# Maximising the performance and minimising the cost of filtration

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Blue H2O Filtration

BHF TECHNOLOGIES

AUS & NZ

VINPAC INTERNATIONAL

TORRESAN

WINERY ENGINEERING ASSOCIATION - LIMITED -



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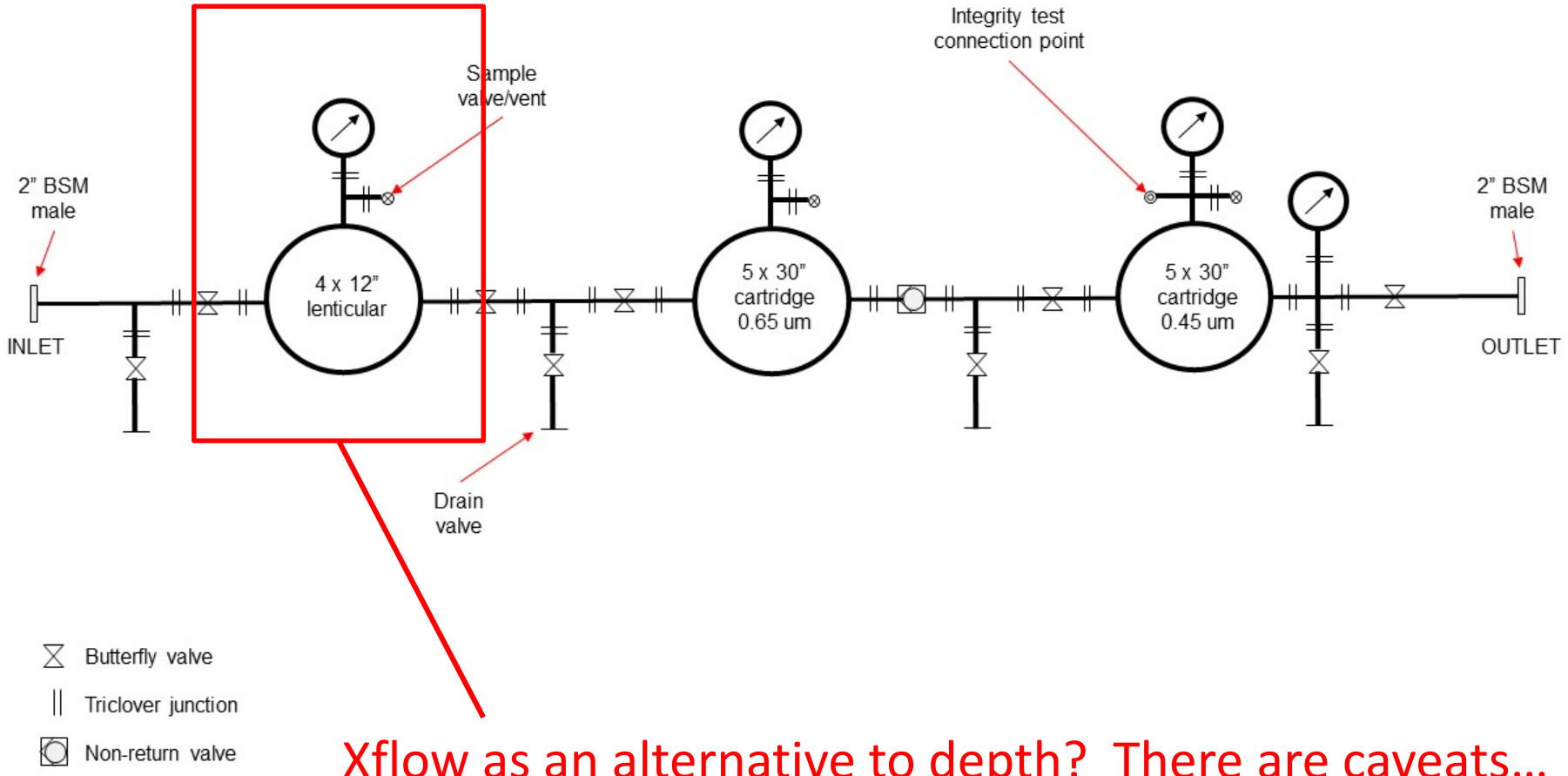
# Typical bottling filtration setup




Xflow as an alternative to depth? There are caveats…

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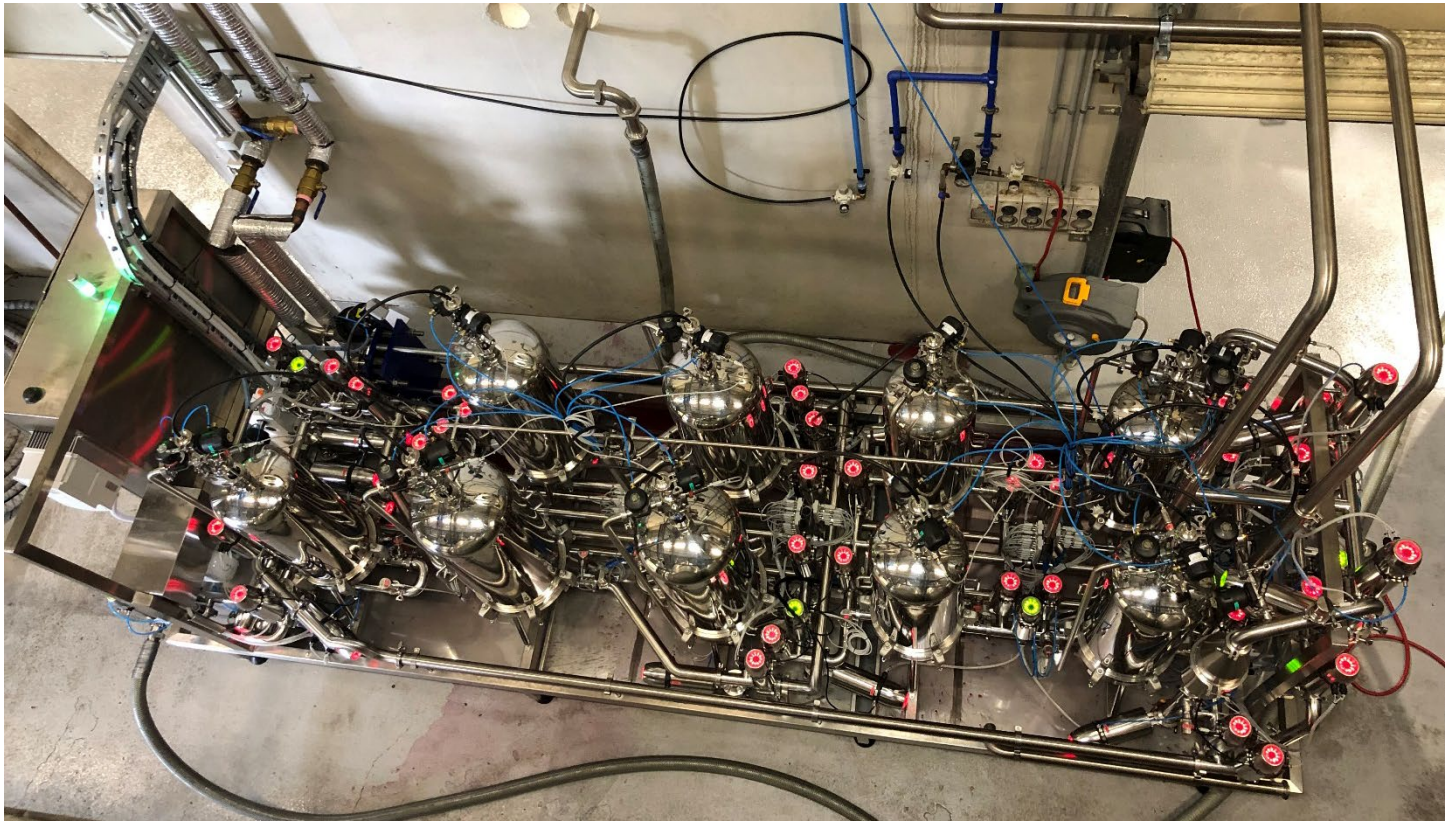
# Torresan Estate MV



- No lenticulars – all cartridges for ease of handling
- Minimal operator input required
- Constant data logging: P & DP, T, flow, conductivity
- Used for xflowed wines with FI analysis for maximum benefit
- Maximises filtration $/L through large housings ($r^2$ law)

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# The value of monitoring your filtration system performance

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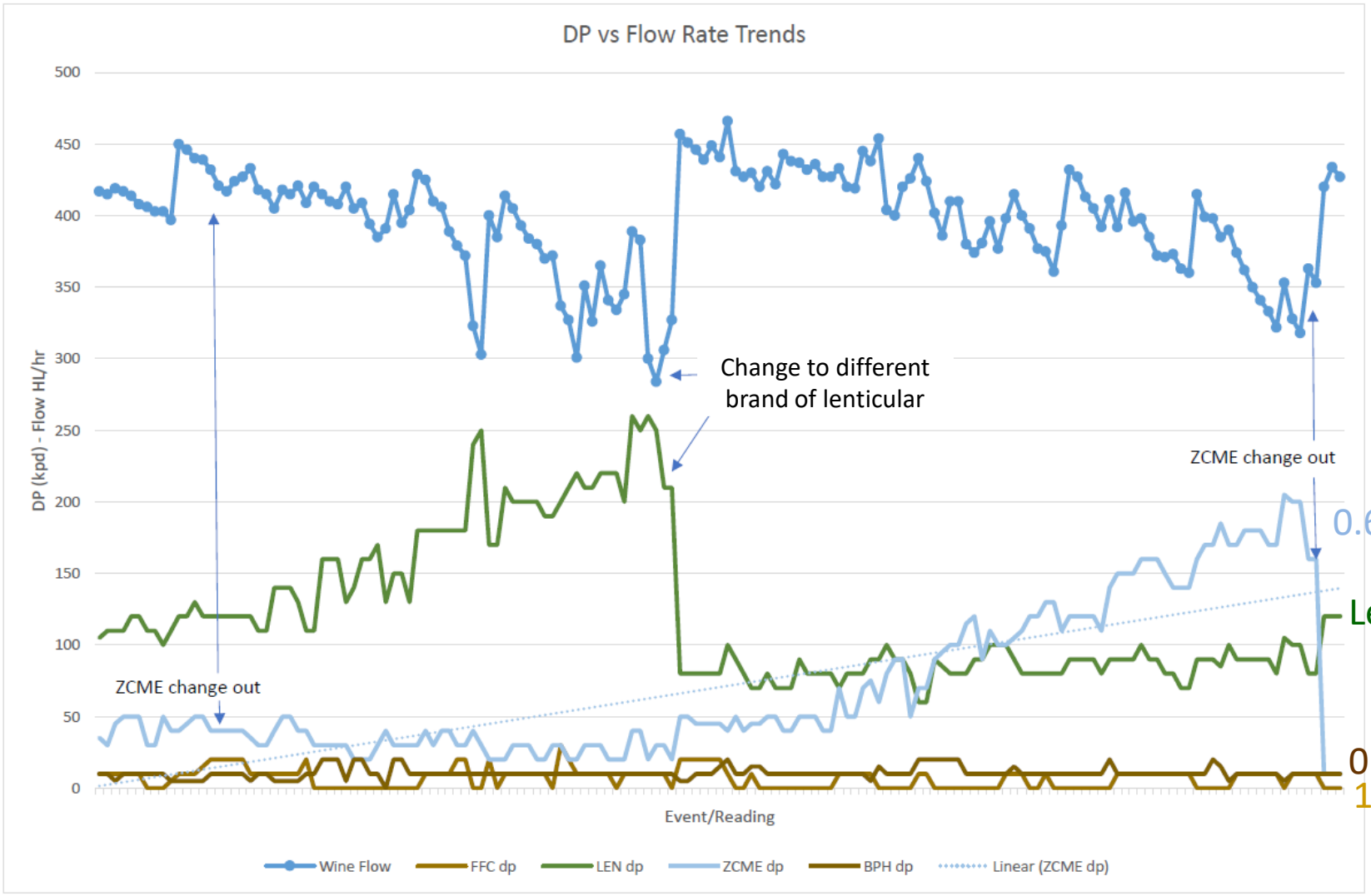
# DP across bottling filters

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# Take home:

## Monitor your filtration system

to maximise performance and minimise $/L (not filter cost!)

