

Pyrolytic decomposition of Ponderosa pine (*Pinus Ponderosa*) bark: West vs. Eastern regions of the U.S. (Phase II)

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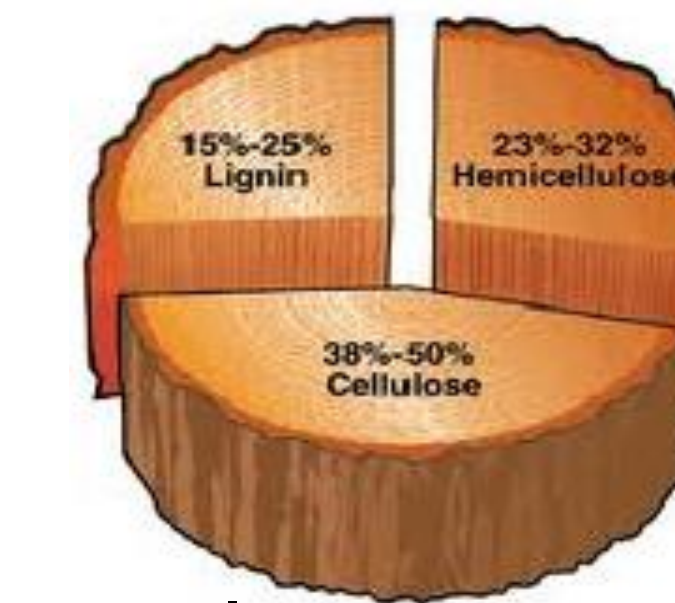
Introduction

In this research I focused on Pyrolysis, and looked more in depth with what's happening with the weight loss in the bark sample. I used a Thermogravimetric Analyzer machine also known as a TGA system to help with my research. TGA is a method of thermal analysis in which changes in physical and chemical properties of materials are measured as a function of increasing temperature (with constant heating rate). I was trained by Michael Lombardo a PhD student, to be able to use the TGA system, This experiment was conducted in the department of Chemical Engineering at the University of Washington.



