



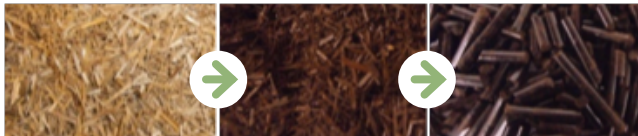
BIOMASS ENERGY

# TORREFACTION

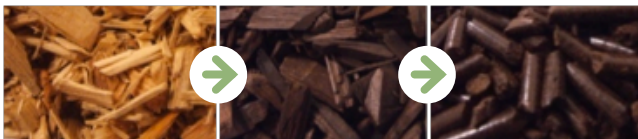
Torrefaction is a thermochemical treatment of the biomass, carried out at temperatures between 200 and 300° C in the absence of O2. This treatment produces beneficial changes on the biomass composition, such as the reduction of fibres content, the increase of calorific value and the improved resistance to degradation.

This treatment can be applied on a wide range of organic materials. It may also generate advantages in their conservation and characteristics for both energy and material uses.

CENER is highly experienced in the development and application of torrefaction treatment on a broad range of materials: biomasses, both herbaceous (cereal straw) and woody (pine, poplar, beech, eucalyptus, pawlonia, olive tree pruning ...); as well as a variety of organic wastes, including low density materials and materials with high content of fines and dust.



Chopped wheat straw



Pine woodchips

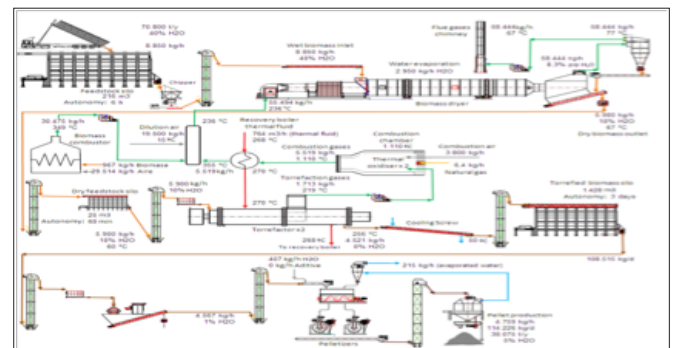
CENER Second Generation Biofuel Centre has a Torrefaction Pilot Plant, with the following characteristics:

- Horizontal reactor with rotating shaft and indirect heating by thermal oil (240-300°C):
- Production capacity from 150 to 350 kg/h.
- Very flexible regarding raw material particle size distribution (0,25-40 mm) and bulk density (50-500 kg/m3), including the possibility of processing agricultural biomasses similar to straw.
- Excellent mixing and agitation capacity, minimizing internal temperature gradients. Easy temperature control, being able to cope with feedstock with exothermal heat of reaction → Extremely homogeneous product.



CENER has developed its own Methodology for the elaboration of Technical and Economic Pre-feasibility Studies of the application of Torrefaction processes for different industrial uses: through the Process Modelling and Simulation based on the compositional and kinetic reactivity Characterization of the material to be torrefied:

- ✓ Kinetic and Thermodynamic Modelling
- ✓ Mass flow and Heat Exchange Modelling
- ✓ Integrated Process Mass and Energy Balance Modelling: process parameters and efficiency
  - > Final Product Characteristics Estimation → LHV, Elemental composition, volatile content.
  - > Production Cost Estimation.



The capacity of the Pilot plant allows to:

- Industrial process Up-scaling.
- Production Cost Optimization and industrial process Technical and Economic Feasibility Analysis Validation.
- Production of product batches for the validation tests of torrefied product use.

CENER Biomass Department also provides the following services in solid Biofuels Characterization:

- Solid biofuels Characterization.
- Development of torrefied materials Pelletization processes.
- Sustainability and Life Cycle Analysis.

