



Compiègne, 19 February 2016

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## Process Description

# BIOGREEN – CONTINUOUS PROCESS FOR PYROLYSIS & GASIFICATION

## CONTAINERISED MODULE



## Content:

- A. General Process description
- B. How Biogreen works



## A- General process description

Biogreen is a new process patented by ETIA for continuous thermochemical conversion of biomass waste that allows continuous torrefaction and pyrolysis process for all kind of biomass residue.

### Torrefaction

- Mode: Range of Temperature:  $250 < T < 300^{\circ}\text{C}$
- Yield: Char 80 to 90% based on bone dried product
- Use: Production of torrefied biomass for fuel

### Pyrolysis Mode

- Mode: Range of Temperature:  $350 < T < 800^{\circ}\text{C}$
- Yield: Biochar 30 to 40% (30GJ/t) - Liquid 40 to 60% - Syngas 20 to 60% (8 to 12 MJ/m<sup>3</sup>)
- Use: Production of Biochar (fertilizer, solid fuel); Biooil (liquid fuel, green chemicals) ; Syngas heat, electricity, gaseous molecule

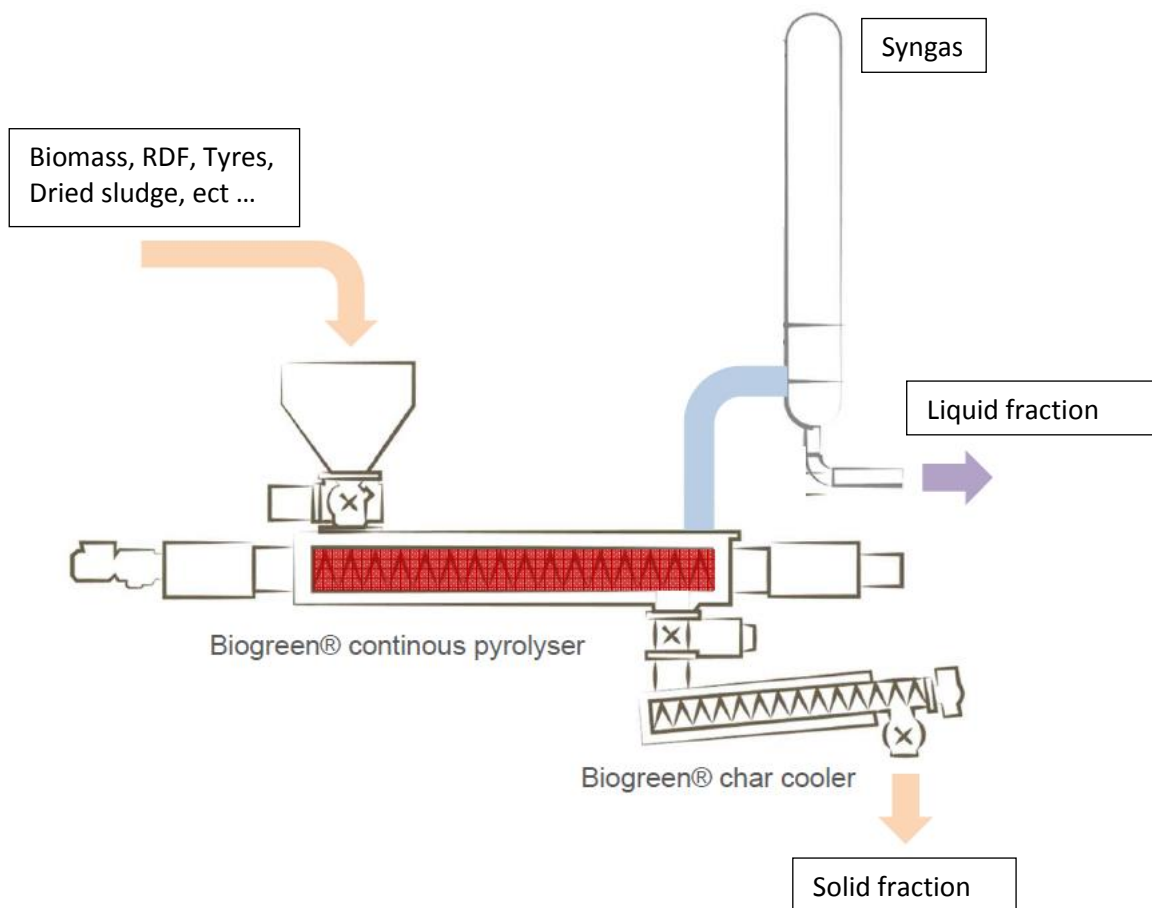
### Gasification Mode

This is for producing maximum gas with pyrolysis principles (no oxygen in reactor)

Depending on feedstock:

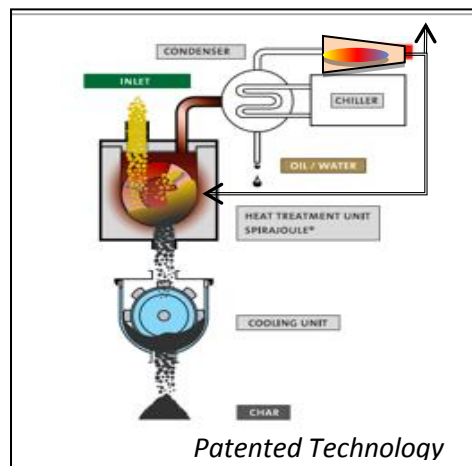
- Mode: Range of Temperature:  $600 < T < 850^{\circ}\text{C}$
- Yield for biomass products:  
average: char 15 to 25% (15-25GJ/t; if from biomass) - Liquid 15-20 % (this is a mix of oil and water; after dewatering the oil can contain 22 GJ/t) - Syngas 50 to 70% (8 to 14 MJ/m<sup>3</sup>)
- Yield for RDF:  
average: Char 15-20% (20 GJ/t) – Liquid 15% (mainly water) – Syngas 65-80% (20-25 MJ/m<sup>3</sup>)
- Use: Production of Char or Syncoal (fertilizer, solid fuel); Oil (liquid fuel, green chemicals) ; Gas heat, electricity, gaseous molecules





## B- How BIOGREEN works ?

1. Dried biomass is introduced in a hopper with regular and controlled flow. Particle size and moisture will affect the yield of biochar, oil and gas. ETIA can also supply continuous belt dryer prior to BIOGREEN process unit in order to prepare the feedstock for the BIOGREEN process.
