

Base Line Testing of 10kw GEK Power Pallet

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Objectives

- Develop testing method for the Power Pallet System.
- Perform initial testing in order to plan future testing capabilities.
- Test the effectiveness of a butterfly valve in changing reactor oxygen ratio.

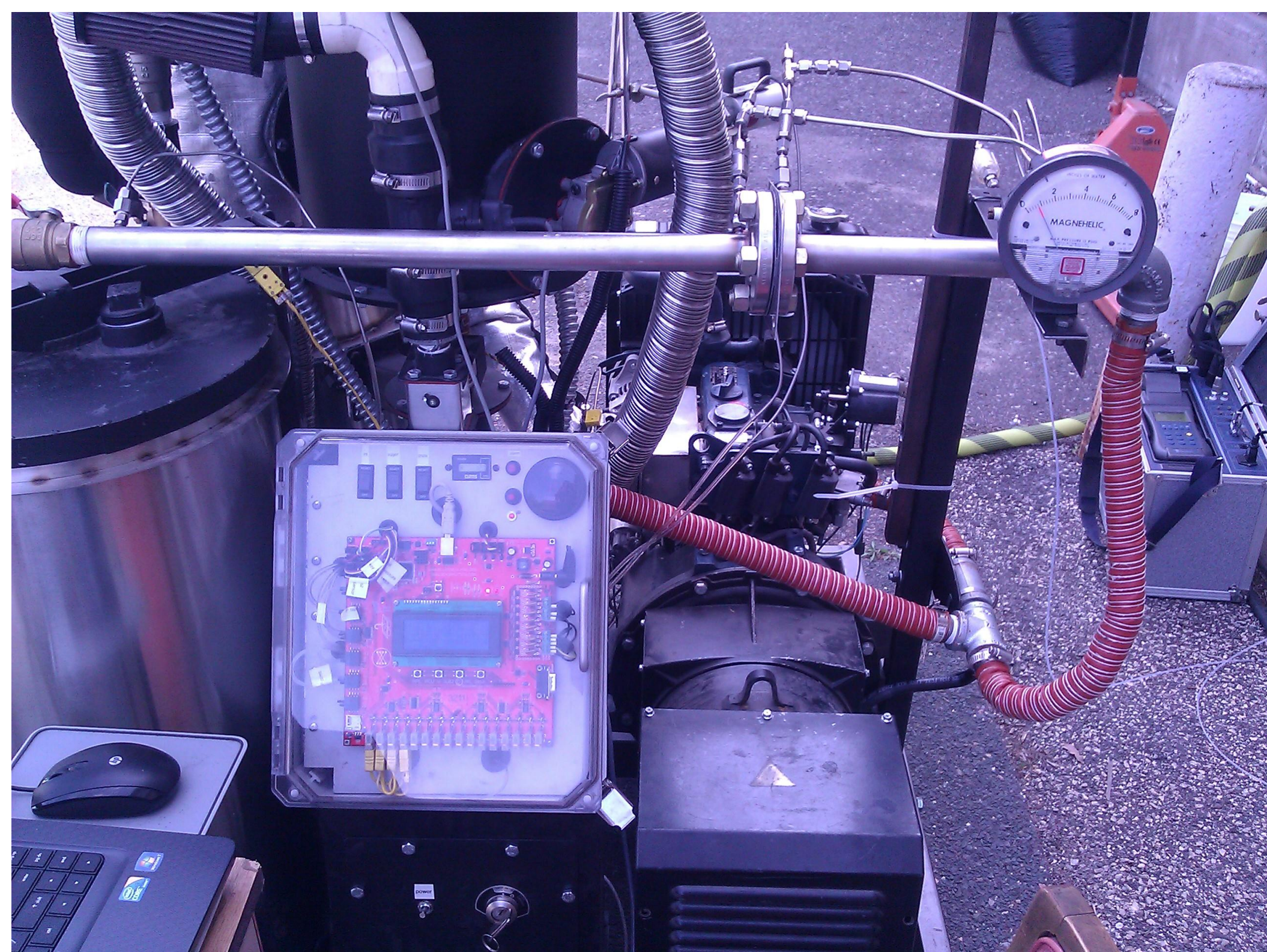
Background

- The Power Pallet is a generator system which uses a gasifier to convert wood chips into a low energy density gas which can be burned in a spark fired Kubota Engine turning a generator.
- Biomass gasification was widely used in Europe during World War II.
- Interest in biomass gasification is returning.

