Winemaking Math: Calculate your Way to Better Wine – Advanced Winemaking

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What's The Big Deal???

- Helps you interpret what goes into an analytical test that you performed, or received a result from
- Allows you to interpret your analytical results and properly calculate planned additions

Calculations – Metric versus US

LIQUID VOLUME MEASUREMENT CONVERSION CHART

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TEASPOON Tsp.	TABLESPOON Tbsp.	CUP C	MILLILITER ml	FLUID OUNCES OZ
3 TSP.	1 TBSP.	1/16C	15ML	1/2FL. OZ
6 TSP.	2 TBSP.	1/8C	30ML	1FL. OZ
12 TSP.	4 TBSP.	1/4C	59ML	2FL. OZ
16 TSP.	5.3 TBSP.	1/3C	79ML	2/3FL.OZ
24 TSP.	8 TBSP.	1/2C	118ML	4FL. OZ
32 TSP.	10.6 TBSP.	2/3C	158ML	5⅓FL. OZ
36 TSP.	12 TBSP.	3/4C	177ML	6FL. OZ
48 TSP.	16 TBSP.	1C	237ML	8FL. OZ
96 TSP.	32 TBSP.	2C	473ML	16FL. OZ

Chef Lola's Kitchen

Basic Conversions

- Common US nomenclature → # per 1000 gallons
- Common SI nomenclature → g/hL (100 Liters)

- 1 # = 454 Grams
- 1 gallon = 3.785 L

- 2#/1000 gal = 25 g/hL = 1 g/gallon

- http://wineserver.ucdavis.edu/industry/enology/methods_and_techniques/techniques/unit_conversions.html

Learn to use the metric systems

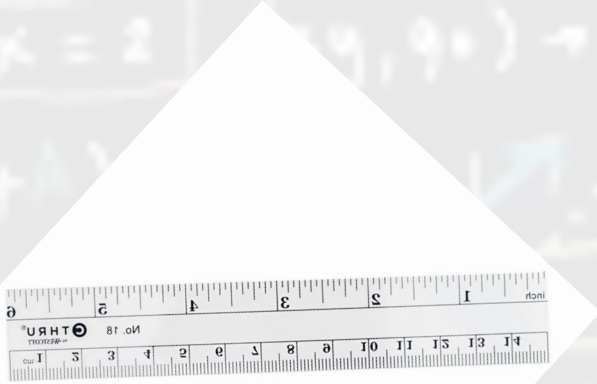
- Understand basic conversions
  - Gallons to Liter 1 gal = 3.785 Liter
  - Ounces to milliliters (Liquid) 1 oz = 30 mL
  - Ounces to grams (Dry) 1 oz = 28 g

  - Work within your comfortability

  - Only negative to the metric system…
    - Your calculation would result in a factor of ‘10’ discrepancy

Tools

- Measuring tape in the metric system
  - Desired units in centimeters (cm)
- Laboratory Vessels
  - Desired units in milliliters (mL)
    - Pipettes, graduated cylinders, flasks, beakers
- Kitchen top loading scale
  - Desired units in grams (g)
- Calculator



Basics of an equation involving additions

- (Desired) Concentration X Volume
- Preferred units
    - Grams per L

- Juice/Wine versus Musts
    - Solids adjustment for musts
        - Winemaker's choice (0.7-0.9) – depending on juiciness

Basics…Determining your Volume?

- Understand what you are trying to measure
  - Cylinder
    - π x (radius)^2 x height ($\pi(r)^2 h$) or alternatively π x ((diameter)^2/4) x height [$\pi(d^2/4)h$]
  - Rectangle
    - Length x Width x Height (L x W x H)

Basics…Determining your Volume?

- Length Measurements and Volume???Why metric???
- Centimeter X Centimeter X Centimeter = cm^3 = 1 cc
  - $[\pi(d^2/4)h]$
  - (L x W x H)
- 1 cc = 1 mL Δ 1000 cm^3 = 1000 mL = 1 Liter (L)
  - Factors of 10X
    - 100 L = 1 hectoliter (hL)
- Variable volumes do not have to be estimated
  - Do this ahead of time
    - Mark your vessels
    - Make a note in your log

Basics…Determining your Mass

- Top Loading balance (General Purpose)
  - Range 0.1 to 2500 g (0.0001 – 2.5 kg)
  - +/- 0.1 gram (g)
  - $ to $$

- Analytical Balance (Standardizing Reagents)
  - Range typically 0.000 to 25.000 g
  - +/- 0.001 to 0.00001 gram (g)
  - $$ to $$$ to $$$$

