# A Simple Fermentation Monitoring and Control System

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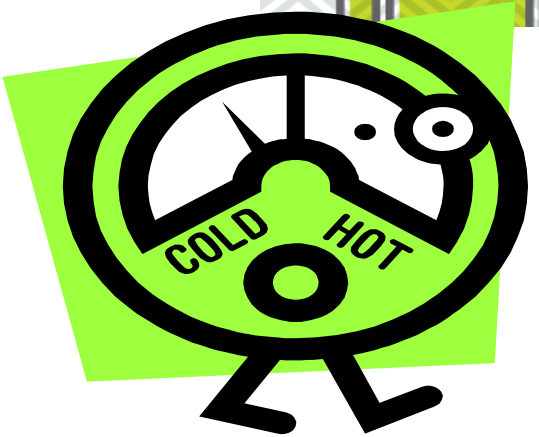
# Overview

- 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

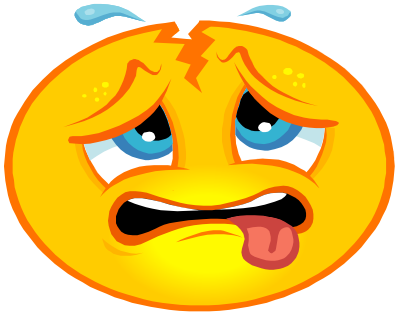
- Temperature control is what the home environment allows
- Not knowing how fermentation is progressing
- Reproducibility and consistency

# 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

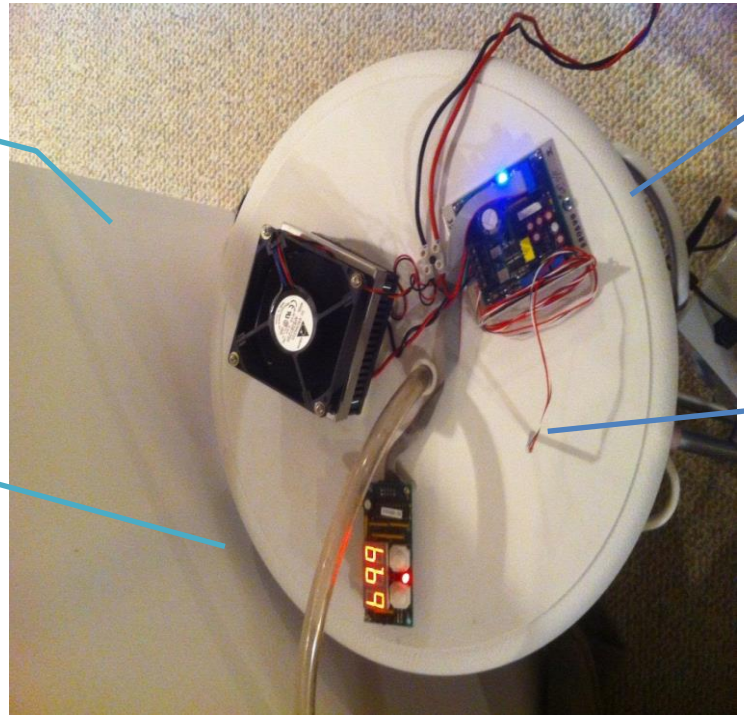


- Effect of Temperature on Beer
  - Determine best fermenting temperature
  - Explore the boundaries of your homebrew