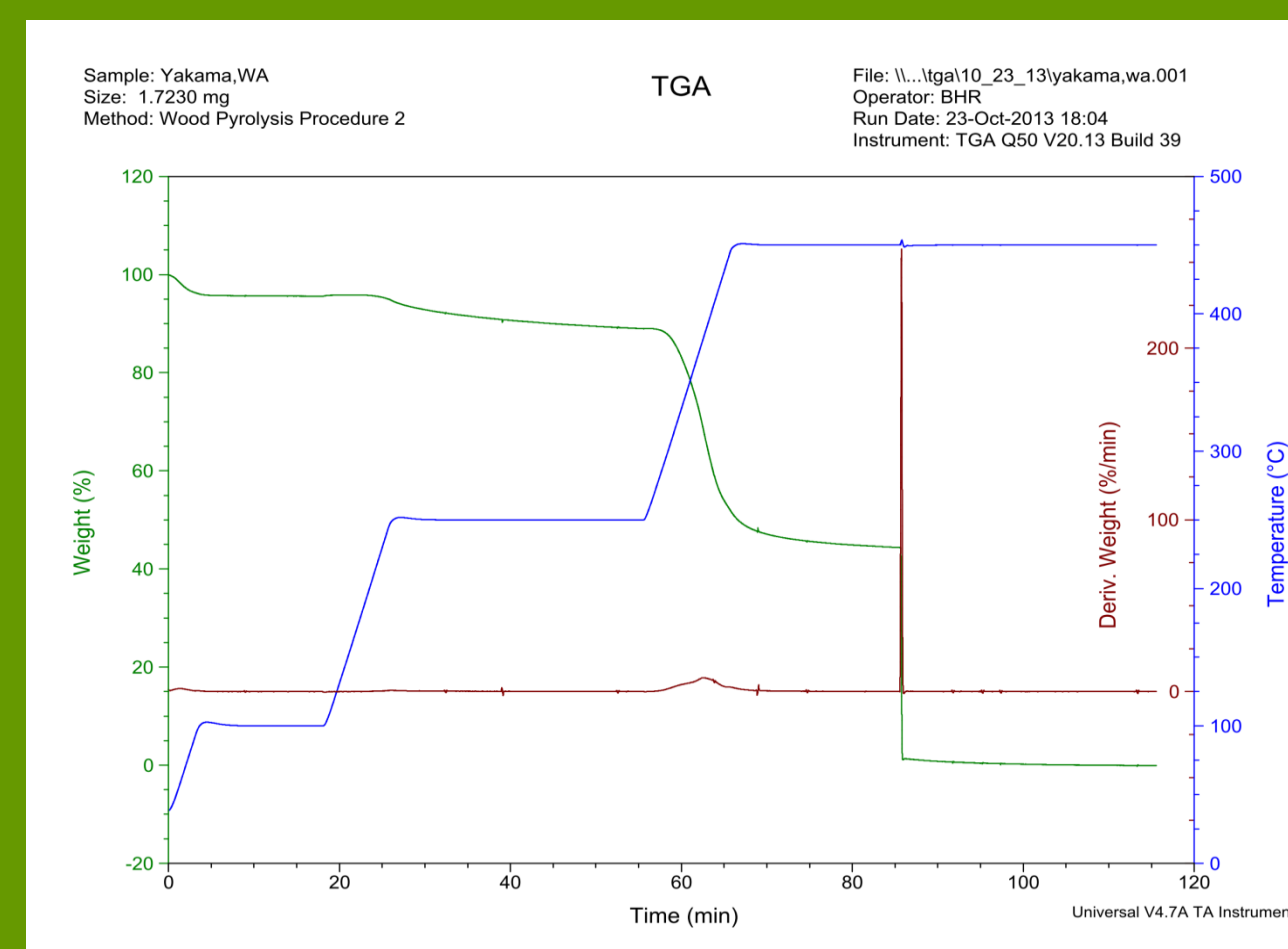
Hypothesis

For this experiment, I am hypothesizing that as the heat exceeds boiling point (100°C) the bark samples will have comparable results to each other for weight loss in the Hemi Cellulose (200-280°C), and Cellulose stage (280-320°C)

