



## CRYO HOPS® PRODUCT OVERVIEW SHEET

### THE CRYO HOPS® PROCESS

Derived from the Greek word 'kryos', meaning frost, CRYO HOPS is an industry-leading, cryogenic hop-processing technology used to separate whole cones into two components—concentrated lupulin and bract. Each component of the hop is preserved using low temperatures in a nitrogen-rich environment during the entire process, from separation to pelleting. This proprietary process displaces oxygen throughout the system, increasing product quality and reducing the oxidation of the lupulin.

### WHAT IS CRYO HOPS®?

CRYO HOPS is the concentrated lupulin of whole-leaf hops containing resins and aromatic oils. It is designed to provide intense hop flavor and aroma, enabling brewers to efficiently dose large quantities of alpha acids and oils without introducing astringent flavors or vegetative material.

### INTRODUCING CRYO HOPS® INTO BEER

CRYO HOPS can be utilized anywhere whole-leaf hops and hop pellets are traditionally applied.

**KETTLE:** Late additions only; early kettle additions should be avoided to prevent boiling out the intense aroma characteristics.

**KNOCKOUT:** Due to fine particle size, there is low risk of clogging heat exchangers.

**WHIRLPOOL:** Whirlpool additions are an excellent way to increase aroma and reduce trub load from large, late additions.

**FERMENTER:** Use in the fermenter is an excellent way to increase aroma while reducing trub loss. CRYO HOPS will settle out during normal conditioning and can be fined, filtered or centrifuged as normal.

### RECIPE ADAPTATION

Regardless of application, early trials indicate CRYO HOPS beers showcase pronounced juicy and resinous flavors with reduced grassy characteristics. As a result, some brewers recommend using CRYO HOPS in conjunction with T-90 pellets to ensure the complexity and flavors of the whole hop cone are retained.

To assess the benefits of CRYO HOPS, YCH recommends adapting any recipe by substituting 40g of CRYO HOPS and either 25g of T-90 or 15g of American Noble Hops™ for every 100g of T-90 used. The larger the substitution, the larger the potential yield increase.

Creating new recipes with CRYO HOPS is an excellent (and safe) way to showcase hops in innovative beers and styles. As a starting point for recipe formulation or modification, the estimated dosing rate of CRYO HOPS is 40-50% of hop pellets by weight.

### BENEFITS OF UTILIZING CRYO HOPS®

CRYO HOPS is processed in an ISO-9001-certified production facility with limited opportunities for oxidation, and monitored to meet quality specifications.

- Controlled, nitrogen-rich production environment
- Uniform particle-size distribution
- Intentional preservation of the lupulin glands
- Nearly twice the resin content of T-90 hop pellets
- Intense contribution of hop flavor and aroma
- Reduced vegetal and polyphenol flavor
- Greater sustainability in packaging, shipping and storage
- Increased yield through reduced brewhouse and cellar trub
- Cost savings and net increases in revenue per batch

ADDITION	CURRENT RECIPE	CRYO HOPS®
60 or 90 Minutes	CO <sub>2</sub> Hop Extract / T-90 Hop Pellets	CO <sub>2</sub> Hop Extract / T-90 Hop Pellets
15 Minute	T-90 Hop Pellets	T-90 Hop Pellets
Whirlpool	1 lb / bbl T-90 Hop Pellets	0.4 lb / bbl CRYO HOPS & either .25lb T-90 Pellets or .15lb American Noble Hops
Dry Hop	1 lb / bbl T-90 Hop Pellets	0.4 lb / bbl CRYO HOPS & either .25lb T-90 Pellets or .15lb American Noble Hops

*An example substitution for a Double IPA hop bill. Actual data will vary per brewery and beer recipe.*



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CRYO HOPS is available in pellet form and can be utilized in the brewery as a full, or partial, replacement for whole-leaf hops and hop pellets. It is twice as concentrated as T-90 hop pellets and should be dosed at 40-50% of T-90 hop pellets by weight.

**COLD PRESSED PELLETS:** To ensure preservation of the essential oils and resins, the production process is conducted at cool temperatures, approximately 30 degrees lower than T-90 pellet production. CRYO HOPS pellets perform similar to T-90 hop pellets and have comparable density and dissolving characteristics.

CURRENT AVAILABILITY	CRYO HOPS® PELLETS		TYPICAL ANALYSIS ALPHA BY UV SPECTROSCOPY & OIL BY DISTILLATION	
	1X5KG/11 LB	4X5KG/11 LB	ALPHA*	OIL* (mL/100g)
AMARILLO® BRAND VGXP01	⊙	⊙	13 - 20%	1.8 - 4.1
CASCADE	⊙	⊙	12 - 19%	1.9 - 3.7
CENTENNIAL	⊙	⊙	13 - 22%	1.8 - 5.4
CITRA® BRAND HBC 394 CV	⊙	⊙	19 - 30%	2.4 - 6.6
EKUANOT® BRAND HBC 366 CV	⊙	⊙	21 - 26%	3.8 - 6.0
LORAL® BRAND HBC 291 CV	⊙	⊙	18 - 23%	3.0 - 4.9
MOSAIC® BRAND HBC 369 CV	⊙	⊙	21 - 26%	2.3 - 4.3
PALISADE® BRAND YCR 4 CV	⊙	⊙	12 - 18%	1.4 - 3.6
SIMCOE® BRAND YCR 14 CV	⊙	⊙	21.5 - 27%	2.6 - 4.5

\* Actual alpha and oil percentages will vary based on lot and crop year.

### SAVINGS & SUSTAINABILITY

CRYO HOPS is designed with efficiency and savings in mind. The leafy material of the hop cone is removed during production, reducing the amount of plant material in the brewhouse. This translates to less trub loss and results in increased brewhouse yields - simultaneously improving beer quality and the bottom line.

During R&D trials, brewers commonly reported yield increases of three to five percent. For every barrel of beer gained, water, malt, utilities and labor are also utilized more efficiently. With half the storage and shipping requirements for CRYO HOPS pellets, breweries are able to experience significant savings and gains.\*

	T-90 PELLETS	CRYO HOPS® PELLETS	NET SAVINGS
REVENUE / BARREL	\$250	\$250	-
ESTIMATED YIELD INCREASE	-	5%	-
ESTIMATED YIELD IN BARRELS	100 BBL	105 BBL	-
REVENUE / BATCH	\$25,000	\$26,250	\$1,250
DOSING RATE	100%	50%	-
POUND OF HOP PRODUCT	100 LB	50 LB	-
COST OF HOPS / POUND	\$10.00	\$23.83	-
COST OF HOPS / BATCH	\$1,000	\$1,191.50	\$(191.50)
<b>NET INCREASE IN REVENUE / BATCH</b>			<b>\$1,058.50</b>

\*Savings calculations are for example purposes only. Actual data will vary per brewery and beer recipe and should be re-calculated on actual usage with specific brewing systems and beer recipes.