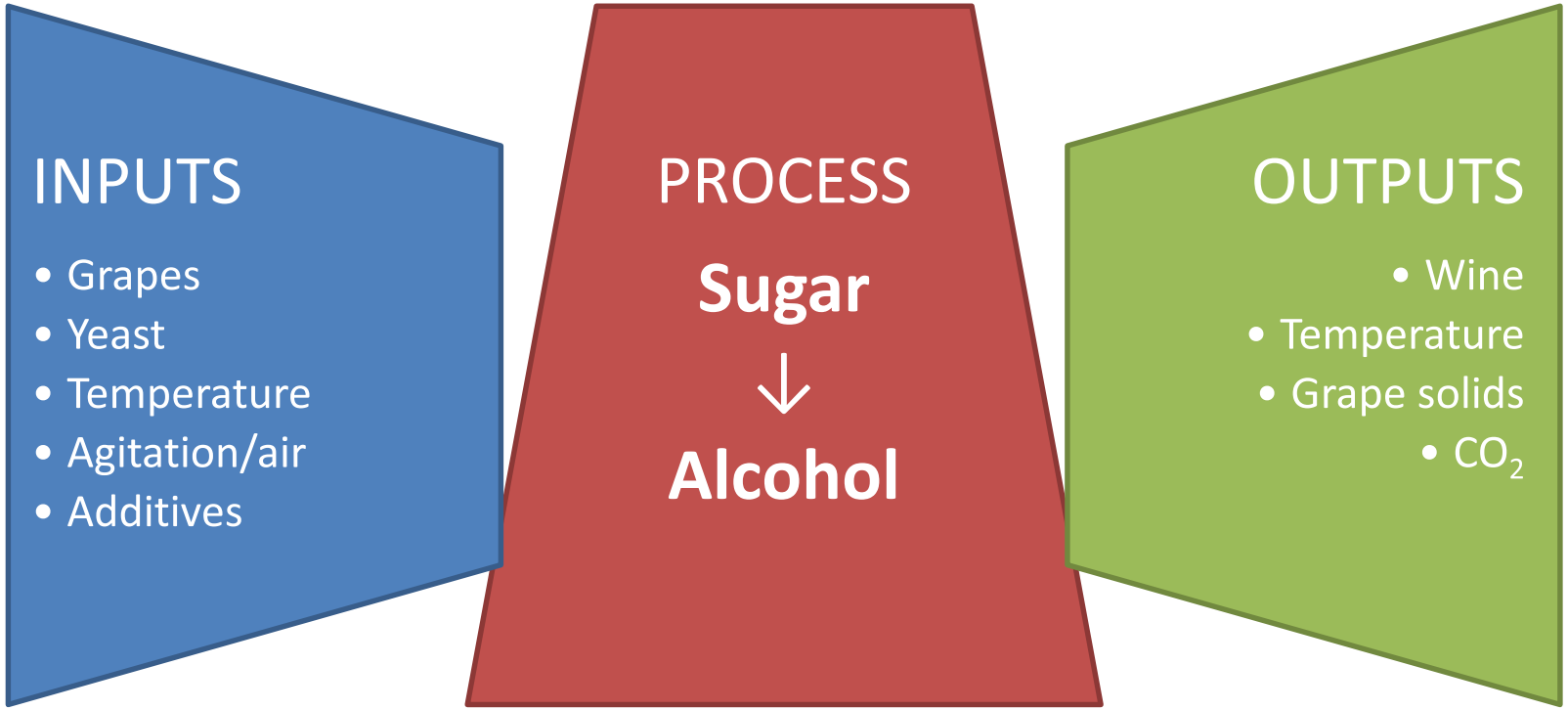
The Australian Wine Research Institute

Using sensors to monitor sugar levels during fermentation

Tadro Abbott
Project Engineer, AWRI Commercial Services

The Fermentation Process

The Australian Wine Research Institute



Fermentation process monitoring

The Australian Wine Research Institute

Objectives

The Australian Wine Research Institute

PETALUMA AUSTRALIA

ESTD 1928
De BORTOLI
FAMILY WINEMAKERS

Evaluation criteria

The Australian Wine Research Institute

- Cost
- Ease of installation
- Connectivity
- Setup/calibration
- Sensitivity to process environment
- Accuracy and repeatability

Screening technology options

The Australian Wine Research Institute

Sensor	Supplier	Measurement principle	Indicative cost (per unit)	Difficulty
Liquiphant Vibrating Fork	Endress & Hauser	Density	$2-3K	Moderate
Deltapoint S	Endress & Hauser	Hydrostatic pressure	$3K combined	High
Micropilot	Endress & Hauser	Volume (level)		High
Fermetrol	Psitec	Osmotic potential	$2K	Moderate
MicroLDS	ISSYS	Mass flow (liquid)	$1K	Low
VS-3000	Vital Sensors	Mid-IR absorbance	$3K	Moderate
Proline t-mass	Endress & Hauser	Mass flow (gas)	$3K	Moderate
Biosensor	OptiEnz	Enzyme response	$1-2K	Low