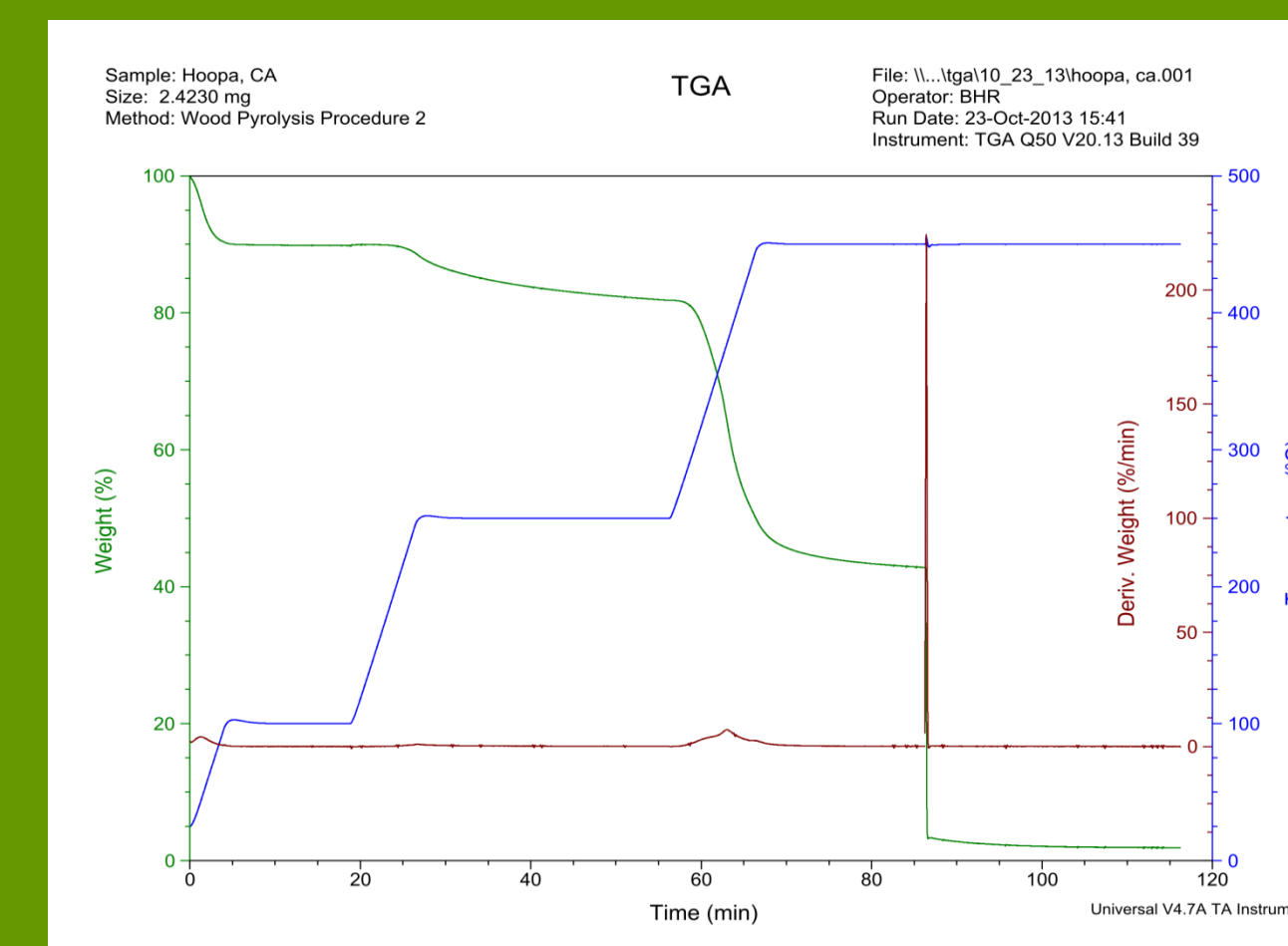


160° = Dehydration phase
 200-280° = Hemi cellulose decomposition
 280-320° = Cellulose decomposition
 320°+ = Lignin decomposition

When the bark samples were collected Yakama had a thick layer of bark, then Hoopa. Mescalero and White Mt. Apache had a small layer of bark as also felt really dry along with Hoopa, when Yakama felt a little moist.



