Semi Annual Project Report – 6

NDIC Grant Project: Commercial Application of Soybean Stalk as a New Alternative Fiber in Particle Boards

Dilpreet Bajwa (NDSU), Sreekala Bajwa (NDSU), Andrew Norris and Chad Rehovsky
Andrew Sunderland, Evan D Sitz (Masonite PrimeBoard)
Report Date: September 28, 2017

This is a sixth report that summarizes the project activities between January 2017 and August 2017. The research funds for this project – "Commercial Application of Soybean Stalk as a New Alternative Fiber in Particle Boards" are provided by NDIC and Masonite PrimeBoard Company located in Wahpeton, ND. The main goal of this project is to explore and demonstrate the feasibility of using soybean stalks as an alternate material for manufacturing particle boards. The specific tasks set to achieve the project goal include (1) understanding the material collection and transportation logistics, (2) equipment and machinery changes required to efficiently process soybean stalks, and (3) optimization of the formulations for manufacturing soy stalk based variable density particle boards. In the last six months research focused on the evaluating the logistics and economics of material collection, baling, transportation, and pricing structure of different materials as well as from processing of biobased resin and testing particleboards properties. The PI requested for an extension of this project which was approved by funding agency NDIC in January 2017. The new project completion date is March 31, 2018.

The investigators from NDSU (Dilpreet Bajwa and Andrew Norris) met with their collaborators from Masonite PrimeBoard (Andrew Sutherland, Plant Manager, and Evan Sitz, New Engineer) on May 18th and later on August 15, 2017 to discuss project progress and share the results of the work that has been going on at NDSU. The company also gave an update on the current material use, processing and discussed various items related to incorporating soy stover in the wheat straw. The project team again revisited the research plan and related tasks to ensure all the project tasks are completed before the revised end of the project. All the goals were again reviewed to check if any critical task was missed in the last three years. It was decided that we

should revisit the processing of raw materials though hammer mill. There are some material processing inefficiencies in the plant that can be fixed to improve the output and lower energy consumption. Incorporation of some recent advancements in the hammer mill design can be extremely beneficial for the company, so it was decided to run some trials with modified hammers and screens. Although this task was accomplished in the beginning of the project but both research team and collaborator thought it will worthwhile evaluating new technology. The new trials are planned to be executed in the November or December 2017 when the production slows down.

The major highlights of the last six months (January 2017 to August 2017) work are described below followed by additional detail specifically discussing the material harvesting and transportation.

Project Update

NDSU (D. Bajwa, S. Bajwa, A. Norris, and C. Rehovsky)

In the last six months the research work primarily focused on assessing economics of material collection, baling, transportation and related costs, some work also focused material processing, and evaluating a new biobased resin for use in the particleboards. The aim was to identify the important factors that influence the cost of different raw materials. Before initiating this objective the research team had a detailed meeting with Masonite personal to understand how they calculate the material cost and what variables are important for them to know that can impact their pricing structure. Some of the factors that can impact the final material cost to collaborator are material type, distance, type of bales, collection method, transportation mode, fuel cost, time of the year and competition or demand for other applications. After understanding how these variables have historically influenced the material cost the research team decided a matrix that will collect all this information so it can be rationally analyzed to make meaningful conclusions.

The research team first conducted an in-depth research on the biomass collection and transportation logistics. In the past few years there have been some studies related to corn

stover, and wheat straw collection and transportation mostly for biomass for fuel or animal feed applications. Some of the constraints that were set in analyzing the cost structure included consistent supply of wheat straw and soy stover, profitability for farmer, bioprocessor and all the intermediaries. Removal rates that do not damage the soil over long term was also considered a factor for wheat straw. Removal rates of 2.0-2.5 tonne/acre of wheat straw and 1.0 to 1.5 ton of soy stover were taken into account. Material harvest and collection time ranged from late summer to early fall. The preferred bale type was high density square bales (11-12/ft^3) weighing 800 to 1200 lbs. The ideal material collection and transportation distance was 50-80 miles that would not significantly impact material cost.

Some of the results showed that fall harvest biomass yields are higher however cons are that higher moisture content, narrow harvest window and sometime lower harvest equipment availability. Trucking will be the dominant transportation mode for the processing plant. Transportation cost for every move less than 62.13 m is approximately $17/tonne. Majority of biomass bales should be directly transported from farm to the processing plant. On-farm storage is usually cost competitive but carries risk for processing plant. On-farm storage costs 8.33$/tonne whereas at plant site it varies with location from 9.00-22.00 $/tonne. Flatbed trucks are most effective for shipping. Open storage is more economical than covered and the bales can be stacked up to 6 rows in height. The increased margin for farm producers from wheat straw and soy stover harvest can vary from $80-120 per acre. The results discussed are from one set of the data, we are currently collecting more information for fall 2017 season. The team plans to collect a minimum of three sets of data related to material cost. It will help the industrial collaborator to understand the price variability due to collection time, year, crop yield and changing biomass pattern.

The research team is going to continue collecting and analyzing additional data on material type, collection methods and transportation logistics. It is expected that with a large data set we should be able to develop a strong raw material pricing model for the collaborator. The outcome of this task should help the collaborator in understanding the price structure of various feedstock and improving their profitability.