# BeerTherm

Peltier Element and/or Heat Sink Fan

Temperature Display and User Interface



Temperature Controller

Temperature Sensor

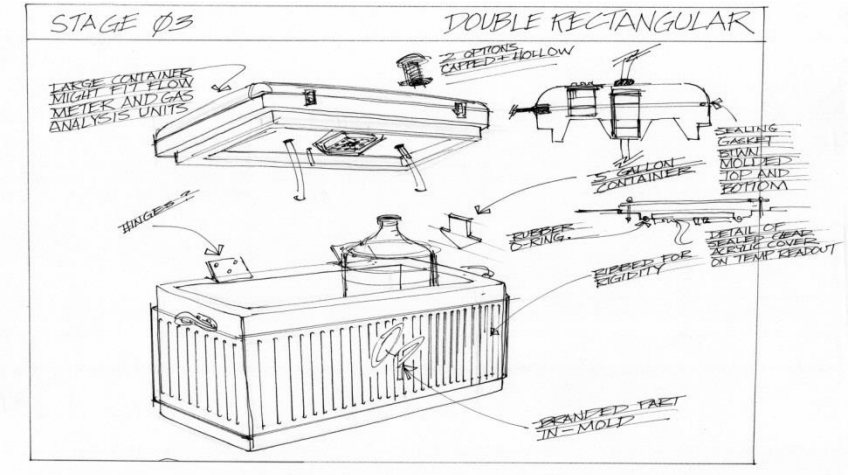
# BeerTherm - Capabilities

- 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 + $CO_2$ + Alcohol
- Amount of $CO_2$ is directly proportional to Alcohol produced
- Measure $CO_2$ evolution to estimate sugar consumption and alcohol production

# FermAT – How it works

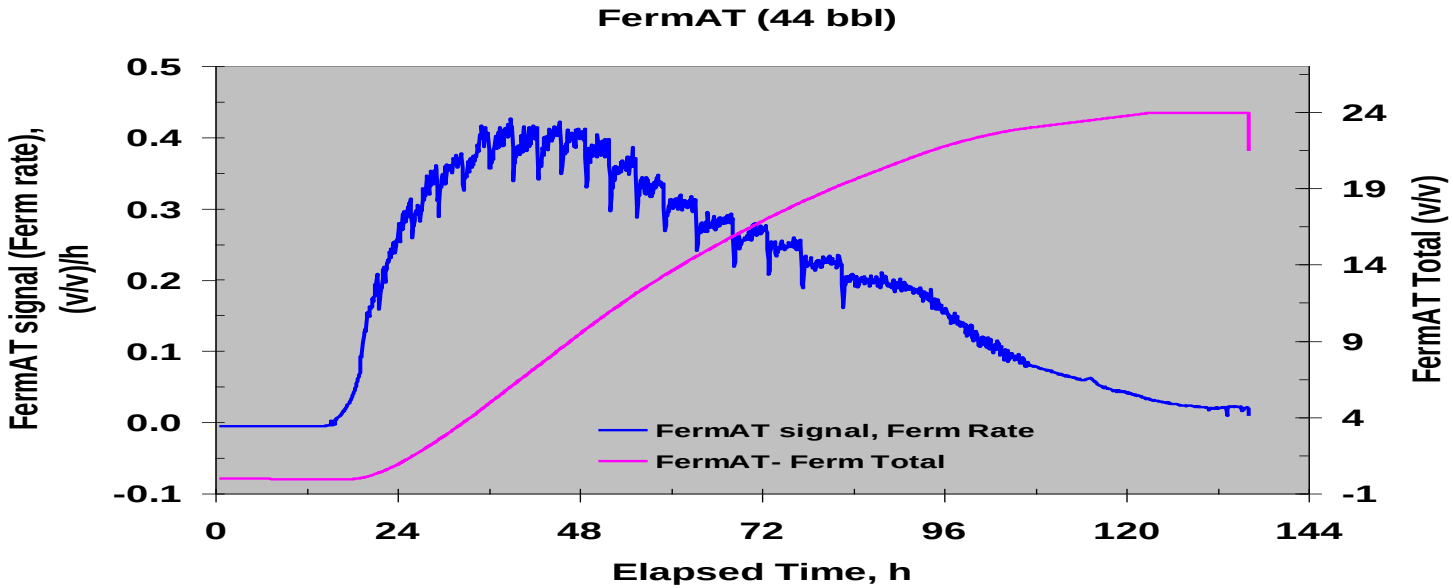
- $CO_2$ flow is measured using thermal conductivity
- Data is transmitted wirelessly to software
- Software displays charts and data real-time and continuously
- http://www.QuantiPerm.com

