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European Regional Development Fund

Pyrolysis of STP/WWTP sievings (cellulose) to (activated) biochar, bio-oil and acids

#EUGreenWeek
2021 PARTNER EVENT

European Commission

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From toilet paper to.....

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Valuable resources

Sewage

↓

Wet part

(Recovering cellulose)

↓

Thermal part

(Drying and Pyrolysis)

↓

Bio-based Products

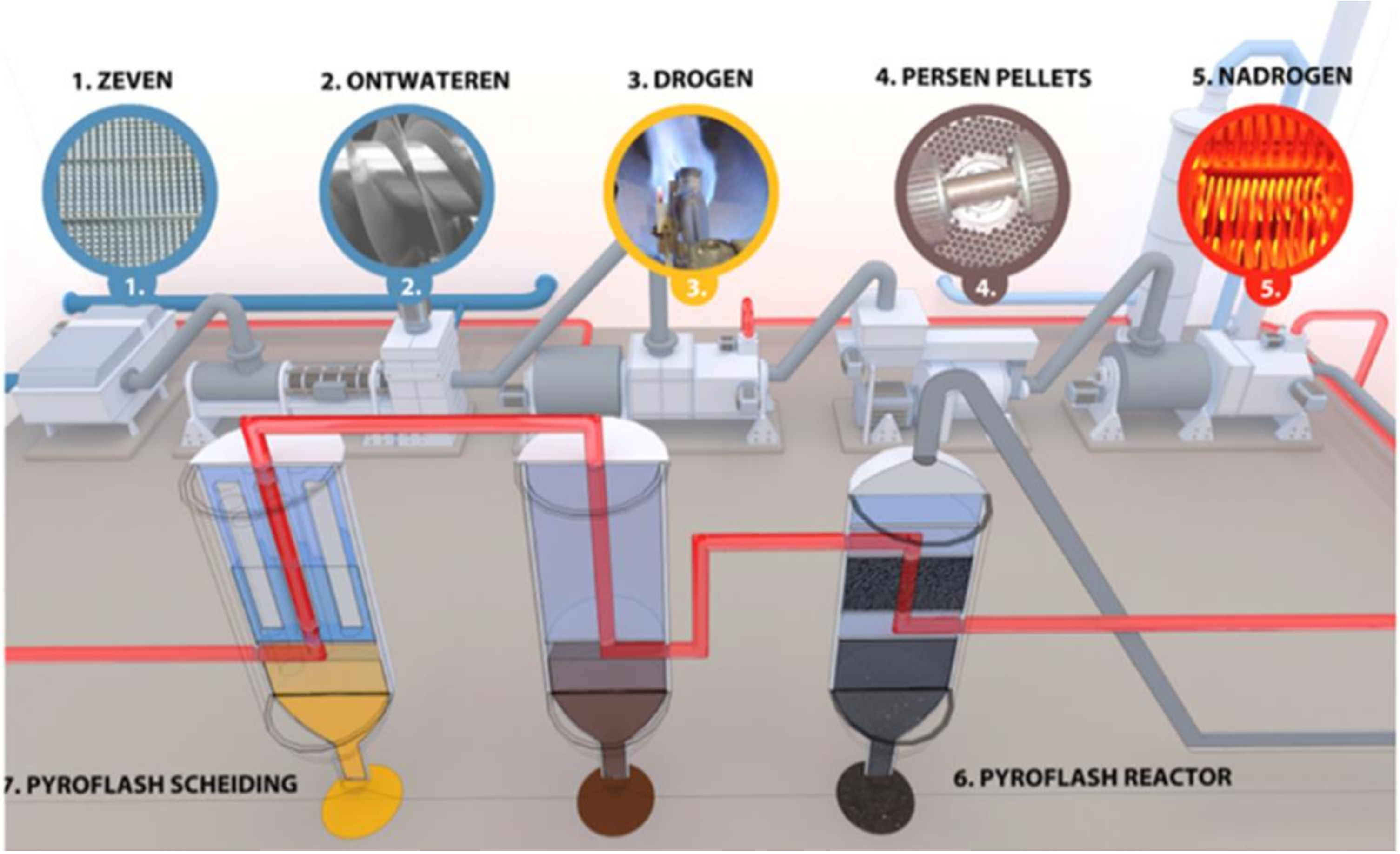
Project partners

CIRTEC

PH

waterschap vallei en veluwe

Process schematic



Cellulose Screens/sieves

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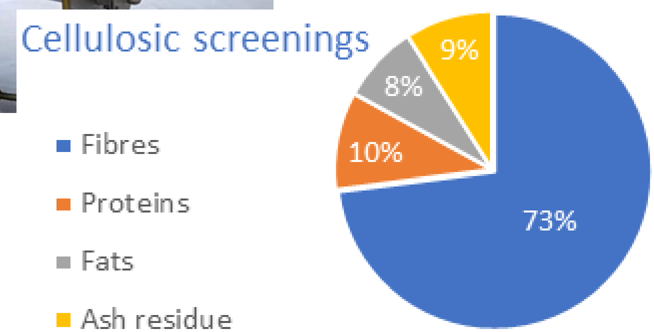
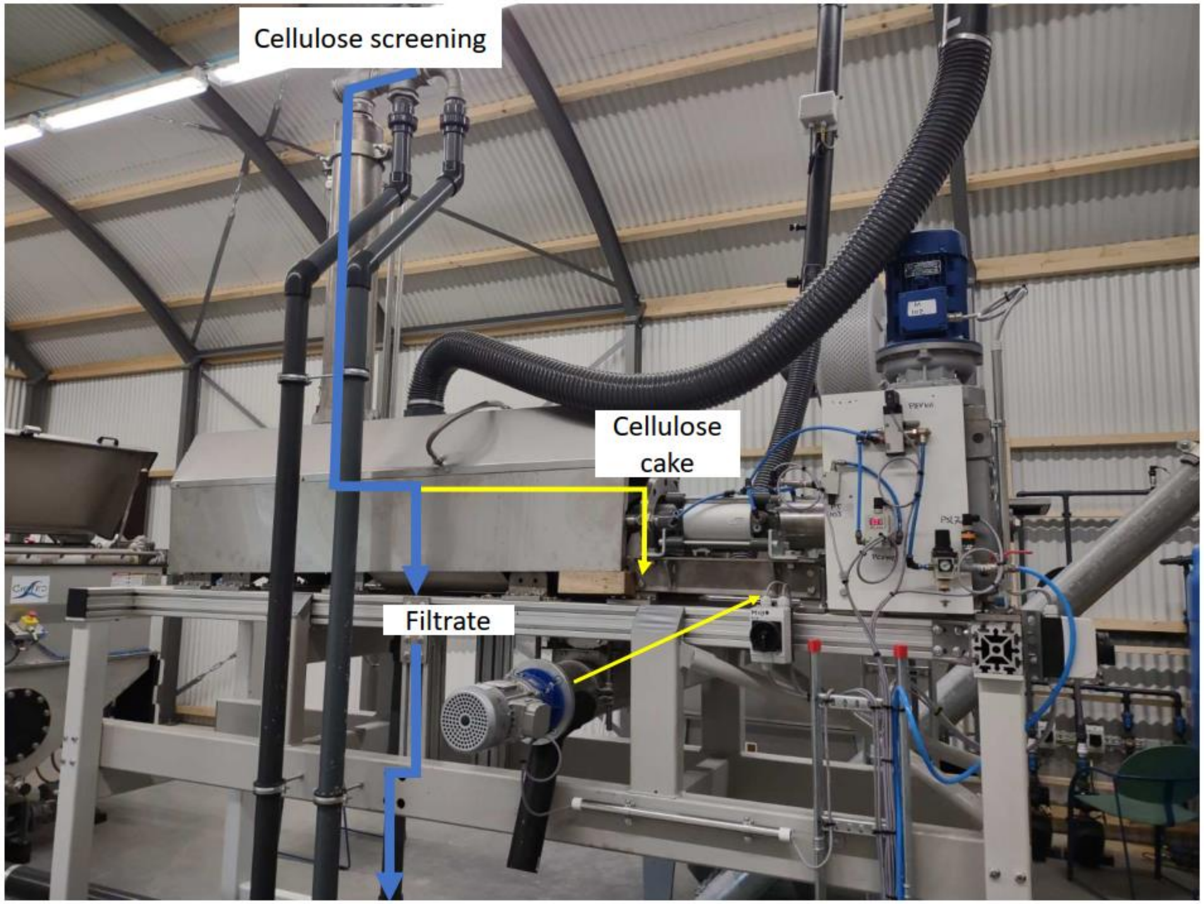
- Screens are placed after coarse screen
- Lower organic load for the WWTP
- 25 % of Ede (300.000 PE)