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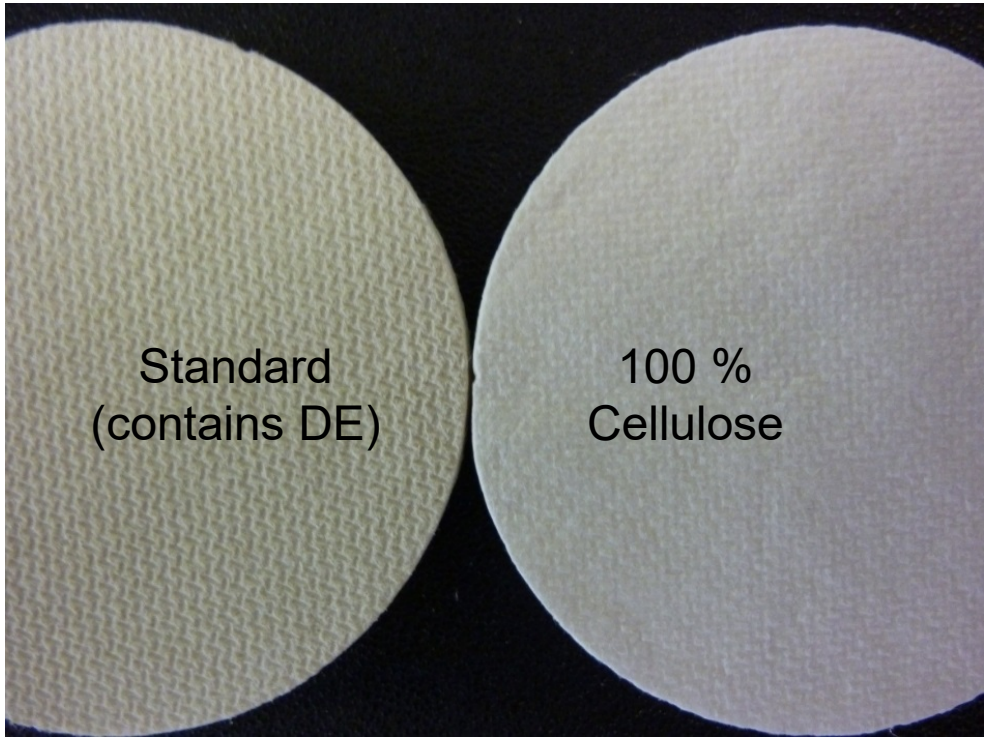
# Depth media

- 100 % cellulose or cellulose/DE
- Cellulose physically ~ 3 - 4 x stronger
- Compostable
- Cellulose-only is steam-sterilisable (less water wastage)
- Differences in colour/aroma adsorption

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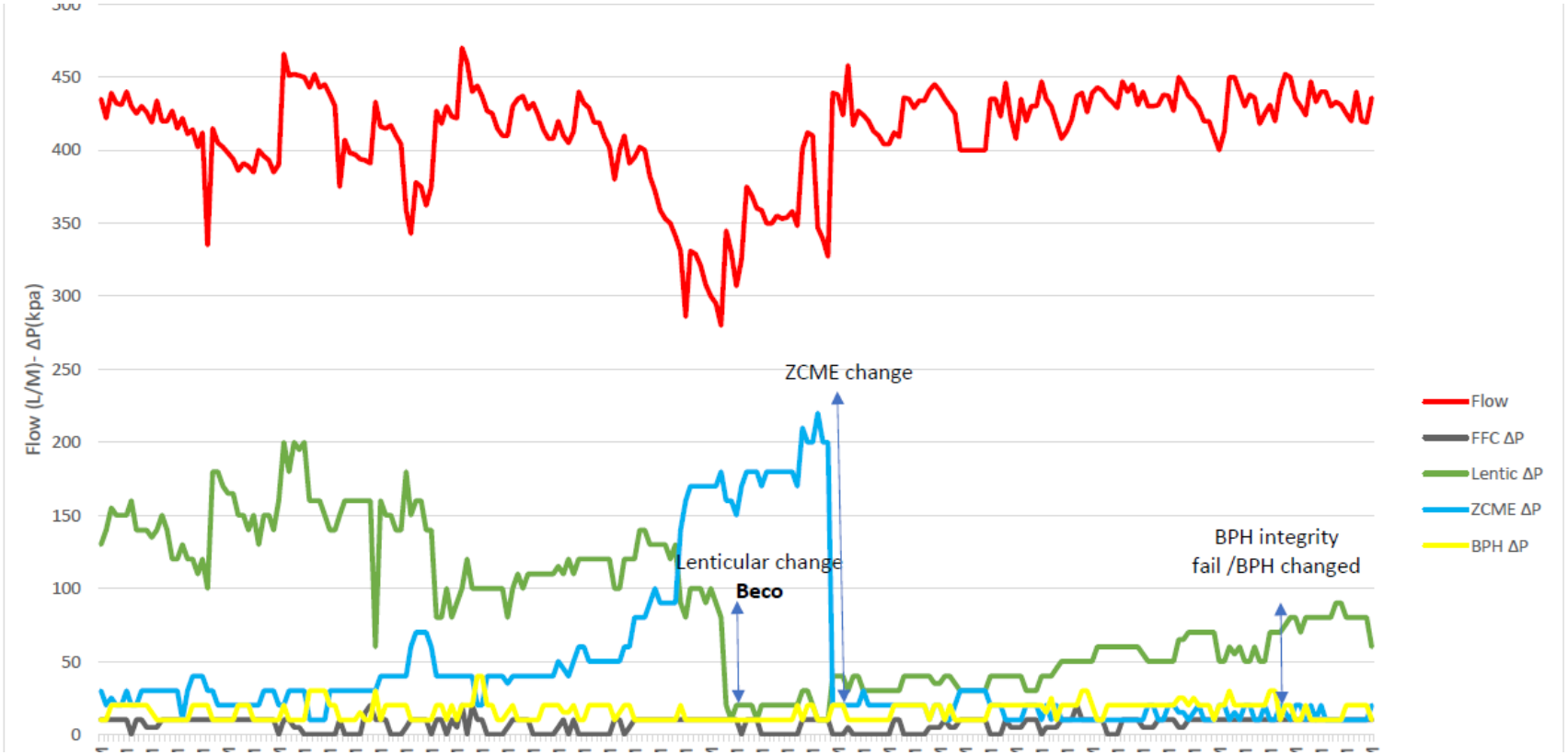
# Flow & clean DP between depth media




- Flow up to max & DP very low with 100 % cellulose depth medium
- Higher flow and ~60 % longer service life with cellulose-only media

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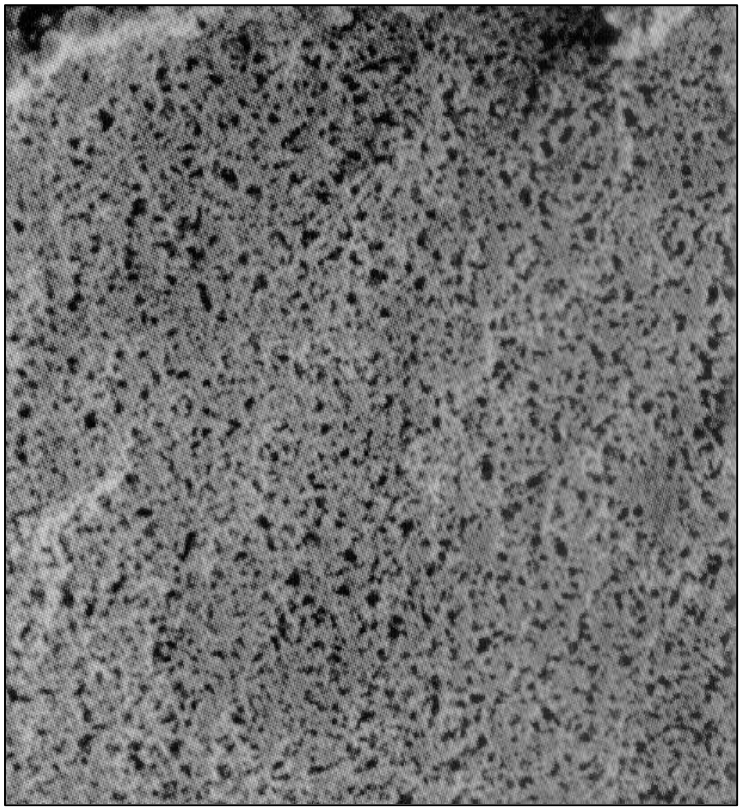
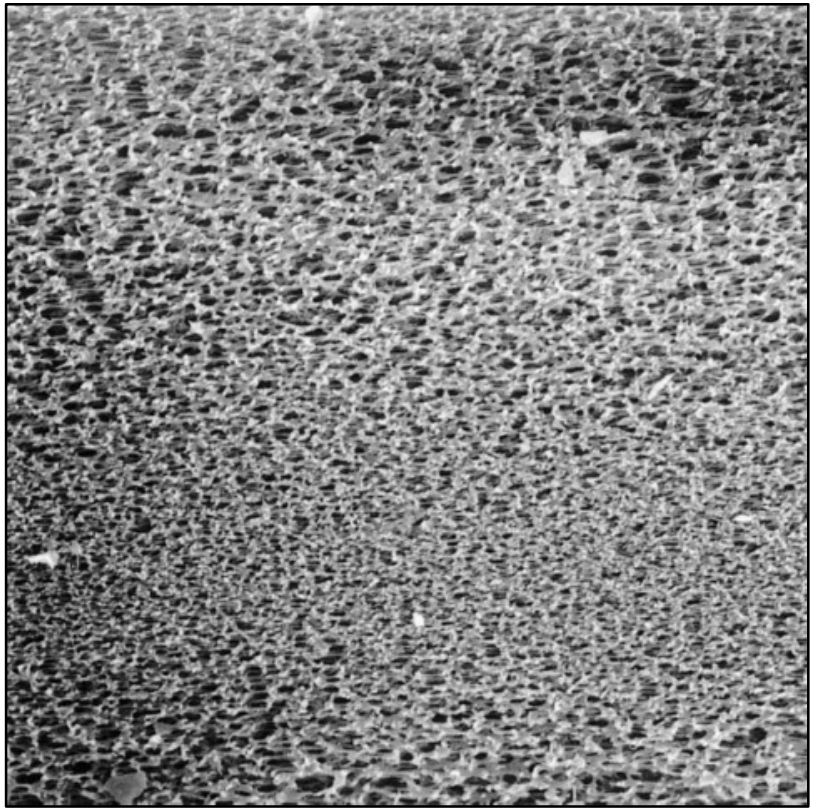
# Membranes

