LODOS: PRODUCCIÓN Y APROVECHAMIENTO

Valorización de lodos de depuradora por carbonización hidrotermal

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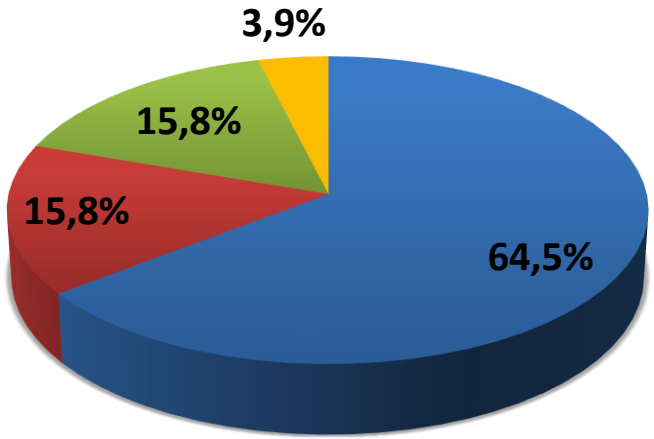
Sewage sludge management

1,400,000 t/year

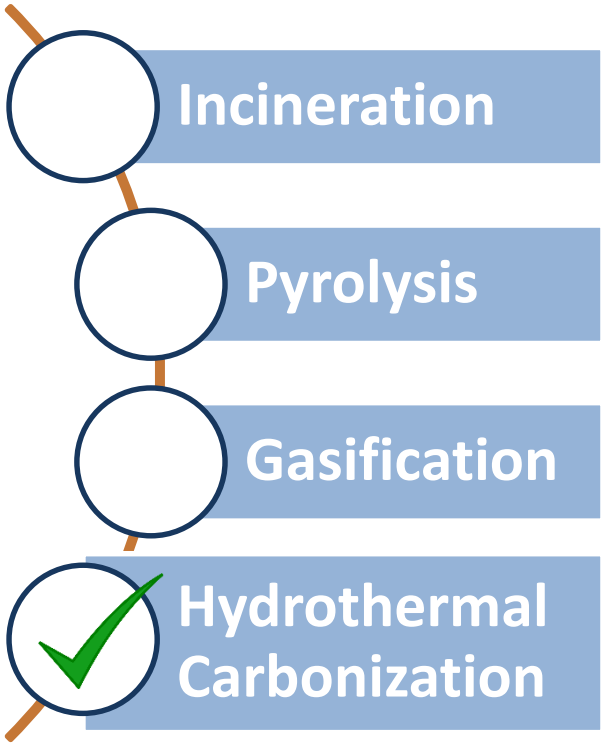
SEWAGE BIOSOLIDS



- Soils remediation
- Landfilling
- incineration
- Others

Thermal valorization of sewage sludge

Thermal technologies



Hydrothermal Carbonization (HTC)

Firstly described by Friedrich Bergius in 1913.