Yakama, Washington



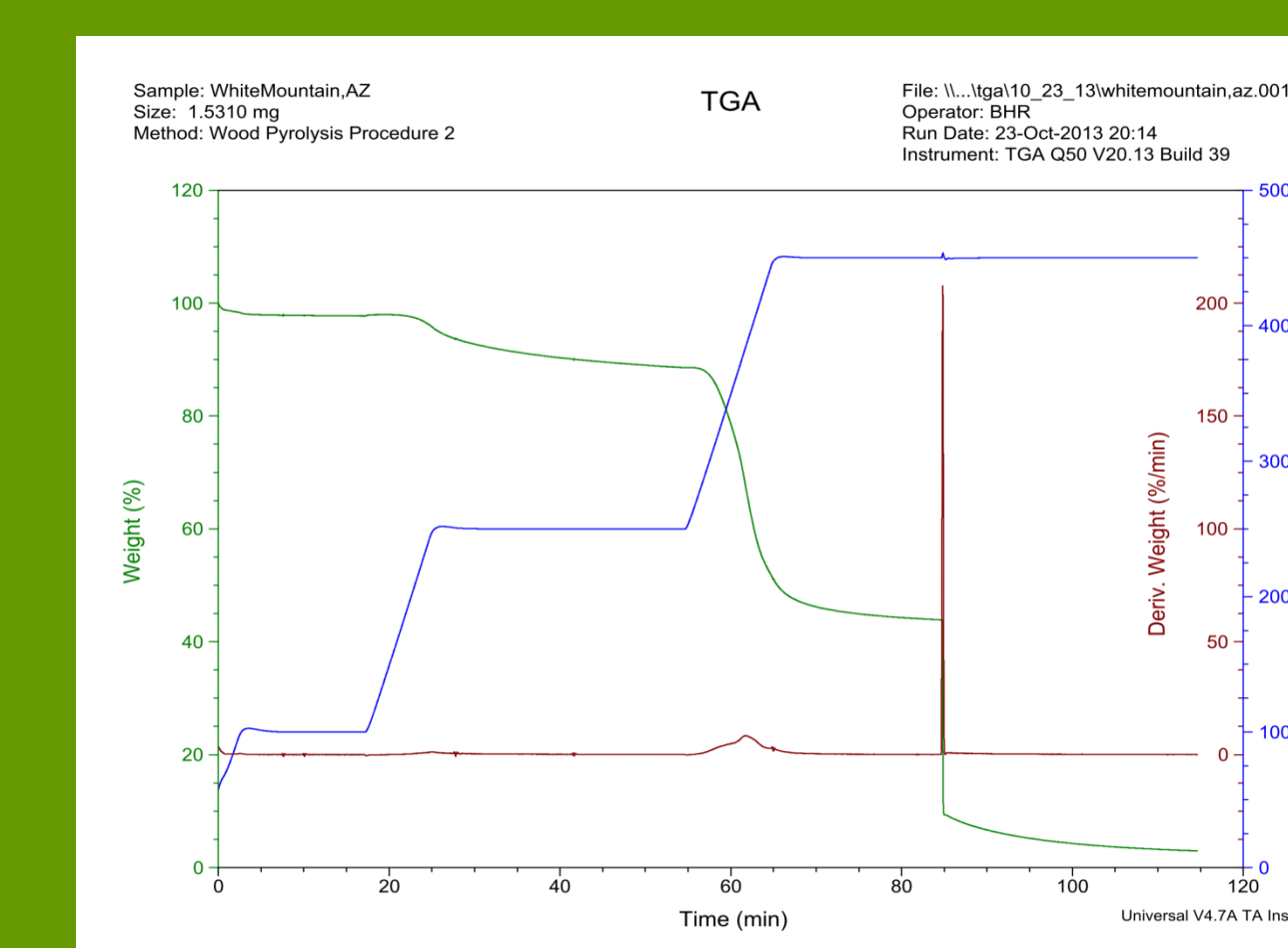
Hoopa, California

Ponderosa Pine Range