Process sensor 1

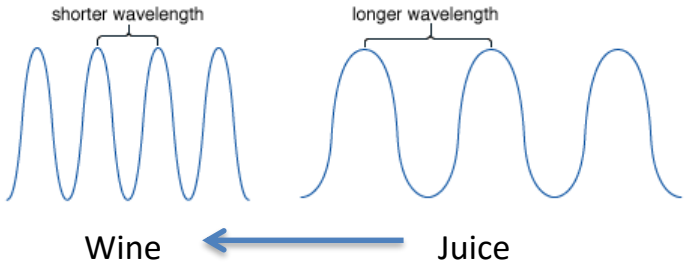
The Australian Wine Research Institute

Liquiphant vibrating fork

Measures density via changes in oscillation frequency

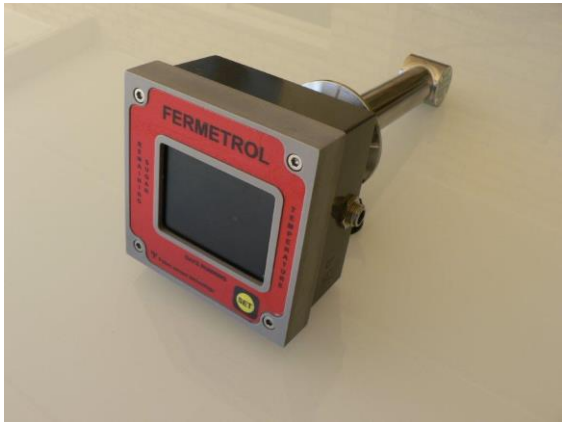
Density converted into Baume reading

Density Computer accommodates up to 4 sensor inputs



Process sensor 2

The Australian Wine Research Institute

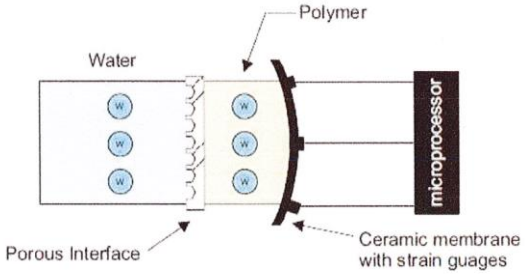


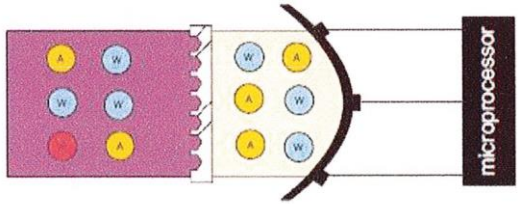
Fermetrol probe

Measures osmotic potential in grape juice

Expansive pressure in semi-permeable polymer converted into electrical signal

Initial Baume required to convert signal into ‘inferred’ Baume reading





Process sensor 3

