BIOMASS ENERGY RESOURCES WITH LIVESTOCK MANURE

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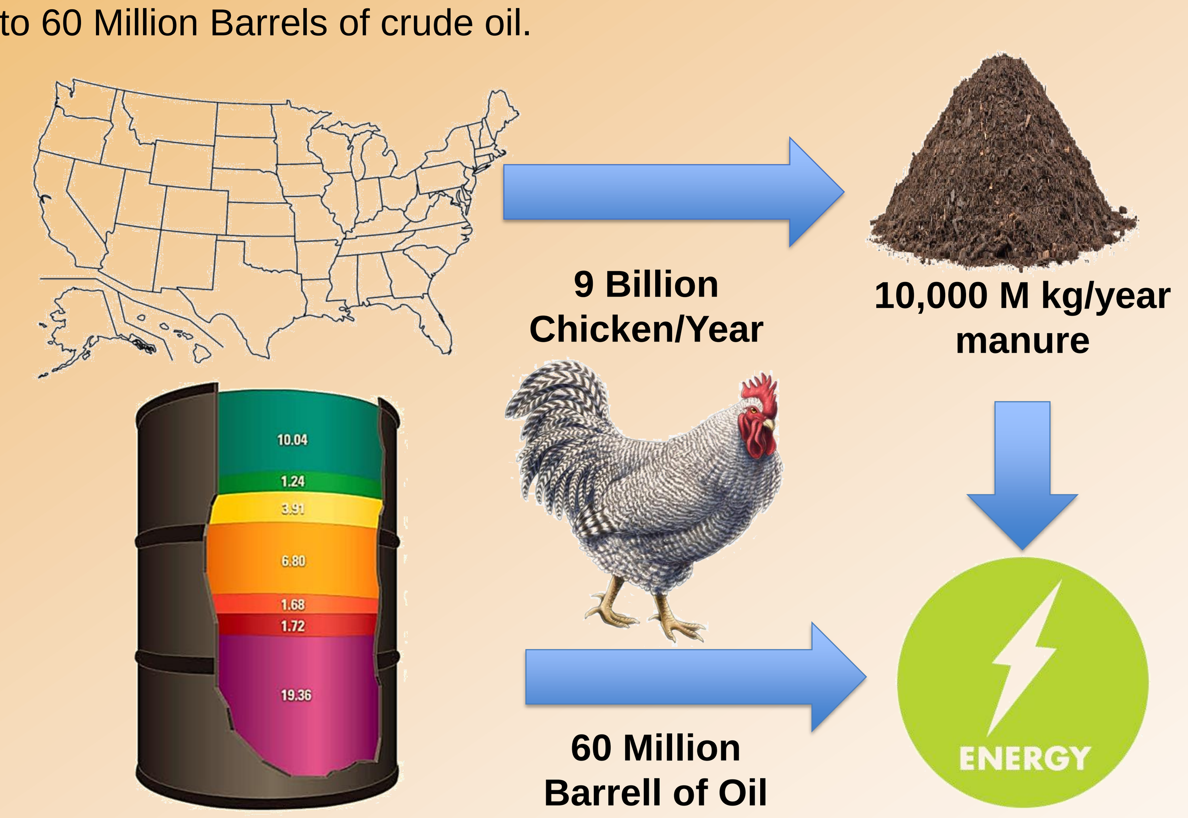
Introduction

Biomass is often considered as an alternative to fossil fuels because of its abundant reserve. The united states consume about 9 Billion chicken a year. The average chicken produces 2.5 lb of dry manure throughout its grow out period. With an average calorific value 10 MJ/kg of the chicken manure, that's equivalent to 60 Million Barrels of crude oil.

