DEVELOPMENT OF AN INTEGRATED PROCESS MODEL FOR THE EVALUATION OF BIOCHAR AND ACTIVATED CARBON FOR WASTEWATER TREATMENT

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ABSTRACT

Activated carbons have been widely used as adsorbents in separation and purification processes for gaseous or aqueous solution systems. Currently, activated carbon production is divided into two main obtention processes. The first is physical activation, where the raw material is initially carbonized, and then carbonized material is activated by steam or carbon dioxide. The second is chemical activation, where raw material is impregnated with an activating reagent, and simultaneously heat-treated under an inert atmosphere at high temperatures (600-900°C). In the latter case, both carbonization and activation take place simultaneously.

The physical and chemical properties of biochar, as well as the process design typically depends on the feedstock used and carbonization conditions (temperature, nitrogen flow and residence time). In addition, is well know that for activated carbons the adsorption capacity of heavier metals, salts, and organic or inorganic compounds seems to be highly influenced by pH, particle size, porosity, and activation temperature among others. Moreover, for good development of surface and structural properties as well as textural characteristics, low ash and high contents of fixed carbon are desired.

In this study, a short description of the production, characterization, and process modeling of the physical activation of agricultural and forest residues is performed, in order to analyze the feedstock impact into the process modeling, technology, configuration, heat requirements, potential use of alternative energy sources as natural gas, biomass, etc. An experimental plan is proposed in order to develop experimental data for a fully integrated engineering process model (ASPEN Plus) capable of evaluating different biomass features to accurately predict yields, process parameters, and potential performance of the resulting product for different types of wastewater streams. This ASPEN model will then be used for techno-economic analysis (TEA) in order to conduct the selection of the preferred material as a function of the water treatment application, e.g. organic or inorganic streams, as well as to evaluate process improvements.

BIOGRAPHY

Eliezer A. Reyes Molina, was born and raised in the beautiful city of Merida on the Venezuelan Andean Mountains, in the state of Merida. He graduated from the Universidad de Los Andes in 2014 with a B.S. degree in Chemical Engineering. In the fall 2016, he moved to Raleigh, North Carolina, USA. Where he spent one year as a Visitor Scholar / Research Associate in North Carolina State University under the guidance of Dr. Steve S. Kelley and Dr. Sunkyu Park. Followed by his research interest, Eliezer Reyes applied the graduate school at North Carolina State and successfully started his Ph.D. studies in the Fall of 2017 in the Department of Forest Biomaterials. Dr. Kelley and Dr. Park guided his PhD as well.

His research projects at NC State includes investigating and modeling fast pyrolysis biofuels and bio-based carbon materials production. In order to reach the scientific and technological development of new renewable materials using thermochemical conversion pathway.