- Not a sheet with defined holes in it – it is cast polymer



Wine flow direction



Nylon, symmetrical, 0.45 μm, profile

PES, asymmetric, 0.45 μm, profile

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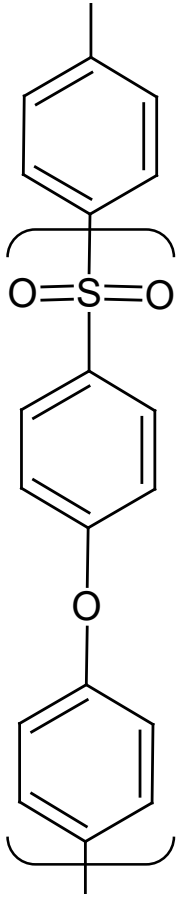
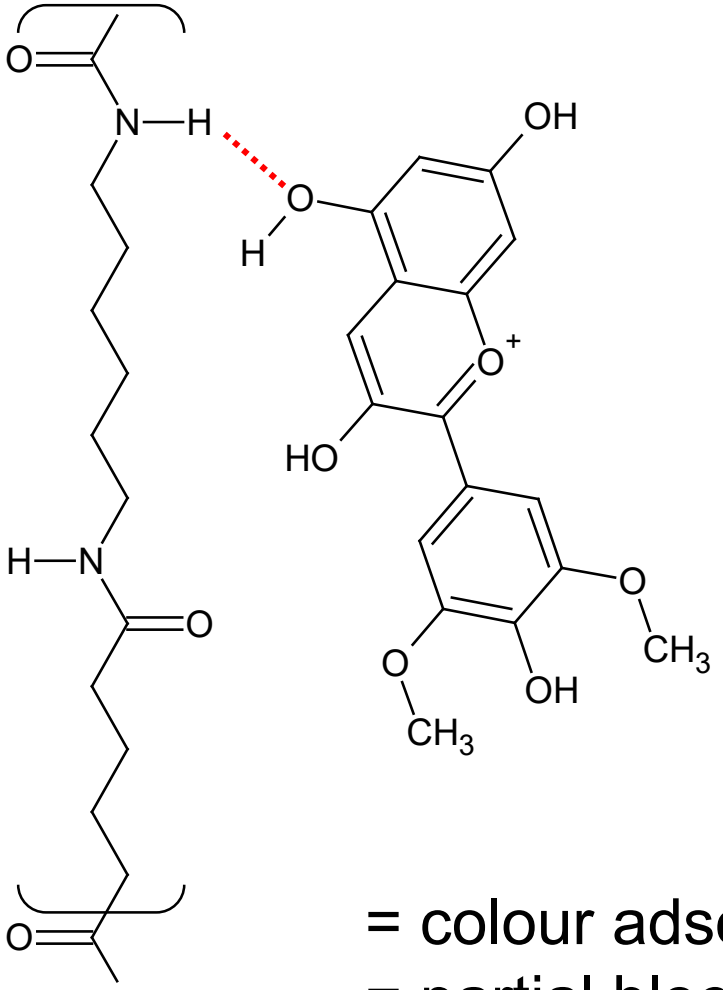
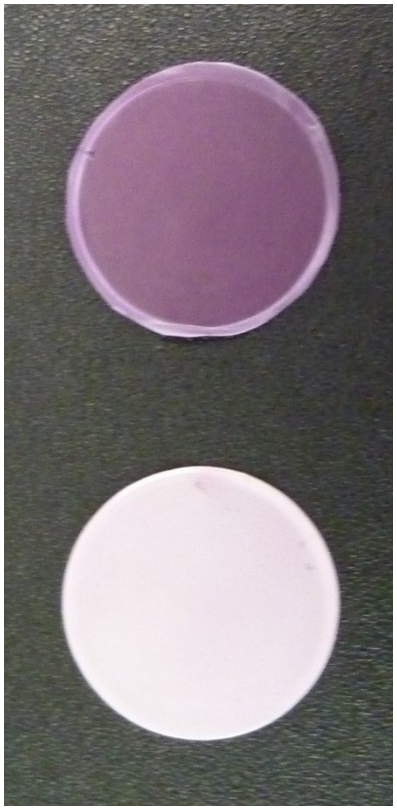
# Membranes







= colour adsorption
= partial blocking

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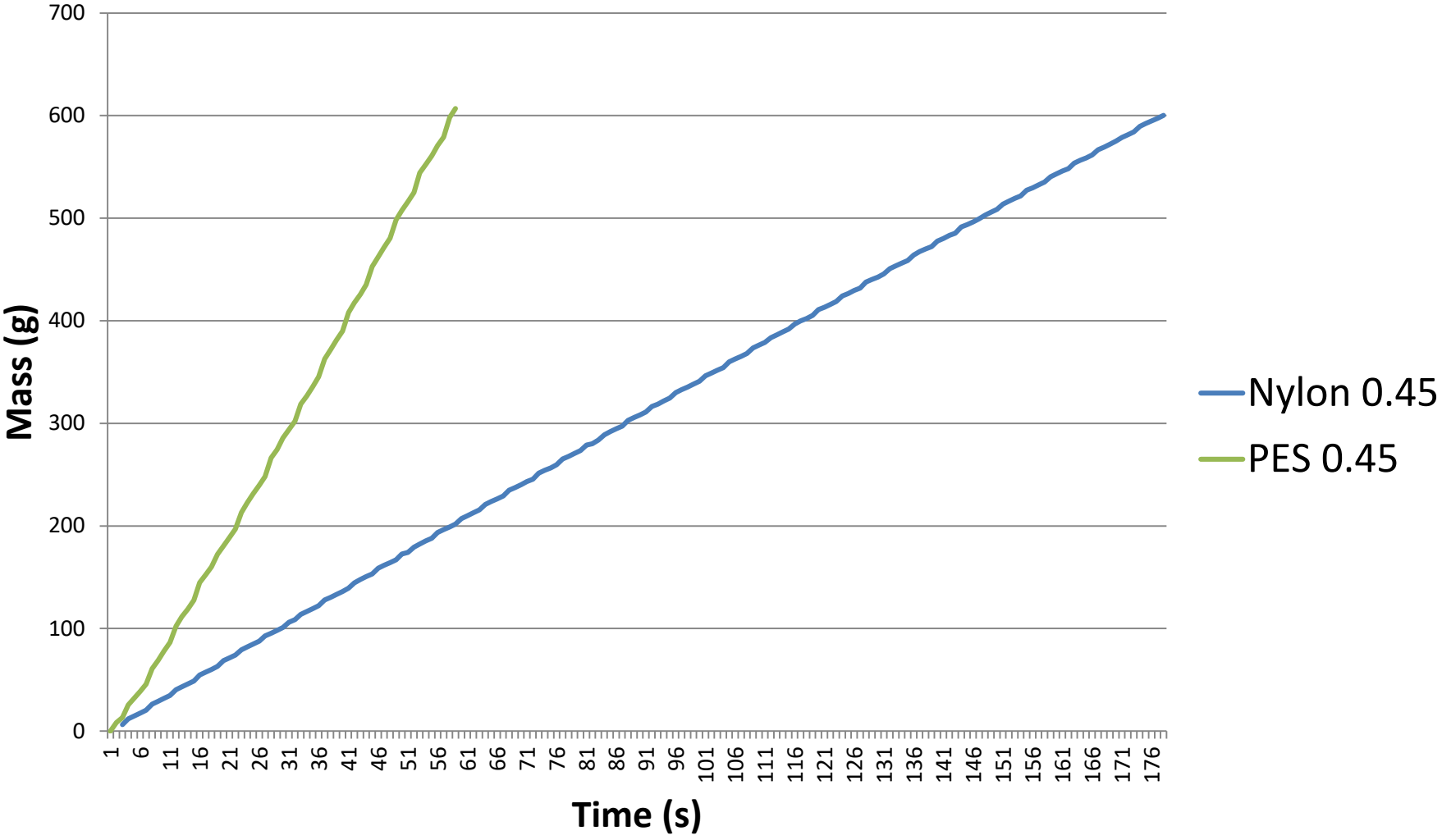
# Flow difference PES vs. nylon

RO water

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# Take home:

## Choose your filtration media

to maximise performance and minimise $/L

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# NTU & Filterability index (FI)

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# NTU

- Wine < 1 NTU = “OK” = “this wine is clean and it is suitable to sterile filter”. Really?
- A measure of light scattering orthogonal to the incident beam.
- Gives an indication of suspended particulates.
- Does not account for reflectance of particulate (e.g. tartrate crystals reflect more than microorganisms).
- Provides no indication of dissolved material. What about the things we can’t see?
- NTU does *not* indicate colloidal status of wine (e.g. glucans, mannoproteins, tannins, protein, gum Arabic, CMC).