Dewatering press



Cellulose Screens and dewatering

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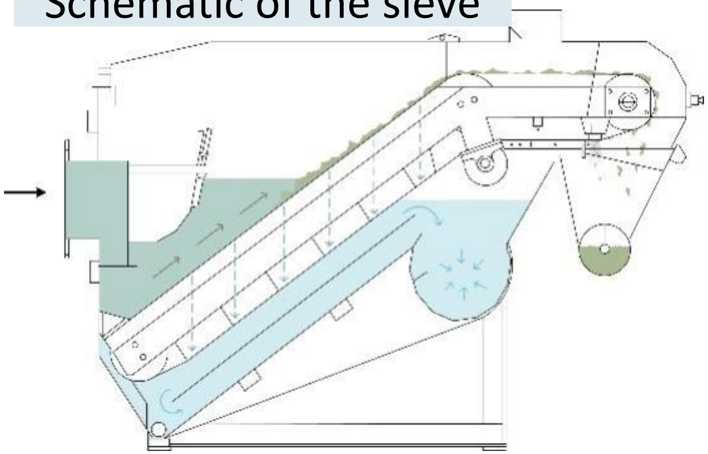
Schematic of the sieve



- Hydraulic capacity: 300 m3/h per sieve
- Mesh size: 90-1000 micron (350 µ mesh used)
- Pre-coat → removal smaller particles
- Mesh cleaning (low pressured air)
- Dewatering by a press (45…50% DS)

Cellulose on the mesh

Cellulose screenings

Dewatered cake in the buffer

Drying section

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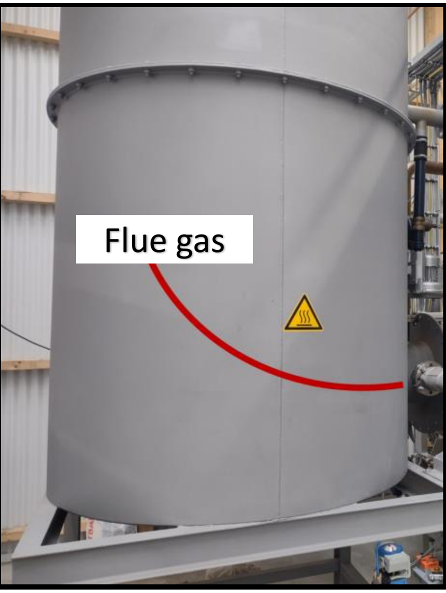
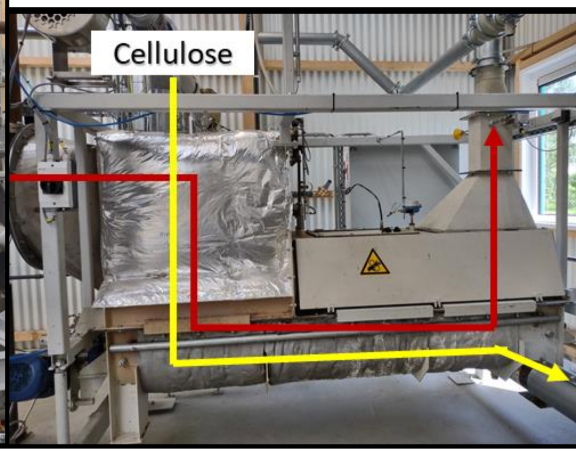
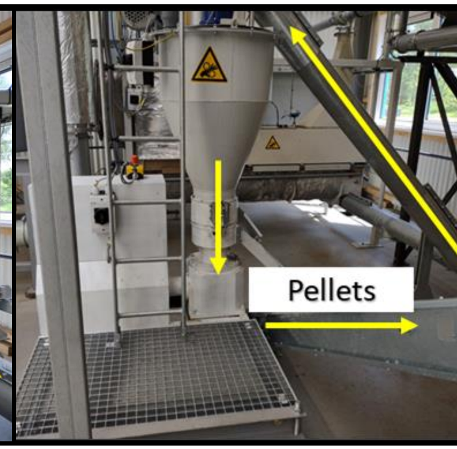
(2) Pyrogas co-combustor



