Master Brewers Association of the Americas
Dedicated to the technology of brewing.

Center to Center
Innovations in High speed separators and benefits for Craft brewers

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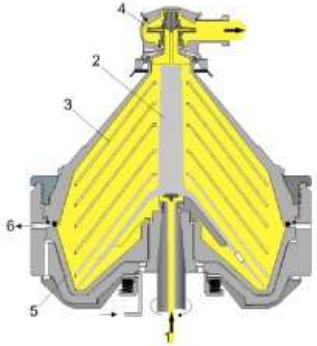
Agenda

- Fundamentals of the Hermetic Concept.
- Center to Center bowl design philosophy.
- C2C benefits for craft Industry.
- Latest innovations based on C2C technology
  - E-motion. Reduced pressure
  - Top Stream.

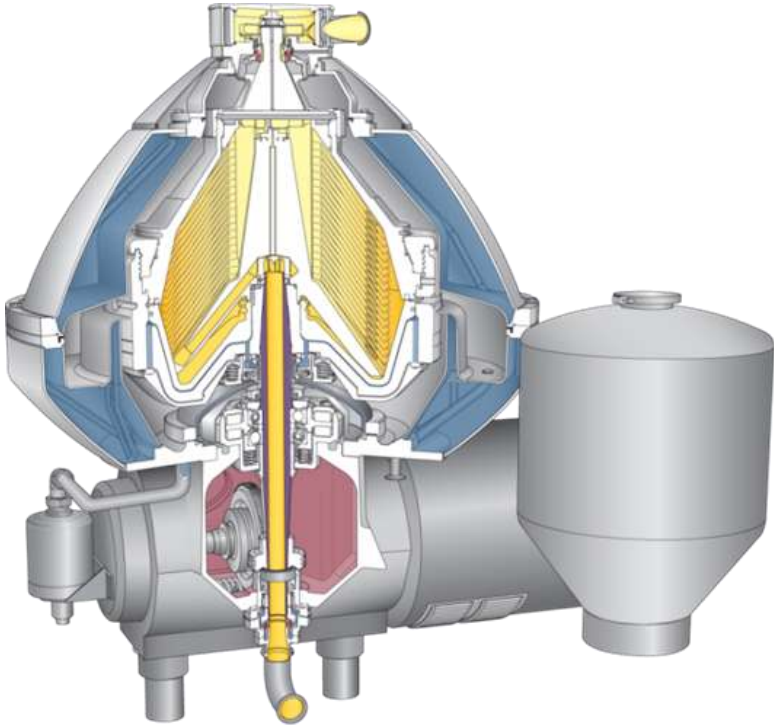
What is an hermetic bowl.

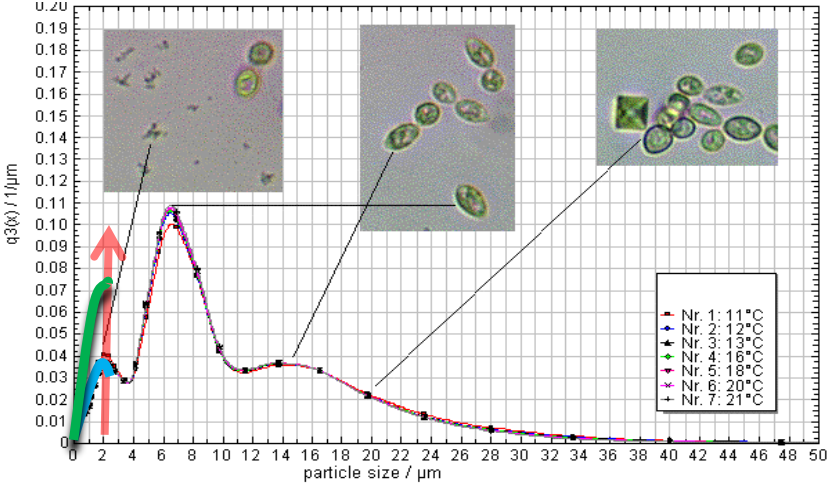


- Unlike traditional separators, it is a bowl´s design characterized for feeding the product from the bottom trough a hollow spindle. Bottom fed separator
- Product is not in contact with air during clarification. Bowl Air tight.
- Product enters and leaves the bowl at ratio zero (axe of rotation). Central inlet-outlet
- It has no fixed paring disc
- It has no level ring. Bowl full of liquid.
- It has not Oxygen stop upper chamber