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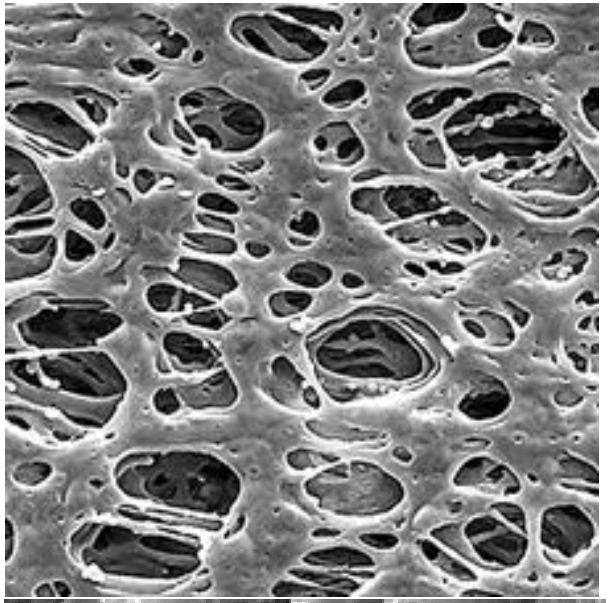
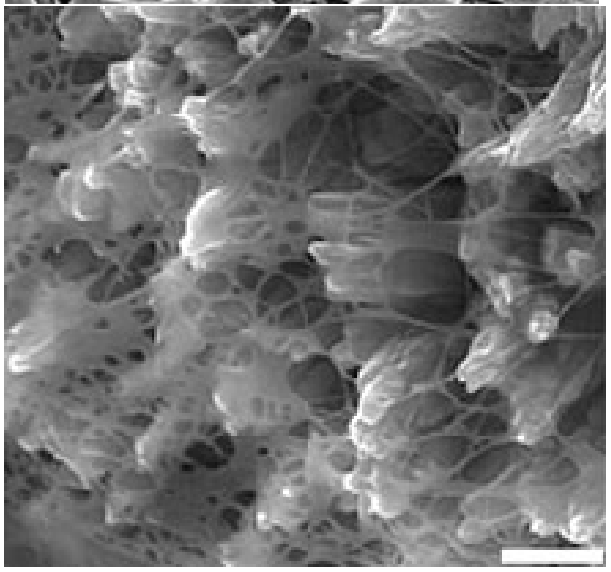
# Glucans

Clean PES membrane



PES membrane fouled with glucans from *Botrytis*



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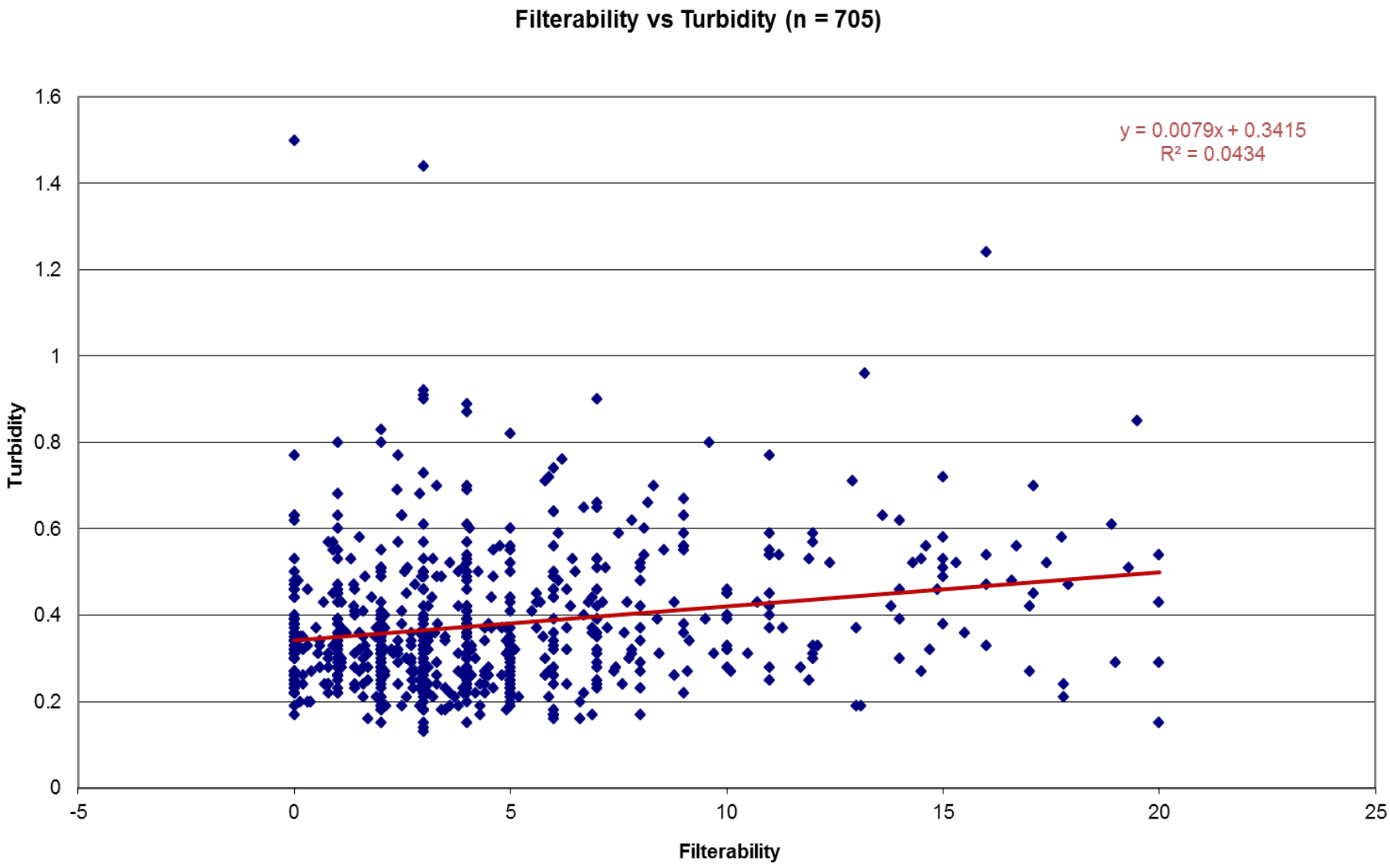
# NTU vs. FI: Correlation? No.

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# Filterability measurement

- Many winemakers have little awareness of FI.
- Several methods in use to measure “FI”.
- All require a technician to monitor the analysis from start to finish – a big disadvantage, especially if the wine sample being run is not greatly filterable (ie high FI = long analysis).
- Some labs use 0.45 um, some 0.65 um, regardless of final wine membranes (porosity & medium) being used in bottling.
- Often cellulose acetate (lab cell counting) membranes are used to measure FI. Cellulose nitrate often used in NZ (!).
- Vast performance differences between membrane types and therefore data obtained.
- FI measurement is not a replication of bottling filtration. It is a method for flagging potentially problematic wines. In reality bottling depth and 0.65 prefiltration *should* be doing little work.
- No standard exists for a 0.45 um wine membrane…

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# Filterability measurement

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# BHF filterability measurement

Measures **time** for a given volume.

- 25 mm 0.45 um disc identical to bottling membrane.
- Push wine through at 2 bar constant pressure.
- Record time to pass 200 mL & 400 mL.
- Index:

$$FI = T_{400} - 2T_{200}$$

- **Bottling: FI ≤ 20**

Note:

- Useful as a guide to bottling performance.
- Reflects wine colloidal and particulate loading.
- Reliable data + works with any membrane test disc.
- Can never run out of wine.
- Results must be evaluated in conjunction with other data – e.g. wine volume, condition of filters etc.

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# Gen I-III report

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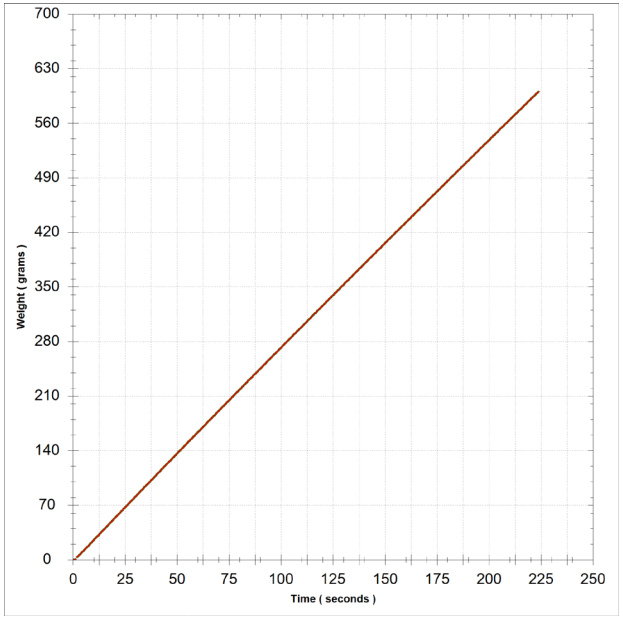
0401 446 119
bhftechnologies.com.au

**TYPE** : Step Rd 802 Boronia
**STOCK** :
**BASIN** :
**MEASURE DATE** : 6/17/2014 1:33:55 PM

| | WEIGHT (gr) | TIME (sec) |
|---|---|---|
| **START POINT** | 10 | 4.540 |
| **POINT NR. 1** | 200 | 73.446 |
| **POINT NR. 2** | 400 | 147.952 |
| **POINT NR. 3** | 600 | 223.768 |

| | | |
|---|---|---|
| **FILTERABILITY INDEX** | **IF** = T2 – 2 * T1 | **5.599** |
| **MODIFIED FILT.INDEX** | **IFm** = (T3 – T1) – 2 * (T2 – T1) | **1.310** |
| **MAX VOLUME** | **Vmax** = 400 + ((400 * T1) / IF) | **5322.399** |




NOTES :
NTU 0.52

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# Gen IV: Water blank

**Filtrability Index** v2.1:

| | |
|---|---|
| 1800 gr | 1800 ml |
| 1600 gr | 1600 ml |
| 1400 gr | 1400 ml |
| 1200 gr | 1200 ml |
| 1000 gr | 1000 ml |
| 800 gr | 800 ml |
| 600 gr | 600 ml |
| 400 gr | 400 ml |
| 200 gr | 200 ml |
| 0 gr | 0 ml |