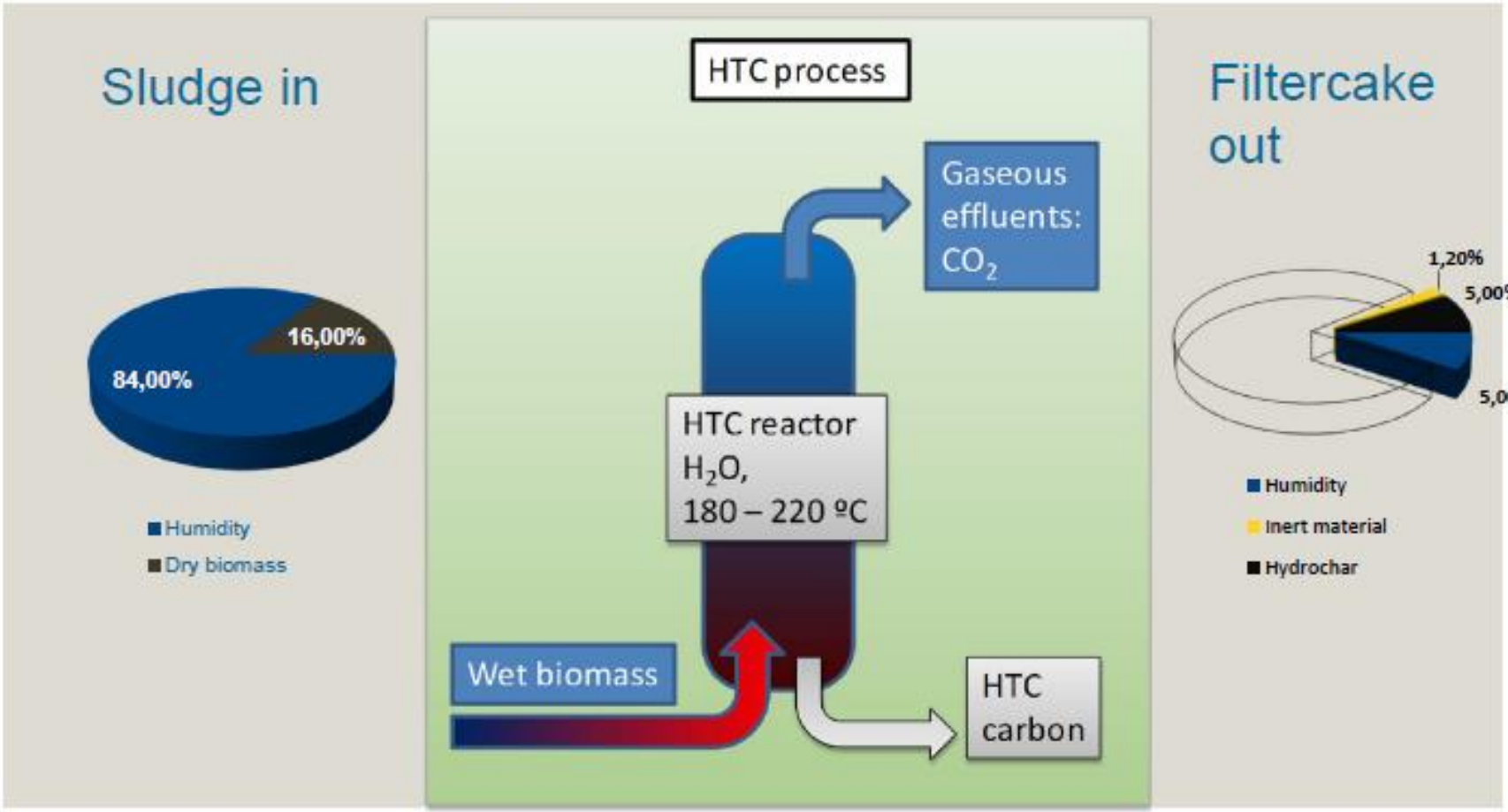
Rediscovered for biomass applications by Max Planck Institute of Colloids and Interfaces (Potsdam, Germany) (Antonietti and Titirici, 2006).

1st International Symposium on Hydrothermal Carbonization. April 2017. Queen Mary University of London.

Thermal valorization of sewage sludge

		Pyrolysis	Gasification	Hydrothermal Carbonization
Temperature (ºC)		400 - 800	600 - 900	180 - 300
Time		5 min - 24 h	10 - 20 s	5 min - 24 h
Yield (%)	Solid	25 - 35	<10	45 - 70
	Liquid	20 - 30	< 5	5 - 25
	Gas	25 - 35	> 85	5 - 25

Hydrothermal Carbonization (HTC)

