



Grass Combustion – Woodpecker Pellet Boiler

Purpose: The purpose of this publication is to describe grass pellet combustion in the Irish Woodpecker Model 25 wood pellet boiler.

Appliance Description

The Woodpecker boiler has a horizontal burner tube that is cleaned out with compressed air (Fig. 2). The fuel hopper has a capacity of 240 lbs and a flexible wire screw feeds the pellets into the burn chamber. The lower portion of the pellet feeding tube has a safety thermostat and burn back protection plate that seals off the feed tube if the safety thermostat is tripped. The boiler is rated at 106,000 BTU/h.



Fig. 1. Irish Woodpecker pellet boiler.

Control Panel

The LCD display controls auto-ignition and a wide range of programmable settings for fans and feed and ash augers. The display shows the current pellet program, boiler temperature, exhaust temperature, and other messages. There are five adjustable combustion fan and pellet feed levels. The periodic cleaning interval for the burn chamber is adjustable, primarily influenced by ash content of the fuel.

Pellet Feed Rates

The control panel has a program to automatically feed pellets (diverted into a bucket) for a known time interval, in order to calculate feeding rates. Mixed grass pellets fed

at a rate up to 50% higher than wood pellets (Fig. 3). This was caused by some sort of interaction between the type of pellet and the wire screw that pulls pellets up the 45° angle pipe from the storage bin. At feed rate #5, mixed grass pellets were being fed much higher than maximum capacity for the boiler, resulting in very poor combustion. The feed rate settings were individually readjusted for the mixed grass pellets, to feed at similar rates to the other pellet lots.

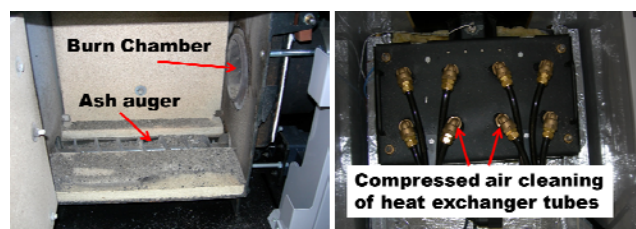


Fig. 2. Burn chamber and vertical heat exchangers are cleaned with compressed air.

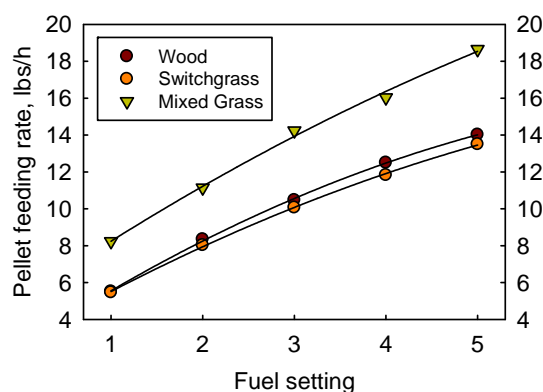


Fig. 3. Pellet feed rates for wood, switchgrass, and mixed high ash pellets at 5 fuel settings.

Combustion Measurements

A Testo 350XL emissions measurement system determined CO, CO₂, O₂, H₂, NO, NO₂, and SO₂ concentrations in the flue exhaust. Spring-harvested switchgrass pellets (Ontario, CAN) and high ash mixed grass pellets were used. Switchgrass pellets averaged 4.6% ash and 7621 BTU/lb. High ash grass pellets averaged 5.5% ash and 7891 BTU/lb. Premium wood pellets averaged 1.0% ash and 8088 BTU/lb. The BTU values are on an “as is” basis.

Smoke Spot Tests

Smoke spot tests for the Woodpecker boiler gave low readings. Smoke spot tests averaged 1.3 and 0.5 for wood feed rates 1 and 5. Smoke spot tests averaged 1.5, 0.9 and 0.6 for switchgrass feed rates 1, 3, and 5. No smoke spot readings were taken for mixed grass pellets.

Emissions Results

Emissions were recorded every second, with CO emissions decreasing with increasing pellet feed rate. NO_x emissions were considerably lower with wood compared to grass pellets, as would be expected. Both NO_x and CO₂ tended to increase with increased pellet feeding rate. Emissions testing runs typically had one or more sharp spikes in CO emissions, regardless of pellet type or feeding rate (Fig. 4).

Table 1. Average emissions readings for wood, switchgrass, and high ash mixed grass pellets at several pellet feed rates.

Fuel	Fuel Setting	CO	NO _x	CO ₂
		ppm	ppm	%
Wood	1	154	91	10.72
	3	124	139	14.77
	5	34	169	14.40
Switchgrass	1	105	274	8.68
	3	29	396	11.54
	5	23	473	12.01
Grass, high	1	652	251	8.57
	5	178	438	14.89

Concerns with Grass Pellets

There is a photocell in the combustion tube that measures the light (flame) in the chamber. The photocell is located about halfway up the height of the combustion tube, high ash fuels block the photocell after a relatively short period of time, shutting down the boiler. The spring-like feed auger responds very differently to different types of pellets, feed rate settings will need to be customized to the type of pellet. Also pellets with high dust content (fines) have greater potential of clogging the feed auger, and it will need to be cleaned out regularly.

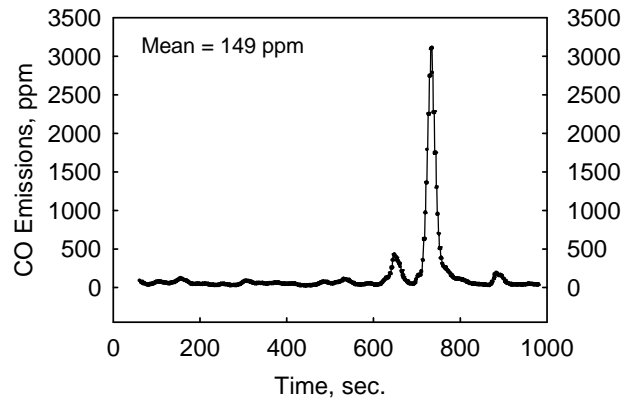


Fig. 4. High ash mixed grass pellets burning at the fuel setting of 5.

Warranty Issues

The Woodpecker boiler is only certified to burn wood pellets, and burning non-wood pellets may void the warranty.

Summary

The Woodpecker wood pellet boiler appears to be an excellent boiler for wood pellets, but is not recommended for any high ash fuels, due to blockage of the combustion tube photocell. It is not clear if the metal components of the combustion system will be durable over prolonged use with high ash fuels with a greater corrosion potential than wood pellets.

Additional Resources

Cherney, J.H. and K.M. Paddock. 2013. Basic emissions testing for residential appliances. Bioenergy Information Sheet #18. www.grassbioenergy.org.

Acknowledgments

Testing was supported by the New York Energy Research and Development Authority (NYSERDA), and the Cornell University Agricultural Experiment Station.

For more information



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