The Australian Wine Research Institute

Micro-LDS sensor

Micro-coriolis flowmeter

Measures flowrate, temperature, density and viscosity

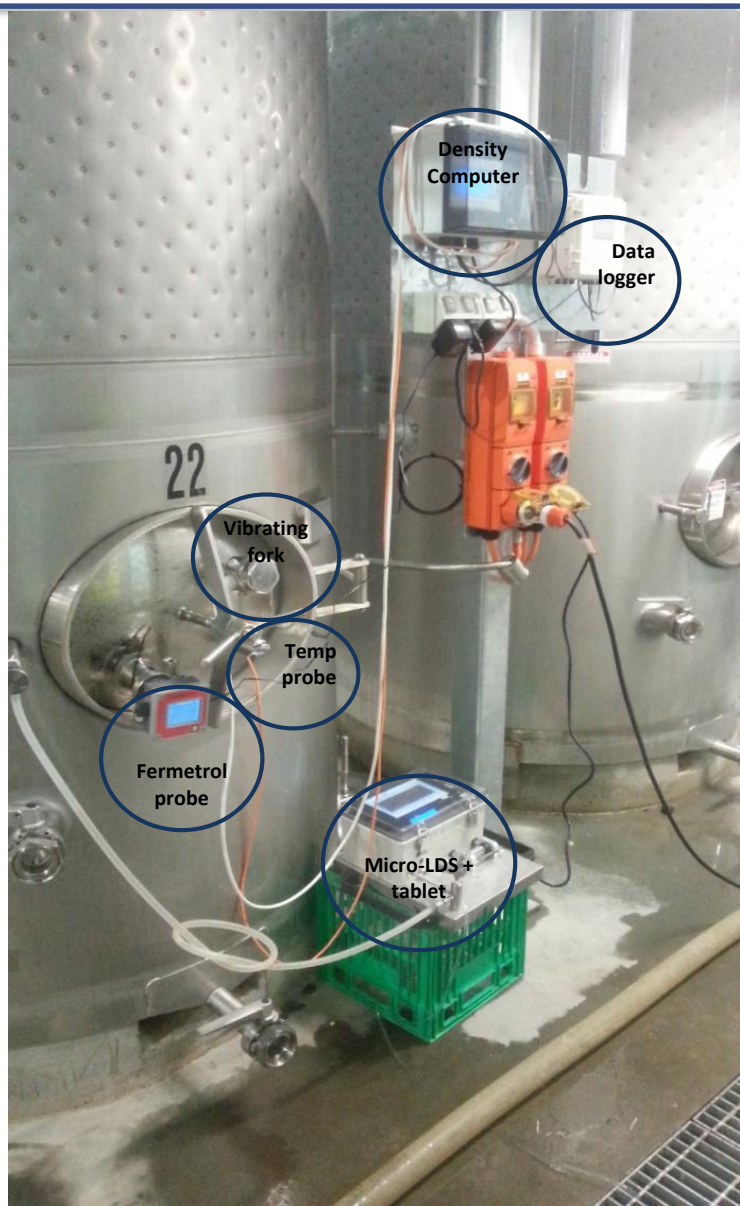
Density readings converted into Baume

Flow through sensor – connected to sample tap

Petaluma Trial 2015

The Australian Wine Research Institute

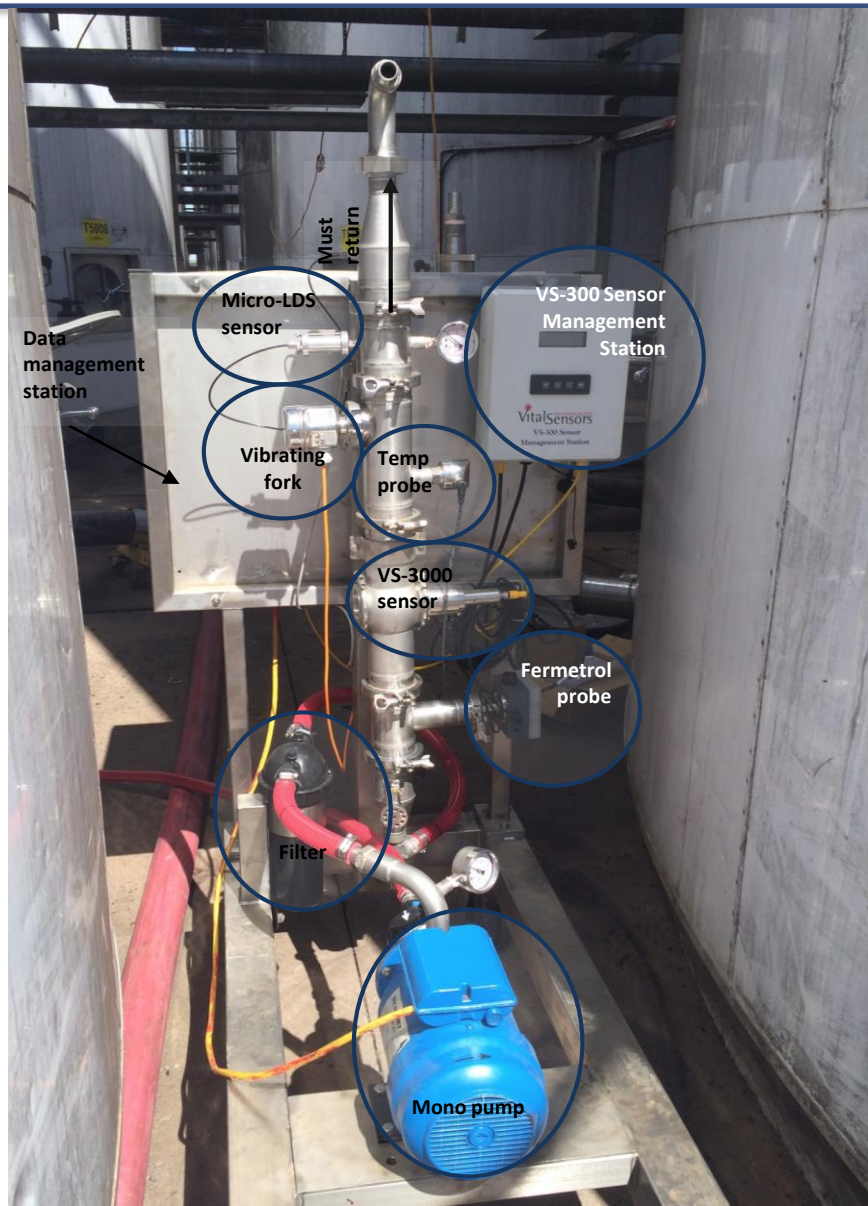
- 6.5 kL white fermenter
- Vibrating fork & Fermetrol probe mounted through modified door panel
- Micro-LDS fed from sample tap
- Fork data converted in Density Computer & locally logged
- Fermetrol data stored locally
- Micro-LDS measurements taken every 2hrs via solenoid valve & filter
- Samples taken daily by lab for reference analysis



