

IPRO 321 Blood, Sweat, and Beers

Introduction

Zymurgy, the practice of fermentation in brewing, is a multi-billion dollar industry and profession that dates farther back than even the beginning of America. It is a stable market that exists on a small scale, such as a microbrewery, or on a larger level, such as a global corporation. The key to a successful business in this industry is a delicious product whose recipe can be designed through a scientific examination of the ingredients used and chemical processes that occur in fermentation.

Mission Statement

Our mission is to effectively work as a team of engineers and scientists to produce a high-quality beer that all can enjoy and market our product on campus.

Business Plan

Blood, Sweat, and Beers Group provided preliminary analysis for continuing the project at IIT, but creating an economically viable brewery was outside of the scope of the current IPRO project.

The groundwork has been laid for preliminary cost analysis. Cost of materials, labor, licenses, and applicable taxes are listed in figure 1 to the right.

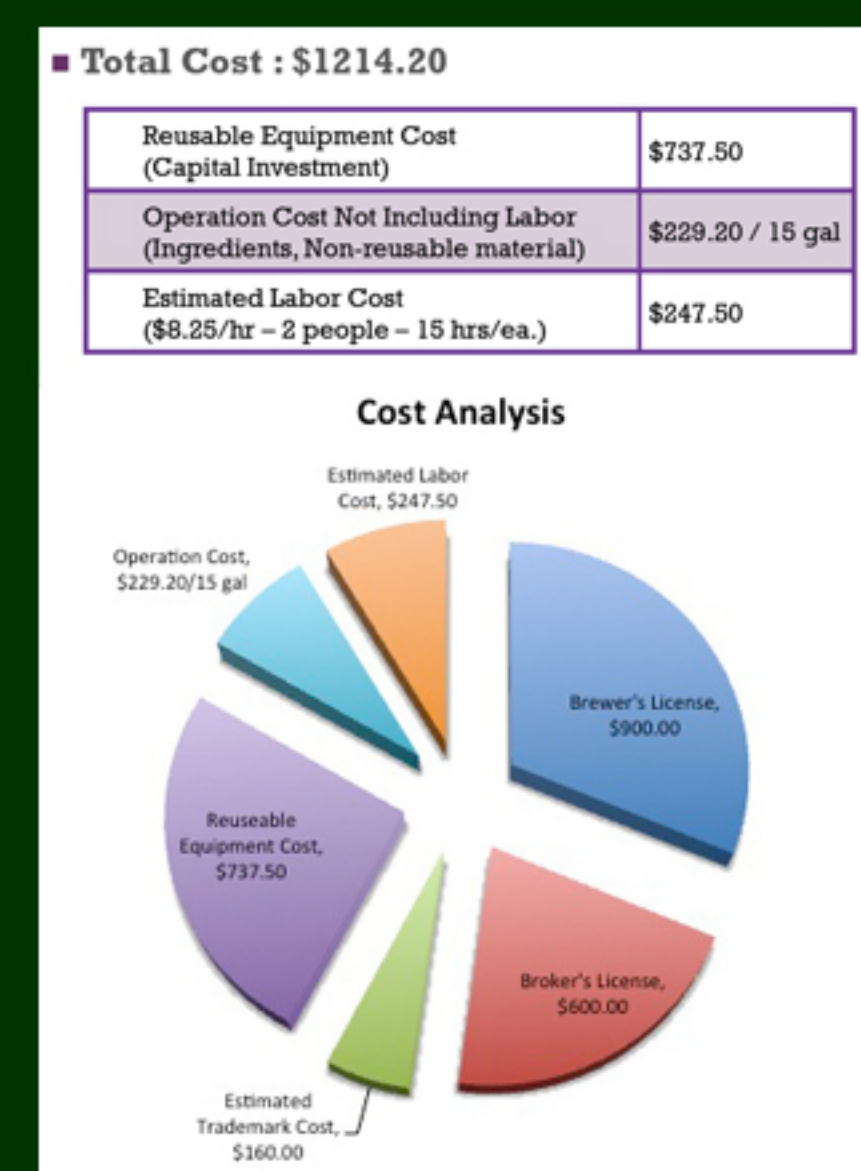


Figure 1, Cost analysis of the Beer Brewing at IIT.