Center to Center (C2C)

- Gentlest acceleration of the feed

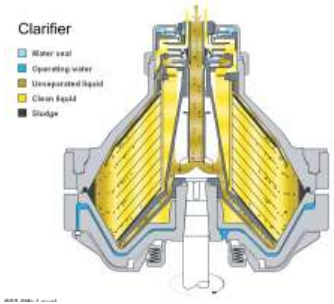


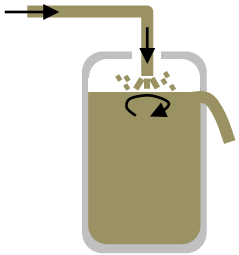


$$v_g = \frac{d^2 \Delta\rho}{18\mu} \omega^2 r$$

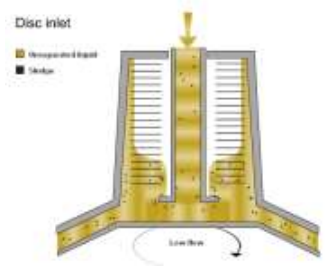
$$\frac{d}{2} \rightarrow \frac{Vg}{4}$$

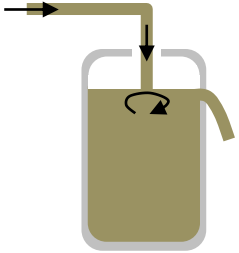
Evolution of feed systems



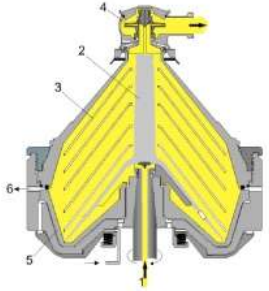


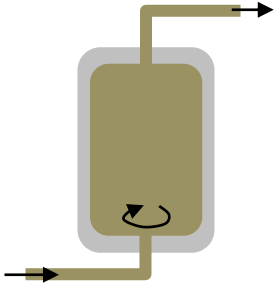
Traditional wing inlet





Disc inlet





Hermetic inlet

More gentle acceleration and no air pick up

Separator Power Consumption

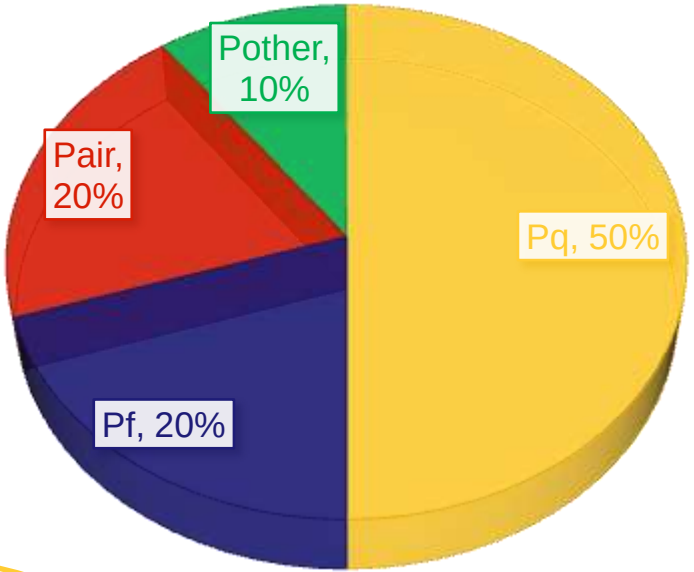
- Contributions to HSS power consumption.

P_Q: Flow Power

P_f : Friction from paring disc

P_{air}: Air Friction (bowl-casing)

P_{other}: Bearings, transmission, seals, discharge system etc.

