineration
forbidden***

Sludge Train Comparison

Thickening



Wet Air Oxidation



Dewatering



Landfill

	WAO	THP+WAO
Design volume	96 m ³ /h	24 m ³ /h
Oxygen need	3 870 kg/h	1 450 kg/h
Electricity	23 000 MWh/y	8 000 MWh/y

Dewatering



Thermal Hydrolysis



Digestion



Wet Air Oxidation

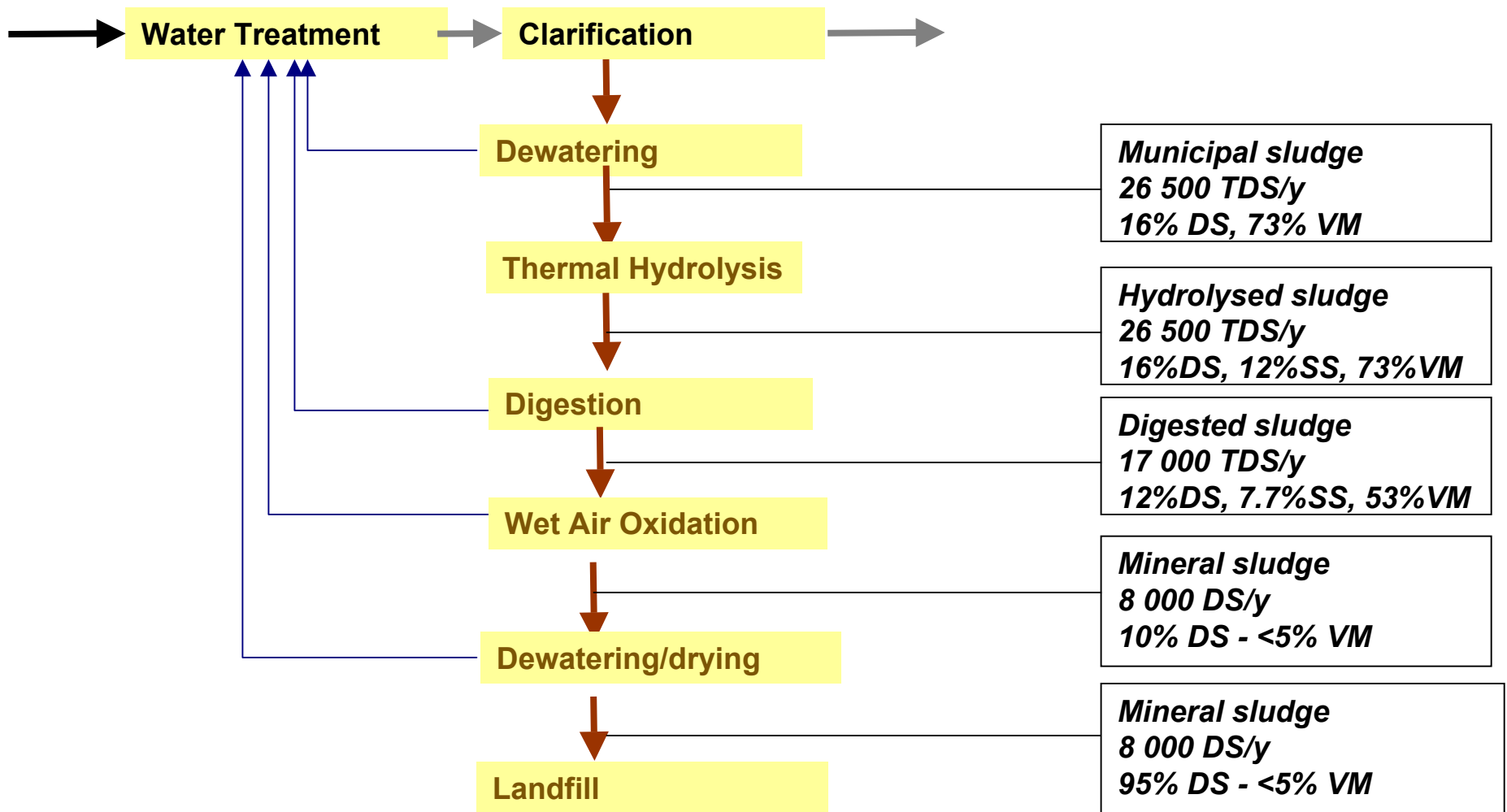


Dewatering



Landfill

N-Brussels Case Study : Sludge Treatment



ATHOS® Process

Mineralization Process in liquid phase & low temperature

↪ Operating conditions

250°C, 50 bar, pure O₂
perfectly mixed reactor
Copper sulphates as catalyst

↪ Typical performance :