| | |
|---|---|
| 3 | gr |
| 3 | ml |
| 133 | sec |

T1 200 ml: 431
T2 400 ml: 876
T3 600 ml: 1338

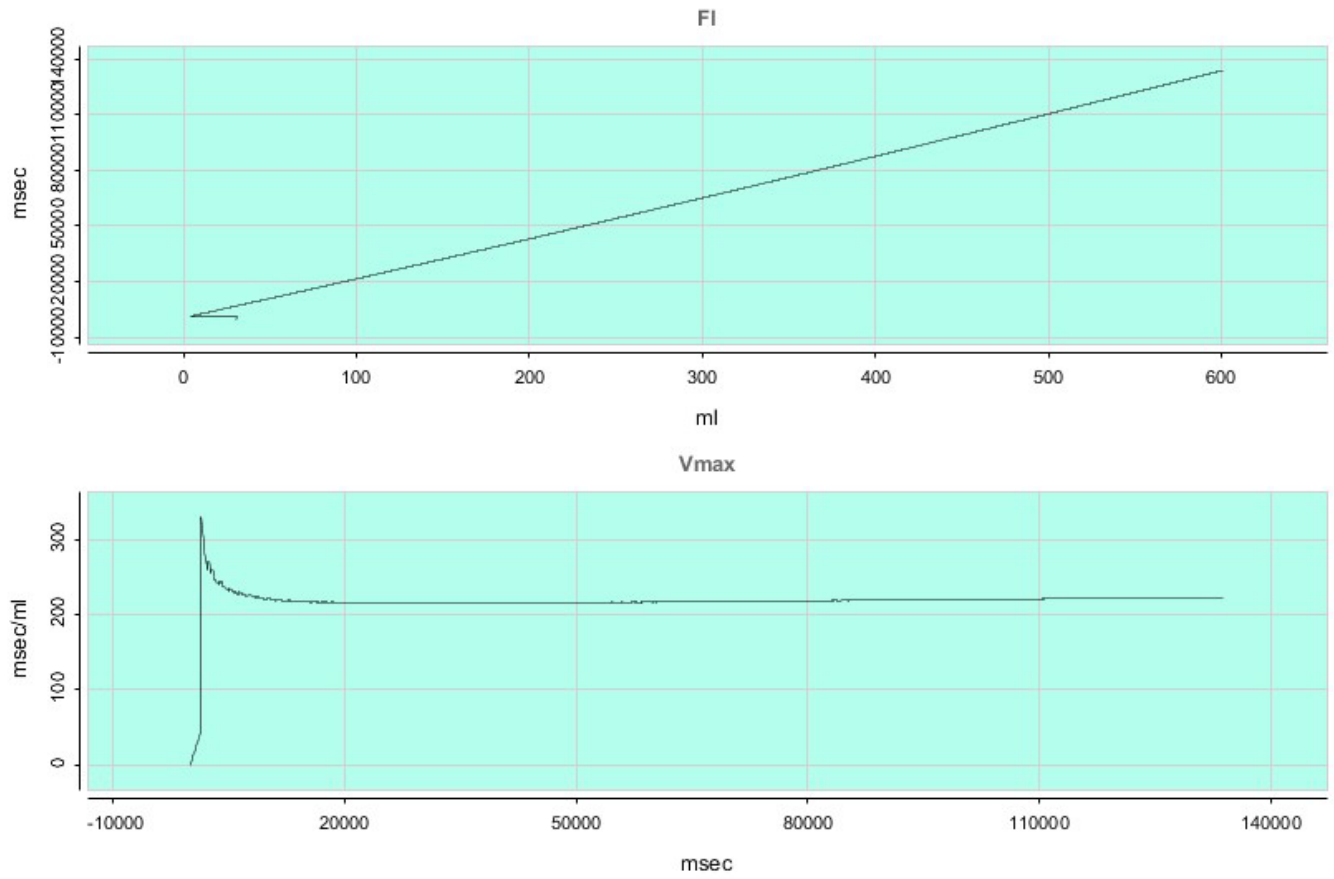
START

TARE

STOP

Gas Release | Gas Open

SAVE




| | | |
|---|---|---|
| Fluid: | Water blank | |
| Density: | 1.0 | Kg/L |
| Filter type: | | |
| Lot n.: | | |
| Sample size: | 25 | mm ø |
| Pore size: | 0.45 | µm |
| Pressure: | 2 | bar |
| Temperature: | 0 | °c |

| | | |
|---|---|---|
| FI: | 1.342 | *FI ~ MFI < = 20* |
| MFI: | 1.752 | *Vmax > = 4000* |
| Vmax: | 13256 | L/m² |
| Date/Time: (g-m-y/h-m-s) | 7. 11. 2018. 12. 53. 3 | |
| sign: | | |

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# Gen IV: Red wine

## *Filtrability Index* v2.1:

| | |
|---|---|
| __1800 gr | 1800 ml__ |
| __1600 gr | 1600 ml__ |
| __1400 gr | 1400 ml__ |
| __1200 gr | 1200 ml__ |
| __1000 gr | 1000 ml__ |
| __800 gr | 800 ml__ |
| __600 gr | 600 ml__ |
| __400 gr | 400 ml__ |
| __200 gr | 200 ml__ |
| __0 gr | 0 ml__ |

| | |
|---|---|
| 0 | *gr* |
| 0 | *ml* |
| 442 | *sec* |

T1 200 ml: 1077
T2 400 ml: 2844
T3 600 ml: 0

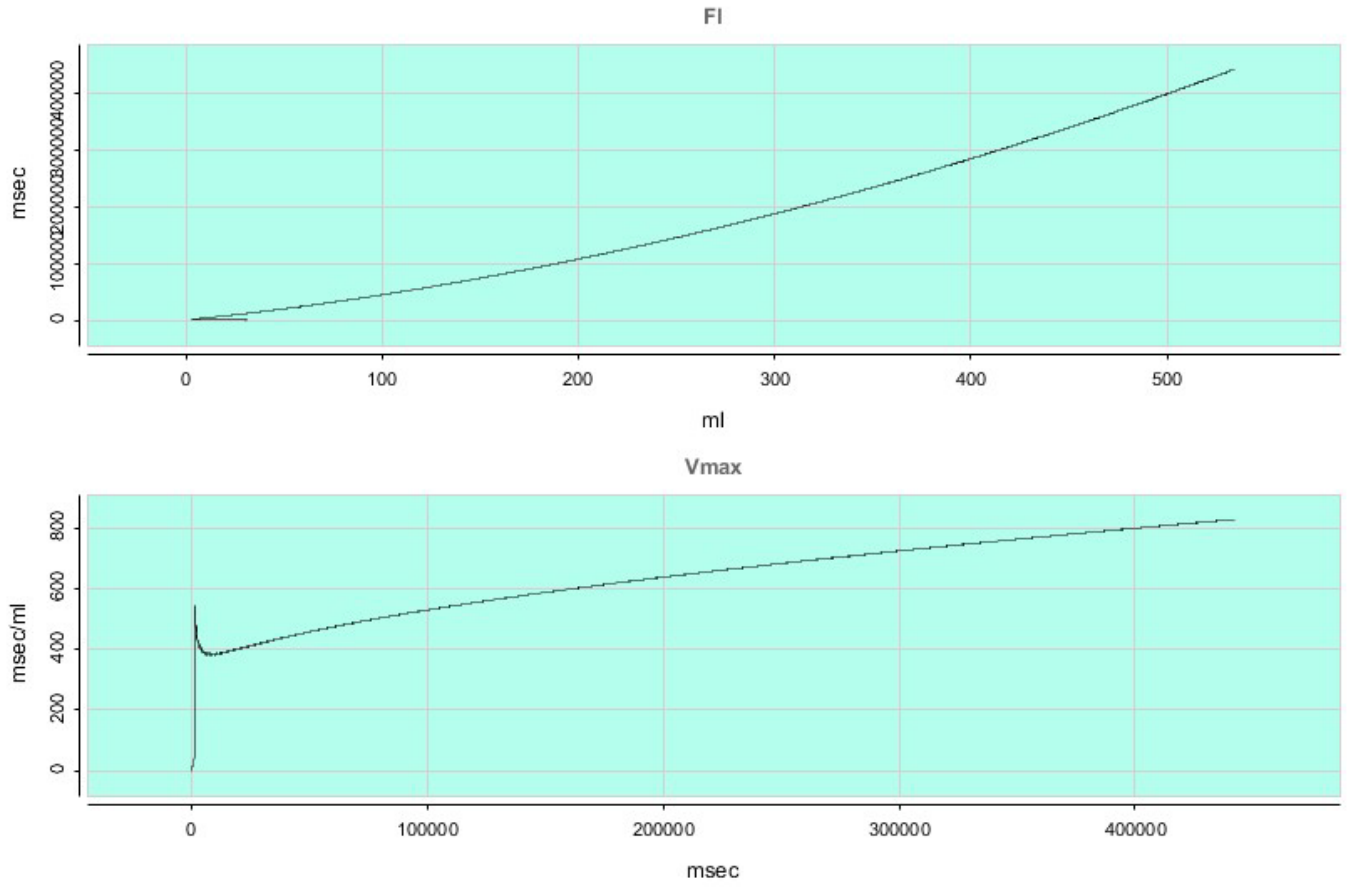
START

TARE

STOP

Gas Release | Gas Open

SAVE




| | | |
|---|---|---|
| Fluid: | Cake red trial 30 filtration at bottling | |
| Density: | 1.0 | Kg/L |
| Filter type: | | |
| Lot n.: | | |
| Sample size: | 25 | mm ø |
| Pore size: | 0.45 | µm |
| Pressure: | 2 | bar |
| Temperature: | 0 | °c |

| | | |
|---|---|---|
| FI: | 69.031 * | *FI ~ MFI < = 20* |
| MFI: | 0.000 | *Vmax > = 4000* |
| Vmax: | 1024 | $L/m^2$ |
| Date/Time: (g-m-y/h-m-s) | 7. 11. 2018. | 13. 11. 53 |
| sign: | | |

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Some filtration suppliers contend that the membrane disc type makes no difference to the FI analysis result.

Let’s examine that.

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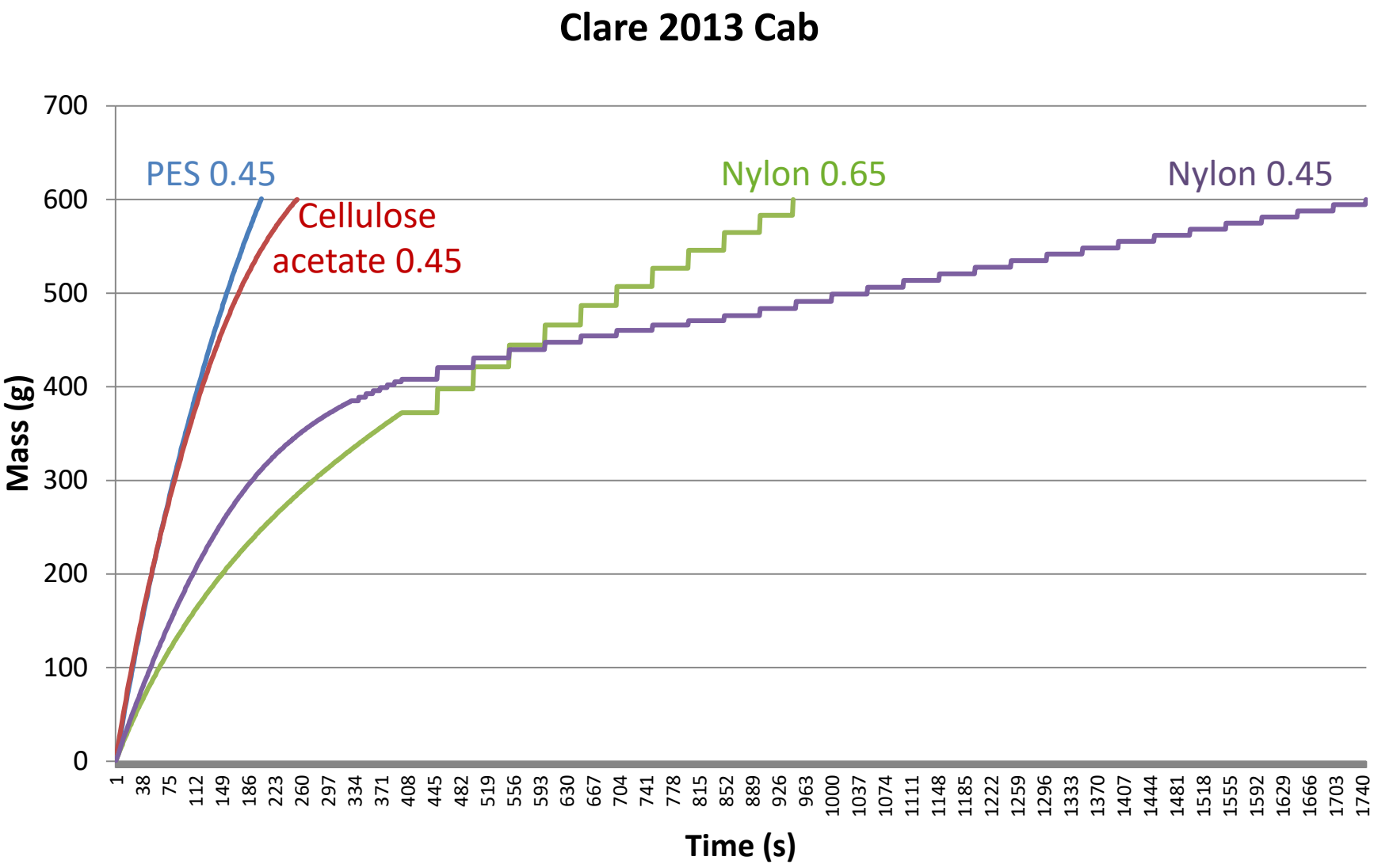
# Membrane comparison 0.45 um

