Tobacco Barn Testing in Durban, South Africa

Maggie Daniels and Erin Peiffer with Rocket Works

Abstract

Deforestation and climate change are challenging nearly every industry globally, including the tobacco industry in the developing world which use significant biomass resources to dry tobacco leaves. The drying of tobacco leaves with inefficient drying methods leads to excessive and rapid deforestation. For this reason, tobacco companies have focused their attention towards the development of more sustainable drying/curing barns. Two ETHOS students were sent to work for the company Rocket Works located in Durban, South Africa to assist with the development and testing of a state-of-the-art tobacco barn. Here we report testing of a novel curing barn via monitoring various temperatures and wood consumption rates. Through two burn trials, it was determined that the average gasifier output was 44.4kW. In addition, the temperatures obtained inside the gasifier and ducting were helpful in establishing a better feed system emphasizing smaller batch fed loads to minimize temperature variance.

Figure 1. ETHOS Students and Rocket Works

Introduction

Tobacco is a major agricultural crop in Malawi requiring massive amounts of biomass fuel to cure. With major companies in the tobacco industry moving towards a more sustainable framework, the need for efficient barns to cure tobacco has drawn the attention of Rocket Works. With their knowledge of biomass gasifiers, Rocket Works has been working towards developing a more sustainable tobacco barn.

Project Description

Tobacco Barn

- Necessary testing equipment was ordered including thermocouples, CO and CO2 sensors, relative humidity probe, and data logging device.
- Pitot tubes were fabricated to fit the ducting using copper tubing.
- Test station was set up near the tobacco barn structure.
- Various temperatures and wood consumption rates were collected through burn trials.

Figure 2. Burn Trial and Thermocouple Setup

- The tobacco barn structure was erected with a foil cover placed over to insulate and a PVC canvas cover for protection.

Figure 3. Tobacco Barn Structure

Figure 4. Tobacco Barn Covering

Results & Discussion

- Through testing of the gasifier, it was determined using the calorific value of the fuel along with the amount of fuel burned in an hour's time that the approximate power generated is 44.4 kilowatts.

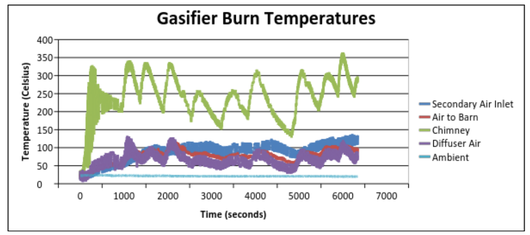
Calculations

Fuel Type: Pine Wood Shavings
Total fuel: 14.06 kg
Total Burn Time: 1 Hour 43 Minutes
Fuel per Hour: 8.2 kg/hour
Calorific Value of Pine Wood Shavings: 19.52 MJ/kg
Energy In: 274.45 MJ
Power Out: 44.4 kW

- The theoretical fuel to dried tobacco ratio of 4.1:1 is a significant improvement from the 7.6:1 ratio common in Malawi.

Theoretical 7 Day Fuel Consumption: 1,377.6 kg
Theoretical Dried Tobacco pure Batch: 334.4 kg
Theoretical Fuel to Dried Tobacco Ratio: 4.1:1

- Through temperature graphing a more efficient feed system emphasizing smaller batch fed loads to minimize temperature variance was established.



Graph 1. Gasifier Burn Temperatures

On average, the air coming out of the diffuser was nearly 70°C, just below the 75°C maximum temperature that the barn can handle.

- There were however a large number of low points in terms of temperature. This was due to the fact that the fuel was added in a small number of large quantities.

Recommendations

- Further steps should be taken such that Tobacco farmers in Malawi can move towards implementing as much of Rocket Works' tobacco barn design as possible to maximize efficiency
- Testing should be conducted using various forestry waste commonly found in Malawi
- Flue gas velocity and emissions should be monitored to establish a baseline for state-of-the-art tobacco barns
- Experience South African Culture

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