




# Measuring Wort Gravity a.k.a. Gimme Some Sugar!

# OG / SG / FG

-  SG – Specific Gravity, a general term for a gravity measurement
-  OG – Original Gravity measured prior to fermentation
-  FG – Final Gravity measured after fermentation is fully complete.

# 2 (or 4?) Major Scales

## Brix (°Bx) / Plato (°P) / Balling

-  Technically different


-  1 Brix / Plato = 1 gram of **sucrose** in 100g of solution

-  Brix is Standard in Wine Industry

-  Plato is Standard in Pro. Brewing Industry, Europe

## Specific Gravity (SG)

-  Compares the density of liquid to pure water

-  Each 10 points (1.010) = 1% heavier than water

-  Does not directly tell you how much sugar you have

# How Do We Measure Gravity?

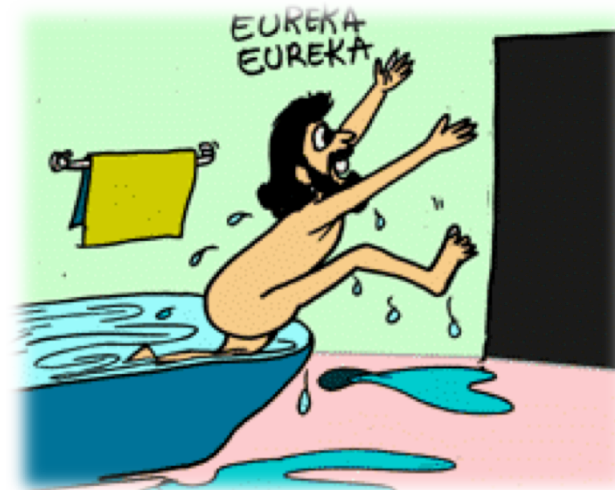
 Two ways amateur brewers can easily do it

 Hydrometer

 Refractometer

# Hydrometer

- ❏ Device that uses buoyancy to find gravity
- ❏ Eureka! Archimedes Principle
  - ❏ Fluids “lift” on objects according to how much volume the object occupies & liquid’s weight
- ❏ Wort lifts hydrometer
  - ❏ More sugar = more lift
- ❏ Most measure SG & Plato
  - ❏ Range 0.980 – 1.160
  - ❏ IGNORE % Alcohol scale!
- ❏ There are pro models

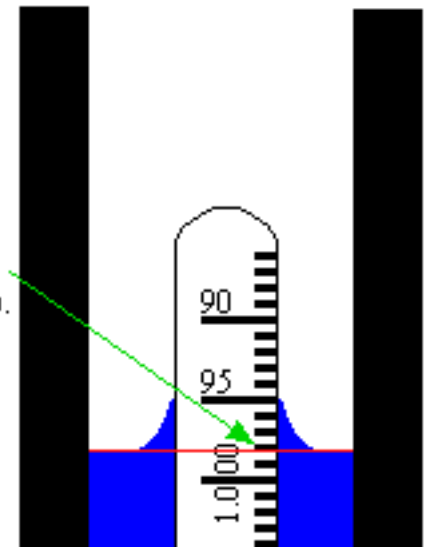


# Using a Hydrometer

- Floaties don't affect the reading!
- They are not in solution
- Measure below the meniscus!









Read specific gravity at the meniscus (the red line).



# Using a Hydrometer

- ☒ Hydrometers need to be calibrated
  - ☒ It's a roll of paper that can move!
- ☒ Add distilled water (Winnipeg's is close enough) at the calibration temperature.
  - ☒ Gravity should be 1.000
  - ☒ If it is not, all measurements need to adjusted +/- error!

# Temperature Correction

-  The temperature of the fluid affects its density
-  Hot wort is less able to “lift” a hydrometer as it is less dense.
-  Temperature Correction is easy if you have a calculator / chart
  -  <http://hbd.org/cgi-bin/recipient/recipient/hydrometer.html>
  -  Some calculators have max temperatures
  -  Be careful! Hot liquid + thin glass = CRACK!