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# Additive influence on FI and process efficiency

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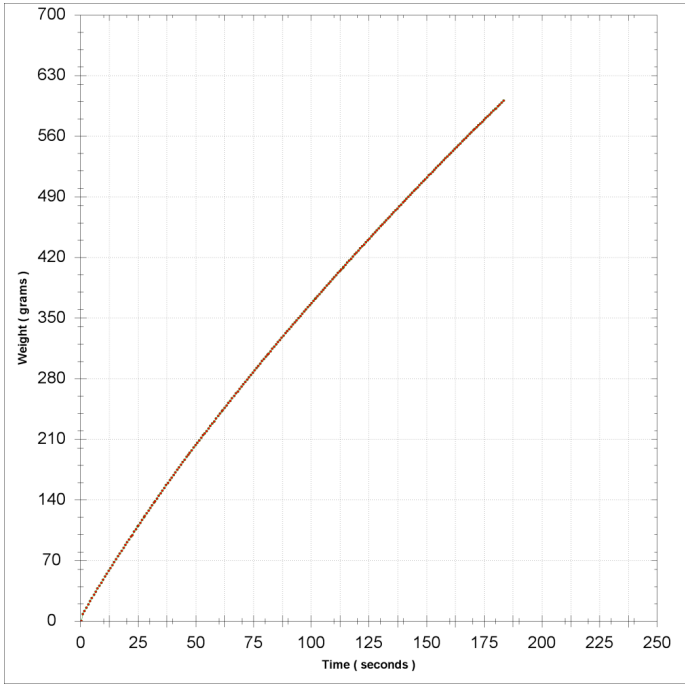
# Tannin

- 2011 Cab post x-flow




| FI | FIm |
|---|---|
| 15.2 | 9.2 |

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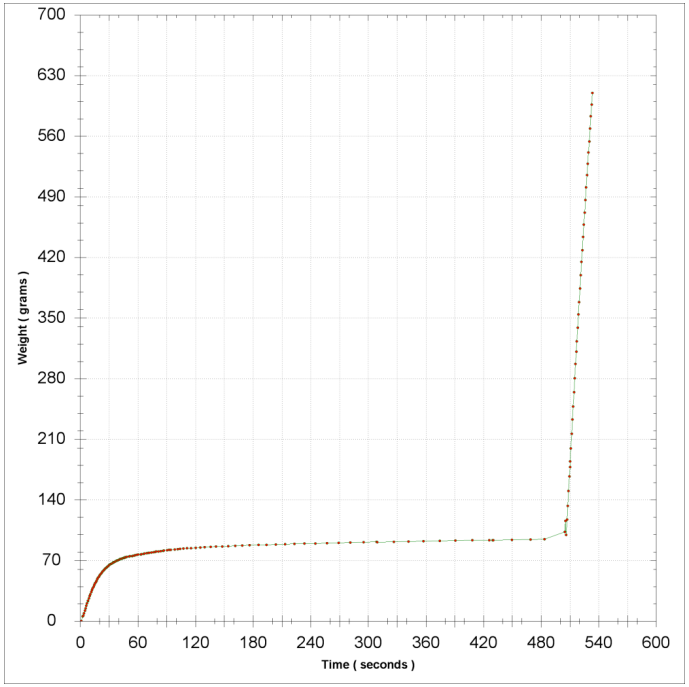
# Tannin

- 2011 Cab post x-flow + 1 mL/L red liquid tannin




| FI | FIm |
|---|---|
| Fail | Fail |

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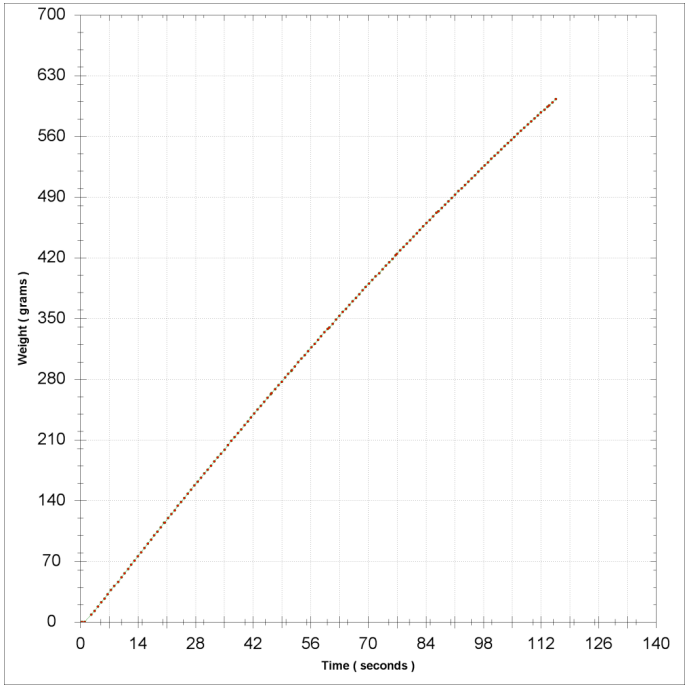
# Tannin

- 2011 Cab post x-flow + 1 mL/L red liquid tannin – post xflow (again)




| FI | FIm |
|---|---|
| 4.3 | 6.2 |

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# Media choice and process efficiency outcomes

- Train 1: standard lenticular, nylon 0.45 um prefilter, PES 0.45 um final
- Train 2: Beco cellulose lenticular, Parker PES 0.65 prefilter, Parker PES 0.45 final.

- 2018 SHZ 45 kL
- Blocked all 3 filters on train 1 after processing 9 kL.
- Train 2 job completed (36 kL – no DP increases.
- Choice of filtration media can play a big role in processing efficiency.
- Not all filters are the same…

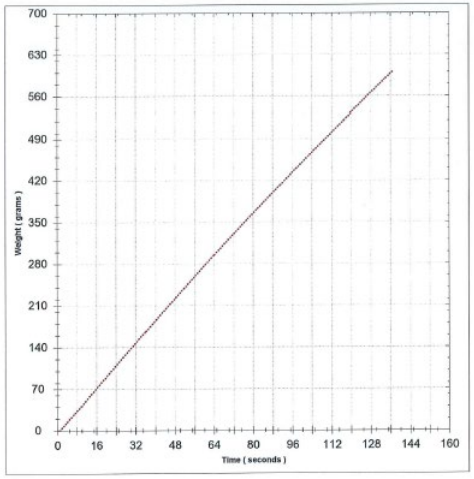
WINE SERVICES ANALYTICAL

Vinpac International Pty Ltd
773 Stockwell Road
Angaston, 5353
lab@vinpac.com.au

TYPE : SRAN
STOCK : 218450 PROWINE
BASIN : 12
MEASURE DATE : 9/2/2019 1:43:38 PM

| | WEIGHT (gr) | TIME (sec) |
|---|---|---|
| START POINT | 10 | 3.401 |
| POINT NR. 1 | 200 | 43.586 |
| POINT NR. 2 | 400 | 88.389 |
| POINT NR. 3 | 600 | 136.624 |

| | | |
|---|---|---|
| FILTERABILITY INDEX | IF = T2 – 2 * T1 | 4.618 |
| MODIFIED FILT.INDEX | IFm = (T3 – T1) – 2 * (T2 – T1) | 3.432 |
| MAX VOLUME | Vmax = 400 + ((400 * T1) / IF) | 3881.081 |




NOTES :
RUN@20 EB

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# Take home:

Beware of additives, choose filtration media carefully and measure FI to maximise performance and minimise $/L

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# Xflow performance and process efficiency – the caveats

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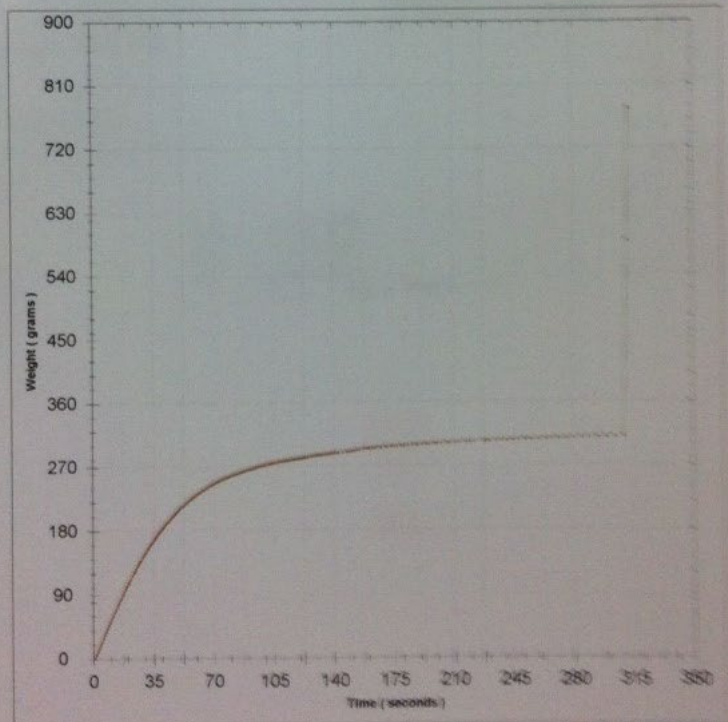
# Xflow influence on FI

| | | |
|---|---|---|
| FILTERABILITY INDEX | IF = T2 – 2 * T1 | 221.682 |
| MODIFIED FILT.INDEX | IFm = (T3 – T1) – 2 * (T2 – T1) | -264.681 |
| MAX VOLUME | Vmax = 400 + ((400 * T1) / IF) | 479.053 |




NOTES :

