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## **Gasification Study of a Biomass Material by High-Pressure TGA (TGA-HP)**

### **ABSTRACT**

This paper describes the use of high-pressure TGA (TGA-HP) to investigate gasification of a biomass material.

### **INTRODUCTION**

Gasification is a term most commonly used to refer to the process of conversion of solid or liquid carbonaceous materials into a gas, typically under conditions of high pressure and temperature, and possibly in the presence of another gas or steam.<sup>1</sup> For example, coal gasification is the conversion of coal into hydrogen and carbon monoxide (a product called synthesis gas or syngas) with the application of high temperature, pressure and steam. There is wide interest in gasification because it produces lower quantities of air pollutants and the syngas burns cleaner than the original material.<sup>2</sup>

Additional interest lies in the fact that the process can also produce clean gases from materials that would not usually be considered useful. For example, biomass is a general term used for plant material, vegetation and animal waste. Gasification of biomass by carbon dioxide under pressure produces carbon monoxide. Examples of biomass include leaves, trees, branches, grass and animal waste. By converting what are normally considered waste products, the gasification process can have a direct environmental impact on waste disposal.<sup>2</sup>

### **RESULTS & DISCUSSION**

High-Pressure TGA is an excellent tool to investigate the gasification of materials such as coal and biomass. The TA Instruments TGA-HP Series products are specialty gravimetric analyzers designed to provide unique capabilities for High-Pressure, Ultra-High Vacuum, and High-Temperature under static or dynamic reactive atmospheres. These instruments are designed for sorption studies using water vapor, organic vapors, hydrogen, methane and carbon dioxide as well as permanent gases and corrosive gases.

Using the continuous flow method, the TGA-HP Analyzers provide isotherms, isobars and time course data for the study of:

- General gas/solid reactions
- Oxidation/reduction of metals
- Degradation of ceramics
- Catalysts, zeolites, activated carbons and other specialty materials
- CO<sub>2</sub> Sequestration techniques

The TGA-HP 150s model is specially configured for gasification and related studies. It includes a steam generator and a double-walled reaction chamber, which allows for higher temperatures. Figure 1 illustrates the two-step gasification by carbon dioxide of a biomass material at 800°C and at 10 bar (145 psi) applied pressure. In the first step the material is pyrolyzed in nitrogen gas to produce a stable carbonaceous mass. The atmosphere is then converted to carbon dioxide and the gasification of the carbonaceous residue begins, as evidenced by the steady weight loss.

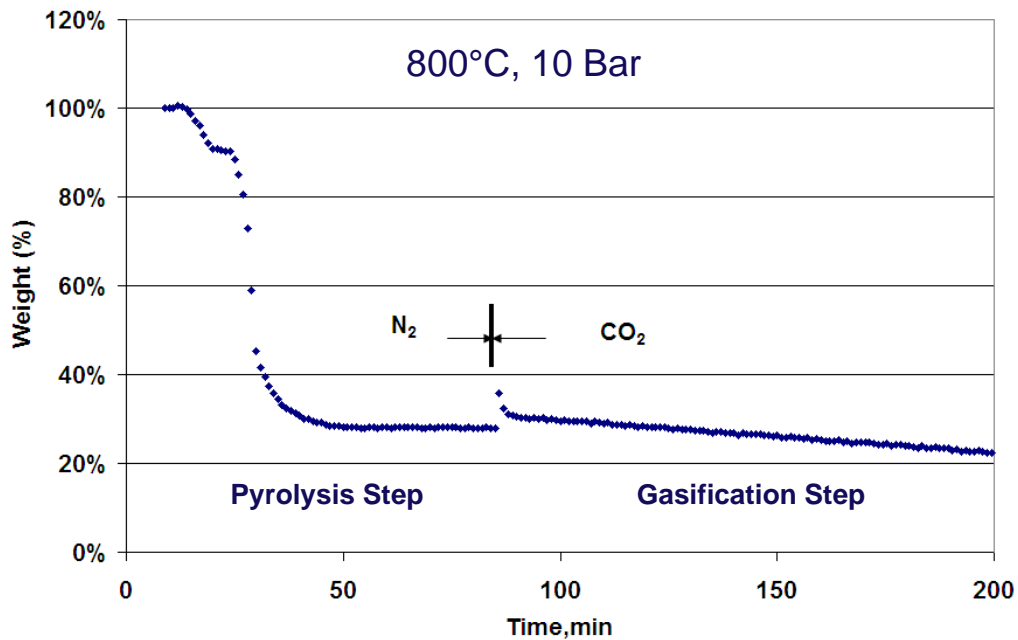


Figure 1: TGA-HP Gasification of a Biomass Material.

Figure 2 on the next page contains an expanded scale of the gasification step. The data can be modeled with a straight line fit to calculate the rate of gasification. The resulting curve-fit quantifies the rate of carbon monoxide production under the applied conditions, *ca.* 81 micrograms/minute.

## SUMMARY

The TGA-HP150s provides an ideal platform for the study and quantification of biomass gasification. The system includes the necessary components (such as an integrated steam generator) and readily achieves the appropriate experimental conditions for gasification research.

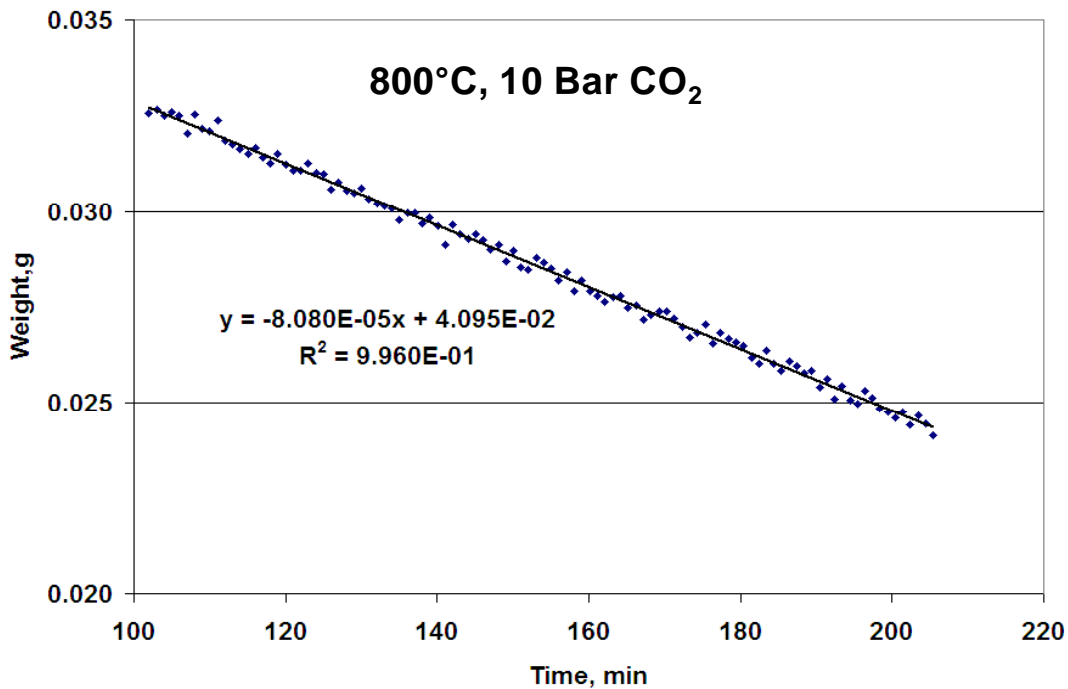


Figure 2: Modeled TGA Data from Gasification Step Indicating the Rate of Carbon Monoxide Production.

## REFERENCES

1. <http://www.popularmechanics.com/science/earth/4218251.html>
2. [http://www.gasification.org/what\\_is\\_gasification/environmental\\_benefits.aspx](http://www.gasification.org/what_is_gasification/environmental_benefits.aspx)

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