- COD removal : > 85%
- Volume Reduction > 98%

↪ Liquid effluent

Highly biodegradable
(mainly acetic acid)

↪ Residual Solid

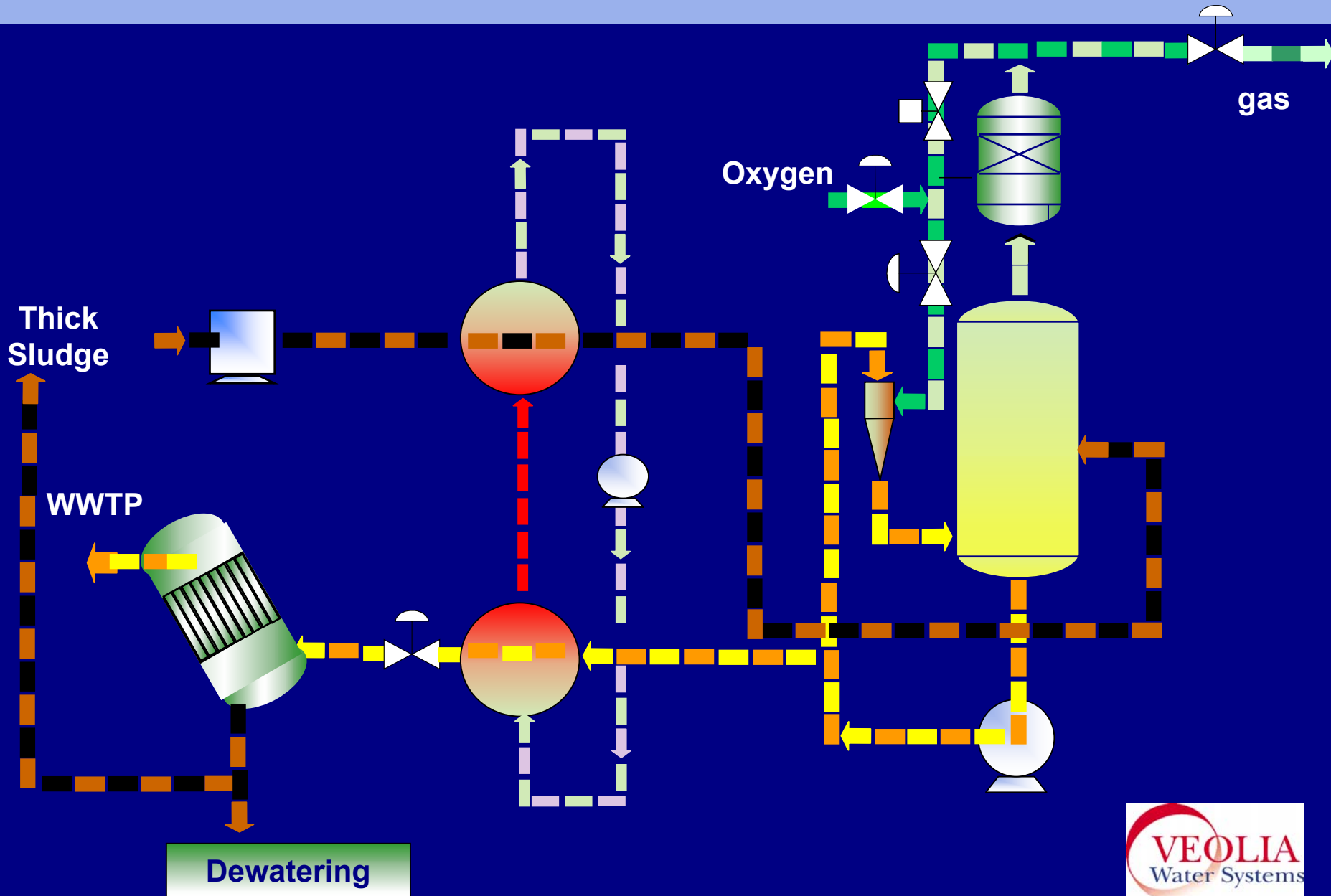
- Mineral, COT < 5%
- No leaching
- 55% DS min dewatering with no additives



↪ Off-Gas

- No dioxins, furanes, NO_x, HCl, and dust
- Thermal Treatment operation needed : CO, VOC