Testing

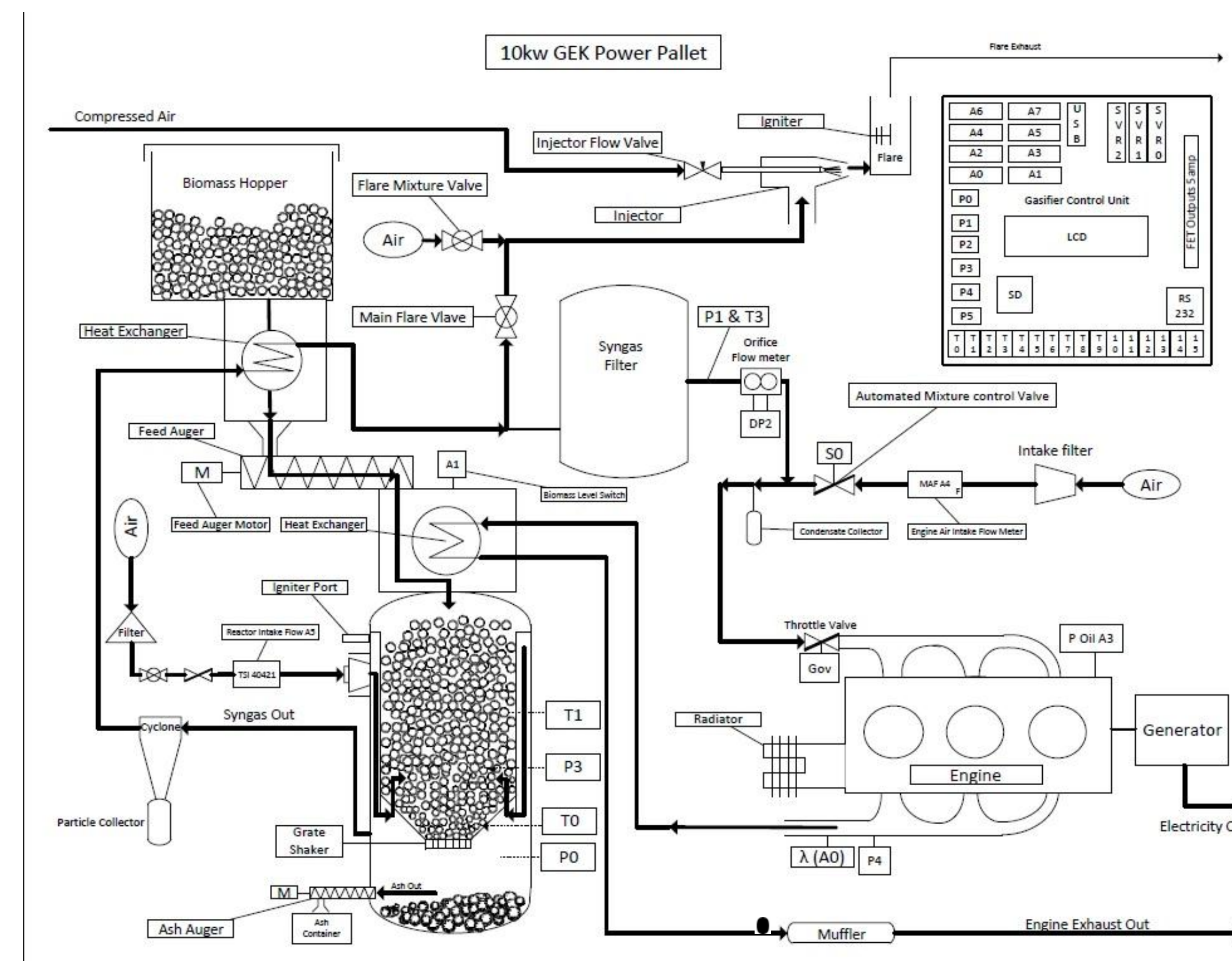
- One hertz flow, pressure, temperature, and gas composition data were taken at three loads.
- Each load was run at three different reactor intake valve positions.
- A Raman Laser Gas Analyzer was used to continuously sample the syngas coming out of the reactor and going into the engine.
- A Green Line Portable Gas Analyzer was used to measure the gas composition of the engine exhaust.

