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# Analysis of biomass

Optimising combustion and reducing drawbacks

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- Analysis of solid biofuels
- Ash composition
- Pollutants quantification
- Expert advice





## The need for analysis

### Anticipating operational problems

#### **BASIC CHARACTERISTICS OF SOLID FUELS:**

also applicable to biomass

Operating a boiler and controlling the combustion process requires knowledge of the fundamental properties of the fuel – for example, calorific value, moisture, and ash content. Whether the fuel is 100% biomass or biomass co-combusted with coal, knowing its basic characteristics is key to successful boiler operation.

#### **MINIMIZING DRAWBACKS**

Producing green energy from solid biofuels requires careful consideration of their drawbacks. For example, slagging, fouling, and unexpected corrosion are all disadvantages that are commonly associated with biomass. In addition, heavy metals and other pollutants in flue gases are subject to strict environmental regulations, so their presence needs to be quantified.

#### **DEDICATED LABORATORY**

for fast and reliable results

A thorough knowledge of the essential properties of biomass requires chemical and physical analyses. ENGIE Laborelec's facilities enable fast, accurate assessments of all relevant chemical and physical parameters.



# Safe and sustainable use of biomass

## Beyond the analysis

### CALORIFIC VALUE

The main goal of boiler operators is to obtain heat from the fuel. As the quantity of extracted heat is directly related to the fuel's calorific value, precisely determining this value is an important step to take before using or purchasing a fuel.

### NO<sub>x</sub> AND SO<sub>x</sub> EMISSIONS

In addition to the principal flue gases, the environmentally harmful NO<sub>x</sub> and SO<sub>x</sub> gases are also present in boiler exhaust. The emission of these pollutants is largely linked to the presence of nitrogen and sulfur in the fuel mix, which is why obtaining a precise quantification of the emissions from the fuel is required for environmental reasons.

### SLAGGING, FOULING, AND CORROSION

Depending on the chemical composition, the melting point of ash varies substantially. This may result in the formation of ash aggregates or deposits in the boiler, which decrease thermal efficiency. In some circumstances, boiler pipes may also get coated with glassy, corrosive layers. By taking into account these risks, preliminary chemical analysis helps assess the compatibility of various biofuels and boilers.

### TRACE ELEMENTS

The quantification of trace elements is essential to certain issues related to biofuels, such as the valorization of fly ash and compliance with environmental standards.

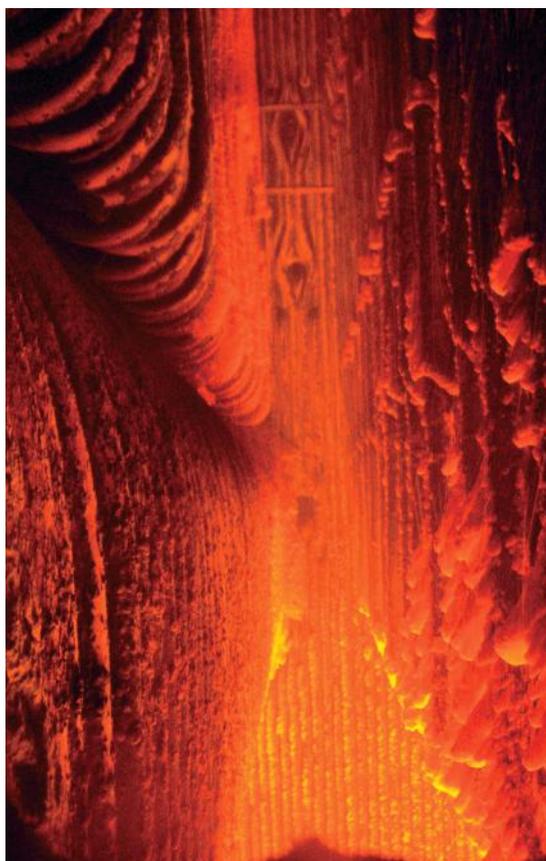
#### FAST RESULTS: AN ESSENTIAL BENEFIT

Decisions about purchasing fuels or fixing operational problems like slagging in a boiler cannot be put off for months or weeks. A good laboratory must therefore be able to deliver results as quickly as possible after receiving a sample.

