

# Hop Bitterness

## Calculating IBUs for My Setup

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

AMOUNT	ALPHA ACIDS (%)	BOIL TIME (MIN)	TYPE
1.5 oz (Amarillo Gold)	8.6	60	Hop Pellets
4 oz (Amarillo Gold)	7.6	5	Hop Pellets
4 oz (Centennial)	8.6	5	Whole Hops
0 oz			Whole Hops
0 oz			Whole Hops
0 oz			Whole Hops
IBU (Ragrin):		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
			<b>35.4 IBUs</b>

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

$$= 13.8 \text{ gal} - 0.8 \text{ gal/h} * 1 \text{ h}$$

$$= 13.0$$

Using the formula to calculate

60 mins	1.5 oz	Amarillo Gold (8.6%)	18.3 IBU
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**mg/l of added alpha acids** = (decimal AA rating \* ozs hops \* 7490) / gallons of wort

$$\text{mg/l} = 0.086 * 1.5 \text{ oz} * 7490 / 13 \text{ gal} = 74.3$$

**Bigness factor** =  $1.65 * 0.000125^{(\text{wort gravity} - 1)}$

$$= 1.65 * 0.000125^{(1.058 - 1)}$$

$$= 1.65 * 0.000125^{(0.058)}$$

$$= 0.979726206292533$$

**Boil Time factor** =  $(1 - e^{(-0.04 * \text{time in mins})}) / 4.15$

$$= (1 - e^{(-0.04 * 60)}) / 4.15$$

$$= (1 - e^{-2.4}) / 4.15$$

$$= (1 - 0.090717953289412) / 4.15$$

$$= 0.219104107641105$$

**Utilization = Bigness factor \* Boil Time factor**

$$\text{Utilization} = 0.979726206292533 * 0.219104107641105$$

$$= 0.214662036162331$$

$$= 0.215$$

**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**

Tinseth'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 =  $1.65 * 0.000125^{(\text{wort gravity} - 1)}$**

**Boil Time factor =  $(1 - e^{(-0.04 * \text{time in mins})}) / 4.15$**

**\*\*Note:  $e = 2.71828$**

## Tinseth'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 Tinseth'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:**

$$(.064 * 1.5\text{oz} * 7490) / 5 = \mathbf{143.808}$$

$$(.050 * 1\text{oz} * 7490) / 5 = \mathbf{74.9}$$

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

**Bigness factor:**

$$1.65 * 0.000125^{(1.05 - 1)} = \mathbf{1.052}$$

**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:

2 YEARS AGO

< Recipes

## Recipes

Edit

Calories: 207 12 oz. ABV: 6.70 % >

Carbs: 12 12 oz. IBU's: 39.77 (T) >

Boil Size: 13.82 Gals Color: 7.5 SRM

Batch Size: 12.00 Gals Preboil OG: 1.058

Boil Time: 60 mins Efficiency: 85 %

**Grains & Adjuncts**

24.00 lbs Canadian 2-Row - 60 mins 91.43 % >

1.00 lbs Carafoam - 60 mins 3.81 % >

1.25 lbs Weyermann Caramunich I... 4.76 % >

**Hops**

2.00 ozs Amarillo Gold - 8.20 % - ... 22.01 IBU >

4.00 ozs Centennial - 8.40 % - 5... 8.99 IBU >

4.00 ozs Amarillo Gold - 8.20 % - ... 8.78 IBU >

3.00 ozs Citra - 13.20 % - 7 days >

3.00 ozs Crystal - 3.50 % - 7 days >

**Yeasts**

3.00 dry pkgs Safale US-05 80 % >

**Additions**

1.00 each Whirlfloc Tablet - 15 mins / Boil >

**Mash / Eq Profile**

Light Body Infusion, Batch Sparge >

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

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

mg/l =  $0.082 * 2 \text{ oz} * 7490 / 13 \text{ gal} = 94.489230769230769$

$$\text{Bigness factor} = 1.65 * 0.000125^{(\text{wort gravity} - 1)}$$

$$= 1.65 * 0.000125^{(1.062 - 1)}$$

$$= 1.65 * 0.000125^{(0.062)}$$

$$= 0.945131776698279$$

$$\text{Boil Time factor} = (1 - e^{(-0.04 * \text{time in mins})})/4.15$$

$$= (1 - e^{(-0.04 * 60)})/4.15$$

$$= (1 - e^{(-2.4)}) / 4.15$$

$$= (1 - 0.090717953289412) / 4.15$$

$$= 0.219104107641105$$

$$\text{Utilization} = \text{Bigness factor} * \text{Boil Time factor}$$

$$\text{Utilization} = 0.945131776698279 * 0.219104107641105$$

$$= 0.207082254536729$$

$$= 0.207$$

$$\text{IBUs} = \text{decimal alpha acid utilization} * \text{mg/l of added alpha acids}$$

$$= 0.207 * 94.489230769230769$$

$$= 19.567042937133528$$

( Other calculator had 22.01 ! )

## References

Reference	URL
Calculating Hop Bitterness: How much Hops to Use?	<a href="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)">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)</a>
BITTERNESS (IBU) CALCULATOR	<a href="https://www.hopsteiner.com/ibu-calculator/">https://www.hopsteiner.com/ibu-calculator/</a>
Bitterness Calculator	<a href="http://www.realbeer.com/hops/bcalc_js.html">http://www.realbeer.com/hops/bcalc_js.html</a>