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# Hop Creep, Costs, and Productivity – Benefits of the Jumbo Star System for Craft Breweries

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## Abstract

Since their origin, microbreweries have always focused on producing high-quality, genuine beers. Strong market growth of the last few years has posed significant challenges to the sector: increased productivity without compromising the pillars of craft-beer vs. industrial-beer making, i.e. quality and genuineness. At the same time, multiple financial crisis, the latest brought on by the Covid-19 pandemic, have caused high uncertainty in entrepreneurial investments.

The Jumbo Star system responds to this demand as a technological solution for the clarification step after maturation. In fact, it ensures improvement of product quality as well as reduction of production costs (reduced beer loss during filtration, low cost of consumables and much shorter filtration time).

The use of Jumbo Star for production in an Italian microbrewery brought about a 3 to 8% beer loss reduction, with 50% knockdown of both post-fermentation processing time and annual cost of consumables. Moreover, for beers hopped with the dry hopping method, filtration with Jumbo Star prevented hop creep in bottled beer.

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# Introduction

The Jumbo Star system is a technological solution for beer clarification. The 5  $\mu\text{m}$  Sartopure® PP Jumbo Star filter used in the system makes it possible to process beers with high NTU values, thus avoiding long downtimes for filter regeneration. The main characterizing features of the Jumbo Star filter are:

- High filtration surface area
- Flow rates of up to 50 hL/h per 40" filter
- Easy regeneration by backflushing
- Closed, compact system
- Easy handling

## The Italian Microbrewery

Founded in 2014 by 7 passionate partners, the brewery now produces 15 different types of beer, with a production capacity of approx. 2,000 hL/year, a boiler room, 8 fermenters and packaging capabilities for bottles, kegs, and cans.

The brewing process used to include, for some types of beer, a sheet-filter filtration step after conditioning, carried out in two different ways according to the desired result: 20 – 8  $\mu\text{m}$  filter sheets for coarse filtration; inverted plate and 20 – 8  $\mu\text{m}$  step, followed by 3 – 1.5  $\mu\text{m}$  filter sheets, for fine filtration. The producer, however, had to face the big problem of frequent downtime during filtration owing to clogging of the filter sheets, because of their small filtration area. Moreover, in order to improve beer filterability, it was necessary to prolong low-temperature maturation with continuous tank purging and consequent beer loss increase.

# Solution with the Jumbo Star System

The proposed Jumbo Star system includes a filtration step with stainless steel filter, followed by a 5 µm Sartopure® PP Jumbo Star filter complete with CIP module to handle washing, regeneration, and sanitization.

Thanks to its high filtration area and regeneration efficiency, Jumbo Star allowed the microbrewery to process 20 hL to 40 hL daily, never having to stop for clogging problems. It also helped reduce maturation time from 20 to 10 days for dry-hopped beers, and from 15 to 7 days for beers without cold hopping, significantly reducing the purging of tanks during maturation (Table 1).

Type	Quality	Maturation (day)		Product Loss (%)	
		Dry	No Dry	Dry	No Dry
Sheets	Coarse	20	≈15	≈10	≈10
Sheets	Fine	20	≈15	#	≈15
Jumbo Star	Fine	10	≈7	≈7	≈7

Dry: beers with dry hopping; No Dry: beers without dry hopping; # not performed

**Table 1**

Moreover, through appropriate saturation and desaturation procedures of the system with inert gas, the producer could obtain very low levels of O<sub>2</sub> released by the system into the beer, reaching oxygen values in the filtered beer lower than 20 ppb.

Lastly, the 5 µm Sartopure® PP Jumbo Star filter brings about an excellent cell count reduction. Table 2 shows count values before and after filtration.

Beer	Pre-count (cell/mL)	Post-count (CFU*)
a	2.5 × 10 <sup>6</sup>	500
b	10.8 × 10 <sup>6</sup>	4
c	26.75 × 10 <sup>6</sup>	236
d	3.1 × 10 <sup>6</sup>	118
e	6.3 × 10 <sup>6</sup>	5
f	2.2 × 10 <sup>6</sup>	4
g	1.6 × 10 <sup>6</sup>	5

\* obtained through membrane filtration of 1 mL beer with the addition of 9 mL sterile water and cultivation in wort medium at 28 °C (82.4 °F)

**Table 2**

# Hop Creep – Jumbo Star

Hop Creep is the refermentation of beer after the dry-hopping phase. It occurs because hops contain enzymes that transform non-fermentable sugars (dextrines) into fermentable sugars. Residual yeasts metabolize sugars and modify Plato degree (°P), CO<sub>2</sub> contents, final alcohol level, and organoleptic properties, with the risk of diacetyl production.

The big reduction in yeasts, thanks to filtration with Sartopure® PP Jumbo Star, is fundamental to avoid the Hop Creep phenomenon in dry-hopped bottled beers.

Table 3 shows the results of a forced fermentation study. Tests were carried out by adding 5 g/L dextrose to the beers filtered and then storing them at 30 °C (86 °F). After 21–28 days, °P was measured and CO<sub>2</sub> production monitored. The absence of Hop Creep is proven by the unchanged °P and CO<sub>2</sub>.

Beer	Filter	CFU	Result
a	Jumbo Star	500	No
b	Jumbo Star	#	No
c	Jumbo Star	5	No
d	Jumbo Star	236	No
e	Jumbo Star	#	No
f	Jumbo Star	4	No
g	Jumbo Star	118	No
h	Jumbo Star	4	Yes
i	Filter sheets*	35	Yes

# not performed; \*coarse filtration

Table 3

This resulted in the brewery’s different approach to dry hopping, that, with Jumbo Star, could be performed just before or after filtration, going on to bottling without risking diacetyl production nor variations in °P, CO<sub>2</sub>, and final alcohol level. On the contrary, before the Jumbo Star introduction, dry hopping was performed during fermentation final stages to elicit the Hop Creep phenomenon, with consequent reduction of the final °P and longer processing time. This helped lessen the risk of undesired refermentation in the bottle.

The benefits of using Jumbo Star are evident: reduction of beer production times and improvement of organoleptic quality.

# Conclusion

By implementing the Jumbo Star technology in its manufacturing process, the brewery obtained the following benefits:

- Beer loss reduction: from 15% to 7% for dry-hopped beers and from 10% to 7% for beers without cold hopping; tank purging is needed only once.
- Maturation time reduction: from 20 days maximum to 7 days minimum.
- Filtration costs reduction: by comparing cost of filter sheets and Jumbo Star Sartopure® PP filter, a 50% annual reduction is expected.
- O<sub>2</sub> pick-up: being the Jumbo Star a closed system, through appropriate saturation and desaturation procedures with inert gas the O<sub>2</sub> passed into filtered beer amounts to around 20 ppb.
- Hop Creep reduction: trials have proved that Hop Creep is reduced in beers filtered with Jumbo Star Sartopure® PP.

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