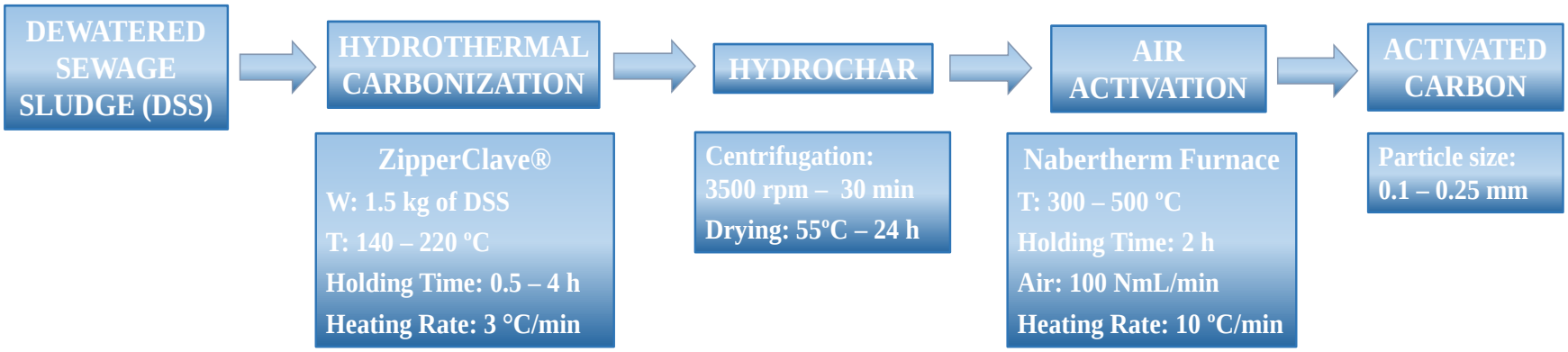


Objetives

Valorization of sewage sludge by HTC to obtain a hydrochar, which can be used as energy source (solid fuel) and/or activated carbon precursor.

Air activation of hydrochars has been studied in order to achieve materials with potential applications as adsorbent or catalytic support, among others.