ATHOS PROCESS



ATHOS MINERAL SOLIDS

➤ Mineral solids characterization

- Typical analysis (% de DS)

SiO ₂	CaO	Al ₂ O ₃	CO ₃	SO ₄	P ₂ O ₅
38.3	16.8	12	3.6	2	13

- Particules : $\varnothing_{\text{medium}}$ 2.7 μm (1 ~10)

- COT < 5 %

- Leaching tests : all metals fixed,

Construction Solids Re-use

Thermal Hydrolysis and Digestion

Principle : *Thermal hydrolysis under moderate pressure (8 bars) and temperature (165°C) of dewatered sludges*

- Thermal Hydrolysis Process (THP)

- Batch Process
- Solubilization process - **steam**
- 150-165 °C < 10 bar
- < 1 hour

- Digestion

- 100-120 g/l - 14 à 18 days retention time
- VM Total removal: 55 to 62%
- 60 to 85% more biogas production
- No need of recirculation heating loop
- Easy dewatering : up to 35% DS



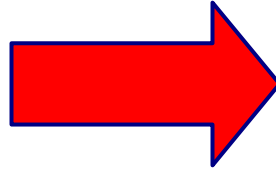
Sludge Thermal Hydrolysis



15 - 16% DS sludge

15 - 16 % SS sludge