Brew Quality

Brews were made using the finest purified water to ensure untainted taste and brew. It was brewed in the halls of Illinois Institute of Technology to ensure the constant love and attention it needed. Multiple batches were made to test variations of the recipe and samples were taken during fermentation changes to ensure the best taste. Samples will be given to those older than the legal drinking age and guests are encouraged to give us feedback.

Safety

The main concern when brewing beer is personal safety. Explosions from heated substances and pressure build up are generally more associated with, but not limited to industrial scale brewing. The possibility of explosion lies in the following conditions:

- flammable dust that arises from grain storage
- milling or transport operations
- anything that involves dry cereal or grain

Sanitation is a necessity in brewing beer anywhere. There is a difference between cleaning and sanitizing, cleaning is the removal of dirt and grease, while sanitizing removes the unseen bacteria and other microorganisms. All brewing equipment was cleaned and sanitized prior to usage in this project.

Kinetics and Heat Transport

Kinetics

Glucose breaks down in a 10-step process called glycolysis when it enters the yeast. Two pyruvates, which are three-carbon sugars, and adenosine triphosphate (ATP) are the products of glycolysis. The yeast converts the pyruvates into carbon dioxide and ethanol, which is the source of alcohol in the desired beer.

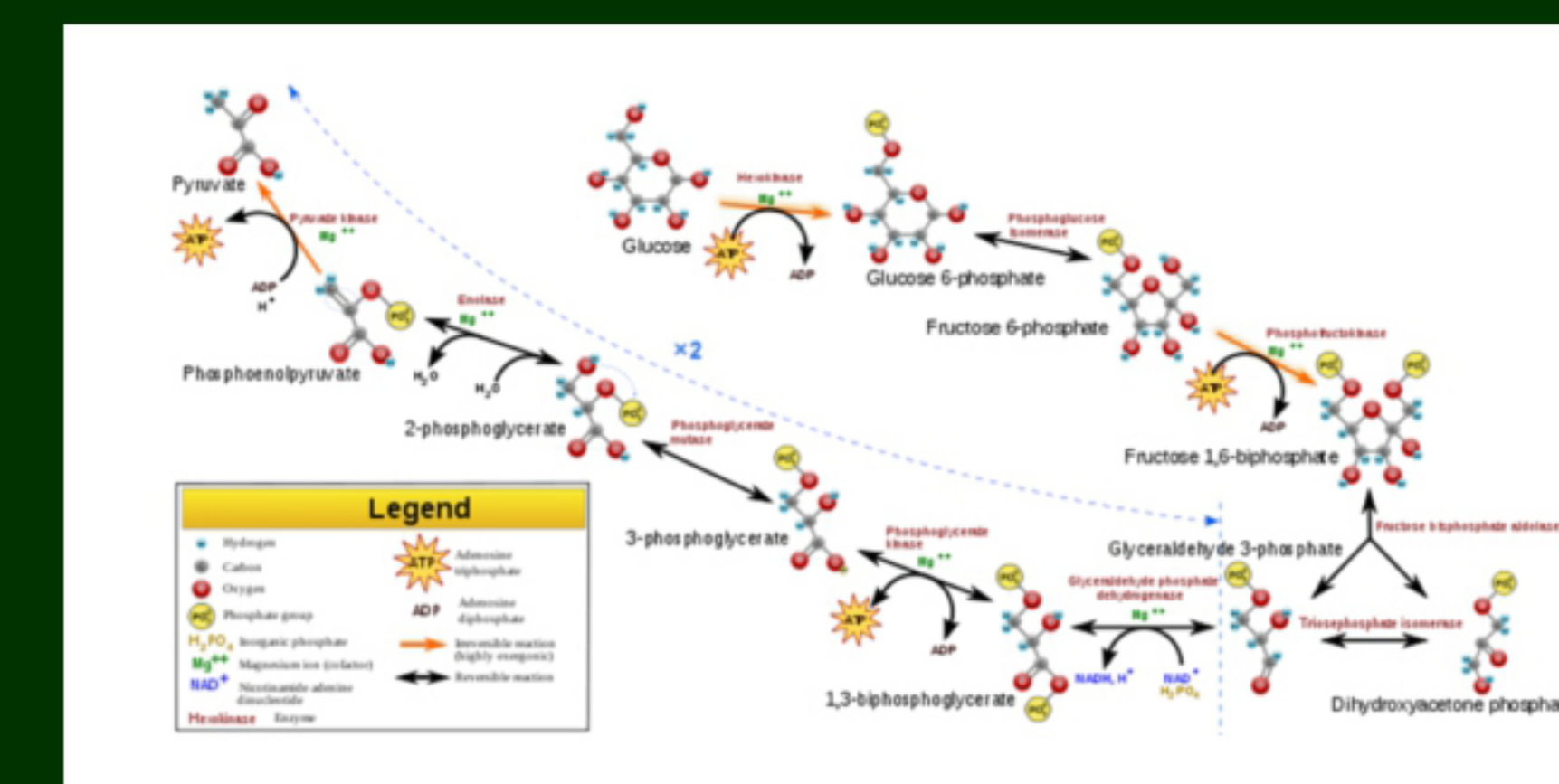


Figure 2, Diagram of glycolysis reaction

Heat Transport

As the wort was chilled, the temperatures of the wort and outlet water stream were measured. Heat transfer analysis was performed and the results are in Figs. 5 & 6 below.

With a more sophisticated analysis the heat transfer coefficient could be estimated and used to scale the process or optimize utility usage or production time.