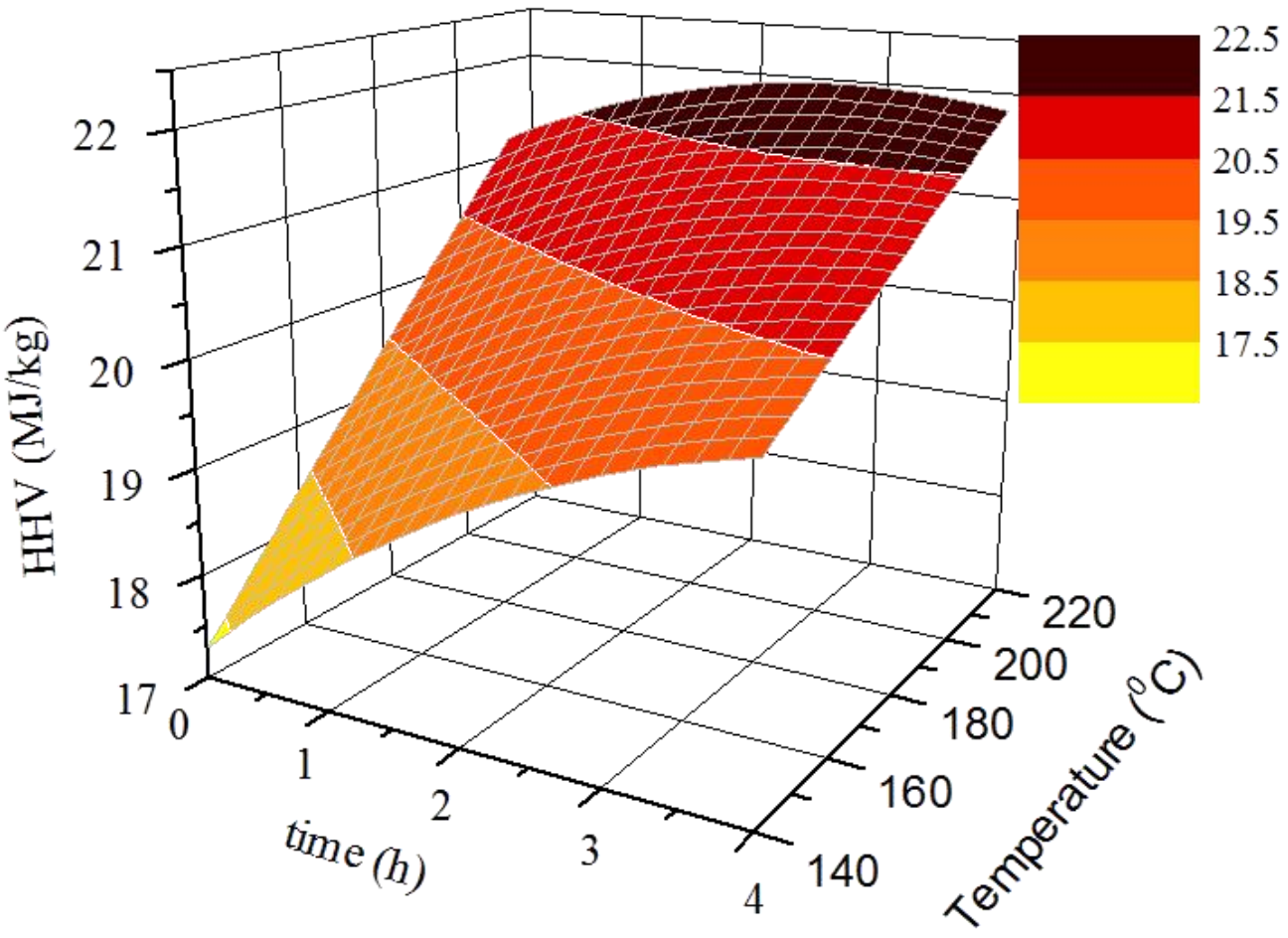
HTC experiments



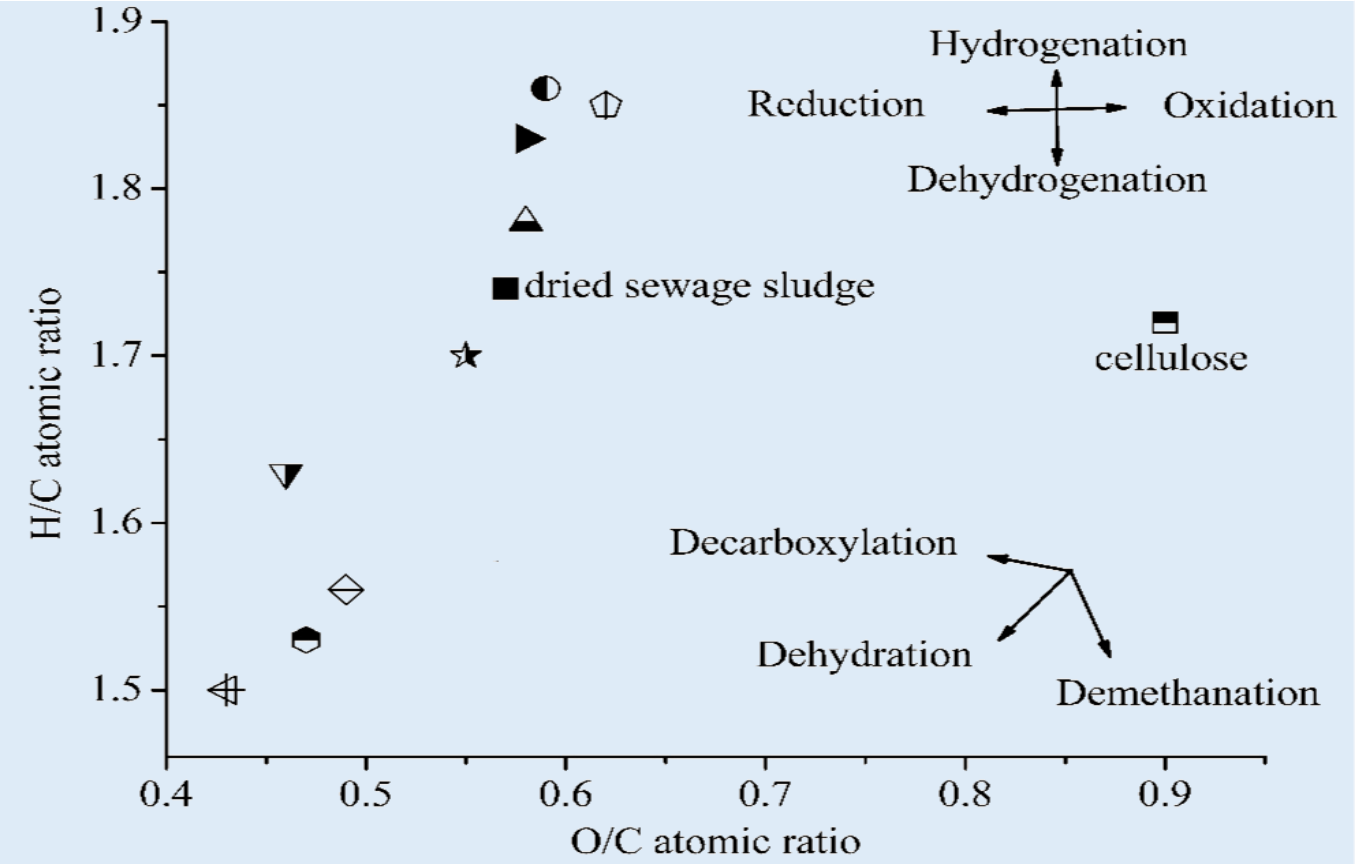
1. Characterization of hydrochars from HTC experiments

