Assessing Moisture Content in Biomass Piles

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The Problem

The overall goal of this project is to turn biomass piles into useable biofuels. One problem with this is the logistics to ship these biomass piles to the locations where they will be converted to biofuels.

It is economically challenging because of the high moisture content of the material and current market prices. A truckload containing material with a moisture content of 30% will get $771 for the whole truckload. As the moisture content increases then the payment per truckload decreases. With a moisture content of 60% a truckload will earn only $392 (Anderson 24).

Since mills are paying more for drier material we want to be able to determine the best time to ship these piles to their destinations. To do this we will determine the moisture content of the material and relate it to the amount of time the piles have been sitting in the field.

The Strategy

After this summer my goal is to determine how much moisture is in each of the biomass piles. To gather this data my coworkers and I followed this procedure:

1. Measure the moisture content of the biomass pile samples
2. Collect samples
3. Weigh green samples
4. Dry samples in an oven for 48 hours
5. Weigh the dry samples

The difference in weight of the green samples and the dry samples is the amount of water that was in the pile at that time.

References

Anderson, Boston, Sessions, Tuers, Zamora. “Pricing Forest Biomass for Power Generation.” 2012.

Dr. Glen Murphy, 1987, PhD Forest Engineering, Oregon State University.

Dr. John Sessions, 1979, PhD Forest Economics, Oregon State University.

Simpson, William T. "Specific Gravity, Moisture Content, and Density Relationship for Wood." *United States Department of Agriculture*. N.p., 1993. Web.

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Collecting Samples

My coworkers and I traveled to eastern Oregon to collect samples from several biomass piles. The piles we found were in one of two conditions: pre-ground or ground.

Pre-ground Piles: For the pre-ground piles I used a tool called a Humimeter (see figure directly below) to measure the moisture

content of the samples. This tool has two small probes that are inserted into the bark of a log. Once the species of the log specified, the Humimeter gives a moisture content reading. This reading is converted to a true moisture content percentage based on the species of the log. Ten readings were taken per pile, and two samples (See “Samples” below) were taken per reading.

Ground Piles: For piles that had already been ground I used a tool called a WILE (See figure below). This tool is pushed into the pile and gives a moisture content reading, which also has to be adjusted according to the type of material the pile has been ground into. Three readings need to be taken per sample, and all three readings should be within four percent of each other. Four samples were taken per pile, and each sample was about 10 kilograms of ground material from where we used the WILE.

The Samples:

Each sample was weighed before being put in the oven at 103° Celsius. The tins are filled with samples from ground piles, and the bottom half of the picture are samples from pre-ground piles. Each sample was put in the oven for 48 hours and then was weighed again.

Challenges Faced

There have been quite a few challenges with this research project so far. First, the Humimeter works by selecting the species of the tree from a list. However a lot of species we found in the piles were not in the list, like Cedar and Hemlock. We took note of this but it will take away form the accuracy of our results.

The Humimeter results need to be converted to an adjusted moisture content using several formulas that are calibrated for each species. The formulas were determined by Dr. Glen Murphy and his Masters student Fernando Becerra. The formula for Ponderosa Pine is giving results that are over 100%, which should not happen. Dr. Murphy had to leave suddenly for Australia and has not been able to look at the data. This is why I have focused this results section on the moisture content found from the green and dry weights of the samples.

