The Thermogravimetric Analyzer (TGA)

Introduction

The Wood Science and Testing Laboratory is equipped with a LECO TGA-701 Thermogravimetric Analyzer. The LECO TGA-701 is a unit that combines the heating and burning capacity of a muffle furnace with a 20-position automated carousel and highly accurate, four-point internal balance. The TGA-701 has the ability to burn samples in either an oxygen or nitrogen atmosphere for a diversity of applications.

The combined specifications of the TGA-701 eliminates many of the common issues that arise when performing standard muffle furnace work:

1. **Weighing**

   Transporting crucibles to and from a desiccator to cool and then to a balance to be weighed is often a source of error. The TGA-701 eliminates this source of error by automatically weighing the samples in real-time inside the furnace. As the program ramps up the furnace temperature, the carousel turns and continuously monitors the weight changes of your sample (to the nearest 0.0001g).

2. **Crucible Moisture**

   In order to get accurate measurements, it is imperative to account for, and/or remove, crucible moisture. The TGA-701 is equipped with a reference crucible that is weighed throughout the duration of each analysis to detect changes in weight due to moisture loss and adjust the calculations accordingly.

3. Atmosphere

Methods such as percent volatile matter, require or are greatly improved when a sample can be heated in a non-oxygenated atmosphere, to prevent combustion from taking place. At the same time, some methods require high oxygen levels to promote combustion and ensure a sample is burned completely. The TGA—701 is able to operate using multiple gas sources, the most common being pure oxygen, nitrogen, as well as ambient atmosphere.

4. Multiple samples

Many muffle furnaces and TGA's are small in size and can handle only a few samples at one time. The TGA-701 is able to accommodate up to 19 samples at one time, increasing productivity and reducing cost per sample.

Operation

The operation of the TGA-701 is user-friendly, handling and technician input is minimal.
There are only three steps involved:
1. Method Selection
   The operator selects a predefined method, enters the sample ID's into the software, and starts the analysis.
2. Load Empty Crucibles
   The instrument automatically opens and prompts the user to load the empty crucibles into the carousel, the instrument closes and the empty crucibles are automatically weighed.
3. Load Samples
   The instrument opens again and prompts you to individually load each sample into the appropriate crucible and begins the programmed analysis.

The program runs method without any other user input. When the analysis is complete the gases automatically shut off, the results are calculated and stored in the application window, and ready for export.

Common Applications

The LECO TGA-701 is commonly used to measure parameters such as moisture content, percent volatile matter, ash, fixed carbon, and organic matter estimation by loss-on-ignition (LOI), and on a wide variety of sample types such as soil, coal, wood, food products etc. New methods can also be created and individually tailored for specific applications; users are able to define the ramp rate, temperature, duration, gas type, flow rate etc.
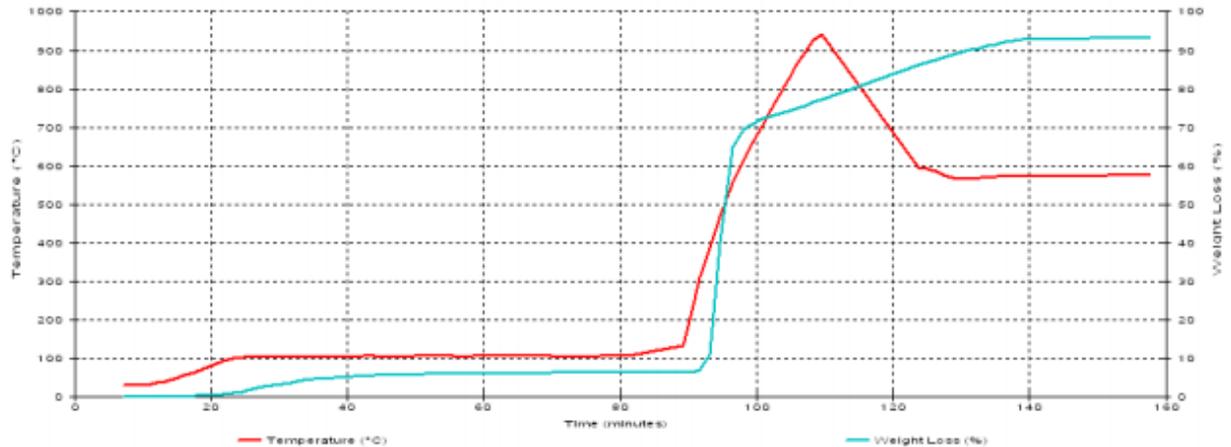

Figure 1. Graphical printout of a wood biomass sample being analyzed for moisture content (105°C to constant weight), volatile matter (900°C for 7 min under N2 gas), and ash (575°C) to constant weight.

LECO TGA Specifications
Balance precision: 0.0001 gram
Instrument precision: ±0.03% (1 sigma, inert sample)
Furnace temperature: 100°C to 1000°C
Furnace stability: ±4°C
Ramp rates (25-104C): 5°-15°C/min
Ramp rates (105-950C): 5°-40°C/min