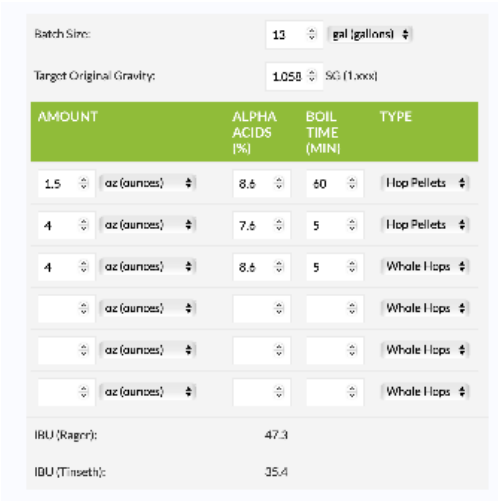
Hop Bitterness

Calculating IBUs for My Setup

Using https://www.hopsteiner.com/ibu-calculator/



Batch Size:	13 gal (gallons)		
Target Original Gravity:	1.058 SG (1.xxx)		
AMOUNT	ALPHA ACIDS (%)	BOIL TIME (MIN)	TYPE
1.5 oz (ounces)	8.6	60	Hop Pellets
4 oz (ounces)	7.6	5	Hop Pellets
4 oz (ounces)	8.6	5	Whole Hops
oz (ounces)			Whole Hops
oz (ounces)			Whole Hops
oz (ounces)			Whole Hops
IBU (Rager):	47.3		
IBU (Tinseth):	35.4		

60 mins	1.5 oz	Amarillo Gold (8.6%)	18.3 IBU
5 mins	4 oz	Amarillo Gold (8.6%)	8.6 IBU
5 mins	4 oz	Centennial (7.6%)	8.5 IBU
			35.4 IBUs

Batch Size = Boil Size - Boil Off (0.8 gal/hour)

= 13.8 gal - 0.8gal /h * 1h

= 13.0

Using the formula to calculate

60 mins	1.5 oz	Amarillo Gold (8.6%)	18.3 IBU

mg/l of added alpha acids = (decimal AA rating * ozs hops * 7490) / gallons of wort

mg/l = 0.086 * 1.5 oz * 7490 / 13gal = 74.3

Bigness factor = 1.65 * 0.000125^(wort gravity – 1)

= 1.65 * 0.000125^(1.058 – 1)

= 1.65 * 0.000125^(0.058)

= 0.979726206292533

Boil Time factor = (1 – **e^**(-0.04 * time in mins))/4.15

= (1 – **e^**(-0.04 * 60))/4.15

= (1 – **e^**(-2.4)) / 4.15

= (1 - 0.090717953289412) / 4.15

= 0.219104107641105

Utilization = Bigness factor * Boil Time factor

Utilization = 0.979726206292533 * 0.219104107641105

= 0.214662036162331

= 0.215

IBUs = decimal alpha acid utilization * mg/l of added alpha acids

= 0.215 * 74.3

= 16.0

(Other calculator had 18.3!)

Tinseth's IBU Formula

IBUs = decimal alpha acid utilization * mg/l of added alpha acids

Tenseth's base formula is simple enough, We just need to solve for our **mg/l of alpha acids** and **decimal alpha acid utilization%** to find our brews estimated IBU.

mg/l of added alpha acids = (decimal AA rating * ozs hops * 7490) / gallons of wort

Decimal Alpha Acid Utilization = Bigness Factor * Boil Time Factor

Bigness factor = 1.65 * 0.000125^(wort gravity – 1)

Boil Time factor = (1 – **e^**(-0.04 * time in mins))/4.15

***Note: e = 2.71828*

Tenseth's Formula Example

Batch Information

Pre-Boil Volume: 6.5 gallons
Target Batch Size: 5 gallons
Original Gravity: 1.050

Hop Additions

1.5oz Hops – 6.4% AA @ 45 mins

1 oz Hops – 5% AA @ 15 mins

The nice thing about Tenseth's formula is that it can easily be broken down into smaller components. We just have to solve the foundation equations, then we can plug in our variables to find our IBU for the example beer recipe above.