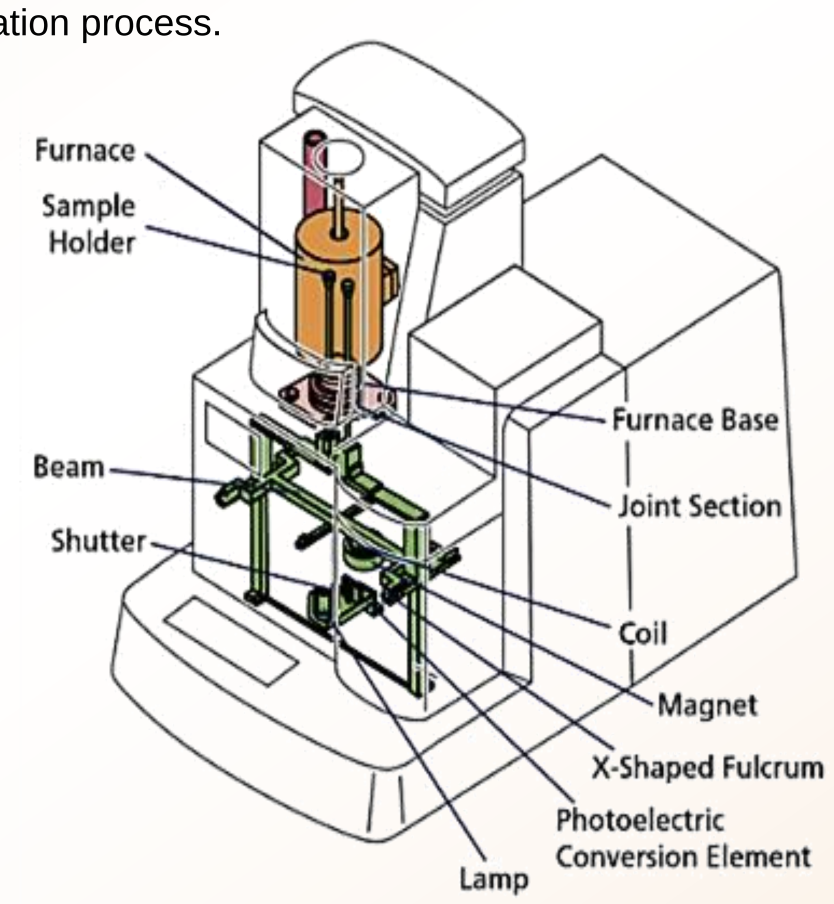


Objective

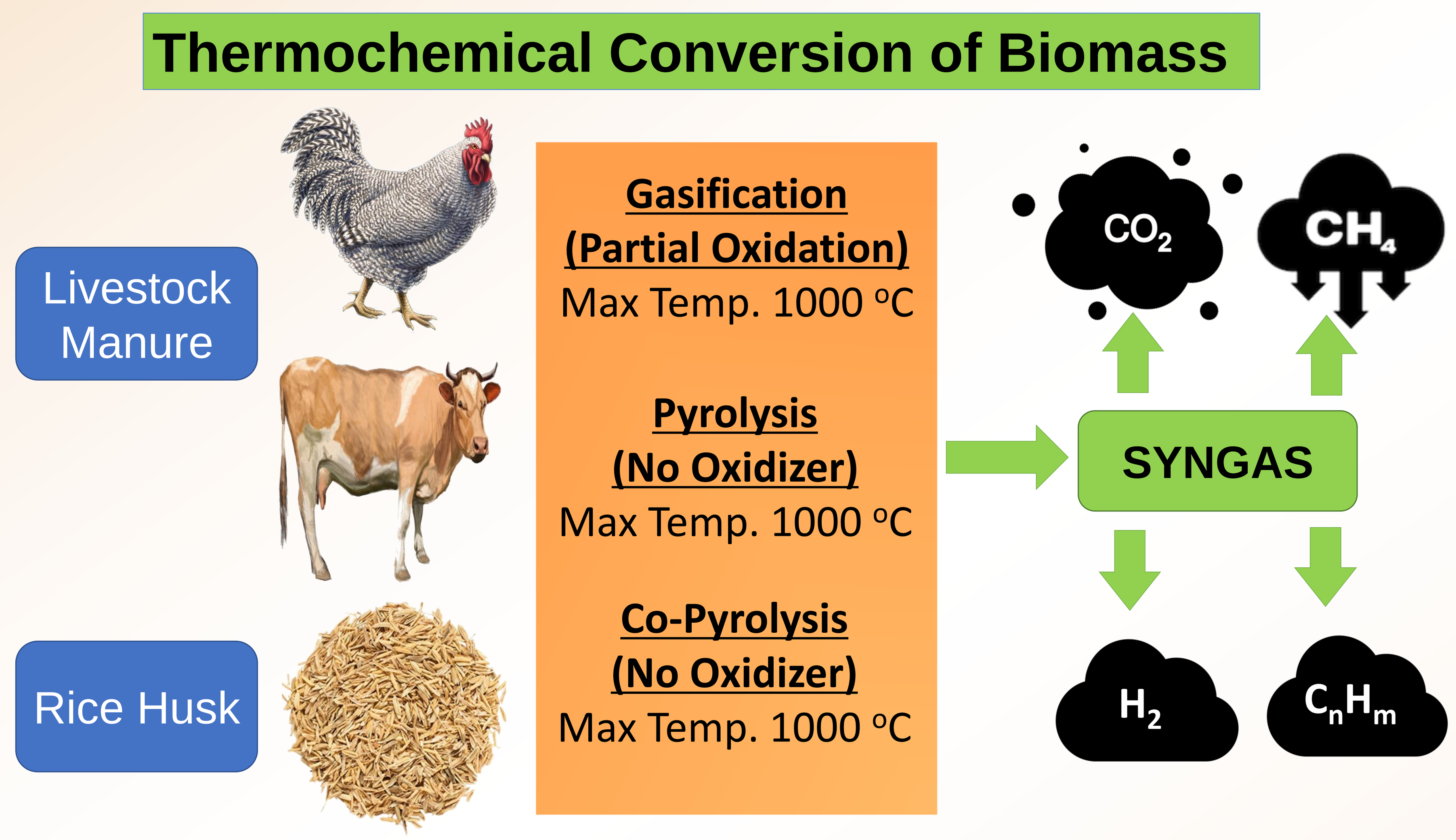
- Optimal use of energy resources and optimization of energy processes; Waste Management.
- Experimentally investigate the biomass pyrolysis and gasification of chicken manure using different gasifying agent with eight different heating rates.
- Experimentally investigate the co-pyrolysis process by mixing the livestock manure with the rice husk, aiming to increase energy extraction and reduce energy input.

Methodology

- Thermo-gravimetric analysis is utilized in this research. The change of the mass of the biomass specimen is monitored with time.
- Differential Thermal Gravimetry apparatus is used simultaneously to perform the Thermogravimetric and Differential Thermal Analysis.
- The main parts of the devise are Furnace to supply the heat, measurement system including two detector rods and some thermocouples to measure temperature.
- The sample is loaded on one of the detectors while the other one is kept empty as a reference to the mass degradation with temperature.
- The purge gas used varies based on the process. The nitrogen was used for pyrolysis and co-pyrolysis processes while air and carbon dioxide were used for gasification process.

