A Simple Fermentation Monitoring and Control System

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Overview

• Limitations facing the homebrewer
• BeerTherm
  • Temperature control system for the home-brewer
  • Video demo
• FermAT
  • Fermentation monitoring system for fingerprinting
Problems faced by a Homebrewer

• Temperature control is what the home environment allows
• Not knowing how fermentation is progressing
• Reproducibility and consistency
Experiments with Temperature Control or How to get a quick separation
BeerTherm – Why control?

• Fermentation Temperature impacts Beer
  - Slow growth
  - Incomplete attenuation
  - Fusel oils, diacetyl, esters
  - Flavor profile

• Effect of Temperature on Beer
  - Determine best fermenting temperature
  - Explore the boundaries of your homebrew
BeerTherm

Peltier Element and/or Heat Sink Fan

Temperature Display and User Interface

Temperature Controller

Temperature Sensor
BeerTherm - Capabilities

• Insulated Chamber with Temperature Control
• Temperature range
  45°F – 100°F
• Accuracy ± 0.2°F
• Beta Model
  • Tested brewing ale and lager
  • Currently brewing a lager
www.kickstarter.com /BeerTherm
BeerTherm – What Next

• Product offering for brewers
• Expand to have multi-chamber system
• Expand to have higher capacity
Current Practice in Fermentation Monitoring

• Fermentation is monitored by sampling and testing
  - Extract
  - Alcohol

• Not commonly done by home-brewers
• Cumbersome and time consuming
• Discontinuous and not real-time
FermAT – How it works

• Sugars + Yeast = More Yeast + CO2 + Alcohol

• Amount of CO2 is directly proportional to Alcohol produced

• Measure CO2 evolution to estimate sugar consumption and alcohol production
FermAT – How it works

• CO2 flow is measured using thermal conductivity
• Data is transmitted wirelessly to software
• Software displays charts and data real-time and continuously
• http://www.QuantiPerm.com
FermAT – Case Studies

• 20 – 120 bbl microbrewery scale fermentations
• 100 mL – 10 gallon laboratory fermentations
• Several ales and a lager were tested
FermAT - Results

• 40 bbl Ale Fermentation
FermAT - Results

• 20 bbl Ale Fermentation

![FermAT signal, Ferm Rate](#)

**Elapsed Time, h**

**FermAT Total (v/v)**

**FermAT signal, Ferm Rate**

**FermAT- Ferm Total**

![Graph showing FermAT signal and FermAT total over elapsed time](#)
FermAT - Results

Alcohol Estimation

\[ y = 0.9718x \]

\[ R^2 = 0.9917 \]

Extract Estimation

\[ y = 0.9818x \]

\[ R^2 = 0.9905 \]
FermAT – Case Study Summary

• Able to monitor fermentation CO2 evolution continuously and in real-time
• Close correlation between off-line and real-time data for sugar and alcohol
• Ales and Lager fingerprinted
  - Deviations from norm can be easily detected
FermAT – What Next

• Current version suitable for larger scale fermentations

• Scaled down instrument for home-brewing applications in progress
Summary

• A simple control system for fermentation for the home-brewer
  - Develop, explore, and optimize your recipes
  - Explore range of conditions for your home-brew

• Non-invasive, continuous, real-time monitoring of fermentation
  - Fingerprint your home-brew
  - Identify deviations and root-cause