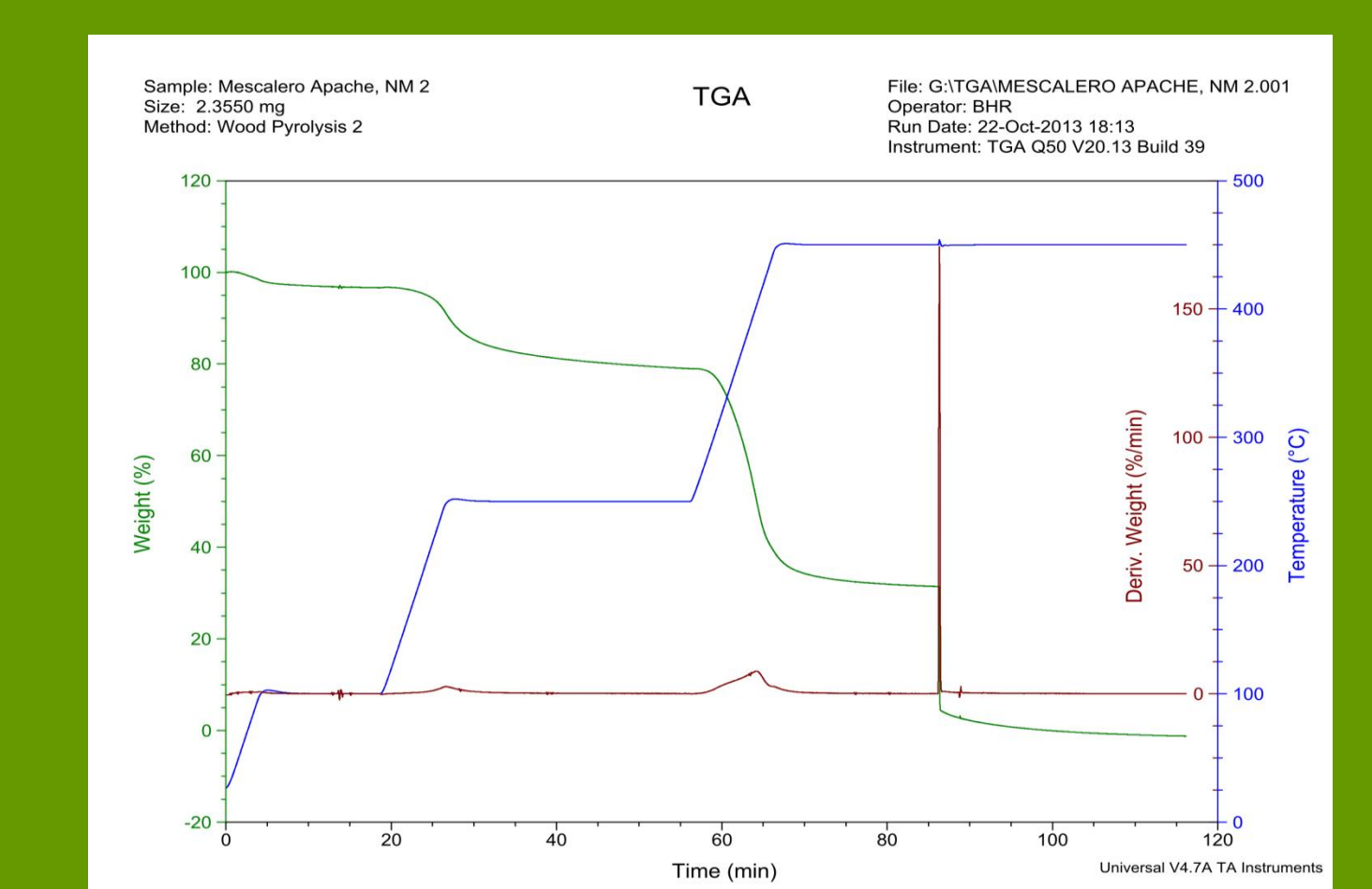
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