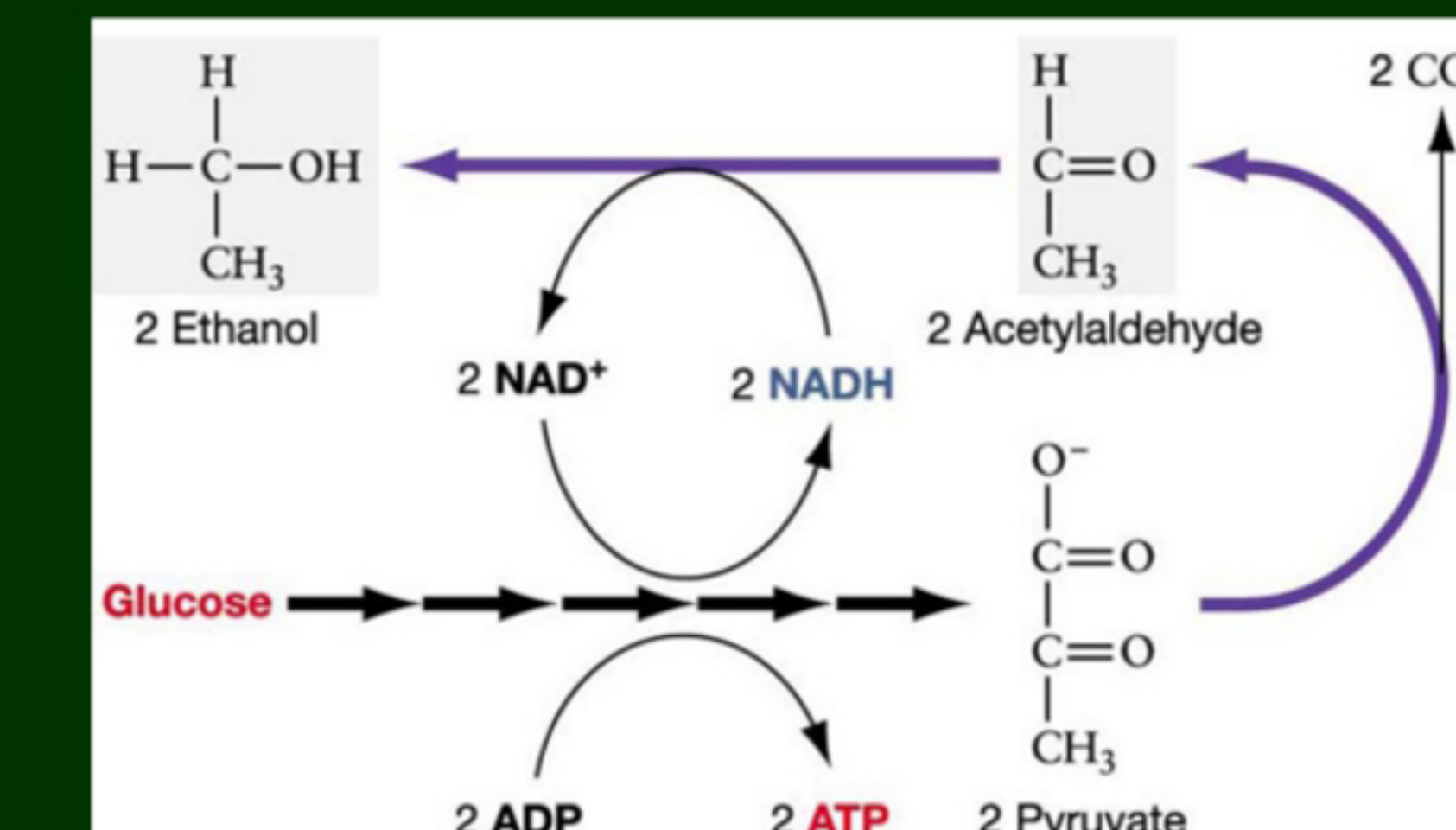


Figure 3, Fermentation of glucose in beer

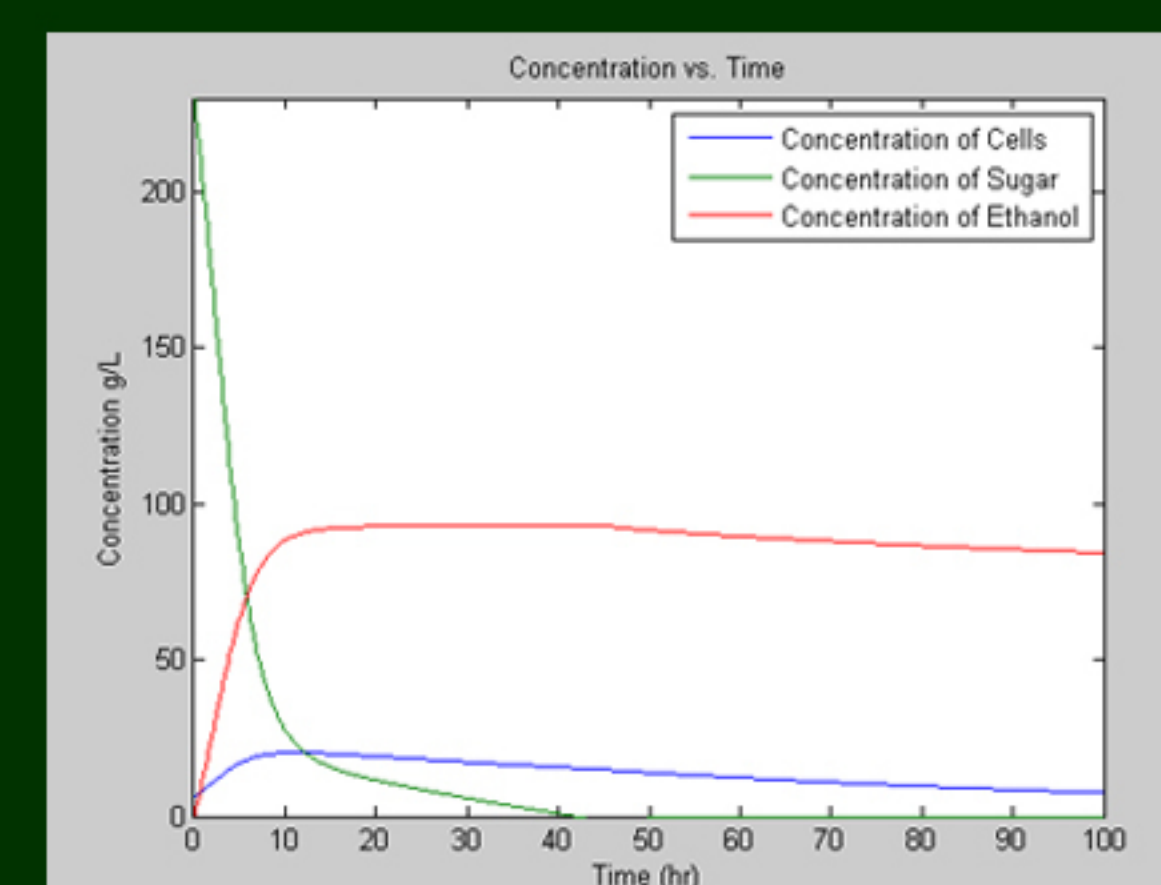


Figure 4, Simulated Concentrations of yeast cells, glucose, and ethanol versus time using Matlab.

