Industrial-Scale Waste Pyrolysis in a Novel Pyrolysis Reactor

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INTRODUCTION

Pyrolysis → thermochemical decomposition of biomass in the absence of air or oxygen at a high temperature for the production of noncondensable gases, solid biochar and liquid product. There are three types; slow, intermediate and fast.

The main product of the slow pyrolysis is the solid product, the biochar. The main characteristics of the charcoal produced are:

- Renewable
- It contains virtually no sulfur or mercury and little nitrogen and ash
- It conducts electricity as well as metal
- High surface area
- Good fuel for cooking, preferred to kerosene

Figure 1: Municipal solid waste

PHD OBJECTIVES:

Two stages with different goals

EXPERIMENTAL:	INDUSTRIAL:
Conduct slow pyrolysis test to obtain biochar and gas	New industrial scale pyrolysis process assistance
Characterization of biochar combustion process.	Technological and economical assessment.

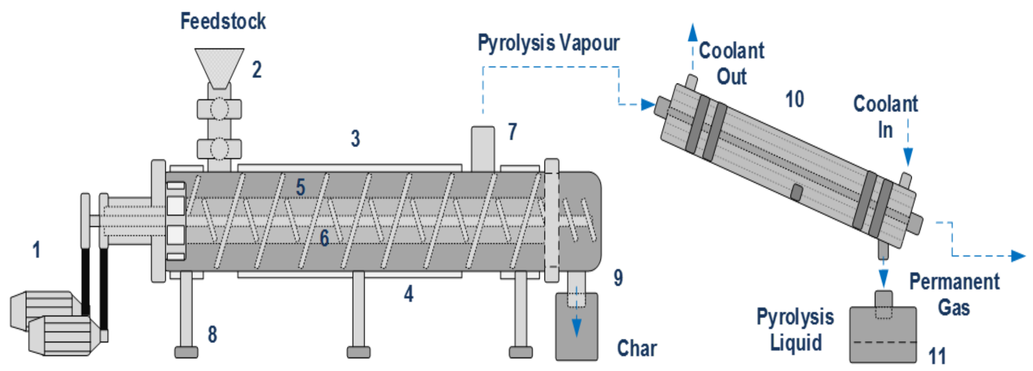

Figure 2: Pyroformer Scheme

CHALLENGES

Process design improval

Typical scheme of pyrolysis process

Feeding→ Reaction→Collection

Plant commissioning and design

Limited experience and knowledge in industrial environment

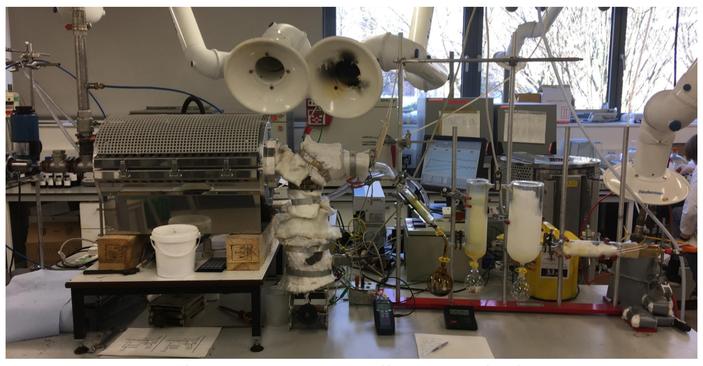

Figure 3: Intermediate pyrolysis

IMPACT

Wider understanding of slow pyrolysis→ different feedstocks.

