Abstract

Masters of Engineering Degree (Mechanical) *(or Aerospace or Engineering Mechanics)*

Project Title:

Sustainable Cook Stove – Modeling and Design

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Abstract:

As energy becomes a heated issue, fuel, traditional or not, attracts more and more attention. All around the world, in spite of the difference in technology and wealth, people use different types of stoves to prepare their food. At Cornell, students designed and manufactured a Cook-Stove that uses heat from ordinary combustion to cook, along with facilitating pyrolysis reaction. In turn, this generates gas that becomes part of the fuel. Pyrolysis reactions, fueled by biomass, would convert biomass into char, tar and gas. As gas itself can facilitate combustion, char, on the other hand, can fertilize soil.

This study investigates the possible improvements of the cook stove. To achieve this goal, a numerical simulation approach is adopted and ANSYS software package (Fluent) is used to model the heat transfer processes and chemical reactions inside the pyrolysis chamber of the Cook-Stove. In the report, the process of model development is introduced, which includes geometry simplification, mesh generation, boundary condition set up and the heat source implementation. In particular, the heat source is the heat of reaction of the pyrolysis reaction, which is simplified to the decomposition of cellulose. Fluent User Defined Function (UDF) is used to simulate the heat source of pyrolysis.

Results such as temperature distribution and remaining cellulose mass fraction were verified by the experimental data and hand calculation. While fuel is combusting rather thoroughly in the combustion chamber, there is still leftover biomass present in the pyrolysis chamber, which means that there is still room for improvement. With the reference result, new designs aiming at enhancing the pyrolysis reaction were proposed, tested and justified. According to the results, some new design recommendations were made for further improvement and some drawbacks of the current model are stated for the reference of future modeling.

Report Approved By:

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