

July 2021

Keywords or phrases:

Filtration, Jumbo, clarification, beer, craft beer, quality, microbrewery

Use of Sartopure® Jumbo Star Cartridge for Beer Clarification at Microbirrificio “Birra dell’Eremo”

Filtration Tests Report

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Abstract

Over the past 10 years, Italy has seen a steady increase in the production of craft beer. Starkly contrary to the common trend of the economic crisis, the 335 microbreweries active in 2010 grew to over 800 by the end of 2018.

Craft beer differs from industrial beer in that it is not pasteurized, therefore keeping its organoleptic qualities unaltered. Moreover, the presence of live yeasts makes the beverage alive and evolving over time. The strong growth of this market is surely to be attributed to the consumers’ preference for healthy food without the addition of preservatives and adjuvants; that is, craft beer.

The filtration solution offered by Sartorius to the microbrewery Birra dell’Eremo made it possible to optimize its production efficiency, increasing its competitiveness, and improving the quality of the bottled end product.

Thanks to the high filtration capacity of the Sartopure® PP2 Jumbo Star and its ease of regeneration and sterilization, the Sartorius solution has proved an excellent system for beer clarification after fermentation.

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Introduction

Craft Beer

The production process of craft beer is shown in Fig. 1. Ground malted barley is first boiled to activate the malt enzymes that bring about starch hydrolysis and the production of maltose. This phase usually lasts about two hours with a variable temperature range according to the type of malt used.

There follows the filtration, then the wort is boiled with the addition of different varieties of hop; this allows the wort sterilization and the extraction of the hop alpha acids which will define the aromatic characteristic of the product. Boiling is followed by whirlpool clarification to remove coagulated proteins; wort is then cooled and transferred to the fermenter where seed yeasts will be introduced: **Saccharomyces cerevisiae** for high-gravity beers, **Saccharomyces uvarum** for low-gravity beers.

Fermentation usually lasts 7-10 days at a temperature of ca. 20 °C for high-gravity beers and ca. 8°C for low-gravity beers. For a maltose reduction of approx. 80%, the yeast dosage is about 70 g/hl (~10⁷ cell/ml). For some types of beer, fermentation is followed by dry hopping and conditioning at 4 °C. Other types do not need dry hopping and go directly to the conditioning phase which typically lasts 14 days. The next stages are the coarse filtration of beer and addition of sugar, beer bottling and maturation in the bottle – generally for 2 weeks at 20 °C.

The production process of a raw high- or low-gravity craft beer lasts approx. 30 – 40 days.

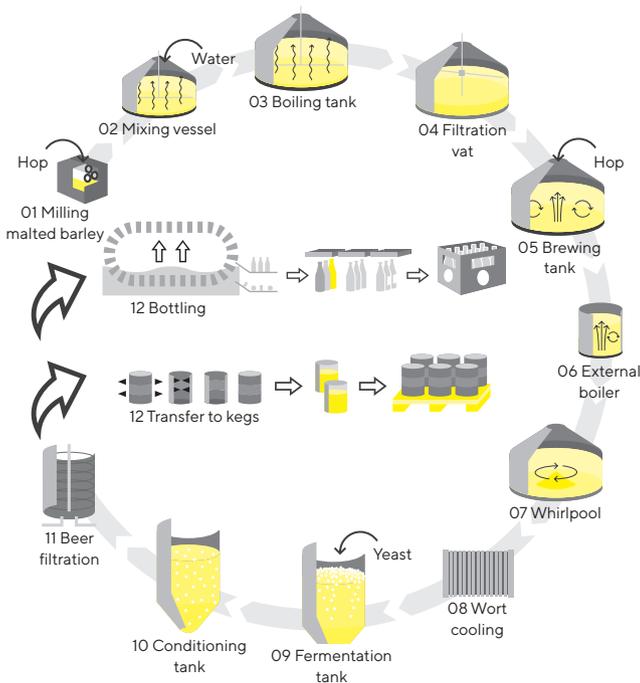


Figure 1: Standard beer production process

Birra dell'Eremo

The microbrewery Birra dell'Eremo was established in 2012 and has a current production expectation of 3000 hl/year, with a 15 hl brew room and a 30 hl daily production. The fermentation room has six 30 hl fermenters and an Alfatek bottling line.

