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NOVEL OPTIONS FOR UPSTREAM STABILIZATION OF BEER

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INTRODUCTION

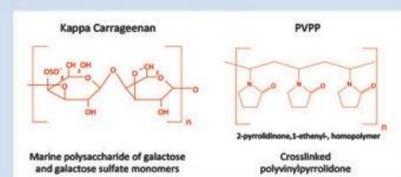
Polyclar™ Brewbrite stabilizer and wort clarifier is a composite of a selected carrageenan and micronized PVPP. It is added to the brewing kettle 10 minutes before the end of the boil, the boiling action provides effective dispersion.

Ashland selectively uses kappa carrageenan to create the admixture Polyclar Brewbrite stabilizer. The kappa form of carrageenan provides enhanced wort clarification due to its higher gel formation properties at higher temperatures. While PVPP effectively reduces polyphenolic haze material early in the brewing process.

This selected composite produces a clear wort, higher wort yields, decreased fermentation times and increased colloidal shelf life.

CHEMISTRY

A composite of selected carrageenan and micronized polyvinylpyrrolidone (PVPP):



VALUE PROPOSITION

Beer Stability is an Important Quality Attribute

Drivers for Beer Stabilization:

- Consumer expectations for better quality and product consistency
- Expanded distribution areas: Beer traveling farther from the brewery
- Challenge of producing quality products in developing markets to compete with imports
- Need to reduce costs – production, minimize returns

What is Beer Stability?

Beer stability is the extent to which a beer tastes and looks as good after aging as it did when it was first packaged. Stability is assessed by:

- Changes in colloidal stability (HAZE)
- Flavor stability (oxidation and staling)
- Color increase
- Microbial stability

Reference : Jean De Clerck, A Text Book of Brewing

Beer Stability

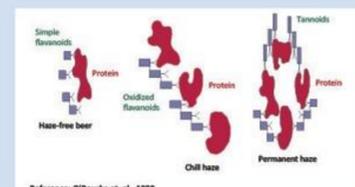
Beer-Haze Stability Definition

- The ability of beer to resist the formation of non-biological colloidal haze (measured in EBC, European Brewery Convention haze units)
- The end of useful shelf life is generally considered to occur when a beer develops haze of 2 EBC

EFFICACY

Schematic of Haze Formation in Beer

- Simple flavanoids give haze free beer
- Oxidized flavanoids produce CHILL HAZE
- Fully oxidized flavanoids = TANNINOIDS produce PERMANENT HAZE



Reference: O'Rourke et. al., 1998

How Haze Develops Over Time

Age of Product	Haze Development Activity
1 Month	Tannoids react with proteins to produce haze
2 Months	Flavanoids oxidize, polymerize and react with proteins to form haze
3-6 Months	Flavanoids oxidize further forming tannoids
6 Months	Tannoids complex with proteins to produce permanent haze

Haze Development – Forced Aging



Why Carrageenan and PVPP?

- Wort clarity and beer colloidal stability are key factors in the shelf life of beer
- PVPP is the method of choice for colloidal stabilization of beer

- Kappa carrageenan (or kettle finings) is very effective in reducing non-microbiological particles (NMPs) in the wort
- NMPs act as templates to which the protein-polyphenol complexes attach, accelerating haze formation in beer
- Both materials are widely used in brewing

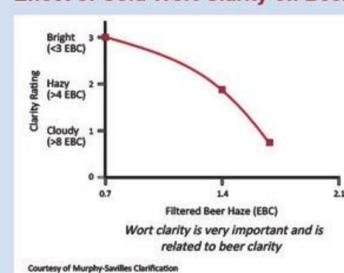
Polyclar Brewbrite Stabilizer Effects



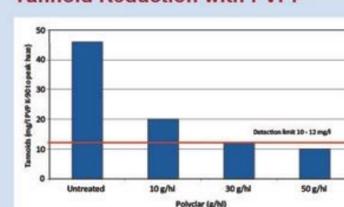
Addition of Polyclar Brewbrite stabilizer:

- Increases removal of particulates from wort
- Reduces tannoids
- Improves clarity of the finished beer

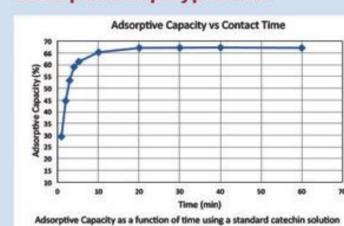
Effect of Cold Wort Clarity on Beer Clarity



Tannoid Reduction with PVPP



Contact time required for adsorption of polyphenols



CASE STUDY

U.S. Brewery

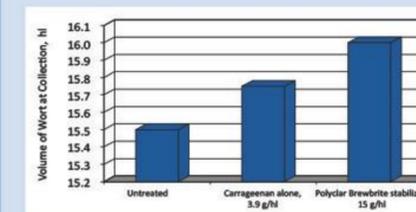
Protocols

- 100% malt lager at 13.5 plato (5.5% ABV)
- Control – carrageenan alone, at 3.9 g/hl
- Test – Polyclar Brewbrite stabilizer at 15.0 g/hl
- Fermentation (regular) at 13°C (6 days)
- Cold conditioning at 1°C (4 weeks)
- Filtration through a horizontal leaf filter using diatomaceous earth
- Packaging in keg and bottle

Additional Benefit of Using Polyclar Brewbrite Stabilizer

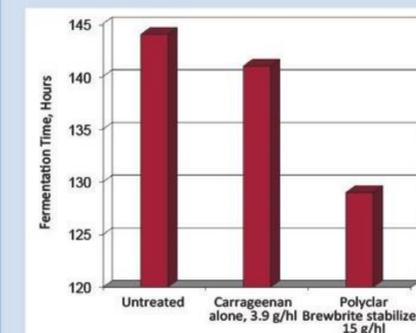
Increase in Wort Yield – Commercial Trial

Polyclar Brewbrite stabilizer gave 3.2% increase in cold wort collected in fermentation vessel as compared to untreated wort.

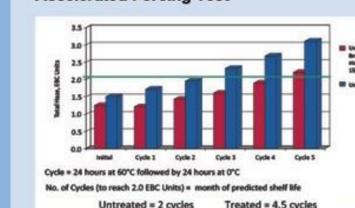


Decrease in Fermentation Time – Commercial Trial

Polyclar Brewbrite stabilizer gave 10% reduction in fermentation time as compared to untreated.



Analysis of Packaged Beer – Commercial Trial Accelerated Forcing Test



Colloidal Stability Analysis of Packaged Beer

Sample	Polyphenols			Proteins	
	T-125 (mg/100ml)	Tannoids (ppm)	Total Polyphenols (ppm)	P-40 (mg/100ml)	SAPS (mg/100ml)
Control, Carrageenan, 3.9 g/hl	11.7	39	168.1	22.0	14.1
Polyclar Brewbrite stabilizer, 15 g/hl	62.2	Not Detected	137.5	27.9	14.6

Addition of Polyclar Brewbrite stabilizer reduced the amount of tannoids while maintaining protein content.

USAGE GUIDELINES

Polyclar Brewbrite Stabilizer: Kettle Addition

- Upstream wort clarification and beer stabilization
- No specialized equipment – slurry tanks, dosing pumps etc.
- Good hydration and mixing in the kettle
- Removal with the trub

How Is Polyclar Brewbrite Stabilizer Used?

- Slurried in cool water and added to the kettle ~ 10 min. before the end of the boil – best practice
- Added as a powder to the kettle ~ 10 min. before the end of the boil
- Added to the whirlpool

CONCLUSION

Use of Polyclar Brewbrite stabilizer:

- Enhances clarity of wort and beer
- Increases wort production
- Decreases fermentation time
- Longer filter runs
- Extends shelf life of packaged beer
- Improves total productivity of brewery

Note: May require further stabilization downstream to achieve even longer shelf life.