

**SAMUEL
ADAMS**

**Boston Beer
Pure Hop Pellet**

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**Evolution &
Benefits**



Background



- BBC has committed millions of pounds of hops to dry hopping process over 30 years of brewing
- We have historically used traditional aroma hops from Germany, France, Czech Republic, Kent
- For our Rebel family of IPA's and other specialty beers we also use hops from U.S., Australia, New Zealand, U.K.
- It is important to BBC and many other Craft Brewers to use the Whole Hop...
- We believe this adds many important flavor cues to the final beer, even if difficult to quantify; i.e. reminds you that you are drinking beer.

Approach to Hop Quality

- Objective is the highest level of consistency possible, and the most stable hop character in the pellet
- Dry hopping is a commitment primarily to the quality of hop oil going into the beer
- Timing of harvest: picking later can improve brewing value for purposes of dry hopping
- Management of a complete cold supply chain is key to creating maximum potential brewing value per pound of hops, involving:
 - Cold storage of raw hops
 - Blending raw hops for uniformity ahead of pelletization, something the brewer can manage
 - Hop grist and temperature management during pelletization
 - Cold storage of pellets until use

BBC Hop Philosophy



- Like all Craft brewers, BBC has explored several approaches to dry hopping over the years, gradually improving addition methods to optimize and preserve the quality of hop character in our beers.
- We focus on using high levels of single varieties to explore the signature and characteristics of hop variety and growing area
- Also specifically design beers to showcase blends of varieties at dry hop addition rates ranging from ¼ to 3+ lbs per bbl

Optimization Journey at BBC



1. Dry Hop Slurry Method
2. Centrifuge
3. Collaboration with Barth-Haas for a Craft Friendly Pellet Design

Early Dry Hopping Approaches

- Early production of Boston Lager, Boston Ale was in a series of traditional lager breweries with a variety of tank types and no consistent way for introducing the hops to the beer:
 - Open the man-way on the storage tank, toss in the hops, CO2 purge, add beer ...led to loss of hop volatiles and poor flavor stability
 - Create a slurry with hops and warm or hot water = grassy and other negative flavors
- Dry Hops also created significant yield issues, beer losses through:
 - Heavy tank bottoms of hops and yeast
 - Use of stand pipes to hold tank bottoms back from DE filter
 - Even with floor shots we had poor filtrations - many stops and starts, increased losses, DO pickup

Dry Hop Slurry & Benefits



- We have found—for our breweries, volumes, and systems—that dry hop additions are best carried out in a slurry with cold Deaerated Water, injected in-line during transfer of fermented beer to storage
- Make-up is in closed, agitated vessels with CO2 sparge
- Approach provides a low DO & pumpable way to add high \$\$ aroma and flavor hops to a closed and DO free storage tank
- This process can be significantly influenced by quality of hop pellets
- We saw greater flavor stability and approx 15% -20% gain in aroma intensity of final beer when we begun slurry addition method with high focus on minimizing oxygen pickup during additions

Hop Slurry Addition Tanks and Platform

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Tank Interior with Agitator

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Hop Addition to Slurry Tank

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One Big Issue....

- ***Significant variation in Pellet Quality and physical characteristics by supplier, sometimes by variety.***
- Not All Pellets from All Suppliers fully broke up in the slurry process
- Pellets did not convert uniformly to a pump-able slurry depending on pellet supplier and process
- Variable slurry make-up times – interrupted scheduling, increased labor requirement and potential for brewer-to-brewer variability.
- Occasionally plugged piping and found whole pellets in the storage tank at the end of dry hopping

We needed to better understand Pellet Processes and work closely with Supplier on final pellet quality, particularly as it applies to dry hopping.....

Stages of Dry Hop Optimization at BBC



1. Dry Hop Slurry Method
2. Centrifugation
3. Collaboration with Barth-Haas for a Dry Hop Friendly Pellet Design

Centrifugation

- Most BBC dry hopping has been carried out in horizontal ruck tanks
- In the past we used standpipes inserted in the tank outlets to hold back tank bottoms, a combination of yeast and hops that would blind the filter if allowed to flow freely to balance tank or filter
- Standpipes worked well...but also drove higher beer losses
- In the mid 90's we added the first centrifuge to our Cincinnati brewery, primarily as a pre-filter step when pulling cider off the lees
- Experimented with centrifugation of Boston Lager coming off dry hops and were able to project immediate benefits:
 - Could eliminate the standpipe in storage tanks
 - Could basically take almost the entire tank forward to centrifuge (no substantiate solids “plug” in horizontal tanks)
 - Dramatic reduction in beer losses

View of Standpipe



Issues:

- Sanitation risk
- High losses
- Varing lengths required – recipe dependent

Centrifugation Issues Related to Dry Hopping with T90's

- Found that the vegetative matter in our Standard Type 90 Pellets would quickly build up on the centrifuge disk stack
- Eventually creates an out-of-balance fault in control system that shuts down the centrifuge
 - Requires some centrifuge tuning, which we are continuing to optimize today.....
- Led to slower runs, more frequent shoots, higher product loss, sub-optimal centrifuge operation

Stages of Dry Hop Optimization at BBC



1. Dry Hop Slurry Method
2. Centrifugation
3. Collaboration with Barth-Haas for a Craft-Friendly Pellet Design

Fundamental Issues

- The Type 90 Hop Pellet was developed for kettle addition, where any variability between hop variety, age of pellets, and supplier are not obvious.
- Without the heat and circulation of the Wort Boil, any Post Brew House additions can slow dissolution of pellets when hop additions are made to fermenters or storage tanks
- BBC and many brewers have seen whole pellets survive the dry hopping process, further reducing overall hop utilization
- Existing hop pellet characteristics did not support easy centrifugation after storage

Barth Collaboration & Breakthrough



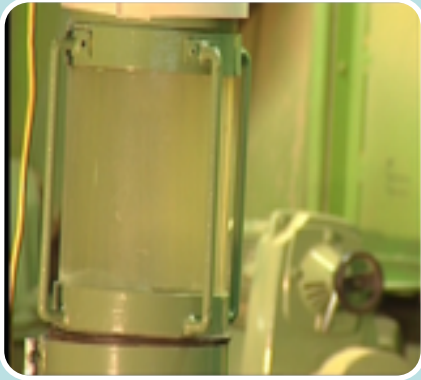
- BBC worked with Dr Adrian Forster at the Barth pellet plant to brainstorm & define parameters of a potentially Craft + Dry Hop + “Centrifuge Friendly” hop pellet
- Focused on examining the milling of raw hop flowers and the resulting grist distribution.
- Determined the milling for Standard Type 90 pellets produced a grist distribution with a significant Coarse Fraction
- We compared this fraction to the material building up in our centrifuge and realized this Coarse Fraction was at the heart of our issue.

Design of BBC Pure Hop Pellet

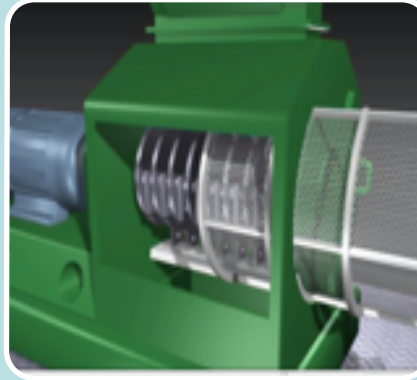


- Our collaboration began to focus on possibilities for producing a Type 90 Whole Hop Pellet on the Type 45 pellet line
- A number of Craft-Friendly benefits emerged:
 1. T45 line uses extreme cold temperature at every stage, with a low of approx -35C to preserve integrity of the lupulin glands-- and hence all the brewing value for dry hopping--during subsequent sieving
 2. T45 line utilizes multiple sequential screen separators to segregate Lupulin Fraction from Plant/Vegetative Fraction
 3. In Standard T45 production the Brewer can choose the final level of concentration in form of how much vegetative matter is recombined with Lupulin Rich Fraction before pelletization
 4. As BBC's interest was in gaining operational benefits AND preserving the tradition of using the Whole Hop we elected to return most of the original plant material to the pellet...all but the most extreme Coarse Fraction.

The Pelletization Process

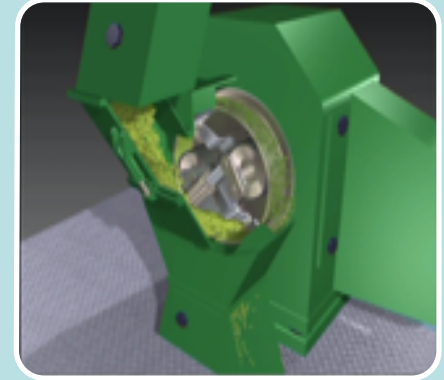


Cleansing
and drying



Milling

- Temperature at T45 line -35°C
- Sieving possibilities at T45 line
- Separators



Pellet
Press

#1....Standard Type 90 Hop Grist

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#2....Coarse Fraction After Separation

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#3....BBC Pure Pellet Grist, Coarse Fraction Removed

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Benefits of the BBC Pure Hop Pellet



