PROCESS CONTROL FOR BEER FILTERABILITY: CFMF

General Principles

Given the same filter area, a 0.20 µm MF can only filter 1% the volume as DE.

Direct Flow Filtration: removes material both on the surface and in the depth of the filter …….particulates removed mostly by size-determined direct interception….dissolved "materials" by adsorption via charge-charge interactions and Van der Waals interaction…..at a constant transmembrane pressure, over time flux through membrane drops to zero – flux very much media driven (size and composition), with adsorptive driven clogging being every bit as relevant as particulate-driven clogging.

Main components responsible for **membrane fouling** are:
a) yeast cells
b) colloidal hazes
c) calcium oxalate
d) beta-glucans
e) arabinoxylans
f) gels in general.

Crossflow Filtration: instead of capturing particles in the membrane, intent is to concentrate particulates in the crossflow stream…...ideally membrane should retain nothing…….adsorptive fouling still a reality...as long as fluid "lift" is greater than the "drag" inside the unit, the particulates will tend to move away from the membrane – and vice versa. Also design system using membrane compositions with the lowest adsoptive potential.

In CFMF, the tangential flow pattern reduce rate of fouling, lengthening run times.

CFMF

Molecular Surface Engineering (MSE) CFMF….antifouling system for filter membranes made by the German firm PolyAn….geared specifically to systems used for microbiological stabilization. Leads to much longer filtration runs by "causing the membrane to have a repellant effect on large molecules, mainly of biological origin, that would otherwise be attracted and bound to untreated membranes."

CFMF systems require 10x more H_2O for rinsing/ CIP/SIP applications vs. DE systems?

CFMF – 0.42-0.72 Euros/hL of filtrate to operate.

Beer Filterability

Norit/Millipore

Heineken's Norit Membrane Filtration....for beer clarification...employs a new oxidative agent for 100x regeneration and long-term use.....much less extract loss than DE.... use of SHG adversely affects performance?

"Brewpore" cartridge filter.....**Millipore** for sterile filtration...uses patented **PVDF** (polyvinylidene) membrane with 0.55 um pore size.....tolerates temps up to 80^0C and all traditional CIP regimens.

Filtrox CFMF Technology: future system is based on Silica Wafer Membranes based on microchip manufacturing technology…… 900,000,000 holes per wafer….. "microsieve" approach…….0.35 to 5.0 um pore sizes possible….smooth surfaces and inert silicum nitride composition….operate using "DCP (**D**ynamic **C**rossflux **P**ulsing)".….easy to clean…..10hl/hr pilot scale studies extent to date (2005)…….. flux rates (40-60 hL/m^2h) are 100x higher than traditional, therefore footprint of units are also 100x smaller systems.

Filtrox

Celtrox PC ….Filtrox's new precoat material reduces precoat # to only one. Contains < 1% cristobalite and delivers following process capabilities: i) yeast cell counts of 0-1 cell/100 ml, ii) stable cakes, iii) lower haze readings of 0.1-0.2 EBC units compared to conventional precoat systems, iv) reduced DE needs for a stable DE precoat, requiring 800 g/m^2 (0.16 lb/ft^2), half the normal requirement, v) precoat times cut in half. Composition: < 5 ppm iron, calcium < 90 ppm, pH of 6 in a 10% slurry solution, wet cake volume of 2.8-3.2 L/kg and mdarcy of 170-230.

"PALLSEP VMF" - **V**ibratory **M**embrane **F**iltration for beer recovery from spent yeast....add "barm" beer back at @ 1.5% to wort *en route* to fermenting. Alternative to CFMF.

Filtrox: new systems have many engineering improvements, including: i) Synox Candle Filter (STABOX) is slimmer at 25 mm vs. 32.5 mm of the first generation candle filters, ii) candle internal volume reduced by 39%, enabling more packed density inside the filter without reducing performance, ii) allows units to have smaller footprints, iv) improved cleaning features with high pressure devices in the open candle core, v) improved spray head performance, vi) filter vessels shape changed from conical at the bottom to flat, void volume reduced, lowering unit heights and interface volumes during start-ups, shut downs or brand changes.

DCP: maximum flux rate seen at 60 hL/m^2 microsieve area/ hour using microsieves of 0.5 µm diameter.

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