# The Beer Recipator

A Beer Recipe Calculator

---

## The Brewery Home Spreadsheet Recipes Discussion

---

### Hydrometer Temperature Correction

Use this page to calculate corrections to your hydrometer reading based upon the temperature of the liquid. The correction formula is based on this [article](#) by Christopher Lyons.

Temperature units:  Fahrenheit  Celsius

Specific gravity:  *Enter the measured specific gravity (i.e. 1.052).*

Temperature (°F):  *Enter the temperature at which the SG was measured.*

**Calculate!**

Temperature (°F):  *The SG will be adjusted to this temperature.*

The adjusted specific gravity: **1.140**

---

*This web page copyright 1997-1998 by Mark Riley.  
All rights reserved.*

*Please direct any comments to [markril@hotmail.com](mailto:markril@hotmail.com).*

# Refractometer

 A device that uses bending of light in a prism

 Light bends differently in water with and without sugars  
(or anything else!)

 Snell's Law if you care...

 Unit temperature affects it

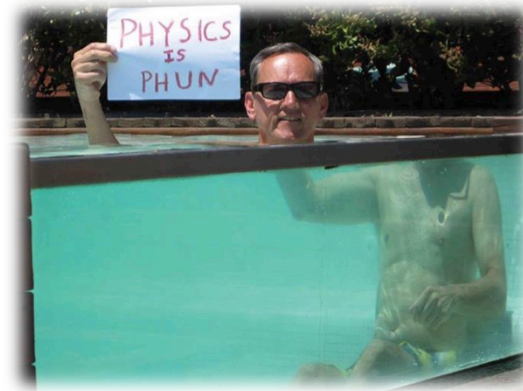
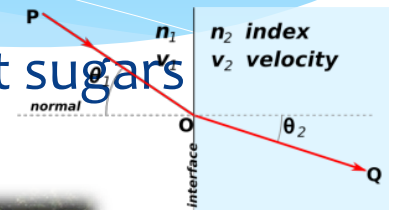
 Use at room temperature

 ATC solves the problem






 Measures Brix

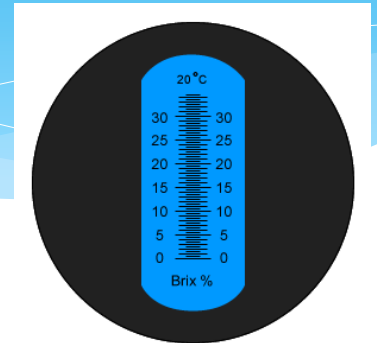
 Some have SG scale – IGNORE!

 20 Brix  $\neq$  1.080!




# Using a Refractometer

-  Adjust focus until you can read the scale
-  Calibrate by putting a drop of distilled water on glass
  -  A blue / white line should appear crossing 0, if not adjust screw until it does
-  Place a drops of wort (cooled is best) onto glass
  -  The blue line should be evident




# What do These Numbers Mean?


 OG – The higher, the higher the potential alcohol

 Dependent on wort composition (mash temps, thickness & length) & fermentation (yeast & temp).

 FG – How much sugar is still left

 Higher FGs for same OG have more dextrins and are perceived as fuller bodied & often sweeter.

 A beer with an FG of 1.040 has more residual sugars than a wort that has an OG 1.040 begins with due to alcohol density less than water

 Apparent Attenuation =  $(OG - FG) / OG - 75\%$  is “normal”

# Problems With Measuring

- ❏ Alcohol screws up measurements!
- ❏ Not as big a deal with hydrometer
  - ❏ Alcohol is lighter than water
  - ❏ Dry saisons & sours can be under 1.000
  - ❏ Built into our thinking & formulas
- ❏ Refractometers are a major problem!
  - ❏ Alcohol bends light very differently
  - ❏ Measurements after fermentation are meaningless
  - ❏ Hop oils *may* affect measurements

# So Refractometers Are Useless?

 Not at all. If you know your OG, there are calculators that help you convert to an FG

 Sean Terrill has an great spreadsheet

 <http://seanterrill.com/2011/04/07/refractometer-fg-results/>

 My results have been mixed though...