Sample	Yield (%)	Fixed Carbon (%)	Ash (%)	Volatile Matter (%)	Elemental composition (%)				
					C	H	S	N	O
DSS	-	12.7	13.7	73.6	41.5	6.0	0.7	6.8	31.3
140 °C - 2.3 h	59.7	12.0	15.5	72.5	39.6	6.1	0.3	5.6	32.9
152 °C - 1 h	57.6	11.5	15.0	73.5	40.6	6.3	0.4	5.9	31.7
152 °C - 3.5 h	62.3	11.1	17.1	71.8	40.1	5.9	0.2	5.2	31.3
180 °C - 0.5 h	48.5	8.1	16.4	75.5	40.4	6.2	0.3	5.6	31.1
180 °C - 2.3 h	49.1	13.6	19.3	67.2	40.7	5.8	0.2	4.6	29.5
180 °C - 4 h	46.2	15.5	18.7	65.8	42.7	5.6	0.2	5.0	27.7
208 °C - 1 h	40.3	14.9	19.7	65.4	43.1	5.8	0.2	4.6	26.5
208 °C - 3.5 h	36.0	15.4	21.3	63.3	43.6	5.5	0.3	4.5	24.9
220 °C - 2.3 h	35.3	15.8	22.8	61.3	41.5	5.3	0.2	4.1	26.1

2. Hydrochars as solid fuel



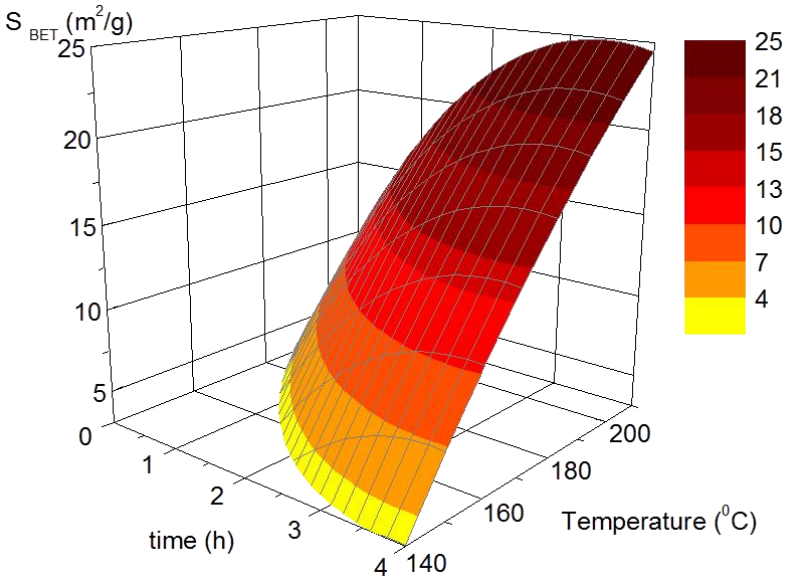
2. Hydrochars as solid fuel. Van Krevelen diagram



dried sewage sludge
cellulose
152 °C - 1 h
152 °C - 3.5 h
208 °C - 1 h
208 °C - 3.5 h
180 °C - 0.5 h
180 °C - 4 h
140 °C - 2.3 h
220 °C - 2.3 h
180 °C - 2.3 h