At ENGIE Laborelec, the different analyses have been integrated into a comprehensive analytical chain in order to minimize the so-called "time to report delivery".



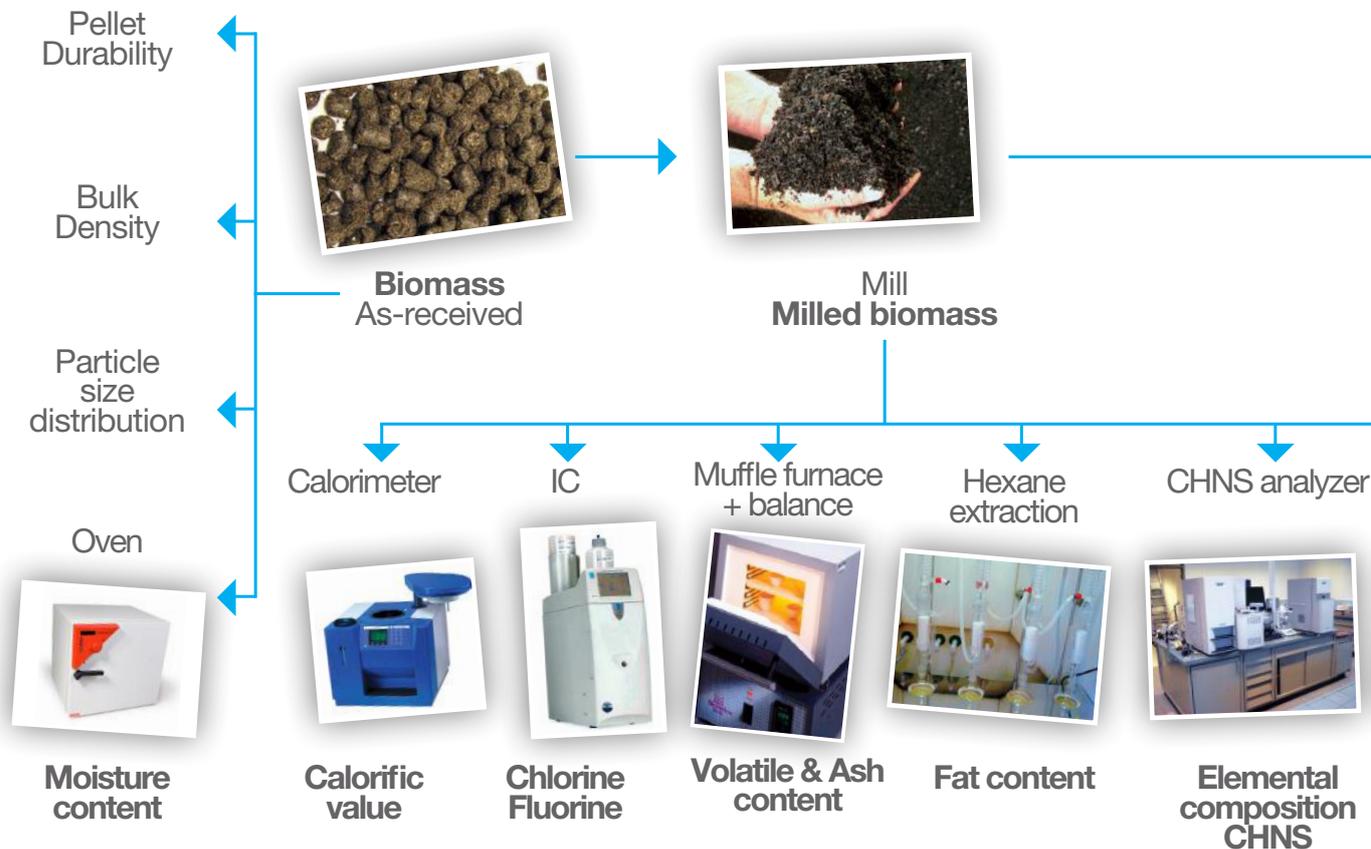
Corrosion of boiler pipes



Severe slagging inside a boiler

# The analytical package at a glance

## From raw biomass to analytical report



- ♥ Moisture content – EN 14774-1 : 2010.
- ♥ Pellet durability – EN 15210-1 : 2009.
- ♥ Bulk density – EN 15103 : 2009.
- ♥ Particle size distribution – EN 15149 : 2010.
- ♥ Calorific value – EN 14918 : 2009.
- ♥ Volatile content – EN 15148 : 2009.
- ♥ Particle size distribution – EN 15149 : 2010.
- ♥ CHN – EN 15104 : 2011.
- ♥ Chlorine & fluorine content – EN 15289 : 2011.
- ♥ Sulphur content - EN 15289 : 2011.
- ♥ Minor & trace elements - EN 15297 : 2011.
- ♥ Ash content - EN 14775 : 2009.
- ♥ Major elements - EN 15290 : 2011.
- ♥ Ash melting behaviour - CEN/TS 15370-1 : 2006.

# Research and standardization of analytical methods



# Solid biofuel analysis



Muffle furnace  
Ash

Direct Mercury  
Analyzer

X-Ray Fluorescence  
ICP-OES

Ash fusibility

X-ray diffraction

TGA-DSC



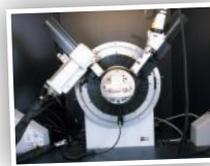
Mercury



Major & Minor  
elements



Characteristic  
melting  
temperatures



Ash Mineralogic  
composition



Thermal  
behaviour

## FROM RESEARCH TO RELIABLE RESULTS

Compared to fossil fuels, the characterization of biomass as a solid fuel is in a relatively early stage and is evolving rapidly. ENGIE Laborelec is continuously investing in the optimization of existing methods and developing new tests that provide better solutions to operational problems related to biomass combustion.

## EXTENDED THERMAL ANALYSIS

Evaluating the slagging risk entails accurately determining the ash's melting temperatures. In addition to the standardized method for determining the characteristic melting temperatures, ENGIE Laborelec also employs a more advanced method in order to provide expert insight into the thermal behaviour of the ash.

## STANDARDIZATION OF SOLID BIOFUEL TESTING

ENGIE Laborelec actively supports the ongoing development of new test standards by participating as an expert in the standardization work of CEN TC 335 and ISO TC 238 "solid biofuels".



# Competence centre biomass

## Expert advice is more than just an analytical report

A chemical analysis is particularly useful when it is used as a tool to respond to industrial needs. Besides analysis, ENGIE Laborelec offers a broad range of biomass-related services. The quality of these services is guaranteed by ENGIE Laborelec's unique combination of expertise in chemical analysis, combustion optimization, and material corrosion processes.