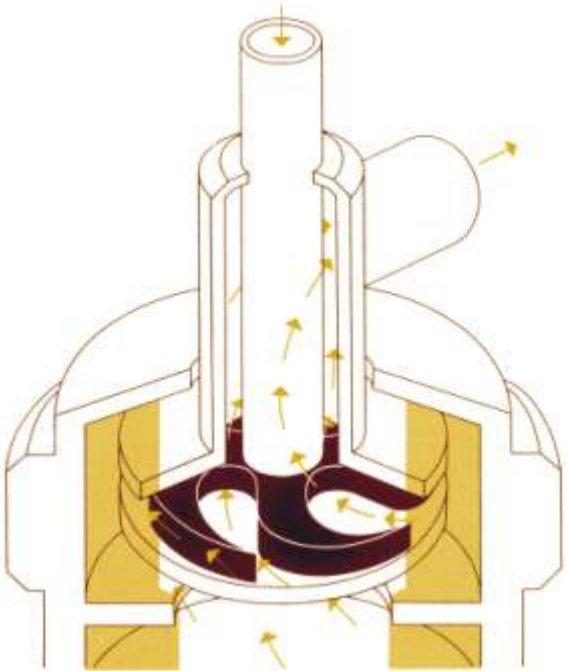


$$Power = P_Q + P_f + Pair + Pother$$

Idle Power

Flow Power

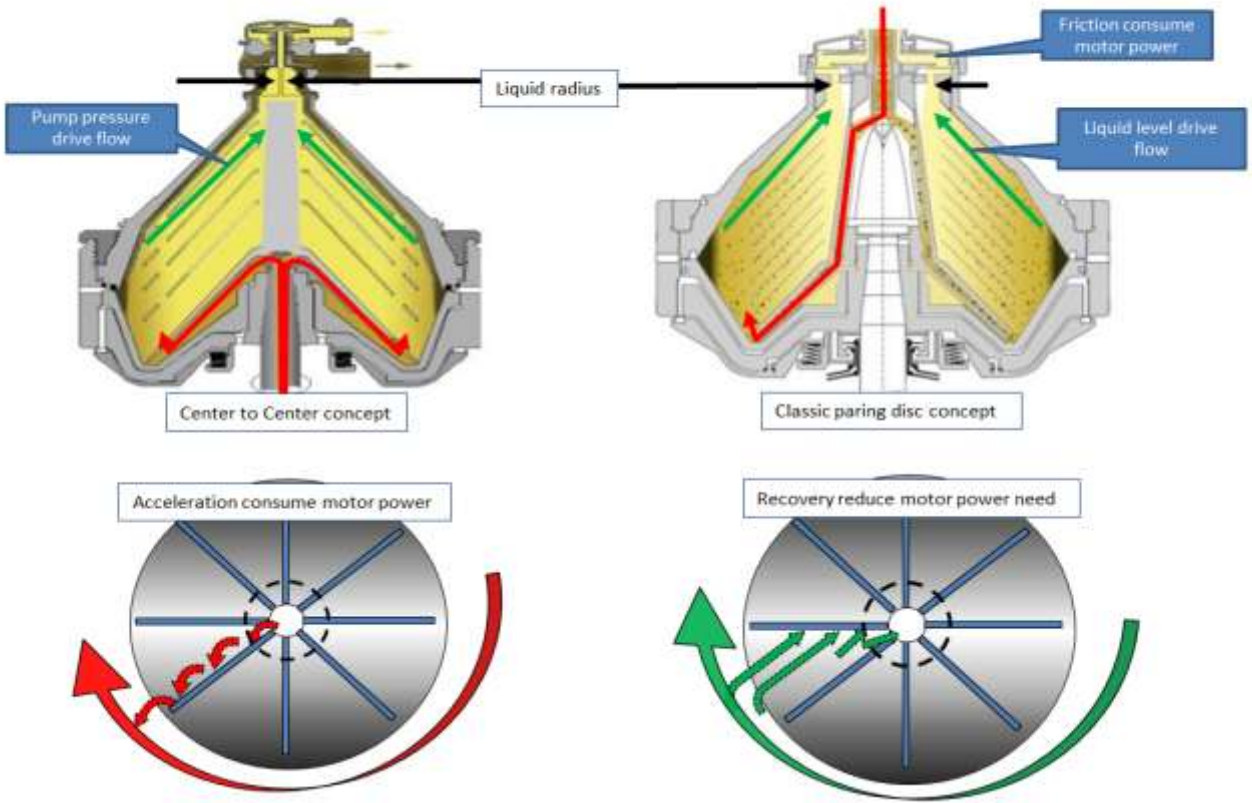
- Paring disc



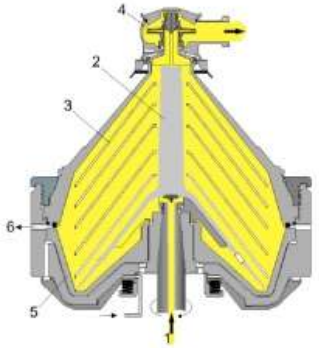
- Centripetal Pump (Static)
- r_u^2 radius of level ring
- ω^2 Bowl Speed
- Q Flow

$$P_Q = \rho Q \omega^2 r_u^2$$

Center to Center – Energy recovery

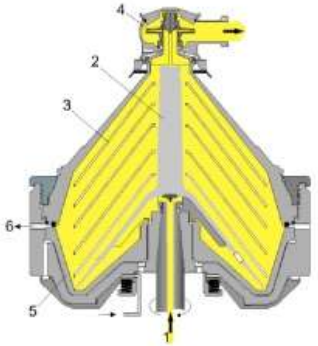


C2C Benefits



- Lowest shearing forces and smoothest acceleration of the feed: This means less disruption of dispersed particles, thus higher separation efficiency.
- Since the feed tube is not occupying physical space in the upper part of the bowl, central inlet/outlet design has always larger discs length
- No heat transfered to the beer in paring discs during conversion of kinetic energy to pressure.

C2C Benefits

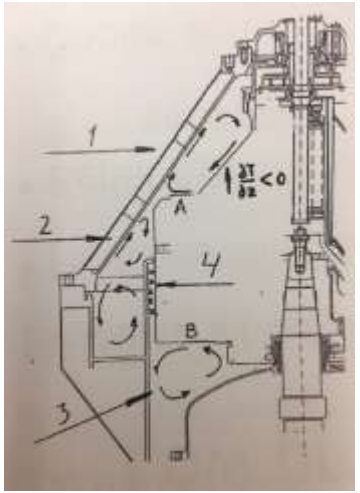


- On equivalent bowl diameters C2C has similar separation efficiency at higher troughputs. In comparable flows C2C has always higher clarification efficiency.
- No product Oxidation, No loss of aromas / hop oil stripping and No Oxigen Pick up.
- C2C is capable to operate in a wide range of flows without any further adjustment. Changing Level ring or paring discs.
- Product Temperature pick up´s exposure is reduced to the minimum in reduced flows.