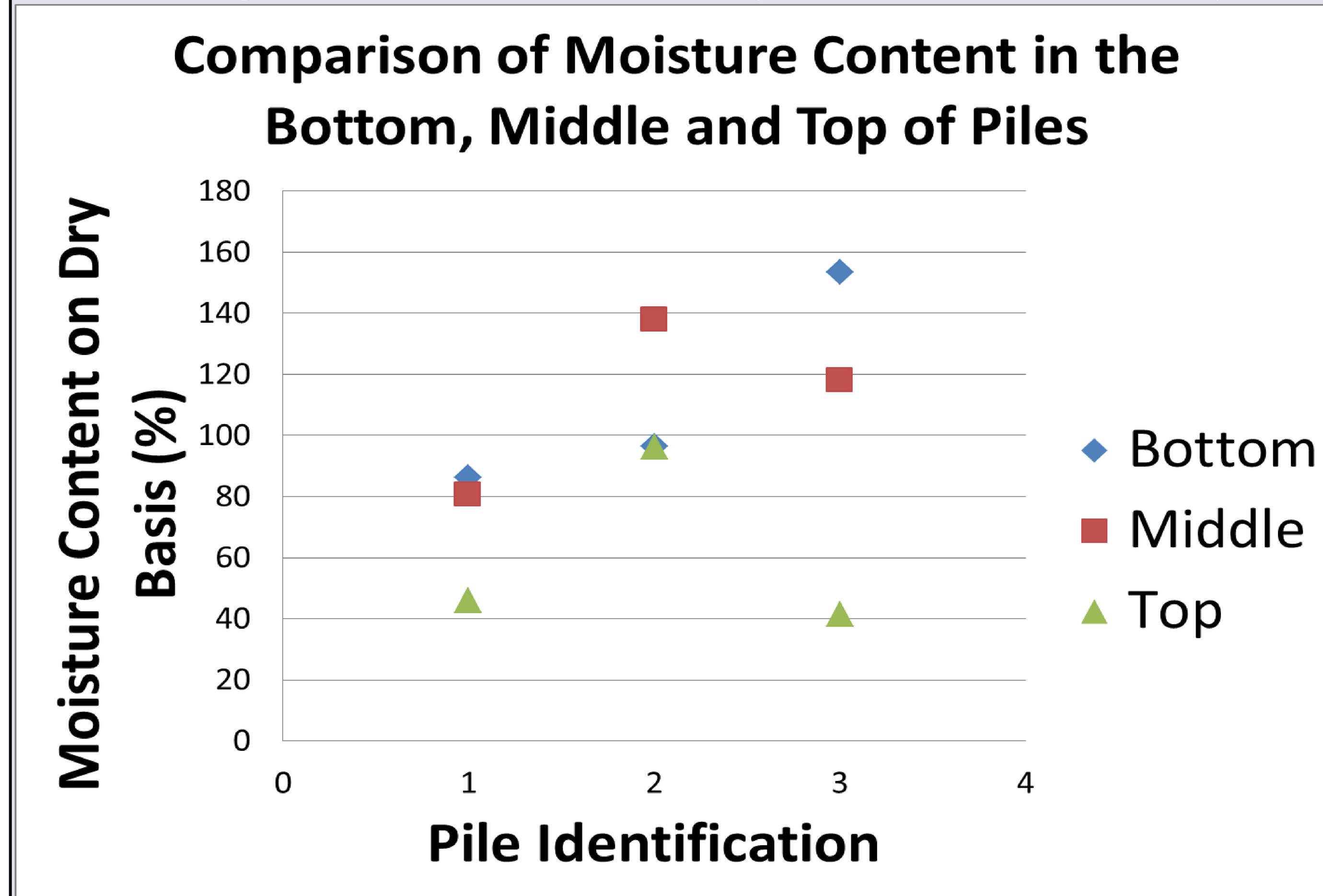
Another issue we are having is with the ground piles. The WILE is supposed to be used on biomass piles that are uniform in their material type, however the ground piles we are finding are not very uniform at all. This is making it difficult to get accurate results from the WILE

Preliminary Results

Given that my coworkers and I are only in week six of the nine week research project, we do not have all the results yet. However we have a lot of data on the moisture content from the drying period using this formula (Simpson 4):

