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- 1 *Torrefied hay.*
- 2 *Untreated biomass material (left) – torrefied biomass material (right).*

## SUPERHEATED STEAM DRYING AND TORREFACTION OF BIOMASS RESIDUES

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The 2020 strategy of the EU recognized the need to decouple economic growth from the use of fossil resources in order to fulfil European Environment Policy objectives. Whilst industry, consumers and the EU all want chemicals to be produced from sustainable and secure feedstocks, the existing situation is that bio-chemicals currently constitute a very small fraction of the market. On the other hand, European agricultural residues are cheap and abundant and do not typically face sustainability restrictions.

However, for widespread industrial use of biomass a number of issues have to be overcome, including material quality, stability, storage and energy density. Therefore the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB together with a European consortium developed an innovative technology that tackles all the mentioned issues by offering an efficient way of treating biomass residues and at the same time an alternative for green chemicals production. In addition this technology is not limited to biomass products and can be used for multiple solid residues which need to be treated such as solid manure, solid digestate or mud.



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### SHS drying and torrefaction with recovery of volatiles

The technology consists in drying or torrefying solid residues with superheated steam (SHS) under atmospheric pressure. The material to be dried or torrefied is introduced to the SHS atmosphere where it is supplied convectively with heat and its moisture content evaporates.

The volatile compounds liberated during torrefaction are primarily recovered in the condensate fraction in a concentrated form for onward transport to a biorefinery. This technology permits significant energy savings in comparison to the conventional drying process with hot air. Due to the absence of oxygen there are no oxidative reactions resulting in higher product quality and there is no risk of explosion. The process is free of sound and odor emissions. Furthermore the properties of the obtained solid output are significantly upgraded:

- reduced volumetric density and increased hydrophobicity for optimal transport and storage
- improved grindability, allowing reduction in power consumption due to milling
- increased calorific value
- minimized decomposition of cellulose and lignin, enabling lignocellulosic biomass to be exploited in biorefinery processes

3 *Demonstration plant in Spain for torrefaction of biomass residues.*

4 *Recovery of volatiles in the Spanish demonstration plant.*

### Performance characteristics

- Efficient drying and torrefaction process
- No oxidative reactions (higher product quality) and no risk of explosion
- High quality solid output (high energetic, grindable, chemically stable)
- Efficient transport and storage of biomass residues
- Less power consumption for grinding
- Production of green chemicals

### Fields of application

- Supply of high energy density and microbiologically stable biofuels
- Supply of green chemicals and fertilizers
- Efficient transport and storage of solid residues
- Treatment and valorization of biomass products
- Treatment and valorization of solid manure/digestate
- Disposal of industrial solid wastes

### Range of services

- Market and technology analyses
- Feasibility studies
- Laboratory plants for test trials
- Scientific evaluation, consultancy and studies in the field of SHS torrefaction and green chemicals production
- Numerical modelling and simulation
- Development of system concepts according to the individual needs of customers

- Specification of the system engineering including automation through to the industrial prototype
- Assisting and monitoring clients from first test trials up to commissioning of a plant
- Process analysis and optimization
- Simulation and modelling
- Product-related analysis of the torrefaction process with a wide range of analytic equipment and competences
- Thermal and chemical separation of recovered volatiles

### Equipment

- Laboratory facilities for drying/torrefaction of solid residues
- Pilot plant with fully automated operation
- Chemical laboratories and pilot plants
- Analytics laboratory
- Design and simulation software: SolidWorks, COMSOL Multiphysics, Design-Expert

### Reference project

SteamBio – Adaptable industrial processes allowing the use of renewables as flexible feedstock for chemical and energy applications, EU (grant agreement no 636865), Sustainable Process Industry through Resource and Energy Efficiency (SPIRE)  
Further information:  
[www.igb.fraunhofer.de/en/steambio](http://www.igb.fraunhofer.de/en/steambio)