# FermAT – Case Studies

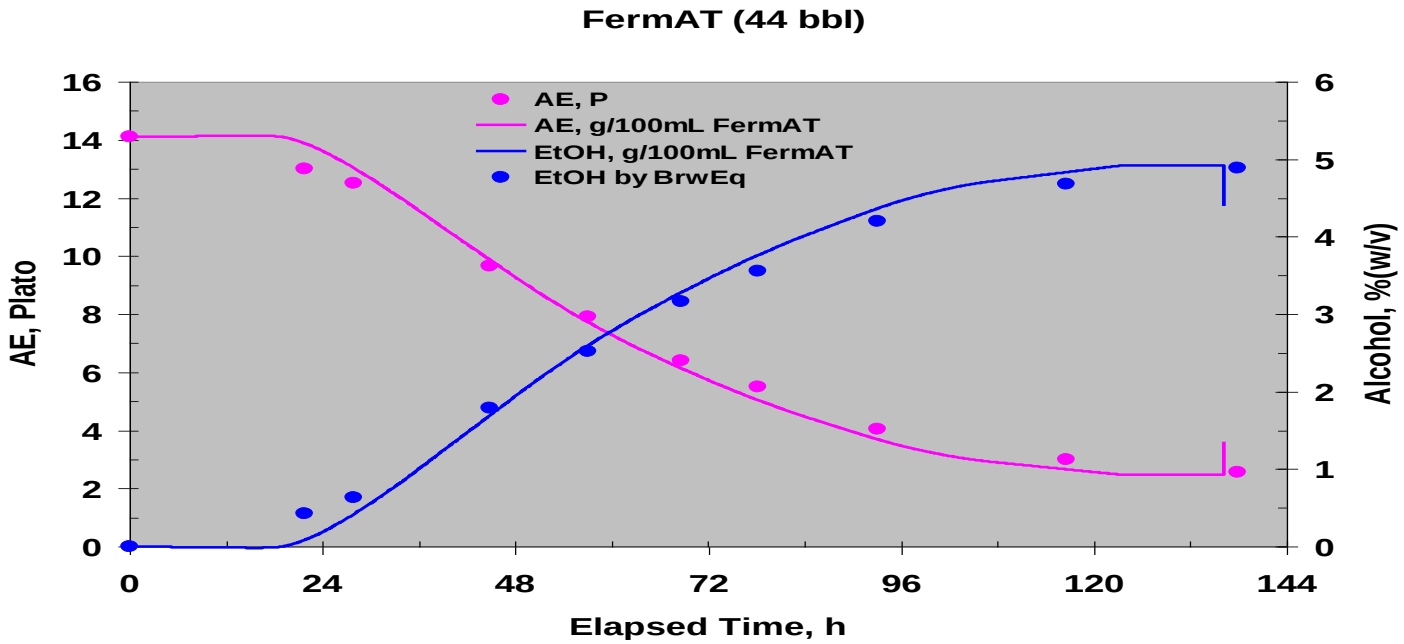
- 20 – 120 bbl microbrewery scale fermentations
- 100 mL – 10 gallon laboratory fermentations
- Several ales and a lager were tested