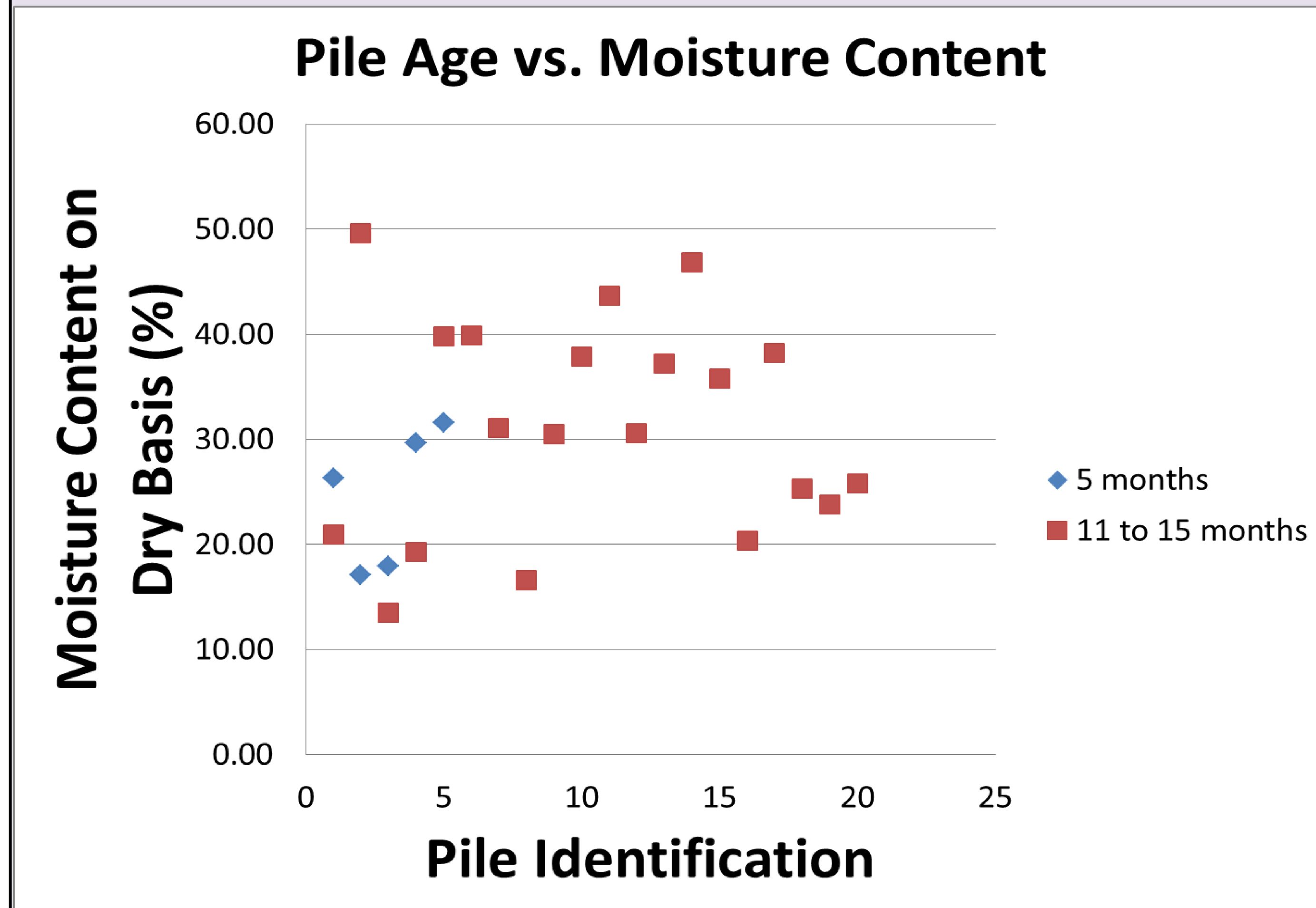
Moisture Content (%) = ((Green Weight-Dry Weight)/Dry Weight)*100

Three of the piles were opened up for us so that we could take samples from the bottom, middle and top of the piles. The following is the average moisture content on a dry basis from those three piles:



With the exception of the second pile, the bottom pile was highest in moisture content, then the middle, and then the top. This shows that the moisture content of a pile increases deeper into the pile.

Below is the age of the piles compared to their moisture contents:



Since we don’t know the age of many of the piles, this data is fairly inconclusive as of right now. A conclusion will hopefully be reached once there is more information on the piles.