2. A high temperature rotary valve or dosing screw introduces the dry biomass into the pyrolyzing chamber. This chamber is based on SPIRAJOULE technology, an exclusive and patented electrical heating screw conveyor design by ETIA. This process allows perfect monitoring and control of dwell time and temperature during the process. Temperature can be adjusted precisely up to 800°C depending on specifications required. Dwell time of the solid phase can be adjusted from 5 to 30 mn. Adjustment of operating conditions defines the ratio of biooil, biochar and gas produced with the process.
3. Gas generated by the process exits from the top side of the SPJ pyrolyzing chamber and goes directly to a condenser cooled by circulation of chilled water (not included). Biooil and water are the liquid phase coming out from the condenser. The w/w ratio of biomass converted into biooil depends on biomass composition and operating conditions but generally in the range from 20% to 60%
4. Solid phase coming out from SPJ pyrolyzing chamber is quickly cooled down into a flash cooler based on a double jacketed auger cooling screw mounted with water spraying device. Biochar is then cooled down to a temperature which should not exceed 50°C. The w/w ratio of biomass converted into biochar depends in biomass composition and operating conditions but generally between 15% and 80%.
5. The non-condensable gas (NCG) coming out from condenser have energetic value and may contain some organic molecules. This gas can be used as fuel to be burned in a combustion chamber or can be treat and use in a turbine or gas Engine to produce electricity and heat (CHP)



## Example views of industrial Biogreen Plant



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**Look at Containerised Biogreen Module (BGR CM series) – 40' Container**



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## Biogreen BGR600 pyrolysis reactor in container



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## Char cooler and other auxiliaries:





