Maximizing Power from Biomass

Introduction

With the world's population projected to eclipse 7 billion in 2011, and growing at approximately 1.2% per year, finding useable energy resources has become a global challenge.   Diminishing supply and environmental concerns have been brought to light in recent years, exposing fossil fuels, currently the world's primary source of energy, as unsustainable and potentially harmful to the environment. Because of this, clean renewable energy sources are controlling more of the available market, and biomass is one of the leading options on this front.

Biomass is renewable energy derived from living organic material, or material that was recently alive. Wood pellets, corn husks, refuse, black liquor (a waste product of the paper making industry), and alcohol fuels are common examples of materials that classified as biomass. These sources are more sustainable than fossil fuels and, like fossil fuels, are typically incinerated for energy production. Understanding and controlling the moisture and ash content of biomass is important for optimizing its efficiency as a fuel.   Further, incomplete combustion generates black carbon, which is a pollutant and major contributor to global warming. Traditionally biomass materials have been analyzed for moisture using a conventional oven, and ash using a furnace. These methods are reliable, but often have long test times, which hinder the manufacturer's ability to address problems that may arise during processing and decrease the materials ability to act as a suitable energy alternative.

A new method for moisture and ash analysis has been developed that enables accurate moisture and ash testing. An instrument using this method was able to provide real time results, and final water and ash concentrations correlated to standard test methods currently used for multiple materials in different industries. Test times were significantly reduced which affords manufacturers the opportunity to make changes in process quickly and maximize output.

Data and Testing

Reference Testing

Reference testing details can be found at http://bit.ly/h5mKQ4.

Moisture and Ash Testing

Moisture and ash testing was conducted on an instrument using the linked testing option. This allowed for a moisture test to be conducted, then an ash test to be conducted without any user input or interface. Testing conditions were established prior to testing and in-situ monitoring was conducted. Waffle pans were preconditioned prior to testing to remove any film that was used to prevent adherence during stacking. The sample was evenly distributed on the sample pan for each test. Moisture and ash testing conditions are as follows:

Testing Conditions	Moisture Test	Ash Test
Idle Temperature	50°C	125°C
Test Temperature	125°C	600°C
Ending Criteria	0.5000%/minute	0.0500%/minute
Sample Size	7g +/- 1g	7g +/- 1g
Pan Tare	Standard	Standard
Sample Tare	5 seconds	5 seconds

Table 1. Testing parameters

The testing conditions in table 1 represent the conditions for this specific analysis. For different materials these conditions would change to optimize results. Also, since the ash testing begins immediately following the moisture testing the idle temperature and tare parameters may not be used. For example, if the idle temperature for the ash testing were set at 110°C the instrument would not cool down prior to testing. Instead it would begin measuring immediately at 125°C, which is the test temperature for the moisture analysis. The sample mass used is dependent on the user's testing criteria. Either the initial sample mass taken prior to the moisture test is used, or the sample mass at the end of the moisture test is used if the moisture content isn't desired in determining the ash. The pan tare is not required since the pan mass is removed at the beginning of the moisture test and does not change.

Sample Storage and Preparation

Sample storage and preparation details can be found at http://bit.ly/himSUA.

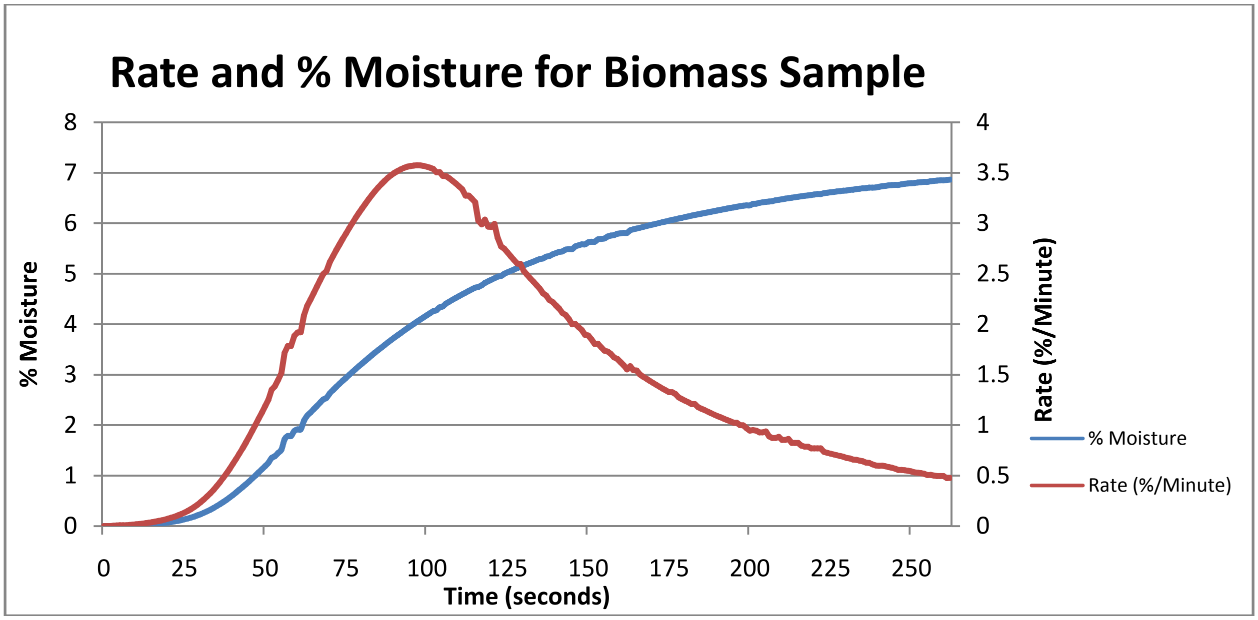
Material	MAX® 5000XL		Reference
Wood Pellet	3 minutes	Test Time	16 hours
	5.9757	% Moisture	5.4472
	0.2283	S.D.	0.0331
Pecan Shell	5 minutes	Test Time	16 hours
	12.5823	% Moisture	12.6090
	0.2893	S.D.	-
Wood Chip	4 minutes	Test Time	16 hours
	5.4632	% Moisture	5.435
	0.2243	S.D.	-
Wood Pellet with Pecan Bagger	4 minutes	Test Time	16 hours
	6.1425	% Moisture	6.247
	0.0922	S.D.	-

Table 2. Moisture results for biomass materials

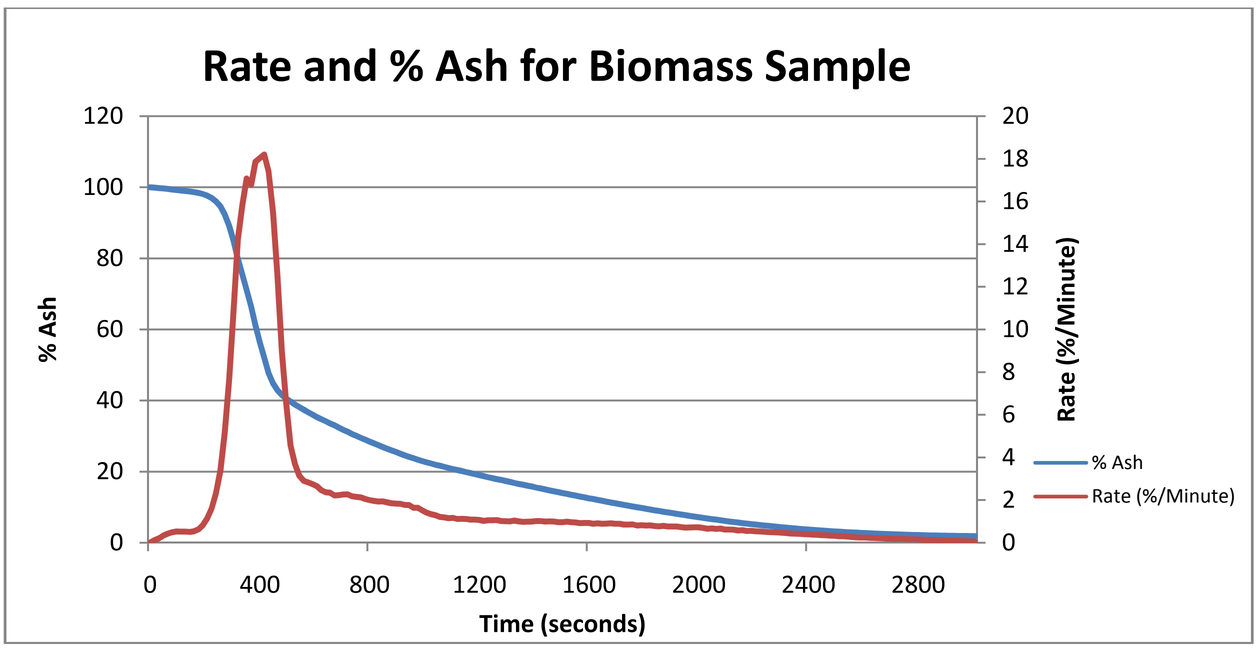
Material	MAX® 5000XL		Reference
Wood Pellet	25 minutes	Test Time	1 hour
	1.3293	% Ash	1.397
	0.1021	S.D.	0.1305
Pecan Shell	35 minutes	Test Time	2 hours
	2.1294	% Ash	2.2734
	0.2437	S.D.	0.0944
Wood Chip	40 minutes	Test Time	2 hours
	0.5575	% Ash	0.5373
	0.0463	S.D.	0.0582
Wood Pellet with Pecan Bagger	30 minutes	Test Time	2 hours
	3.7175	% Ash	4.5263
	0.3465	S.D.	1.283

Table 3. Ash results for biomass materials

Table 1 shows the mean results for moisture testing of four different biomass materials. The data shows strong correlation between the oven reference and the MAX® 5000XL and repeatability using the MAX® 5000XL. There is a large variation in test times between the two methods. Table 2 displays the ash results for the same materials. Strong correlation and repeatability was also produced between these testing methods, but there was a large disparity in test times. Also, it should be noted that the test times reported in table 2 under the heading "reference" is only the time that the material is at the prescribed test temperature. This does not account for the time it takes for the furnace to reach the test temperature or the time it takes for the crucibles to cool to room temperature. The test times shown under the heading "MAX® 5000XL" are averaged test times for each material taken from when the test starts to when it ends.



Graph 1. Test graph for moisture analysis of wood pellets



Graph 2. Test graph for ash analysis of wood pellets.

The test graphs (both 1 and 2) show real time test progress for moisture and ash analysis using the Computrac® MAX® 5000XL. Adjustments can be made to the test criteria based on the characteristics of the graph. For instance, the test graph for ash shows very little change in the ash content of the material after 2400 seconds. From this the ending criteria can be changed to optimize the test times if it is desired.

Conclusion

Remaining competitive in a market is a challenge for businesses and must be addressed as the market changes. As fossil fuel supplies are depleted and in the wake of recent environment tragedies, the world's energy suppliers will continue to search for safe, renewable and inexpensive sources in order to meet demand. This has provided an opportunity for nontraditional resources, such as biomass materials, to grab the increasingly available market shares.

Rapid loss on drying and ash content analyzers are essential instruments for companies producing biomass materials. Their implementation significantly reduces testing times associated with traditional testing methods, which allows companies to bring their products to market faster and increase their production. Additionally, these instruments save money by reducing energy costs, increasing employee output, and removing testing variables. These updated testing features will aide biomass material manufactures in maximizing their control of the available market.