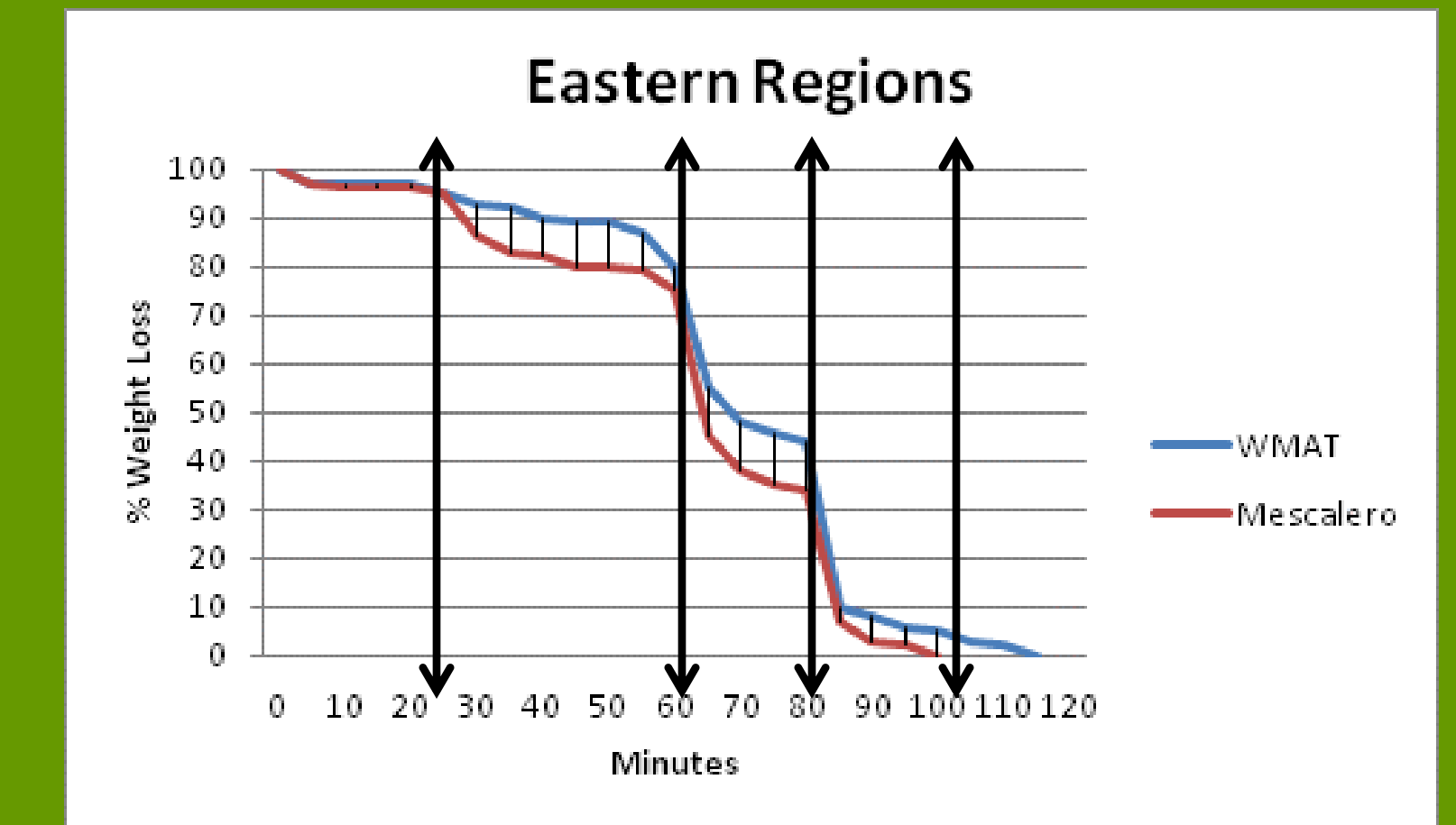
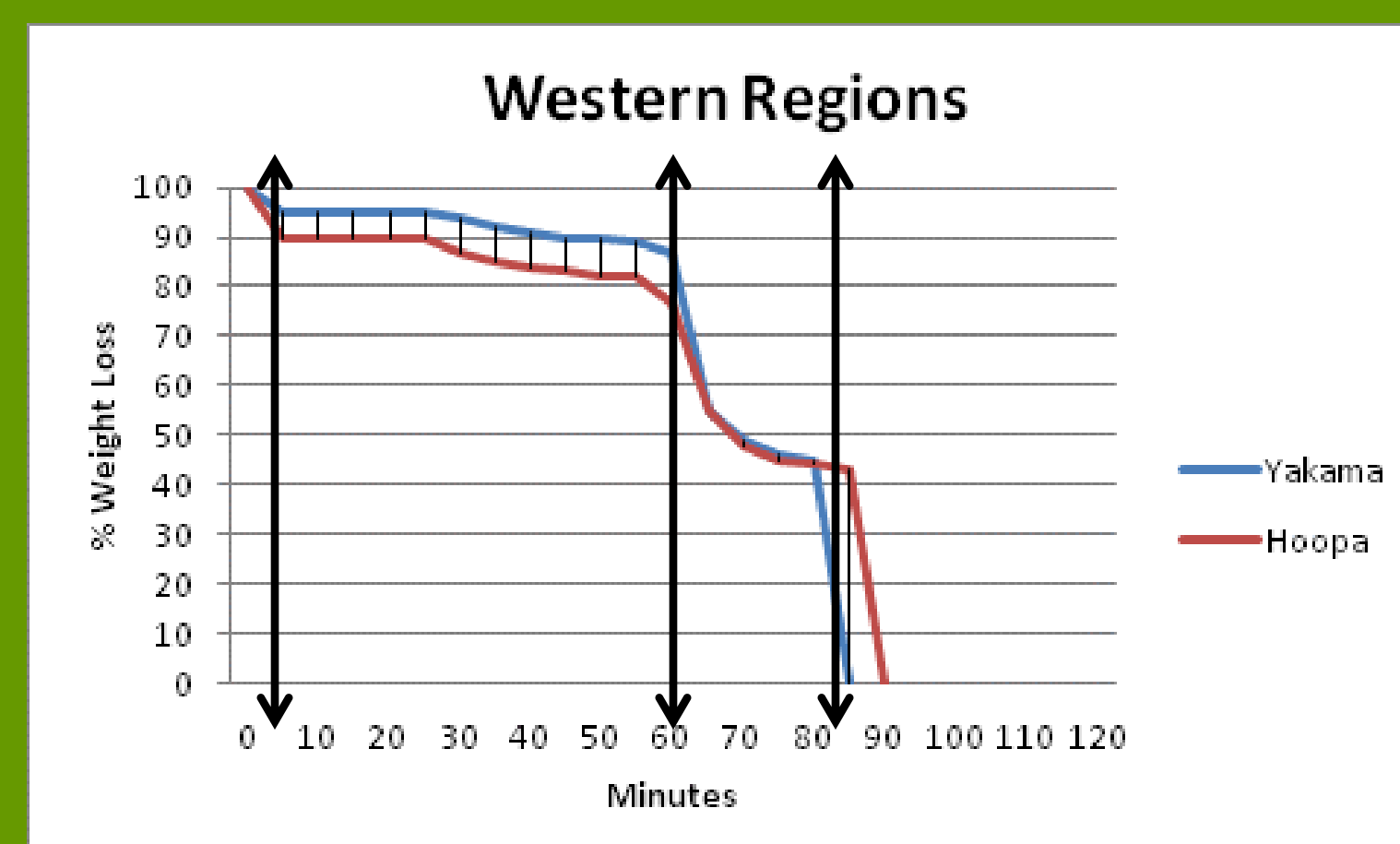
Conclusion