0.55 NTU

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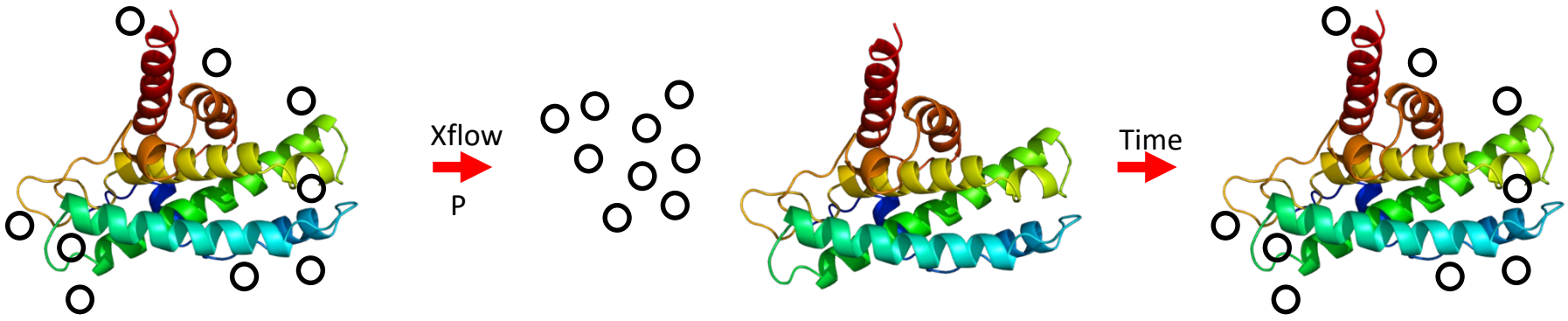
# Xflow influence on FI

Colloids

- Macromolecular (eg mannoprotein, CMC, gum Arabic)
- Association (eg protein-tannin)




High FI

Low FI

High FI

© Blue H2O Filtration 2019

# Monitoring xflow performance

© Blue H2O Filtration 2019

# Monitoring xflow performance

| Cell | Replicate | FI | FIm |
|---|---|---|---|
| 1A | 1 | 5.0 | 3.0 |
| | 2 | 31 | 117 |
| | 3 | 40 | 472 |
| 2A | 1 | 11 | 6 |
| | 2 | 5 | 3 |
| 3A | 1 | 4 | 3 |
| | 2 | 3 | 2 |
| 4A | 1 | 6 | 4 |
| | 2 | 16 | 23 |
| 1B | 1 | 5 | 3 |
| | 2 | 5 | 3 |
| 2B | 1 | 16 | 31 |
| | 2 | 22 | 47 |
| 3B | 1 | 4 | 3 |
| | 2 | 5 | 4 |
| 4B | 1 | 16 | 12 |
| | 2 | 7 | 6 |

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# Monitoring xflow performance

| Cell | Replicate | FI | FIm |
|---|---|---|---|
| 1A | 1 | 5.0 | 3.0 |
| | 2 | 31 | 117 |
| | 3 | 40 | 472 |
| 2A | 1 | 11 | 6 |
| | 2 | 5 | 3 |
| 3A | 1 | 4 | 3 |
| | 2 | 3 | 2 |
| 4A | 1 | 6 | 4 |
| | 2 | 16 | 23 |
| 1B | 1 | 5 | 3 |
| | 2 | 5 | 3 |
| 2B | 1 | 16 | 31 |
| | 2 | 22 | 47 |
| 3B | 1 | 4 | 3 |
| | 2 | 5 | 4 |
| 4B | 1 | 16 | 12 |
| | 2 | 7 | 6 |

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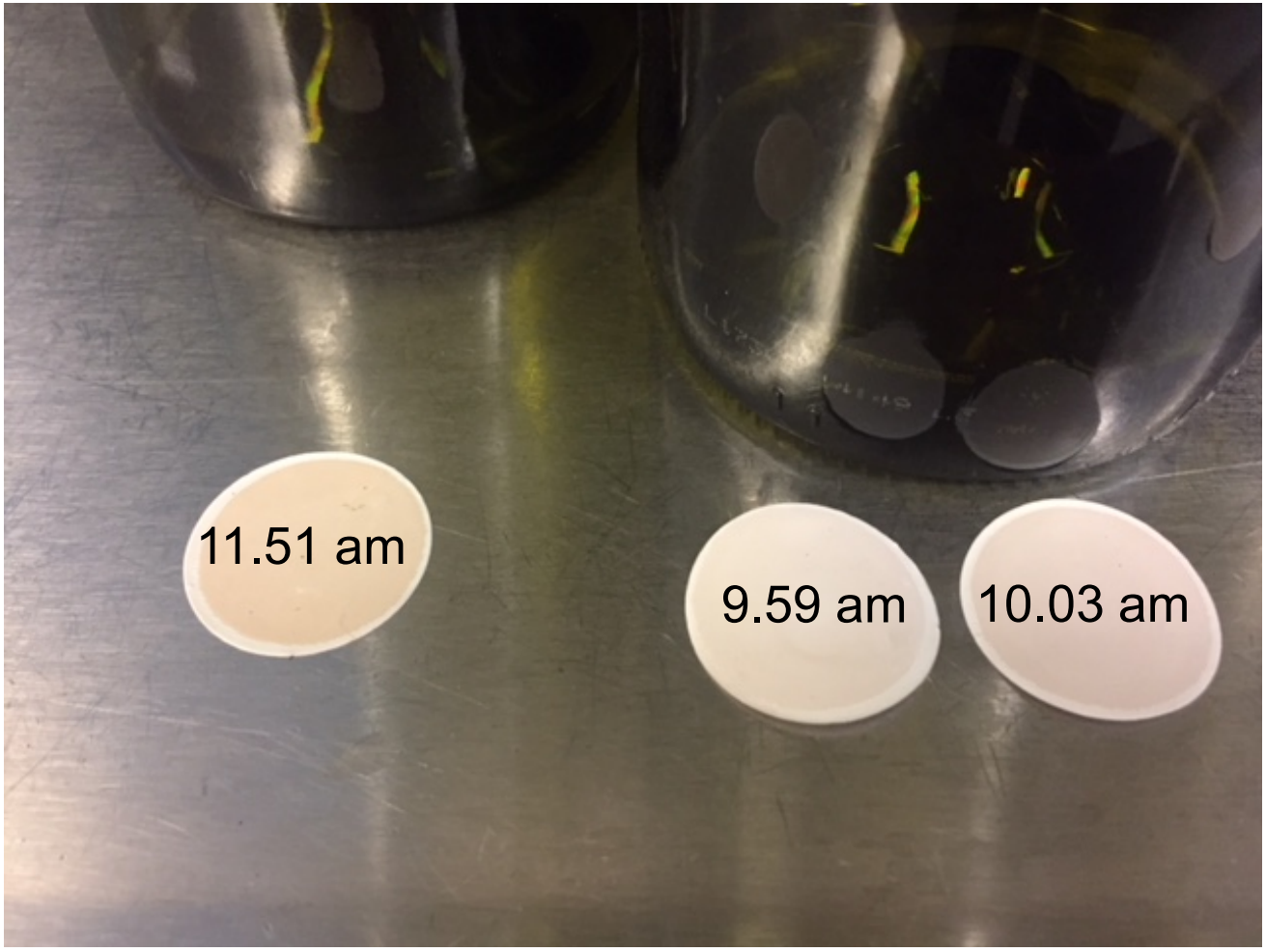
# Monitoring xflow performance

## Cell 1A

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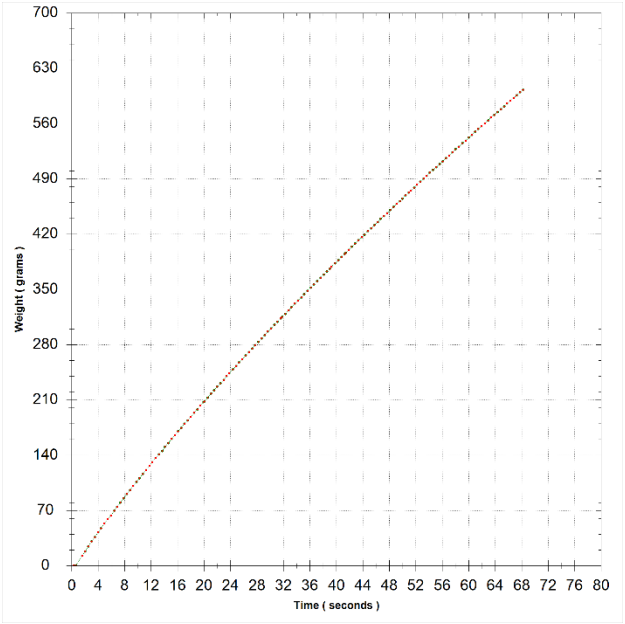
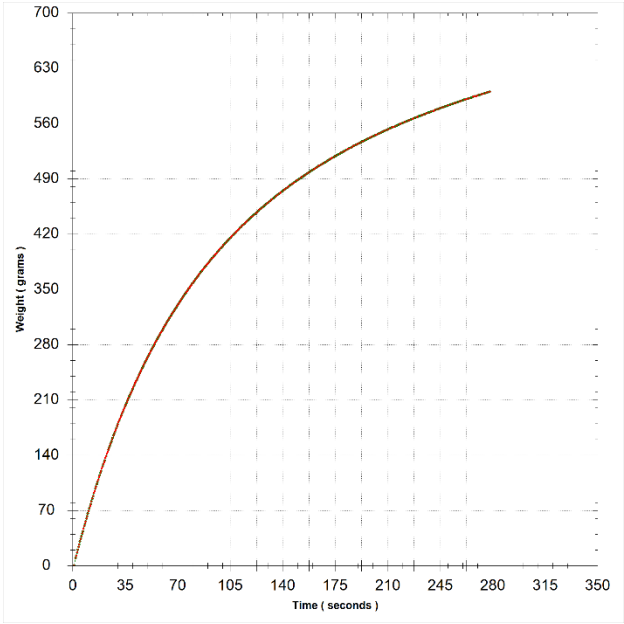
# Monitoring xflow performance

## Cell 1A

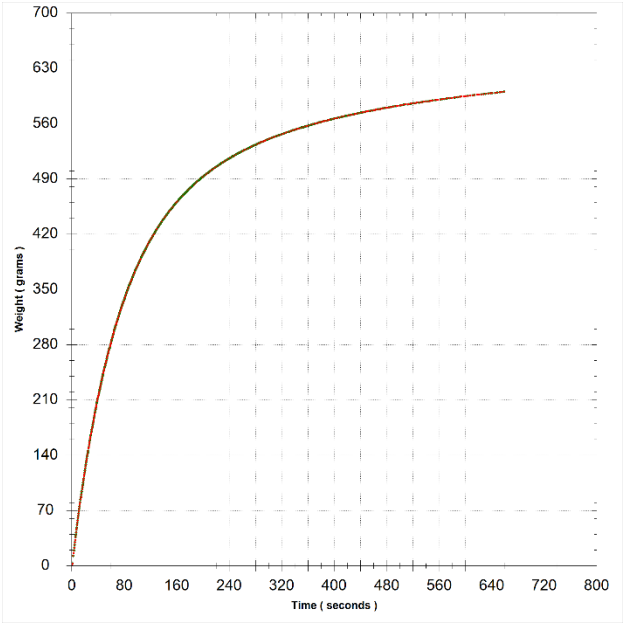
9.59 am




10.03 am




11.51 am




Note time scale changes

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# Take home:

Recheck wine FI just before packaging and monitor your xflow performance using FI to maximise performance and minimise $/L

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# Does reliable FI measurement minimise packaging cost and improve process efficiency?