mg/l of added alpha acids:

(.064 * 1.5oz * 7490) / 5 = **143.808**
(.050 * 1oz * 7490) / 5 = **74.9**

Next we need to solve for our **Decimal Alpha Acid Utilization** by solving for our Bigness Factor and Boil Time Factor:

Bigness factor:

1.65 * 0.000125^(1.05- 1) = **1.052**

Boil Time factor:

Hop Addition #1: (1 – *2.71828*^(-0.04 * 45))/4.15 = **.201**
Hop Addition #2: (1 – *2.71828*^(-0.04 * 15))/4.15 = **.108**

Now we can go ahead and solve for Utilization % for our hop additions.

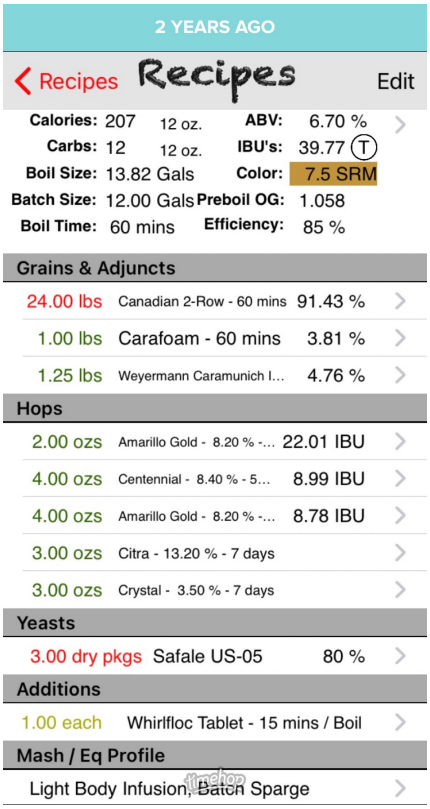
Hop Addition #1:1.052 * .201 = **.211**
Hop Addition #2:1.052 * .108 = **.113**

IBUs = decimal alpha acid utilization * mg/l of added alpha acids

Hop Addition #1: **.211 * 143.808 = 30.34 IBU's**
Hop Addition #2: **.108 * 74.9** = **8.08 IBUs**

30.34+8.08=38.42 Total IBUs

Example:



Boil Size	13.82 Gal
Pre Boil OG	1.058
OG	1.062
Amount	2 oz
Alpha	8.2%
Time	60 min

mg/l of added alpha acids = (decimal AA rating * ozs hops * 7490) / gallons of wort

mg/l = **0.082** * **2 oz** * 7490 / **13gal** = 94.489230769230769

Bigness factor = 1.65 * 0.000125^(**wort gravity** – 1)

= 1.65 * 0.000125^(**1.062** – 1)

= 1.65 * 0.000125^(0.062)

= 0.945131776698279

Boil Time factor = (1 – **e^**(-0.04 * **time in mins**))/4.15

= (1 – **e^**(-0.04 * **60**))/4.15

= (1 – **e^**(-2.4)) / 4.15

= (1 - 0.090717953289412) / 4.15

= 0.219104107641105

Utilization = Bigness factor * Boil Time factor

Utilization = 0.945131776698279 * 0.219104107641105

= 0.207082254536729

= 0.207

IBUs = decimal alpha acid utilization * mg/l of added alpha acids

=0.207 * 94.489230769230769

= 19.567042937133528

(Other calculator had 22.01 !)

References

Reference	URL
Calculating Hop Bitterness: How much Hops to Use?	https://beersmith.com/blog/2008/04/20/calculating-hop-bitterness-how-much-hops-to-use/#:~:text=A%20simplified%20equation%20from%20Ray,*%200.7489)%20%2F%20(V_Gal)
BITTERNESS (IBU) CALCULATOR	https://www.hopsteiner.com/ibu-calculator/
Bitterness Calculator	http://www.realbeer.com/hops/bcalc_js.html