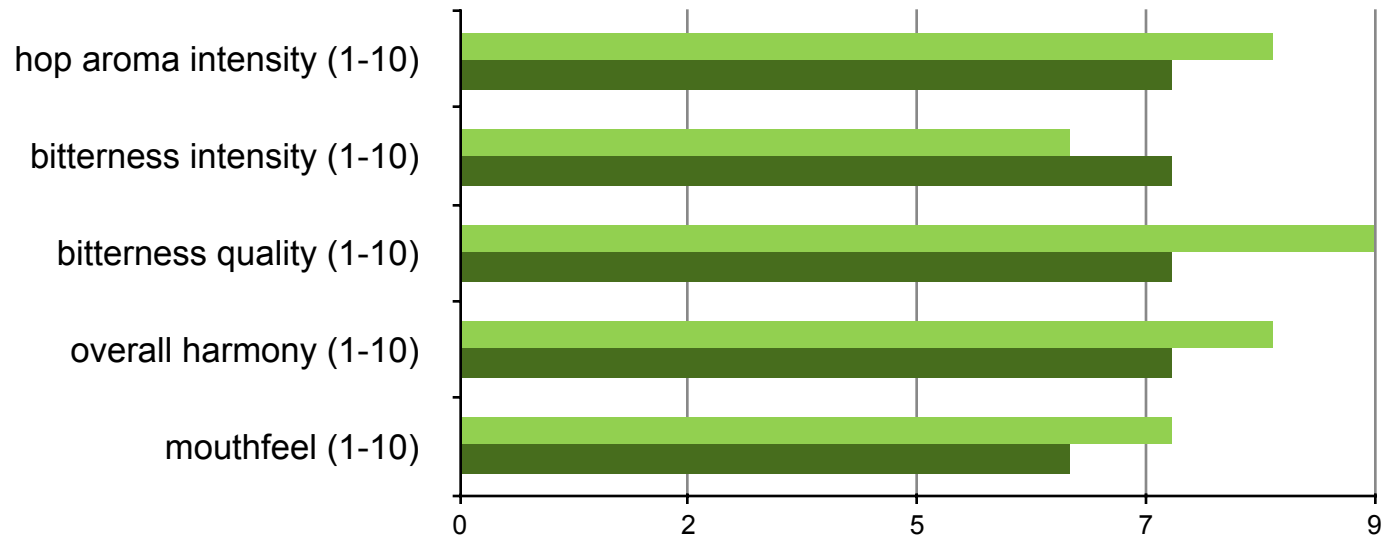
1. **Operational:** The removal of the Coarse Fraction eliminated centrifuge issues and allowed BBC to abandon the use of standpipes in aging tanks...with significant reduction in beer losses

Benefits of the BBC Pure Hop Pellet



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- 2. Operational:** Pellets breakdown much more quickly and uniformly during slurry make-up allowing for a more uniform and pumpable suspension.

Sensory impact of pelletization for Hallertau Mittelfrüh



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- 3. Quality:** Removal of Coarse Fraction from BBC pellets had an unexpected sensory benefit of reducing perceived harshness & astringency in all beers by a factor of 5% - 15% depending on recipe. Includes impact of kettle as well as dry hop additions

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4. **Quality + Financial:** BBC believes the overall colder processing of Type 45 pellets preserves brewing value (hop oils) and is a critical step to maintaining hop freshness in a Complete Cold Supply Chain Strategy from Field to Brewery

Summary

- BBC believes that from this experience and from the analytical, physical and visual attributes of the Coarse Fraction that all Brewing Value is retained in the Pure Hop Pellet
- Standard T90 wt/wt yield from flowers to pellets is around 96%.
- BBC Pure Hop Pellet processing yield by comparison is 91% - 93% depending on variables of variety, crop year, supplier, pellet line.
- Loss of alpha with the Coarse Fraction is very closely monitored as a key quality parameter by the Supplier, and is consistently marginal due to the basic design integrity of the T45 process in general.
- The flexibility and improved aroma/flavor retention created Pure Hop Pellets means Brewers can choose to accept the improved efficiency in the form of:
 1. A hoppier beer for the same original lbs of hops
 2. A reduced volume of hops required to deliver the target hop intensity

Next Steps



- Intent was to share our learnings with the rest of the Craft Community with the belief that the quality and operational benefits may assist brewers wrestling with some of the same issues
- Continued growth and competitiveness in Craft Brewing will require other solutions in terms of how we present our high \$\$/lb hops, spices, other botanicals to our brewing processes and come away with best yield & quality....more partnerships are needed...
 - This presentation describes one aspect—on the ingredient side—of a broader technical effort required to improve overall efficiency & yield in the ingredient intensive Craft Segment.....
 - We strongly encourage all Suppliers to Craft to actively participate in finding new and innovative solutions for the emerging Craft “Kitchen” (i.e. - how & when we introduce and remove large quantities of ingredients to get the highest quality flavor and aroma impact)

Questions and Thanks!

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