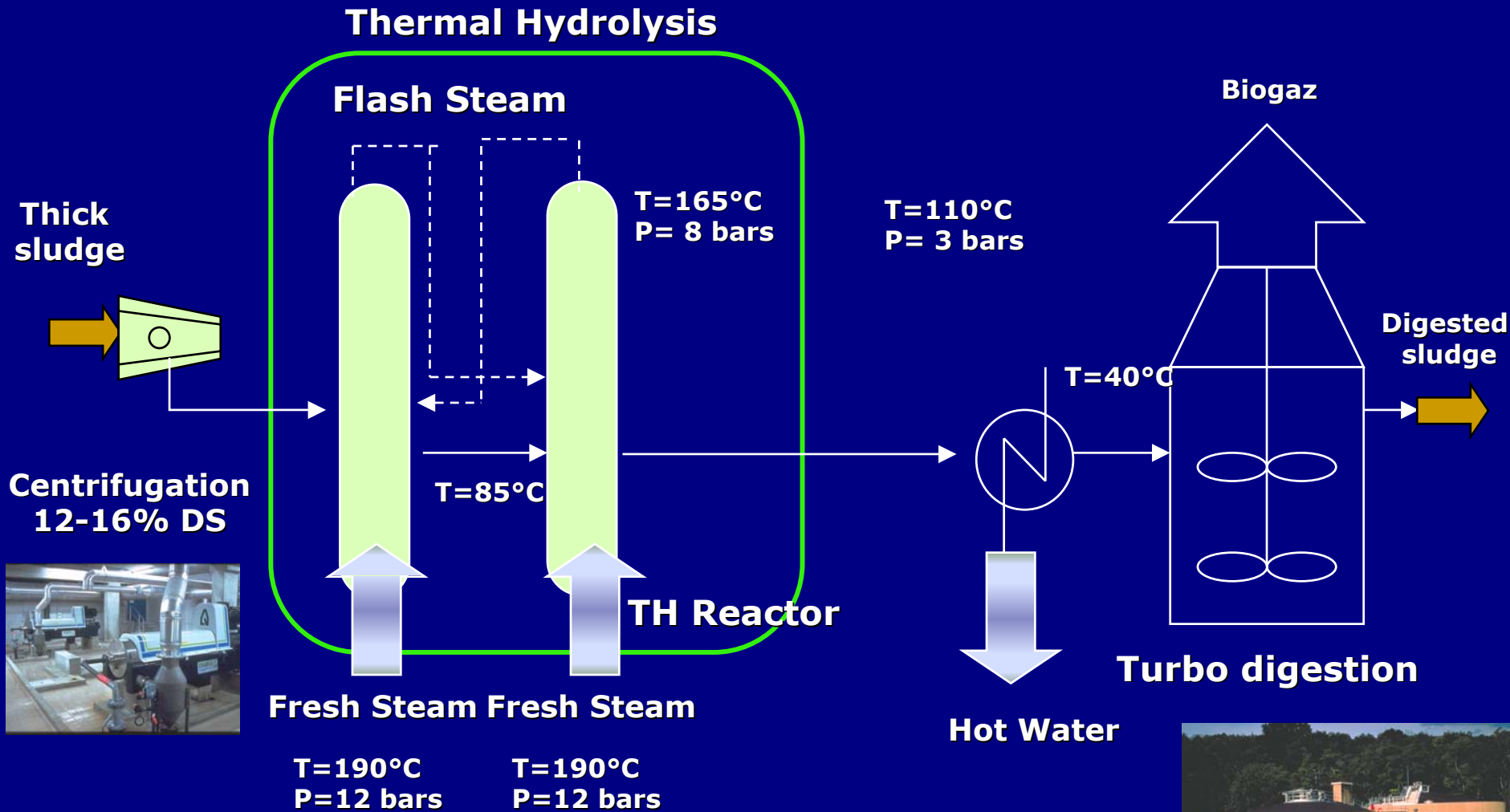
Thermal
Hydrolysis



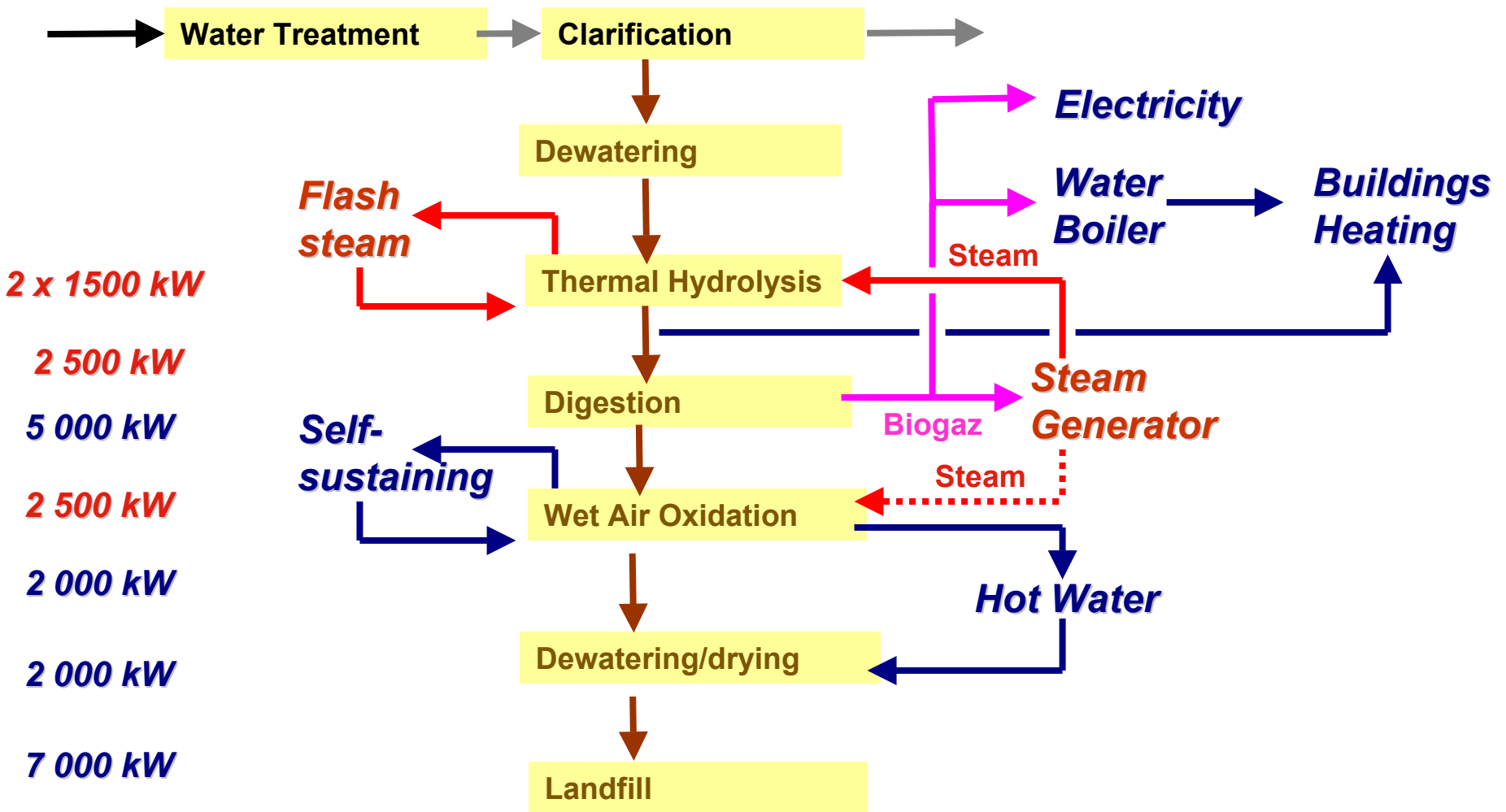
15 - 16% DS sludge

10 - 12% SS sludge

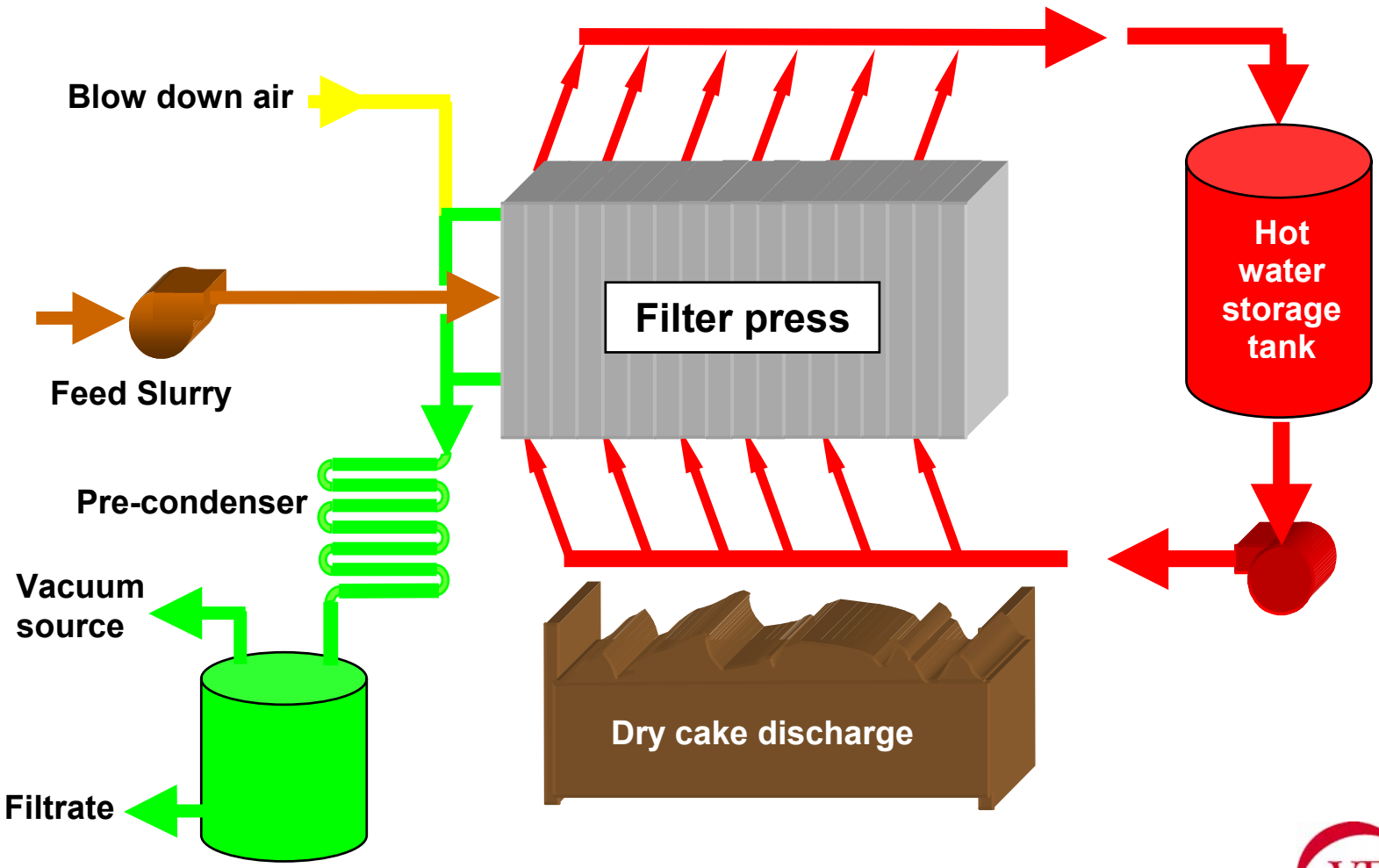
Thermal Hydrolysis & Digestion



N-Brussels WWTP : Heat Recovery



Dewatering/Drying Process



Conclusion:

✓ The innovative N-Brussels sludge train is cost effective for high plant capacity using THP & WAO Process

✓ Better public acceptance for WAO than Incineration