Air Friction

- Bowl Casing

- Bowl Pheriphery speed 700 Km/hr
- R^5 Bowl radius
- ω^3 Bowl speed



$$P_{air} = c_{f\,.\,bowl} \frac{2\rho_{air}\pi\omega^3}{5} R^5$$

Independent of flow rate

E-motion

- Running lean and cool technology

Mount Blanc

0.5 bar
50% vacuum

Mount Everest

0.3 bar
70% vacuum

e-motion
Centrifuge

0.1 bar
90% vacuum

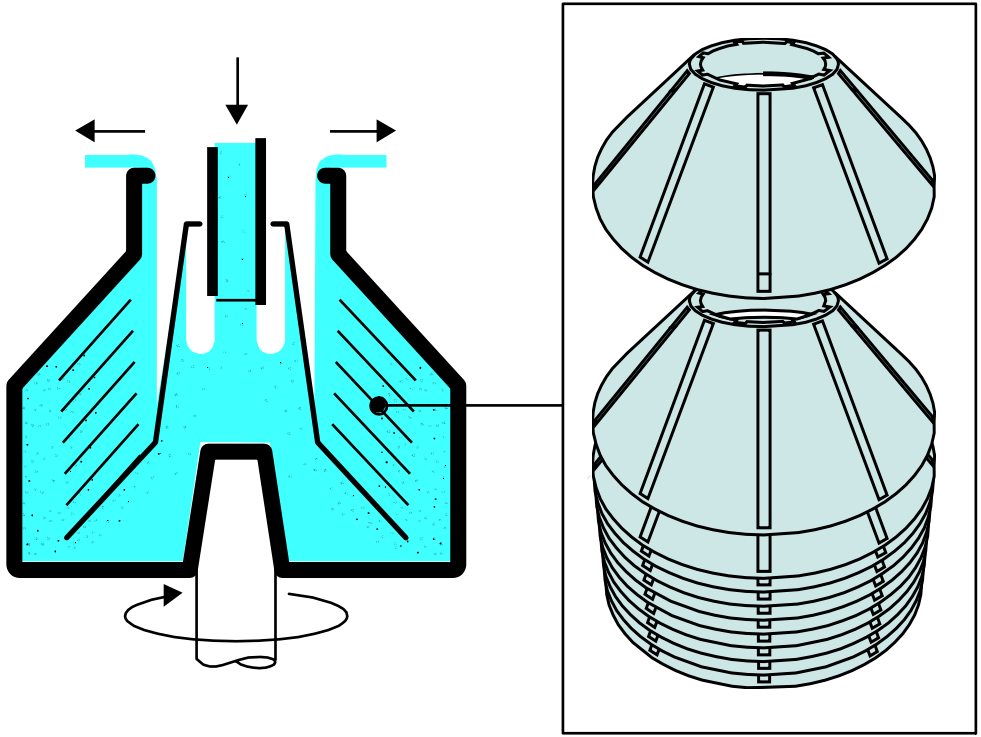
Low Pressure

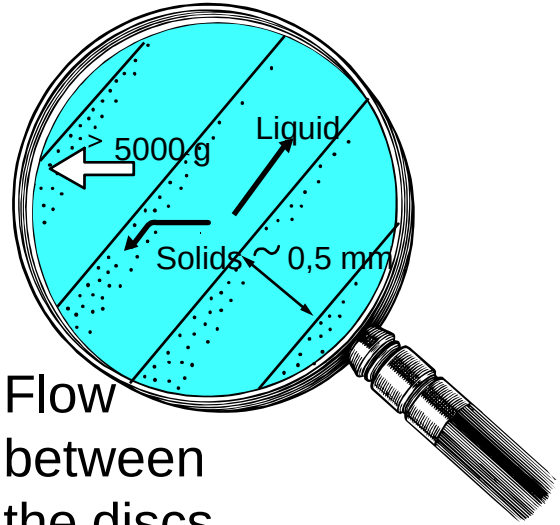
- eMotion. Evacuate air outside the bowl

0.3 Kwh/m³

- Reduces Idling Power
- Better hygiene (less burning-on) reduces secondary flow vortices.
- Cooler surfaces on the outside of the separators.
- Reduced sound level of the separator