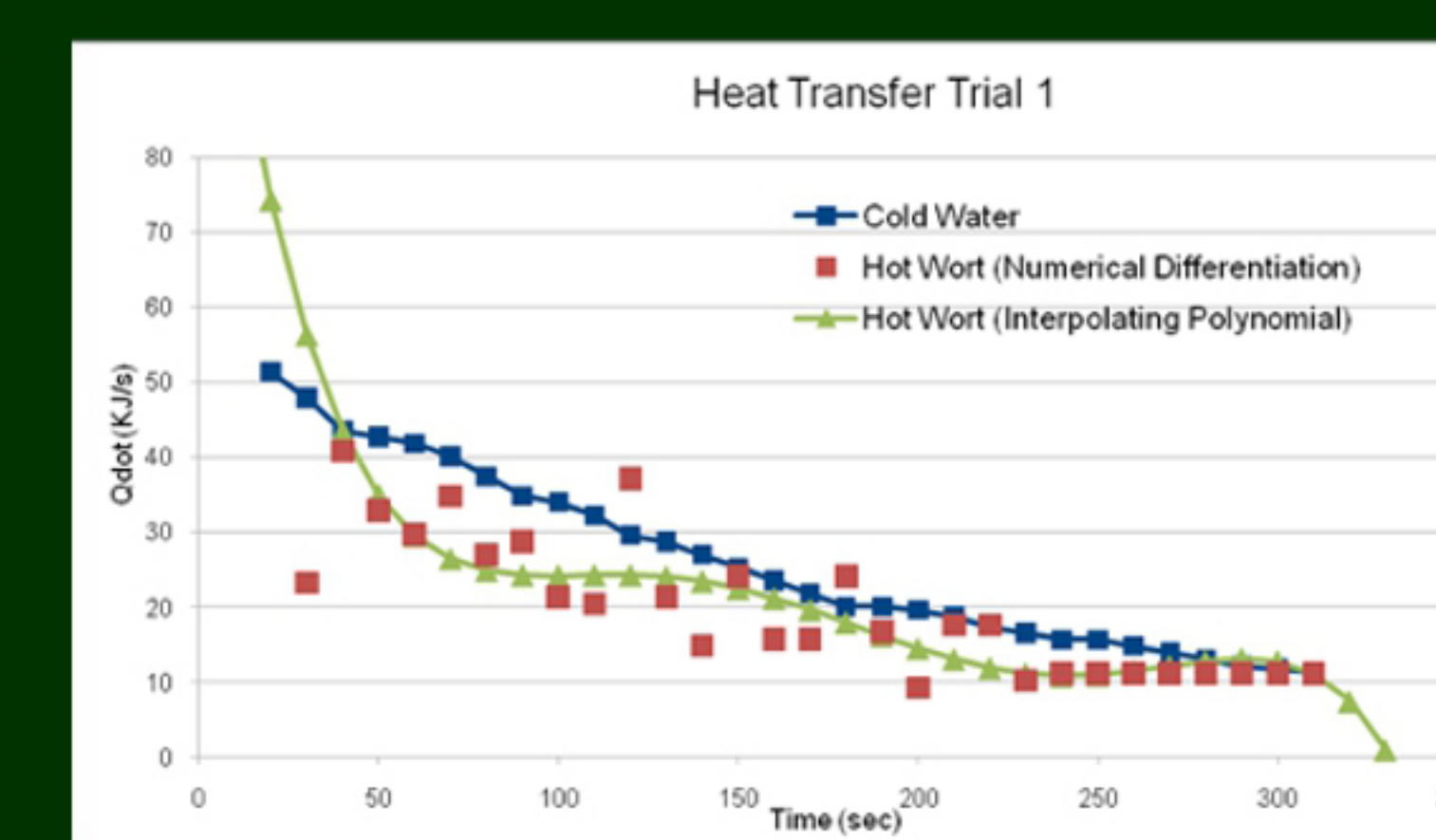


Figure 5, Measured heat transfer of wort chilling versus time

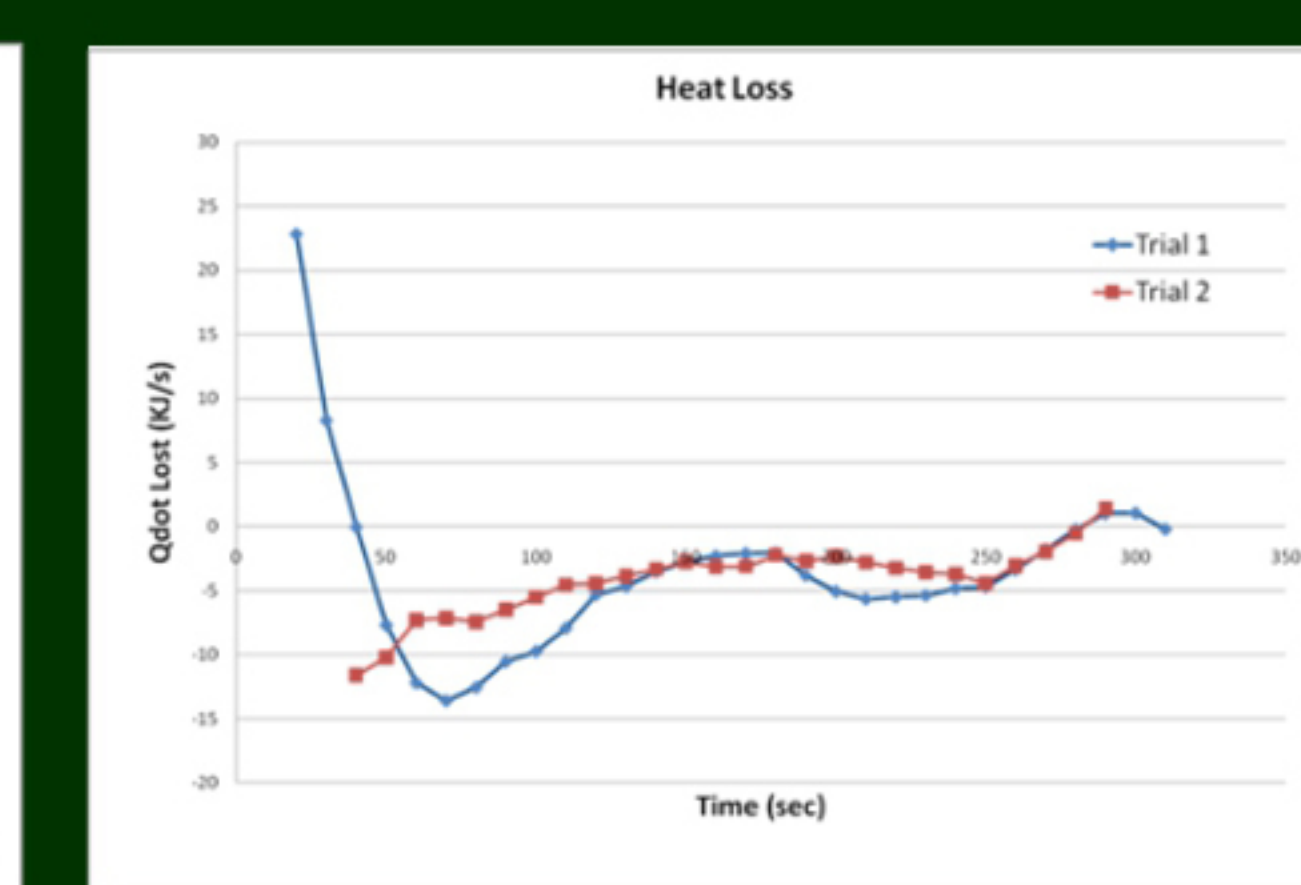


Figure 6, Calculated enthalpy lost versus time

The Tipsy Professor: A Bavarian Weizen

- Boil time: 60min
- Amount Item Type
- 5.00lb Wheat Malt, Ger (2.0 SRM) Grain
- 4.00lb Extra Light Dry Extract (3.0 SRM) Extract
- 0.50oz Tettnang [4.50%] (60 min) Hops
- 0.50oz Tettnang [4.50%] (30 min) Hops
- 1.00tsp Irish Moss (boil 15.0 min) Additive
- 1.50lb Honey (45 min boil) Additive
- 0.50oz Ginger Root (boil 12 min) Additive
- 0.75oz Orange Peel, Bitter (boil 5 min) Additive
- 6.00gal Wasser Water
- 1PKG Weihenstephan Weizen (Wyeast Labs #3068) Yeast

Acknowledgments



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