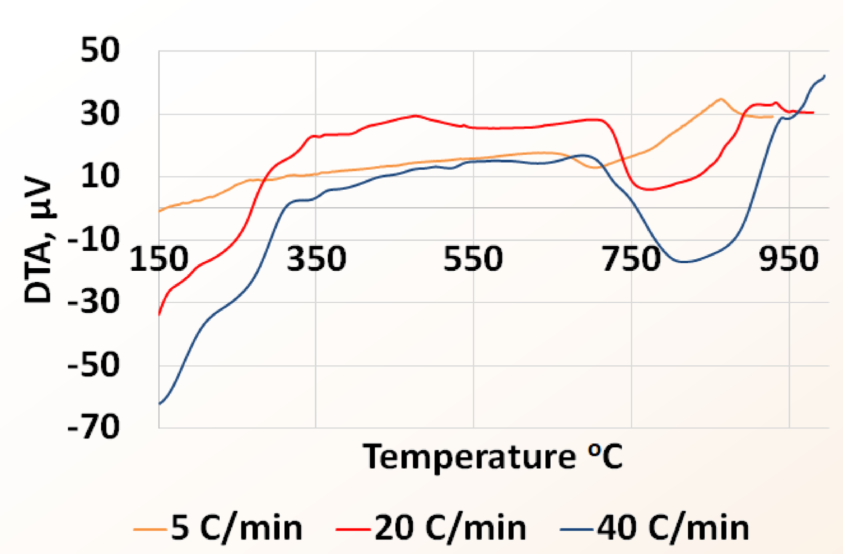


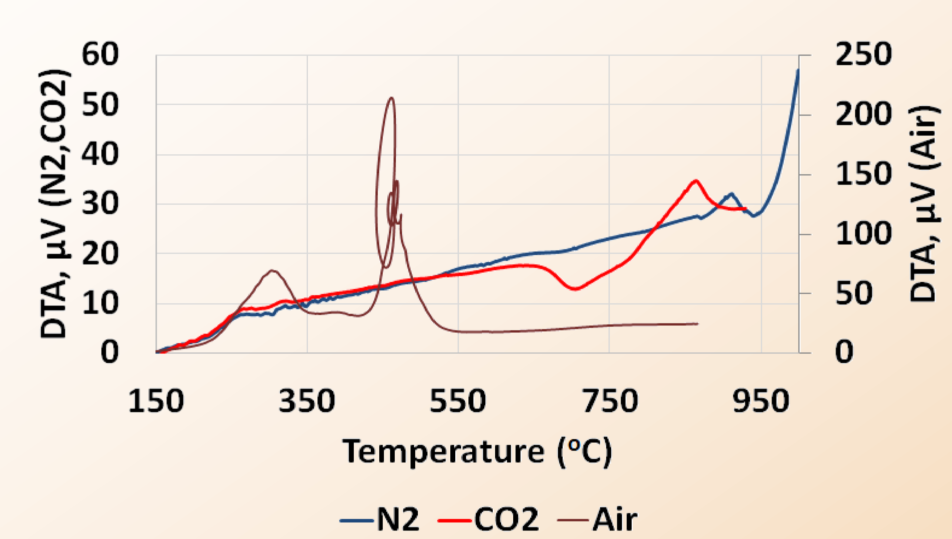
Results



1. Effect of Heating Rate on Chemical Kinetics of Chicken Manure With Different Gas Agents

- For all the three gasifying agents used, the lowest heating rate allows a quasi-equilibrium state and thus decreasing the effect of measurements error.
- For CO2 the reactions were endothermic at 700 ºC and thus energy must be supplied.
- Air gasification was exothermic thus the reaction is self sustainable and self ignition observed at 600 ºC. However the reaction time in case of air is 75% faster compared to CO2 and N2 at the expense of energy yield which is less 55% and 40% respectively as shown in Table 1.