# FermAT - Results

- 40 bbl Ale Fermentation

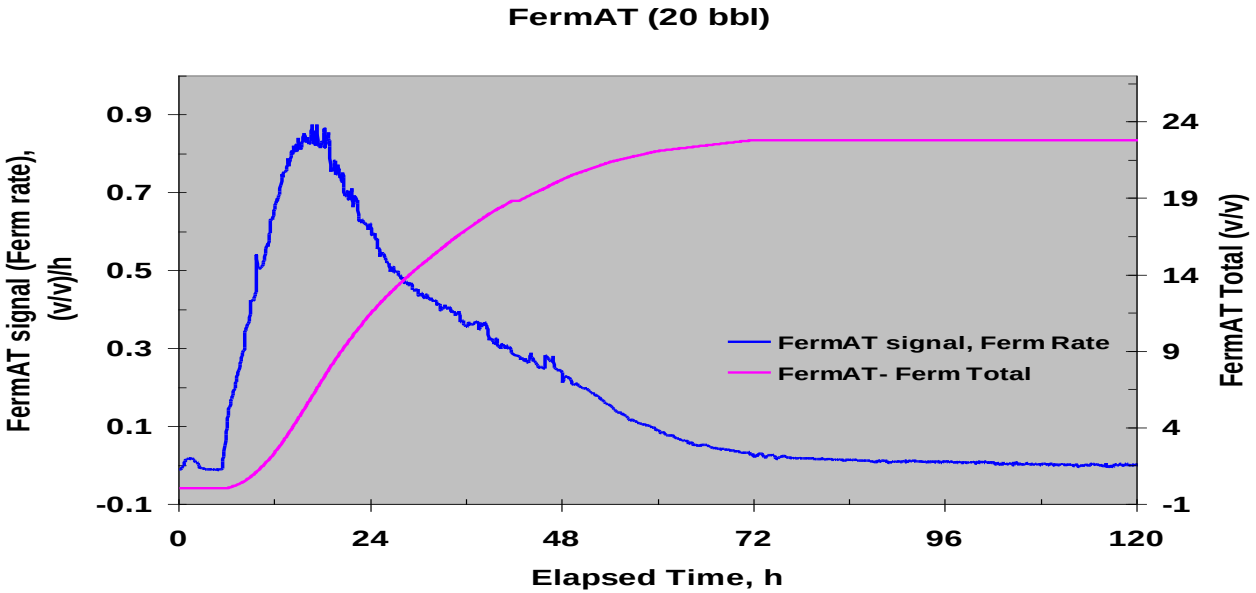


# FermAT - Results

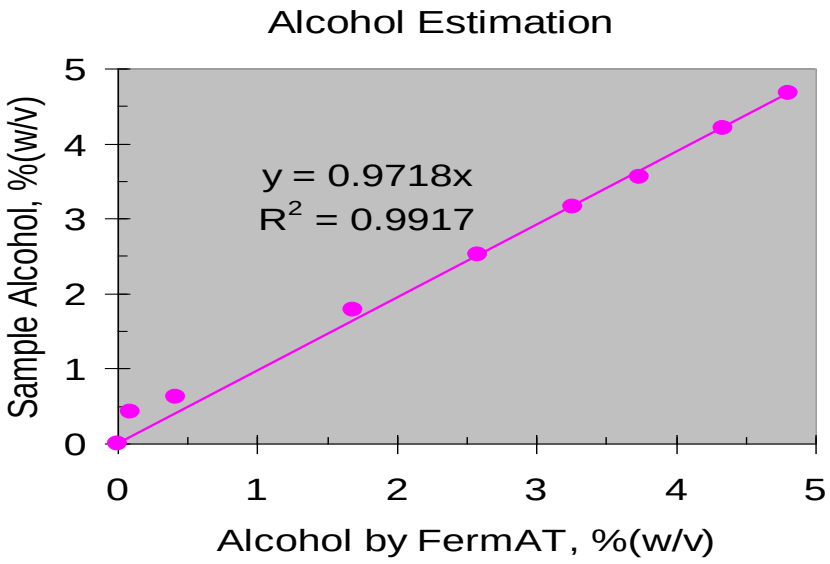


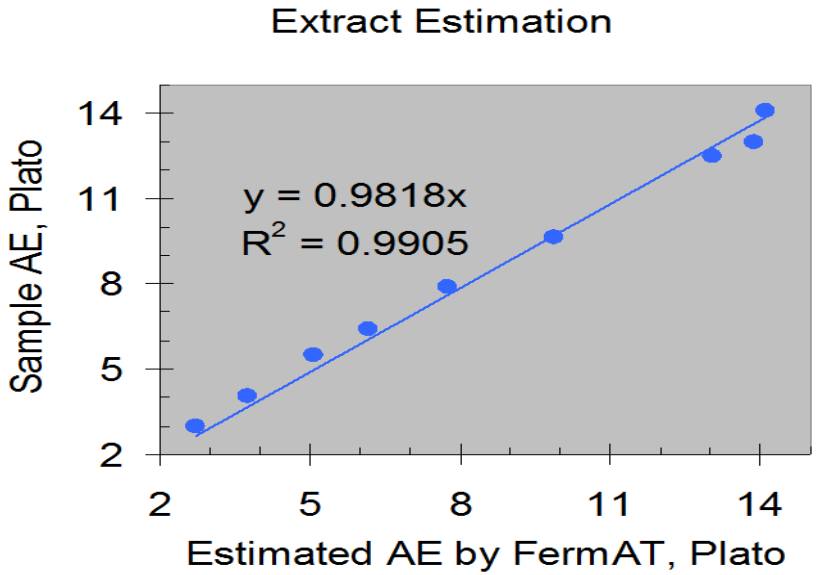
# FermAT - Results

- 20 bbl Ale Fermentation



# FermAT - Results



# FermAT – Case Study Summary

- Able to monitor fermentation $CO_2$ 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