### FUEL SPECIFICATIONS

Cost, local environmental constraints, the type of mill available, and boiler design all have to be considered when selecting the best type of biomass for a particular case. ENGIE Laborelec Biomass Competence Centre assists operators in making these choices.

### MILLING TESTS

When a new type of biofuel is intended to be used in an existing power station, milling tests are used to verify that the existing mills will be compatible with the new fuel. ENGIE Laborelec carries out these tests on different types of biomass, with hammer mills or roller mills.

### OTHER SERVICES

The Competence Centre helps power plants deal with a variety of other industrial issues related to biofuel use, such as material corrosion problems and the global design of injection lines.

### MODELS & SIMULATIONS CHEAP & QUICK WAYS TO GET FIRST ESTIMATES

Computational Fluid Dynamics (CFD) is a powerful tool for optimizing the way boilers operate. ENGIE Laborelec uses CFD to obtain estimates of:

- ♥ the NO<sub>x</sub> production level,
- ♥ the temperature profiles inside the boiler,
- ♥ the unburnt fuel fraction.

In this way, CFD helps identify the locations in the boiler where slagging and corrosion are most likely to occur. Another advantage of CFD is its capacity to optimize the different air flows and to determine the best locations to inject the biomass fraction of the fuel mix.

ENGIE Laborelec experts also make use of other types of simulations to estimate the slagging and fouling risks and the ash valorization potential.



**Would you like  
to know more?**

**ENGIE Laborelec**

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The Technical Competence Centre  
In energy processes and energy use  
From innovation to operational assistance





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## Five reasons for you to choose ENGIE Laborelec

- Wide range of technical competencies in Electricity Generation, Grids, and End-Use
  - Increased profitability and sustainability of your energy processes and assets
  - Unique combination of contract research and operational assistance
  - Independent advice based on certified laboratory and field analyses all over the world
  - More than 50 years of experience
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