The orifice flow meter and Gasifier Control Unit are shown below.



Setup

The process flow diagram for the Power Pallet is shown below.

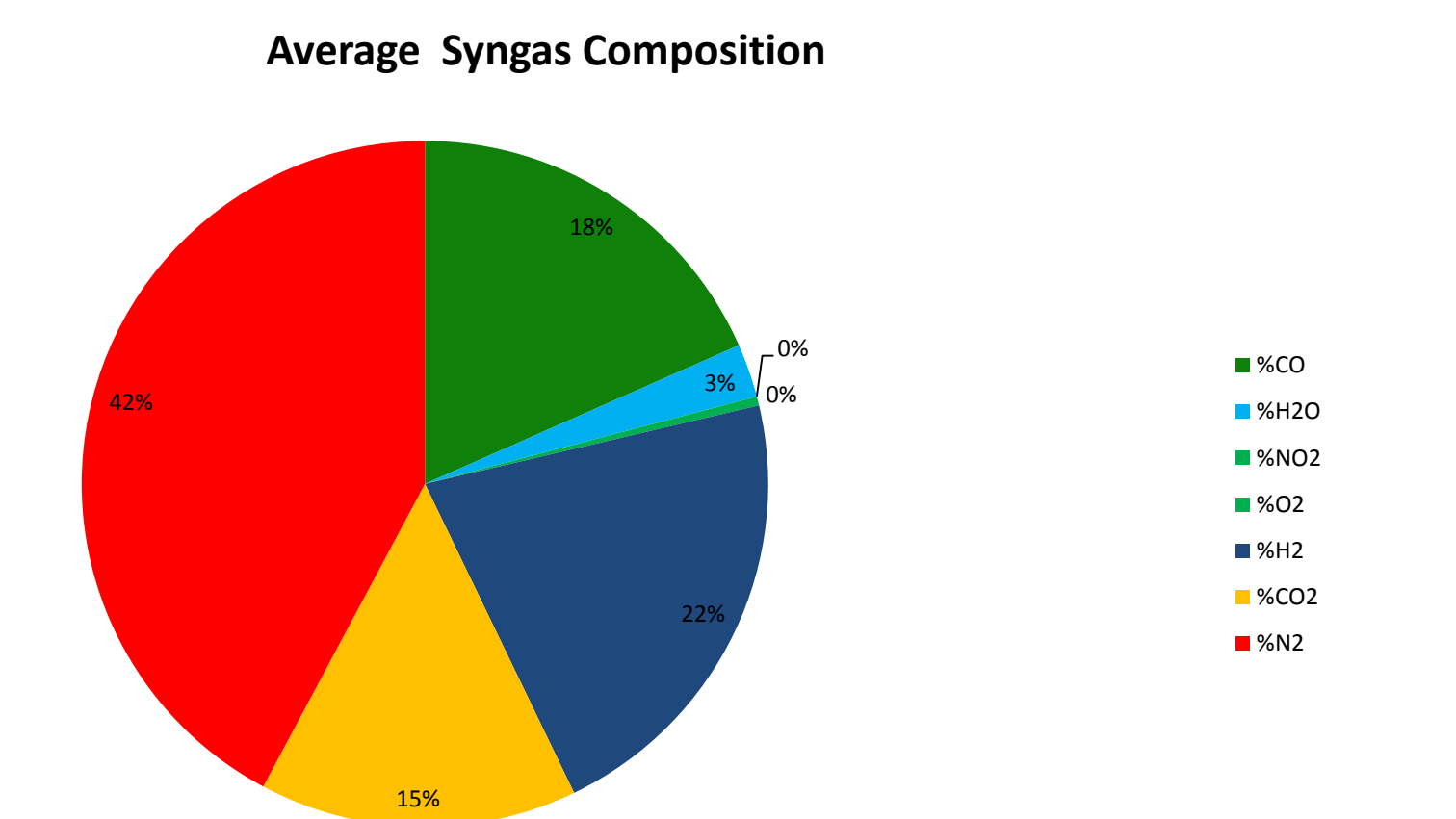
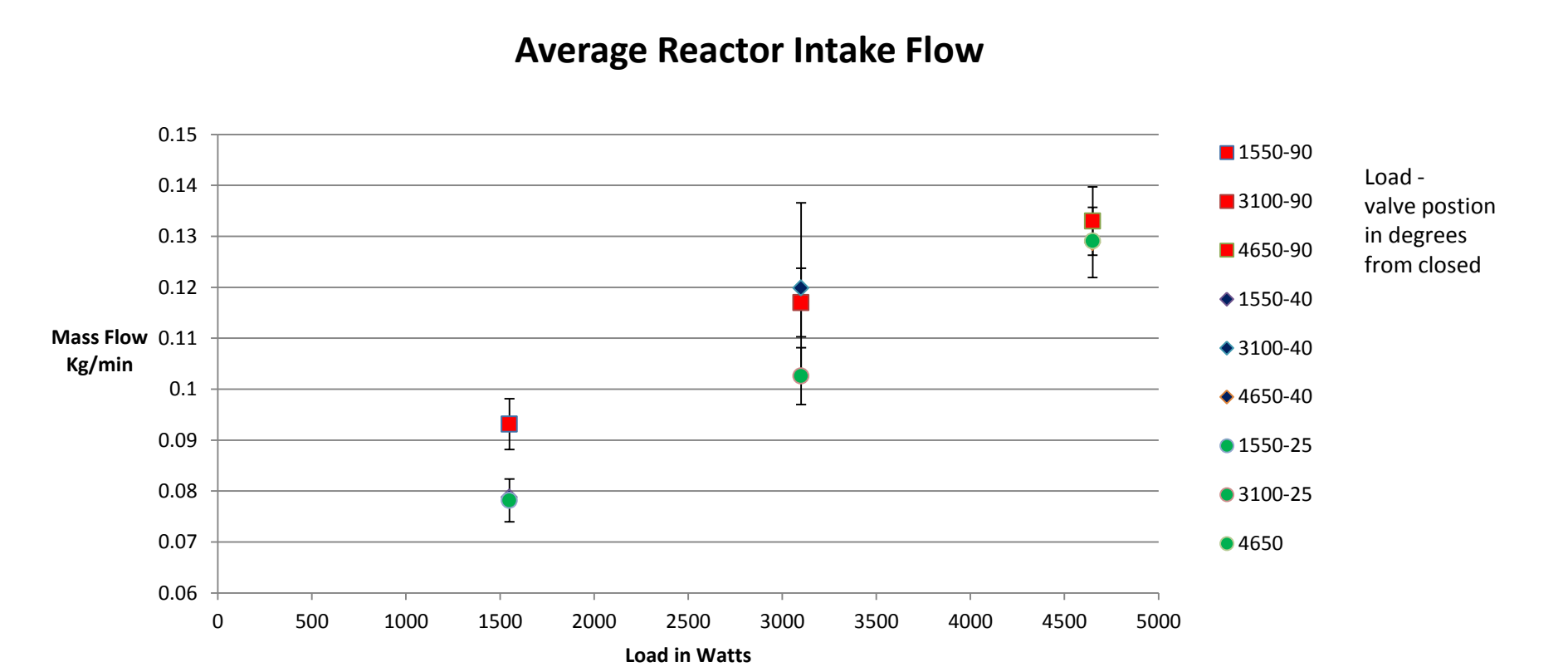
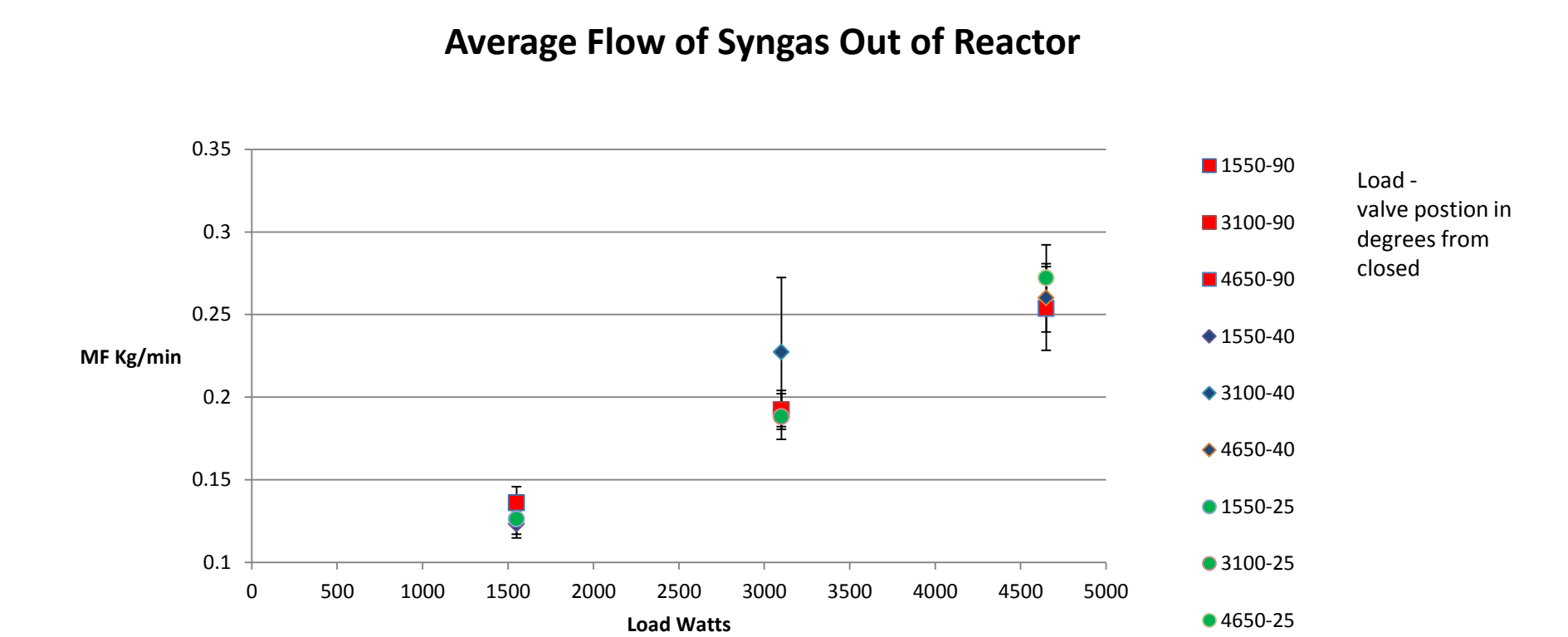