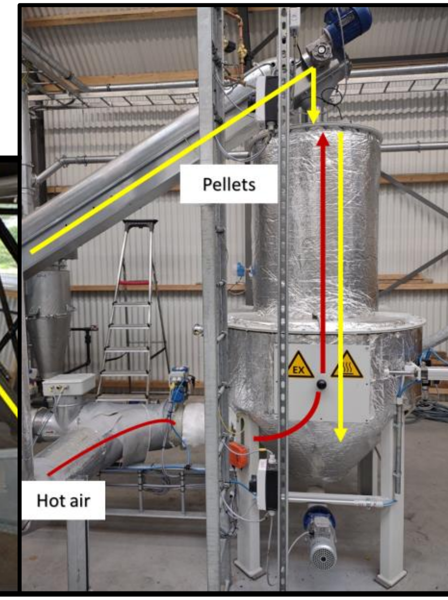
(1) Falling curtain dryer



(3) Pellet press



(4) Deep Dryer




Cake, 45%DS


Fluff, 60...65%DS


Pellets, 90%DS

Pyrolysis

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- Cracking of organic material at a high temperature and low oxygen content
- Temperature gradient 200-900 ^{0}C
- Flash reactor for very rapid pyrolysis

- Advantages:

Degradation toxic components and pathogens; gasses as fuel

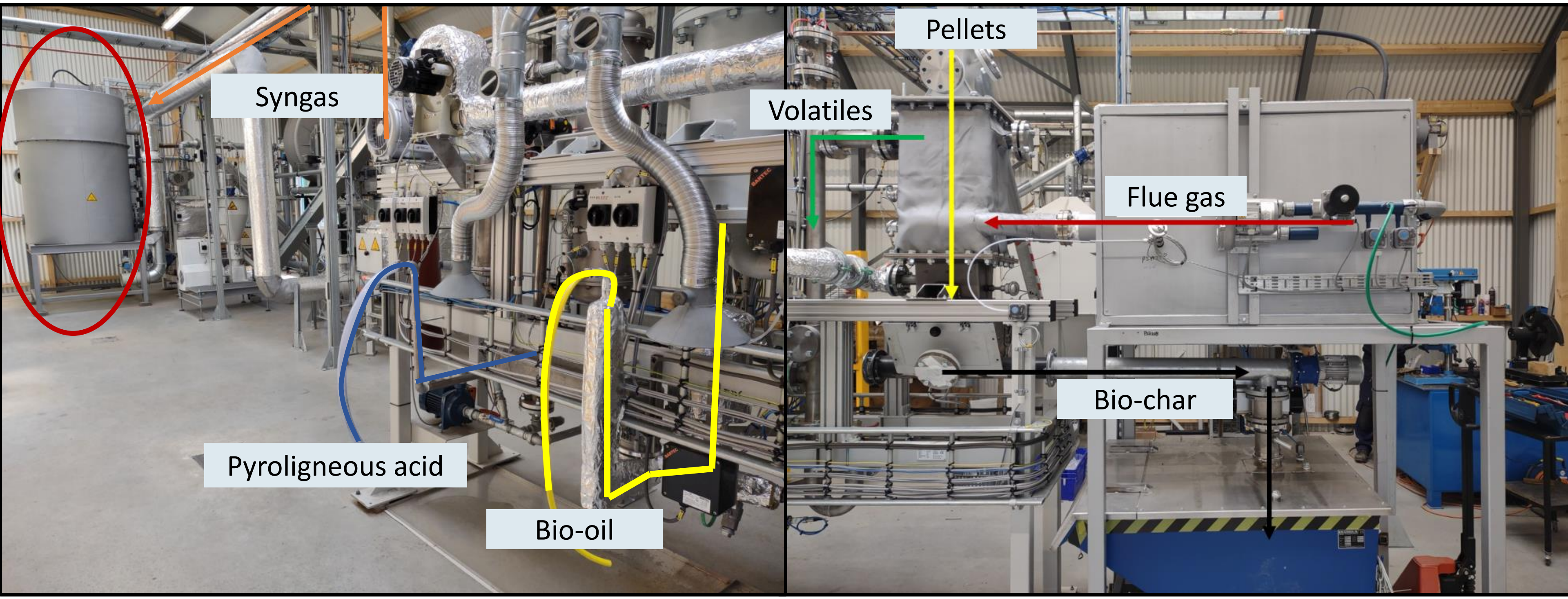
- Disadvantage:

Ash contains heavy metals

(Flash pyrolysis higher bio-oil yield)

Pyrolysis section

(4) Pyrogas co-combustor **(3) Seperation** **(1) Reactor** **(2) Burner**

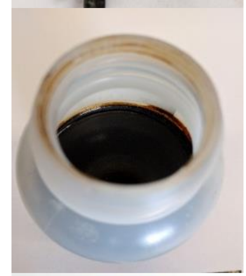


Pyrolysis Products

Cellulose Pellets
Feedstock of the pyrolysis reactor

Pyrolysis

Char
Used as activated carbon,
For adsorption of micro-pollutants in effluent



Bio-oil
Green fuel used
Externally for steam generation

Acid (pH ~5)
Enhances denitrification and biological P-removal in WWTP

Pyrolysis gas
Combusted in the installation,
to supply heat for the dryers

Activated carbon

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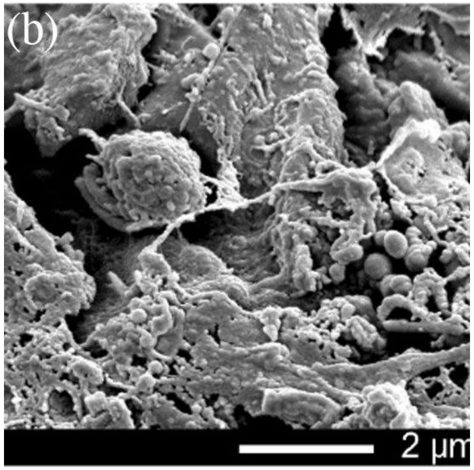
- Microstructure (500...2000 m^2/gram)
- Binding particles/molecules by hydrofilic and aromatic structures
- CO_2 footprint
- Bio-coals: cocoswaste, woodchips, ...etc. And: CELLULOSE
- Activation: thermal, chemical or biological
- High % cellulose en hemicellulose: low yield
- High % lignine: high yield, less functional groups
- Low pyrolyse temperatuur: hydrofilic groups
- High pyrolyse temperatuur: aromatic groups



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Elimination of micro pollutants from effluent

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Factors involving the removal of micro-polutants, using AC

Influent quality

- First flush
- Cellulose content
- Minerals
- Metals

Pyrolysis

- Feedstock quality
- Temperature
- Residence time

Activation

- Bio-char quality
- Activation route
- Residence time
- Temperature

Effluent composition

- AC quality
- Desired removal
- Polutant concentrations

Optimisation of the installation, *reducing energy consumption, and increasing desired products*

How circular and environmental positive is the process?

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- WWTP, reducing sludge deposition, producing biochar, acid, bio-oil
- Replacing fossile activated carbon (removal pharmacueticals)
- Can the energy consumption be reduced?
- Footprint powder/granular activated carbon (PACAS)

Impact on WWTP

Start up soon!

Questions?
or
Suggestions?

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