Research graduation project: Processes, Physical and Chemical Reactions Modeling of demonstration scale pyrolysis unit

Introduction

Pyrolysis is the core technology used at Waste4ME for waste streams valorization; it is defined as a thermo-chemical treatment, which can be applied to any organic (carbon-based) product. During pyrolysis, material is exposed to high temperature, in the absence of oxygen, and is submitted to chemical and physical separation into different molecules.

The present graduation program proposal focuses on a deeper understanding of the on-going reactions occurring in our pyrolytic reactor as well as throughout the whole pyrolysis system. It is crucial for the company to gain knowledge about this complex topic, be it for future fine tuning of our system or the behavioral characteristics of the feedstock used when submitted to thermal depolymerization. Startup conditions but also full continuous operation as well as shutdown of the system are at the core of the model to be created.

Moreover, a step-wise and logical approach should be followed concerning the incrementation of the different parts of our system into the model (such as start-up of the furnace to provide heat for operating conditions, conveyor belt from the operational storage for feeding plastics to the system, reactor, scrubbers etc.). The model should also be made in such a way that the design is methodological; not only this is useful for finely refine our processes conditions, but also for other students to be able to continue the work done during this graduation program as well as a basis for process operators training.

This means that normal operating conditions combined with simulated implementation of a variety of disturbances will be modeled. Additionally, the use of different plastic loads should be modeled, ranging from low loads to full continuous operating conditions. this can be done using the modeling software Matlab, but other modeling software can be used if the student can justify the benefits and reasons to do so, such as academical requirements.

Assignments

- **General end goal:**

Modeling and simulation of the thermodynamic properties, chemical Reaction mechanisms and physical heat and mass transport phenomena (mass and energy balance) of the different parts of our pyrolytic system at start-up, full continuous and shutdown phases:

- o Operational storage and feeding system including, conveyor belt, feeding screws and rotary valve systems
- o Reactor of Gas cleaning system
- o Oil take out and further cracking (potentially in-line distillation)
- o Gas to electricity and excess gas burning
- o Furnace and subsequent heat fed to reactor o De-ashing system

- **To study and model**:
  1. Influence of feedstock on system's overall physical and chemical mechanisms. Important parameters are:

     - o Products yields (part of mass balance phase)

- o Composition (such as metals and minerals in ashes, relative oil fractions, gas capacity etc.)
- o Feedstock type influence (plastic mono-stream, mixed stream, biomass fraction contamination tolerance etc.)

2. Influence of different loads on system's overall physical and chemical mechanisms

3. New design and current design improvements for energy, safety and operation efficiency

4. Potentially, partial implementation of catalysts based on other students' work and influence on the above-mentioned points in the model

Contact Details

If you are interested, send your cv and motivation letter, or even better accompanied with your first idea on how to approach the subject, to project manager Valentin Contin at v.contin@Waste4me.com.

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