Basics…Putting Together the Puzzle

- Concentration times Volume
  - Grams per Hectoliter (g/hL)
    - generally found cellar chemical calculations
  - Grams per Liter (g/ml)
    - Routinely part of an analytical measurement result
      - e.g. Titratable Acidity
  - Milligrams per Liter (mg/L)
    - Routinely part of an analytical measurement result
      - e.g. Sulfur Dioxide, Malic/Lactic acid measurements

Calculations Specific To Winemaking

- Sulfur dioxide additions**
- Nutrient additions**
- Acid additions
- De-acidification
- Yeasting
- Fining agent additions
- Delle Unit Calculations
- Water Dilution
- Chaptalization – Not today…

Wise Words…

- Carpentry Analogy
  - Measure Twice, Cut Once!!!
- There can be some wiggle room, with a notable exception
  - Sulfur Dioxide!

Calculating SO_2 Additions

- How much do you want to add?
- What is the volume of juice/wine?
- Liters and Gallons
- If a little is good, than is a lot….Better? NO!!!
  - Anthocyanin binding and wine bleaching
  - Sensory thresholds of SO_2

Sulfur Dioxide Calculation

- Use of Potassium Metabisulfite is the most predictable method
  - Powder – Salt of Sulfur Dioxide 57.6% SO_2
  - Inodose - Potassium metabisulfite tablets that release 5 g ± 0.5 SO_2.
- Need to treat differently – doesn't seem practical for homewinemakers
- Importance of regular testing

Calculating SO_2 Additions

- KMBS comes as a powder, it is a salt of sulfur dioxide.
- 57% is ‘active’

- Example: add 50 ppm to 100 L
  - (Desired addition (g/L)* volume (L))/0.576= g KMBS
  - 50 ppm = 50 mg/L = 0.050 g/L
  - $\frac{0.050 * 100}{0.576}$ = 8.6 g KMBS

How to add SO_2

- KMBS
  - Diluted with distilled water
  - Use of a stock solution (10%)
    - www.winemakermag.com
      - 10% (v/v) = 10 g/100 mL = 0.10 g/mL
      - 8.6 g /0.10 g/ml = 86 mL

Nutrient Additions

- Di-Ammonium Phosphate (21 % N)
- Go-Ferm (3 % N)
- Fermaid K (Lallemand) (13 % N)
- Superfood (Gusmer) (8 % N)

- Example: Fermaid K at 13 % N
  - 1 g/L of FK = 1000 mg/L (1000 ppm)
  - Therefore 13% of 1000 mg FK = 130 mg/L N

=Continuing

- Target 250 mg N (Using Fermaid K (FK))
- $\frac{250\ mg\ N}{L\ liquid} \times \frac{1\ g\ FK}{130\ mg\ N} = \frac{2\ g\ FK}{L\ liquid}$
- In 5 gallons
- $\frac{2\ g\ FK}{L\ liquid} \times \frac{3.785\ L\ liquid}{1\ Gal\ liquid} \times 5\ gal\ liquid = 38\ g\ FK$

Other Nutrients

- Di-Ammonium Phosphate (DAP)
  - 21 % Nitrogen
- Sometimes more effective in feeding after fermentation has started
- 1 g/gal = 50 mg Nitrogen

Calculations Specific To Winemaking

- ~~Sulfur dioxide additions**~~
- ~~Nutrient additions**~~
- Acid additions
- Yeasting
- Fining agent additions
- De-acidification
- Delle Unit Calculations