 Why bother?

 1 or 2 Drops vs Sample Tube

 Personal choice

# Alcohol By Volume

 If you know OG & FG you can estimate your ABV

 “Old” Formula:

  $(OG - FG) \times 131.25$

 Does not effectively take into account effect of alcohol in higher ABV beers

 “Accurate” formula:

  $76.08 \times (OG - FG) / (1.775 - OG) \times (FG / 0.794)$

 Use a calculator! (<http://www.brewersfriend.com/abv-calculator/>)

# Does That *Really* Matter?

 Valley of Death RIS (Gold Medal – Pro/Am)

 OG = 1.125

 FG = 1.030

 “Old” Formula = 12.5%

 “Accurate” Formula = 14.4%

 15% higher!



# Issues With BIG Beers

- ❏ Fermentation is problematic
- ❏ Need LOTS of yeast (use [yeastcalculator.com](http://yeastcalculator.com) / [MrMalty.com](http://MrMalty.com))
  - ❏ Consider a yeast cake from a fresh batch / lots of dry yeast
- ❏ Ex for 5.25 US gal
  - ❏ 1.110 Ale ~400 billion (2 packs)
  - ❏ 1.090 Lager ~650 billion (3 packs)
- ❏ If you treat your yeast well, it will ferment past recommended range
  - ❏ RIS was 1028 – 11% Alcohol tolerance





# Oxygen is a Must!

- ☒ Yeast need oxygen to replicate
  - ☒ Use pure O<sub>2</sub>
- ☒ Wyeast ([http://www.wyeastlab.com/hb\\_oxygenation.cfm](http://www.wyeastlab.com/hb_oxygenation.cfm))
  - ☒ Air max = 8 ppm, 60 sec pure O<sub>2</sub> = 12 ppm
  - ☒ “generally safe to assume you need at least 10 ppm”
  - ☒ As wort gravity goes up, solubility goes down.
  - ☒ Supersaturated O<sub>2</sub> will come out of solution.
- ☒ Generally I do ~120 s @ pitch & 60-90s @ 12-24 hours








# Things get HOT!

- ☒ Fermentation is an exothermic process (releases energy as heat)
- ☒ Regular beers can get 5+F over ambient at high krausen
- ☒ High gravity beers can get 10+F easily.
  - ☒ Produces fusels, esters, diacetyl, acetaldehyde...
- ☒ Ambient is not the best way
  - ☒ Use a fermentation chamber (control temps inside)
  - ☒ Use a thermowell or strap a the probe to the side of the carboy, insulated from the outside (I use an old towel)

# Two Beers One Mash! a.k.a. Partigyles

-  Need to plan a mash that can create two distinct beers
-  Plan a 75/25 ratio for 1<sup>st</sup> beer / 2<sup>nd</sup> Beer unless you blend
-  Can cap your mash with extra grains to change flavours / colours / etc
-  Be careful to have enough enzymatic activity to convert starchy grains (Roasted & Crystal are only OK)

# Ideas?

-  DIPA & APA / Amber / Brown / IPA
-  RIS & Dry Stout
-  Barley Wine & Mild / ESB / Ordinary Bitter
-  Triple / Quad & Pilsner / Kölsch
-  BDSA & Belgian Pale
-  Dopperbock & Red Ale
-  Hefeweizen & Hoppy Wheat

# Dopplebock & Hoppy American Red

 Know your system! Mine gives:

 65-70% for high alcohol beers (full tun, less sparge)

 75% for normal beers

 80% for low gravity beers (extra sparge)


 I aim for 75-80% for a big beer partigyle. 80-85% for mid gravity.