## Case study:
## Vinpac International

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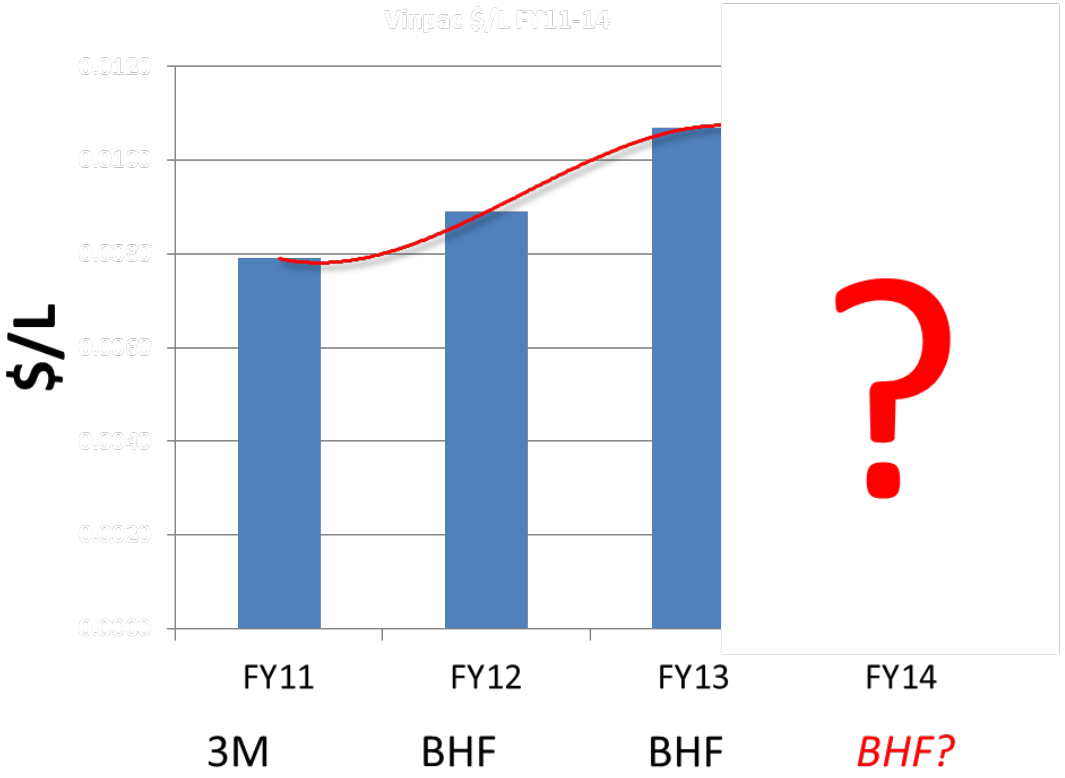
# Vinpac filtration costs

- 2011 SA vintage wet = Botrytis on fruit = glucans in wine
- Strong negative impact of V11 wines on filtration costs due to reliance on NTU.
- Inability to detect wines with poor filterability
- Sneaky winemakers: 2011 wines added to V12 and 13 wines…

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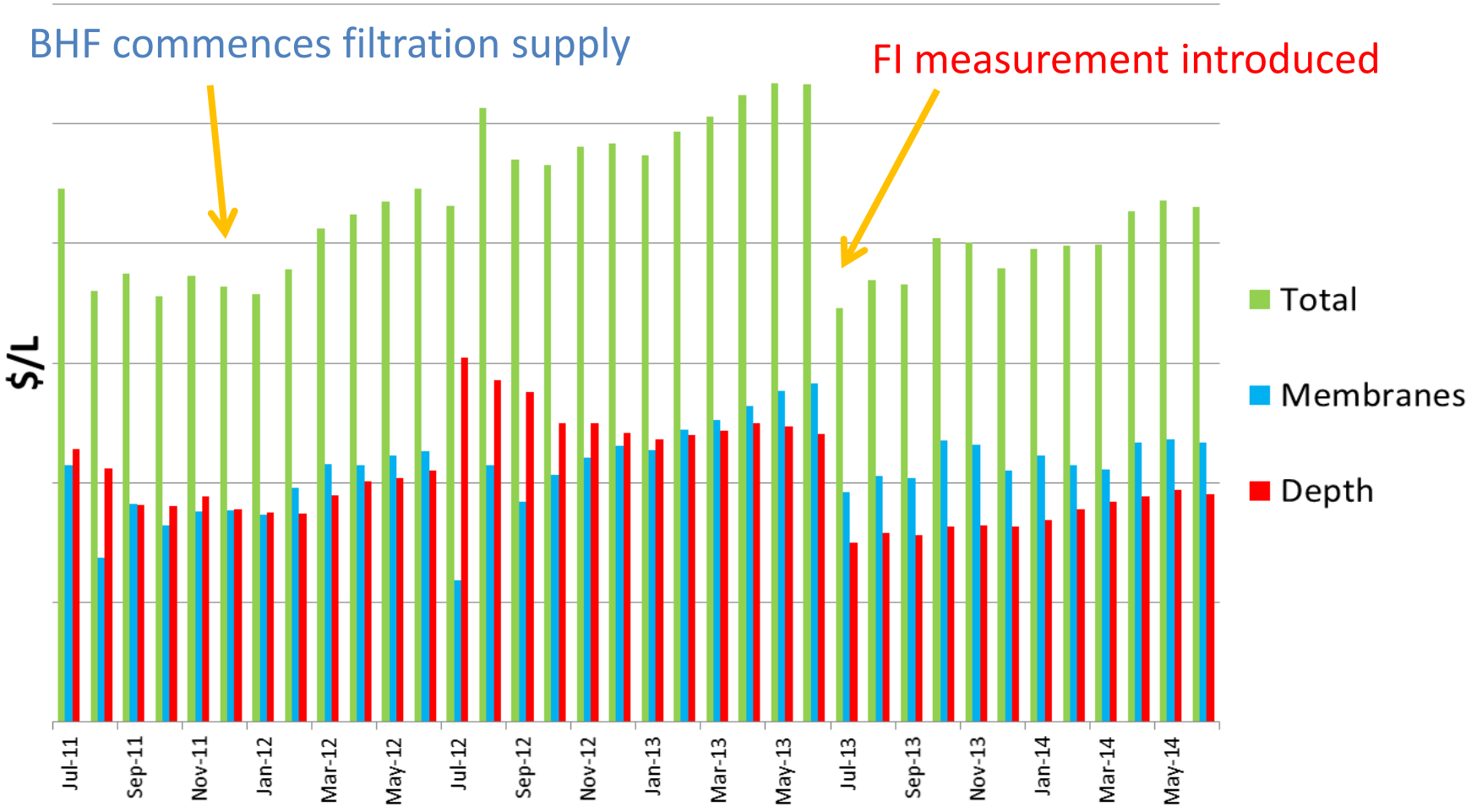
# Cost efficiency

## What impact does implementing FI analysis have?

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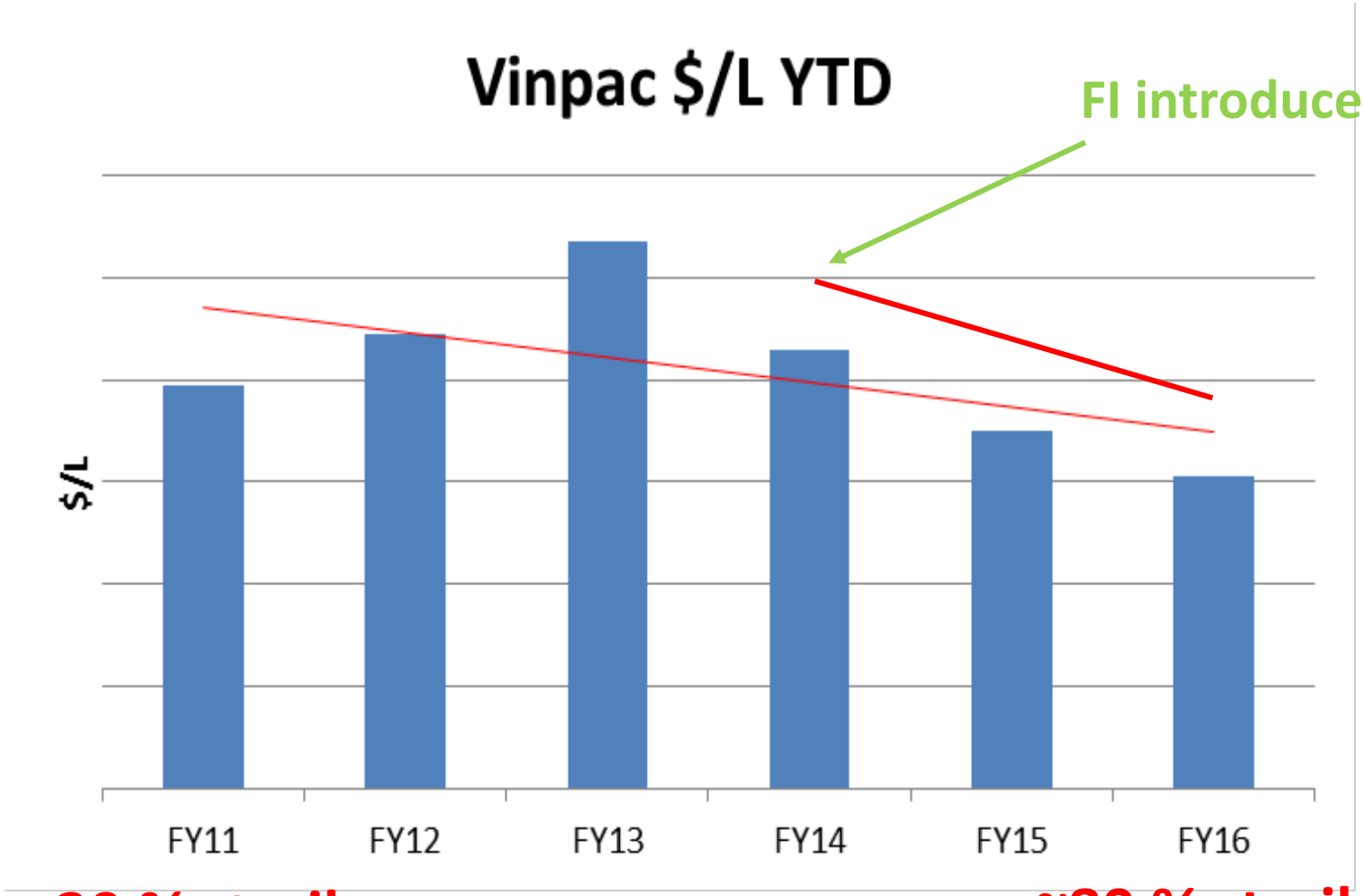
# Cost efficiency




**~20 % sterile** **~80 % sterile**

+ process advantage: virtually no down-time = $$$

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# Does reliable FI measurement minimise packaging cost and improve process efficiency?

YES!

…but mainly through minimised down-time

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# WISA 2016 winners - packaging

# WISA 2019 finalists:

## Packaging

## Winemaking

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# Thank you.

**Paul Bowyer (BHF)**
Greg Edwards (Vinpac International)

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