Energy plant with Municipal Solid Waste and Pyrolysis process

It reduces the amount of waste sent to landfill

Obtain value from a waste stream

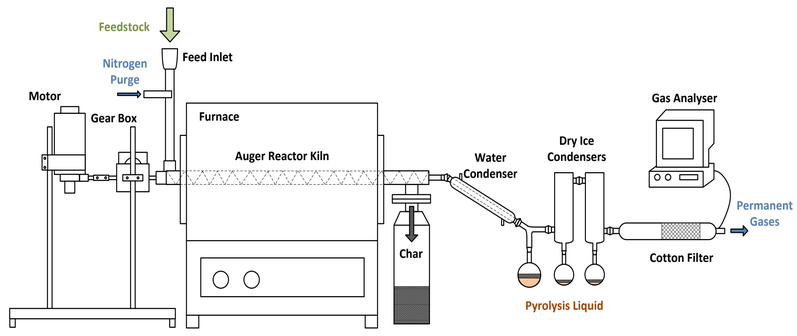

Figure 4: Intermediate pyrolysis system

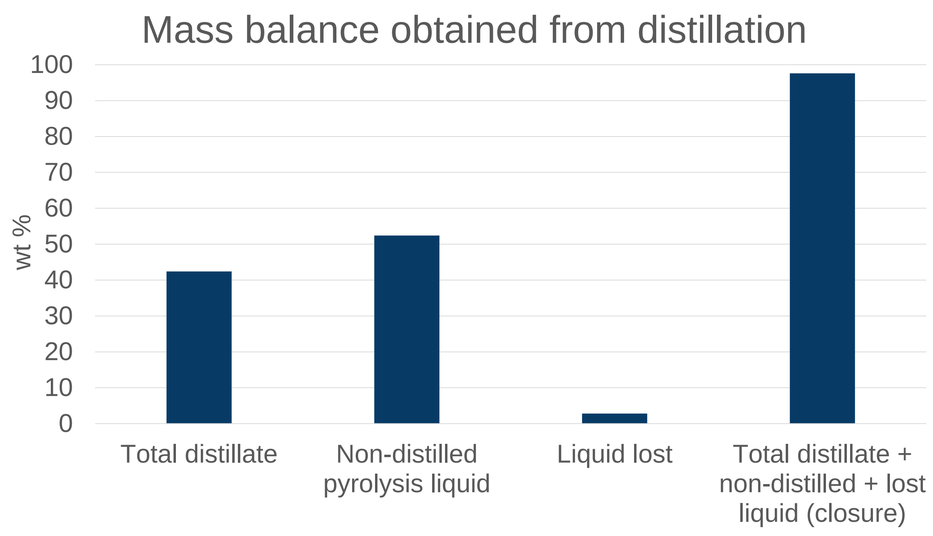

Figure 5: Mass balance of the pyrolysis liquid distillation

RESEARCH PROGRESS

- Beginning of experiments with equipment shown in Figure 3.
- Conducting hot runs and analyzing the results in order to understand the system and the results obtained and mass balance closure. New cooling system installed and leak checking.
- Mass and Energy Balance of the industrial plant desgn
- Bio-oil distillation experiment done with the results of the mass balance in Figure 4.
- Focus on the Slow Continuous Pyrolysis processes within the market. There are some companies already producing biochar with different processes:
  - Labiotte (France)
  - Lurgi (Australia)
  - ProFagus (Germany)

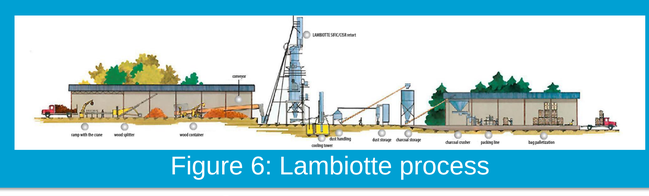

Figure 6: Lambiotte process

REFERENCES:
Antal, M. J. and M. Grønli (2003). "The Art, Science, and Technology of Charcoal Production." Industrial & Engineering Chemistry Research 42(8): 1619-1640.
Basu, P. (2013). Biomass gasification, pyrolysis, and torrefaction : practical design and theory, London, UK : Elsevier : Academic Press, 2013. Second edition.
The pyroformer reactor and its current status, Y. Yang, May 2017.
https://www.baltcarbon.lv/lang/en/images/shema-big.jpg
http://greencarbon-etn.eu/

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