3. Porous structure

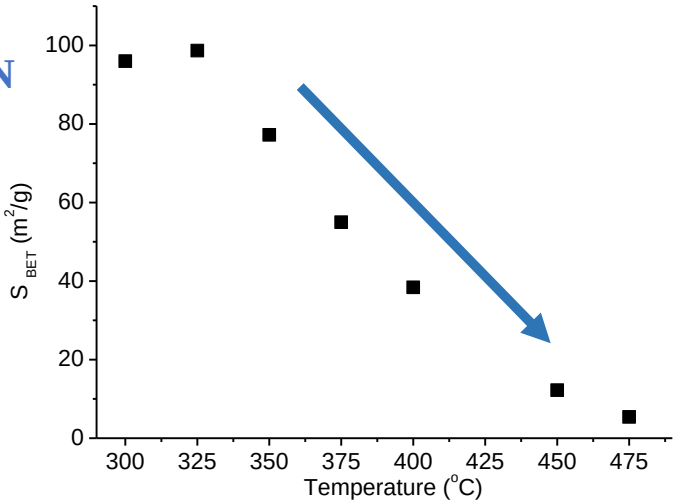
BET area < 24 m^2/g



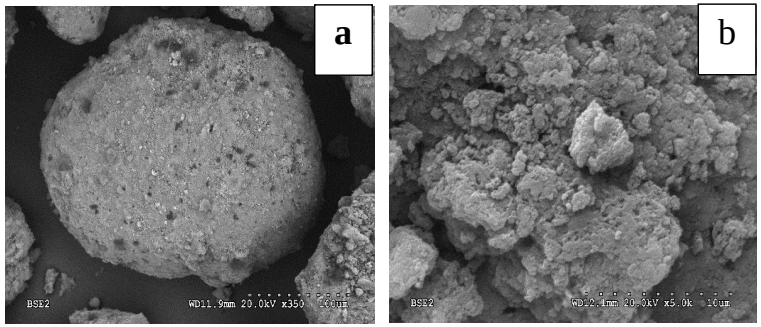
AIR ACTIVATION

Hydrochar 208 °C - 1 h

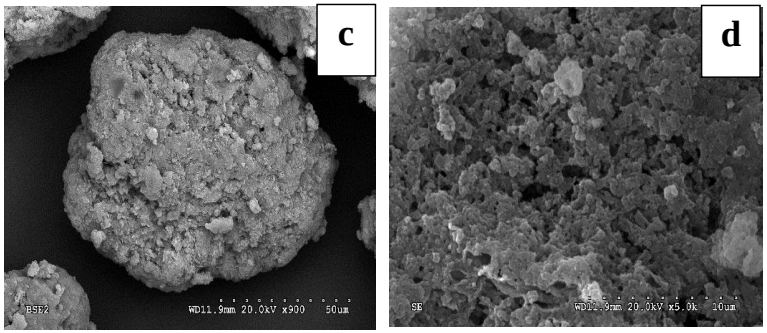
BET area < 100 m^2/g



Hydrochar (208 ºC, 1 h)



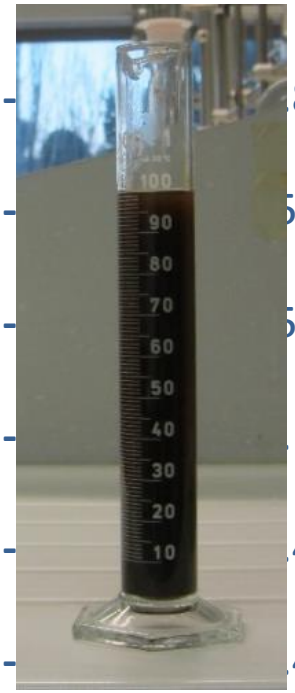
Hydrochar activated al 325ºC



5. Characterization of liquid fraction from HTC runs

Sample	pH	Conductivity (µS/cm)	COD (g O_2/L)	TOC (g C/L)	TN (g N/L)
140 °C		11.4	80.9	35.9	1.8
15	5	10.7	80.5	44.4	1.6
152 °C - 3.5 h	5.2	14.1	95.5	45.5	2.2
180 °C -	8	11.1	87		
180 °C -	5	16.7			
180 °C -	5	18.8			
208 °C -	1	17			
208 °C -	4	21.2			
220 °C -	4	20.1	81.5	40.1	2.6