2. Co Pyrolysis of Chicken and Cow Manures

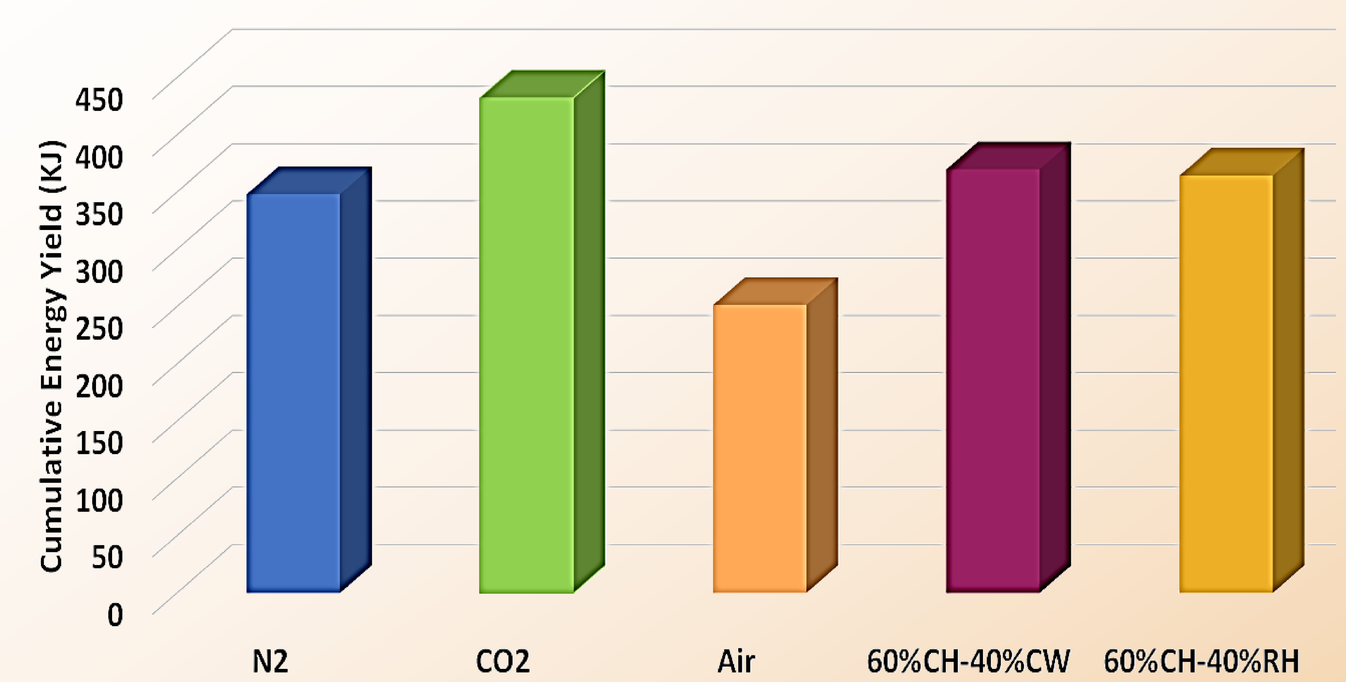
- Four blends were tested 20, 40, 60 and 80% Cow Manure.
- Increasing the cow manure percentage makes the reaction tends to be endothermic, and this is mainly because of the protein and amino acids that need a large amount of energy to be lost.
- Compared to the chicken manure alone, the Co-pyrolysis gives a higher energy yield.
- Based on the energy yield the 40%Cow-60% Chicken achieve the highest energy yield and provide a steady exothermic reaction allover the co-pyrolysis process.

3. Co Pyrolysis of Rice Husk and Cow Manure

- The two samples provide an exothermic reaction over the same temperature range which makes the amount of energy released during the reaction high than each biomass species standalone for all the blend rations.
- As a result the amount of energy needed to start the reaction is lower (Activation of energy) than that one required for the chicken manure or rice husk.
- Among all blends, the highest energy released is obtained from the 40% Rice husk-60% Chicken Manure.

Table 1: Chemical kinetic parameters for different case studies

	Pyrolysis	Gasification		Co-Pyrolysis	
Tested Sample	CH			CH-CW	CH-RH
Heating Rate (ºC/min)	5	5	5	5	15
Blend Ratio%	100	100	100	60-40	60-40
Gasifying Agent	N2	Air	CO2	N2	N2
Activation Energy (KJ/mole)	74.0	70.3	Varies	110.0	106.0



Conclusions

As a response to the world energy demand, fossil fuel depletion and the current oil prices, the use of the biomass fuel becomes a must. According to this study the following point can be obtained;

- Slow Pyrolysis allows a quasi-equilibrium state and thus decreasing measurement error due to delay in response or any transient error.
- Carbon dioxide gasification has the highest energy yield followed by nitrogen pyrolysis then the air gasification.
- Co-pyrolysis process improves the characteristics of pyrolysis oil, e.g. increase the oil yield, and increase the value of oil
- 40% Cow Manure-60% Chicken Manure gives higher energy yield than each of the biomass alone.
- 40% Rice Husk-60% Chicken manure gives the lowest activation of energy and highest energy yield compared to both species alone.

References

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