# Dopplebock & Hoppy American Red

 Can I Mash It? (<http://www.rackers.org/calcs.shtml>)

 12 gal cooler @ 1qt/# ~ 36# grainbill

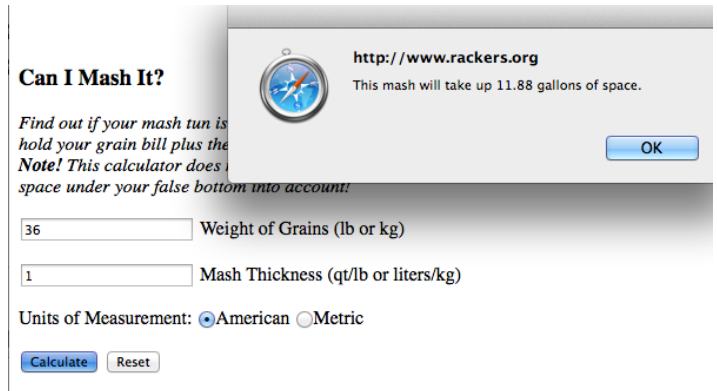
 Designed a grainbill that was 36#

 Aimed for 60/20% efficiency  
(75/25% of extract)

 Adjusted volume accordingly

 Added sugar to boost Red

 Could use extract to boost grav!



**Can I Mash It?**

<http://www.rackers.org>  
This mash will take up 11.88 gallons of space.

Find out if your mash tun is hold your grain bill plus the  
*Note! This calculator does space under your false bottom into account:*

Weight of Grains (lb or kg)

Mash Thickness (qt/lb or liters/kg)

Units of Measurement:  American  Metric

# Fermentables

Efficiency: 60.0 % Batch size: 8.25 gal

Fermentable	Amount		Use	PPG
■ Munich Type I	30.0 lb	84 %	Mash	35
■ Rahr Pilsner	5.0 lb	14 %	Mash	37
■ Caramunich I	0.25 lb	0 %	Mash	30
■ Chocolate (UK)	0.25 lb	0 %	Mash	34

PREDICTED

LOGGED

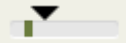
1.091 OG



1.027 FG



23 IBU



8.3% ABV



18 SRM



0.26 IBU/OG



Sweet

# Fermentables

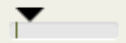
Efficiency: 20.0 % Batch size: 5.0 gal

Fermentable	Amount		Use	PPG
■ Munich Type I	30.0 lb	83 %	Mash	35
■ Rahr Pilsner	5.0 lb	13 %	Mash	37
■ Sucrose (Table Sugar)	0.5 lb	1 %	Boil	46
■ Chocolate (UK)	0.25 lb	0 %	Mash	34
■ Caramunich I	0.25 lb	0 %	Mash	30

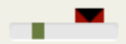
1.055 OG



1.011 FG



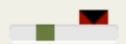
74 IBU



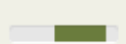
5.7% ABV



26 SRM



1.36 IBU/OG



Very

Bitter

Recipe does not conform to the  
**American Amber Ale** style




# Actual Results / How?

 Keep track of your runnings!

 Figure out how much sugar is in each running & determine your blend

 Use “points”

 3 gallons of 1.100 =  $3 \times 100 = 300$  pts

 2.3 gallons of 1.031 =  $31 \times 2.3 = 71.3$  pts



# Standard Bitter & American Brown

 Need to do a stovetop mini-mash to increase gravity & add desired colour.







 2 Row gives enzymes!

 Bitter was first runnings & water

## Fermentables

Efficiency: 40.0 % Batch size: 5.25 gal

Fermentable	Amount		Use	PPG
■ Maris Otter Pale (UK)	12.0 lb	70 %	Mash	38
■ Crystal 45L (UK)	1.0 lb	5 %	Mash	34
■ Munich Light (DE)	1.0 lb	5 %	Steep	37
■ 2 Row Pale Malt	1.0 lb	5 %	Steep	34
■ Pale Chocolate (UK)	1.0 lb	5 %	Steep	32
■ Aromatic Malt (US)	0.5 lb	2 %	Mash	35
■ Dark Crystal 80L (UK)	0.5 lb	2 %	Steep	33

1.048 OG   
 1.010 FG   
 42 IBU   
 5.0% ABV   
 25 SRM   
 0.9 IBU/OG   
 Very Bitter  
 Recipe does not conform to the American Brown Ale style