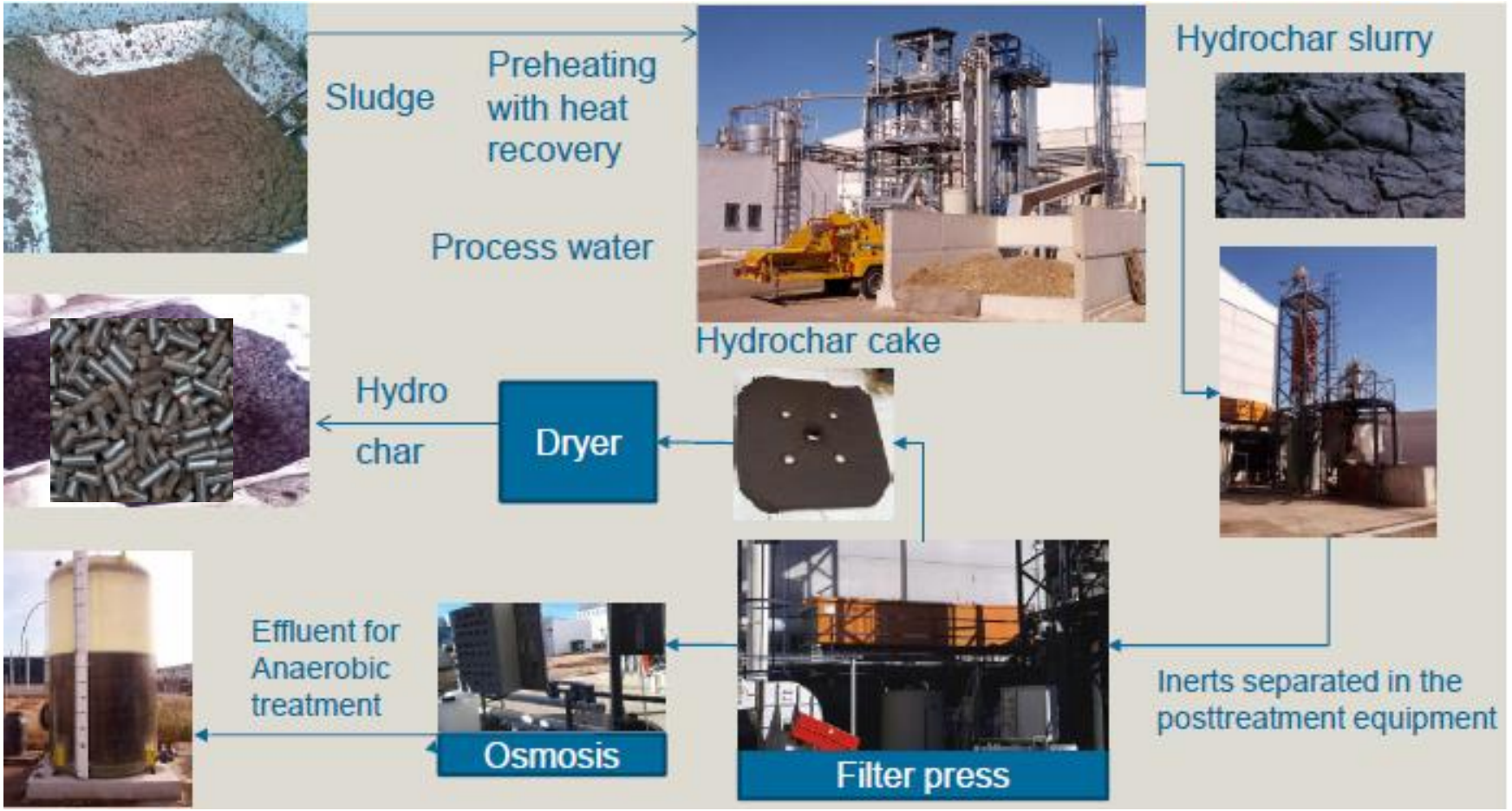
Very high organic matter content !



¡¡¡Anaerobic digestion!!!

HTC plant in Spain

Ingelia, S.L. Náquera (Valencia)



NEWAPP Project (www.newapp-project.eu/es)

HTC plant in Spain

Ingelia, S.L. Náquera (Valencia)

9000 kg sewage sludge, 80% moisture

Thermal energy: 14,8 GJ
1,6 GJ/ton of sludge
(in continous operation, heat consumption will be reduced)

624 kg hydrochar, 30% moisture
HHV: 18 MJ/kg

140 kg separated inert material 25% moisture

31 kg process gas emission

NEWAPP Project (www.newapp-project.eu/es)

ACKNOWLEDGEMENTS

Abengoa: EPS Predation

ABENGOA

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GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA E INNOVACIÓN

THANK YOU