- Three flow meters were added to the system to measure the reactor intake, the wood gas output, and the engine air intake.
- Gas sample ports were added to the pipeline after the syngas filter and in the engine exhaust before the heat exchanger.
- A butterfly valve was added to the reactor intake.
- A serial connection to the Gasifier Control Unit was used to record the sensor outputs with a computer.

Future Testing

- Future testing will focus on instrumenting the engine so it can be analyzed simultaneously with the rest of the system.
- Testing will focus on varying variables such as fuel, engine fuel to air ratio, engine timing, and gasifier configuration.
- The new results will be compared to the baseline results found in this experiment in hopes of optimizing and getting a better understanding of the system.

Results



Conclusion

- Constricting the reactor intake with a butterfly valve had little to no effect on the amount of air entering the reactor and the performance of the system. This may be attributed to the engine being directly linked to the gasifier output being used as the pumping mechanism for the reactor. The steady state engine pulls a constant volume of air which forces the amount of air entering the reactor to remain constant.
- The average syngas composition for normal operating conditions of wood chip fuel, no restricted intake, and a load of 3100 watts for the Power Pallet System is 22% H₂, 42% N₂, 18% NO₂, 15% CO₂, and 3% H₂O.

Acknowledgements:

Funding for this project was provided by the Undergraduate Research Opportunities Program. The Power Pallet was donated by All Power Labs.