They produce different varieties of high-gravity beers and a range of special beers brewed with autochthonous yeast strains isolated within the brewery. The beers produced are listed below:

Beer name	Characteristics
Saggia	Blonde, 5% Vol
Fuoco	Golden Ale, 5% alcohol
Fiera	IPA, 6,5% Vol, Dry hopping
Nobile	Dry hopping
Glaciale	Imperial Ale, 7% vol, Dry hopping
Magnifica	APA, 5% vol, Dry hopping
Terra	Oatmeal Stout 5.2%

Beer name	Yeast type
KO2	Kluyveromyces thermotolerans
TO2	Torulaspota delbrueckii
WE2	Wickerhamomyces anomalus

On account of the strong growth in craft beer consumption at home and abroad, the brewery has considerably increased the volume of beer produced in the last years. As of today, they need to maximize their production yield, especially as they would like to reduce the beer maturation process from 14 to 7 days, ensuring the same quality standard of turbidity and yeast concentration (10⁴ cells/ml). For this reason, they have taken into consideration a cartridge filtration step downstream from the conditioning tank.

Solutions

The beer from the conditioning tank after seven days has a high colloidal suspension of proteins and yeasts. In the preliminary filtration tests on as complex a beer as the Glaciale – with an important protein structure given by the different types of malt used, and considerable hop residues due to dry hopping – Sartopure® PP2 8 µm filter sensibly reduced turbidity, while a Sartopure® PP2 5 µm gave a clear beer with a filtration yield of approx. 60 l/m². Given the complexity of the product, we proposed the Jumbo system for the process tests.

The test results with filter Sartopure® PP2 Jumbo Star 5 µm and different types of beer are shown here:

Beer	Batch	Conditioning time	Concentration after fermenter (20 ml sample)	After Sartopure® PP2 Jumbo Star 5 µm (20 ml sample)	Yeast concentration after filtration (20 ml sample)
Saggia	1300 litres	7 days	10 ⁵ cells/ml	0 cells/ml	10 ⁴ cells/ml (80% filtered with Jumbo, 20% unfiltered)
Fuoco	3000 litres	7 days	2*10 ⁵ cells/ml	0 cells/ml	10 ⁴ cells/ml (70% filtered with Jumbo, 30% unfiltered)
Fiera	3000 litres	7 days	10 ⁵ cells/ml	0 cells/ml	10 ⁴ cells/ml (70% with Jumbo, 30% with filter bag to retain suspended hop of dry hopping)



Figure 2: Beer Saggia. Left: filtered 5 µm; right: from the conditioning tank



Figure 3: Separation between filtered and unfiltered beer

Conclusion

Sartopure® PP2 Jumbo Star 5 µm has proved an excellent filtration system for beer after the conditioning phase, the duration of which was reduced to seven days thanks to the complete retention of suspended colloids, which results in a clear beer with an extremely low yeast count.

Yeast concentration after filtration can be measured considering that the beers produced by Birra dell'Eremo have a concentration of 10^5 cells/ml after seven days of the conditioning phase, and contemplating a dilution of the filtered (clear) beer with the unfiltered beer it is possible to reach the target of $\sim 10^4$ cells/ml. Based on the tests carried out, the intended target cell concentration is reckoned to be achievable by filtering 80% of beer and mixing it with 20% unfiltered beer.

The possibility of controlling the quantity of yeast in the bottle offers the following advantages:

- Beer with reduced turbidity
- Reduced precipitation in the bottle
- Improved organoleptic quality
- Beer clarity
- No addition of yeasts for refermentation

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