White Mt. Apache, Arizona



Mescalero Apache, New Mexico



The results showed some differences for the East vs. West regions. In the western regions, there are 2 distinct patterns of dehydration. In the eastern region samples, there are 3 distinct patterns of dehydration. Three samples dropped in weight by 5-3% as soon as the temperature hit 100°C, however the Hoopa sample dropped a full 10% within the first five minutes of the test.

From my hypothesis, I predicted that in the Hemi Cellulose and Cellulose stage, the weight loss would be similar to each other, that said they all did go down an average 22% at around 350°C.

In this stage of pyrolysis, the Hemi Cellulose and Cellulose decomposition weight loss of the samples is caused by VOC's, CO, and CO2 being released from the bark sample, VOC being Volatile Organic Compounds, CO being Carbon monoxide, and CO2 being Carbon Dioxide.

Methods

1. Obtain samples and drill with 1 inch spade bit to create bark shavings.
2. Grind the bark samples using a coffee grinder, to use in the TGA.
3. Start the TGA, set oxygen tank to 20 psi (pounds per square inch).
4. Check the heating rate, set it to 20 c/min, set isothermal to heating ramp of 100°C, then add 2 more isothermal heating ramps, 1 to 250°C, and then the last one to 450°C.
5. Set one last isothermal that will switch to Gas 2 (Oxygen)
6. Press the Tare button, put 10 mg of one of the bark powder onto platinum basket. press the sample button let the TGA load/weigh the sample.
7. After the TGA weighs and loads the sample, then you may start the experiment.
8. During experiment study the graph as it is in progress to see how the burn off is going.

References:

1. <http://blogs.princeton.edu/chm333/f2006/biomass/treepie.gif>
2. http://nsm1.nsm.iup.edu/for/projects/Cellulose/Wood_McBroom.pdf
3. https://mail-attachment.googleusercontent.com/attachment/u/0/?ui=2&ik=7497baa9ea&view=att&th=14202a55a1df1ff8&attid=0.1&disp=inline&realattid=f_hncoo7710&safe=1&zw&saduie=A_G9B_P-VFMPToCo1S2MINQ3fi8-H&sadet=1383024885547&sads=U1Nlq1NbZUJzB0L088Bl39Sg7Uk&sadssc=1

Acknowledgements:

1. Daniel Schwartz, Michael Lombardo & Jeff Richards
 UW Chemical Engineering (TGA)
 1. Laurel James – University of Washington
 2. Mr. Gaffey, Roosevelt High School
- BARK SAMPLES:
1. Mark Nuetzmann, – Yakama, Erica Enjady – Mescalero Apache, Darin Jamaghan - Hoopa,, Randy Fuller - White Mountain Apache