Traditional Mechanical separation liquid/solids



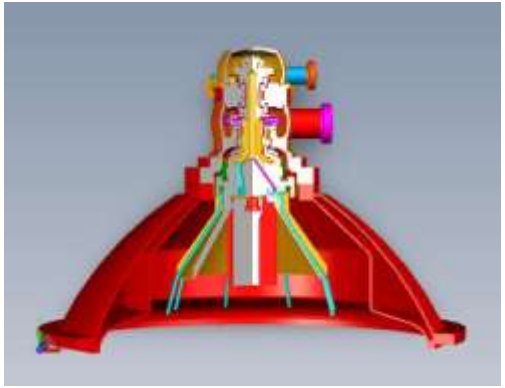


Flow between the discs

Top Stream Technology

- Hermetic Separator with continous concentrate flow sectors over top disc

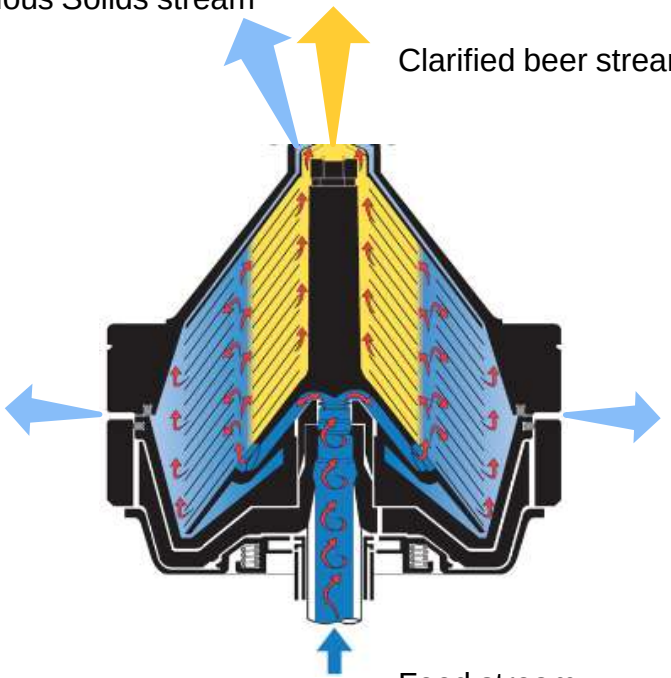
- Fully hermetic design. No Oxygen pick up
- Hybrid separator. It can operate in continious discharge mode or intermittent discharge.
- Higher solids handling capacity than conventional self cleaning separators.
- Increase of beer yields. Beer recovery out of tank bottoms in continous mode. Minimum temperature pick up. No need of beer recirculation. Absence of low flow transitions.
- Centrifuge solids space is no longer a process constraint.