Follow the Concentration X Volume principle

Concentration X Volume

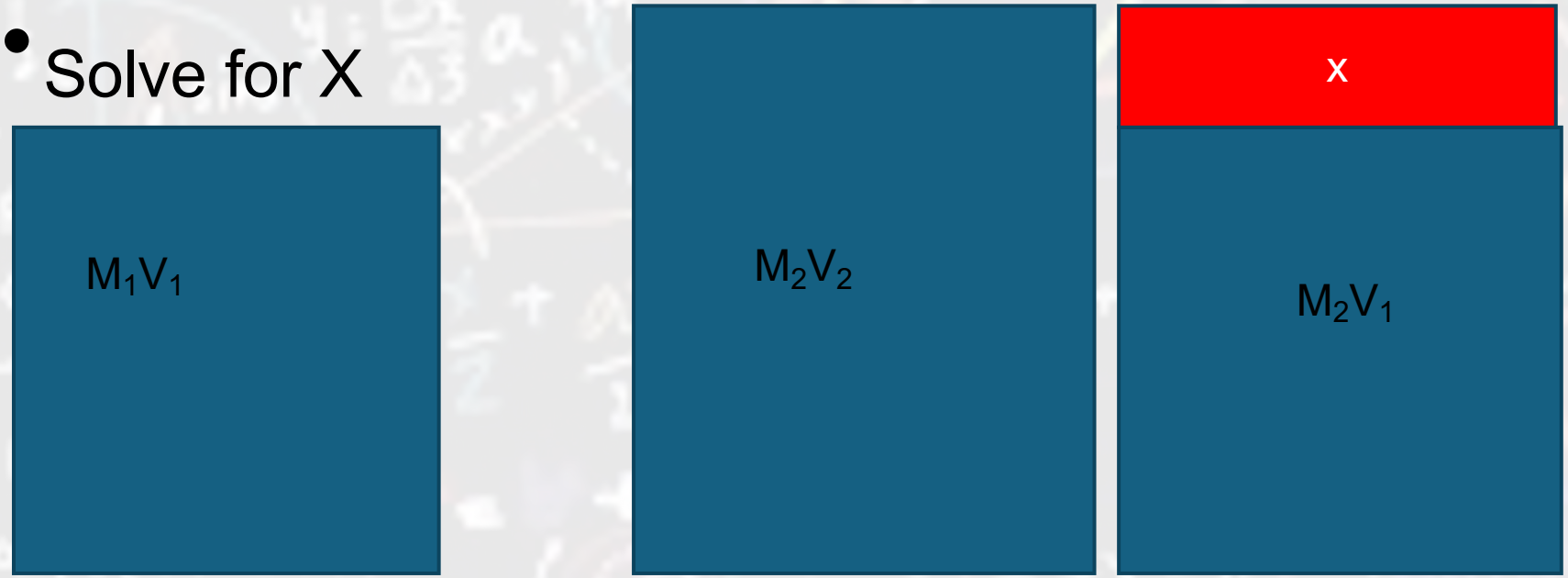
- Ex: You want to add 1.5 g/L of ‘compound Z’ to 5 gallons
  - Convert gallons to liters
    - $5\ \text{gal} \times \frac{3.785\ \text{L}}{\text{gal}} = 19\ \text{L}$
  - $19\ \text{L} \times \frac{1.5\ \text{g}}{\text{L}} = 28.5\ \text{g}$ of ‘compound Z’

How Much Water to Add?

- $M_1V_1=M_2V_2$ → $V_2 = V_1 + x$

Rearranging

- $M_1V_1=M_2(V_1+x)$
- Where x = Volume of water to add to attain M_2
- Solve for X



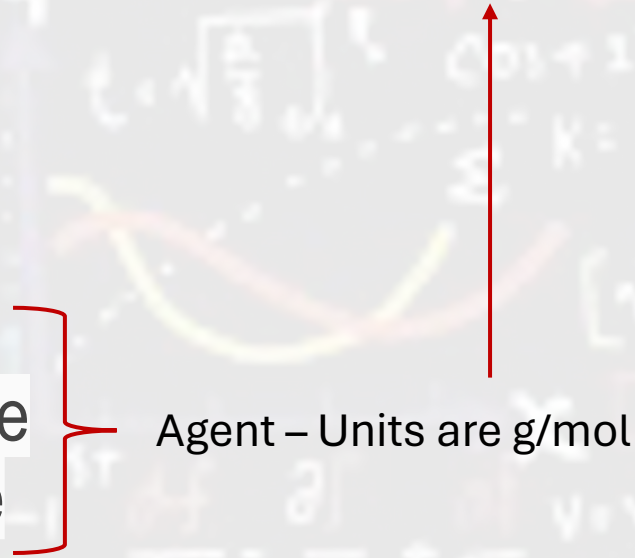
Another Method - Simplified

- Must/Juice at 27˚B
- Target
  - 24˚B,
  - Adjustments necessary:
    - 27˚-24˚ = 3˚
  - 3˚/27˚ = 0.11 or 11%
  - In 100 L , you juice, you will want to add 11 L
- For must additions, reduce total volume by 20%
  - In this case, use 80 L

Simple De-acidification

- Agent(g) = ((current TA - Target TA) * vol) * (MW agent / MW tartaric acid)

Where:
MW = molecular mass
150.087 = MW of tartaric acid
100.087 = MW of calcium carbonate
138.2055 = MW of potassium carbonate
100.11 = MW of potassium bicarbonate



Wine Stability and Delle Units

- The unit of calculation for microbial stability in sweet wines
- DU (Delle Units) = % sugar (w/v) + 4.5 × % alcohol (v/v)
- Target unit range 75 - 85

Concluding

- Calculators are available on-line
  - Wine Business Monthly https://www.winebusiness.com/calculator/winemaking/
  - VinoLab (Croatia) https://www.vinolab.hr/vinolab/en1
  - Intent here was to show what goes into the calculators and getting a feel for how reliable they are.
  - Remember to measure twice and cut once no matter how you perform you calculations