Top Stream process flows

Continuous Solids stream

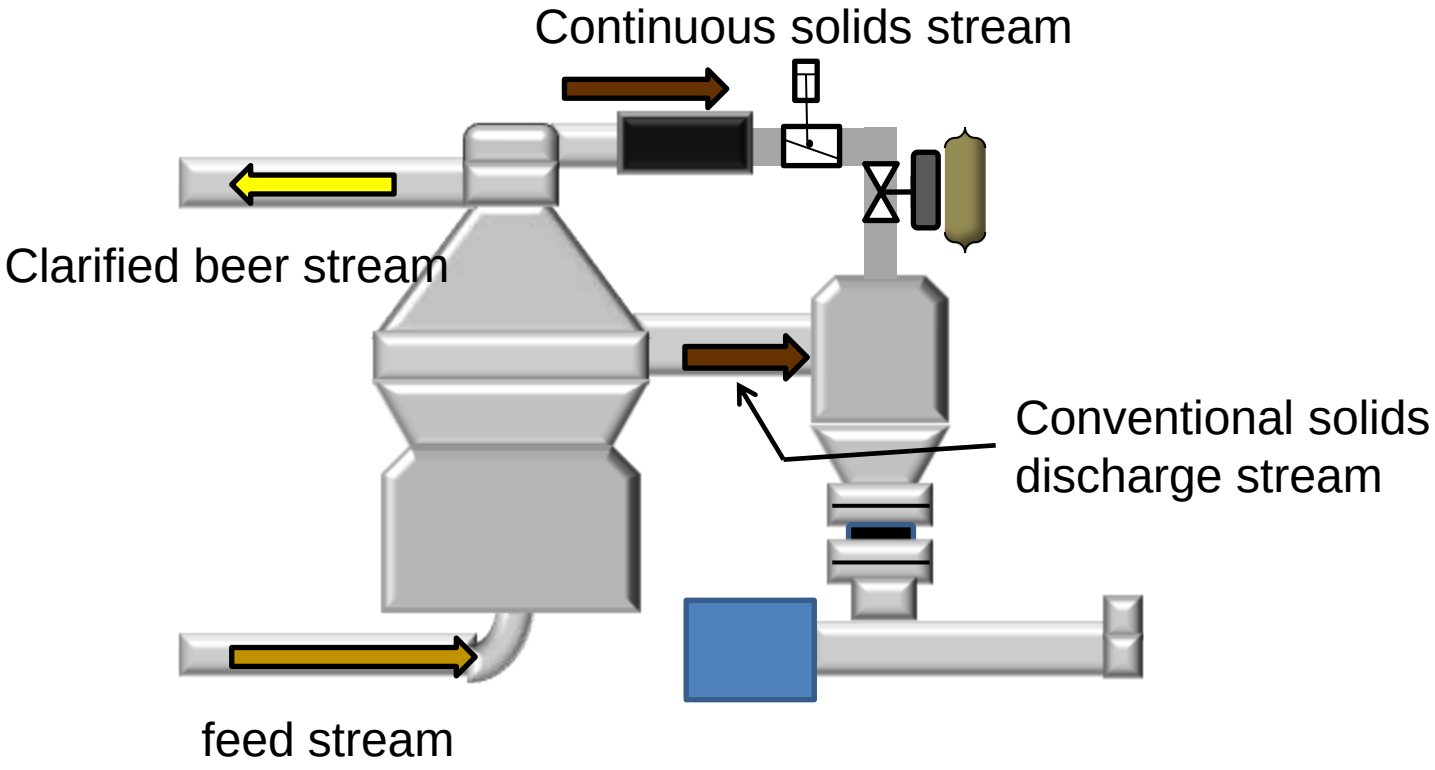
Clarified beer stream



Intermittent solids discharge stream

Feed stream

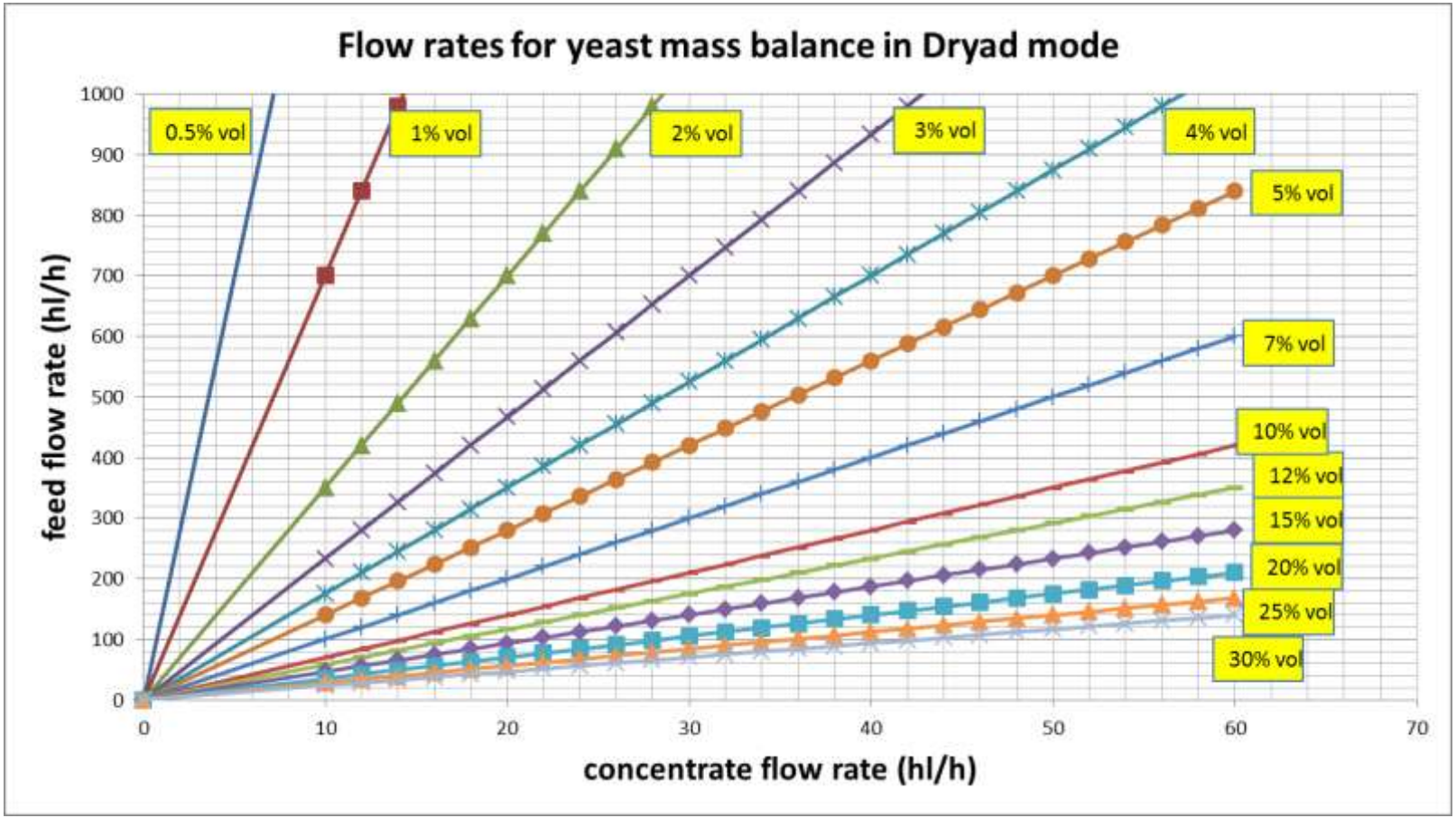
Top Stream Process

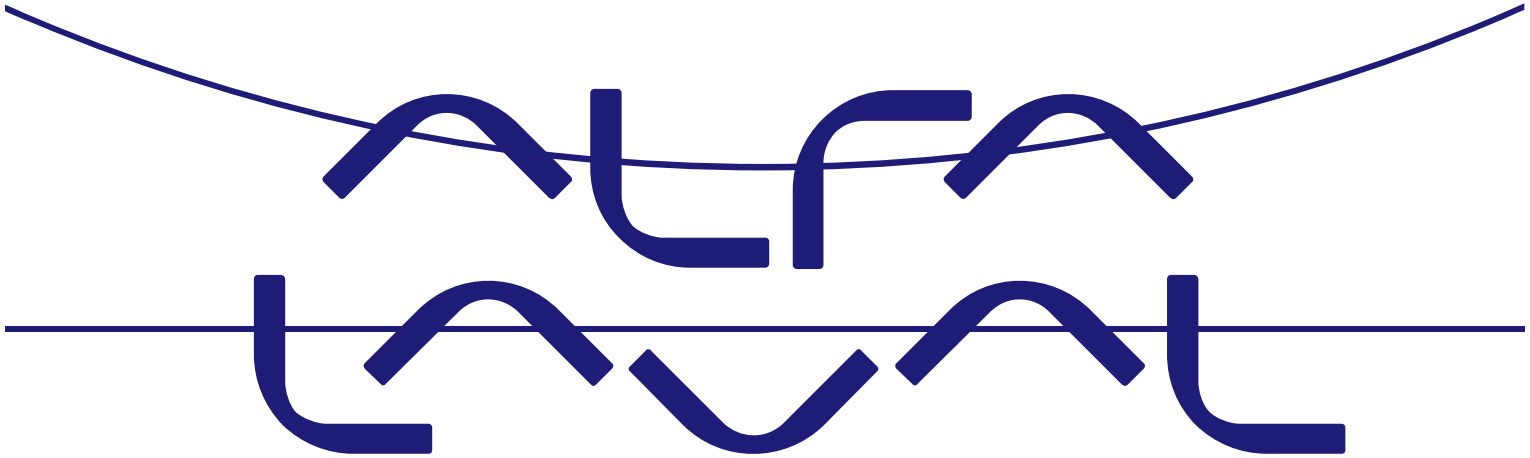


Separator solids handling capacity example comparison between conventional self cleaning vs Top Stream

Traditional self cleaning discharge of 17 liters, 30 times per hour
Maximum solids transport capacity= 17*30 liters per hour = 510 liters per hour ≈ 5 hl/h

Top Stream solids flow capacity, 5-50 hl/h (0.5-5 m3/h). Ten times higher. Top Stream has similar solids handling capacity of multiple conventional separators operating in parallel


Flow rates for yeast mass balance in Dryad mode
feed flow rate (hl/h)
concentrate flow rate (hl/h)
0
100
200
300
400
500
600
700
800
900
1000
0
10
20
30
40
50
60
70
0.5% vol
1% vol
2% vol
3% vol
4% vol
5% vol
7% vol
10% vol
12% vol
15% vol
20% vol
25% vol
30% vol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