De Bortoli Trial 2015

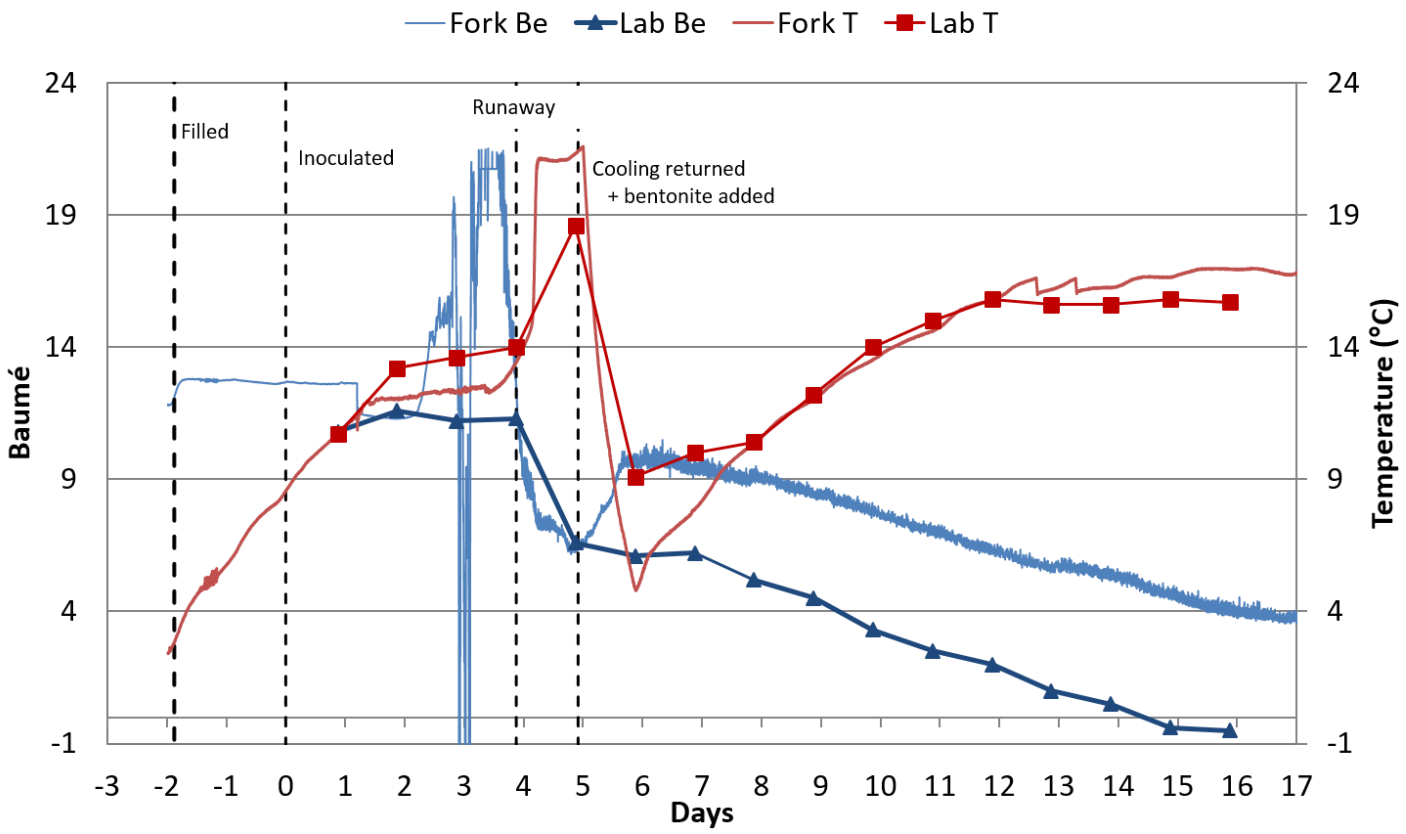
The Australian Wine Research Institute

- 200 kL red fermenter
- Sensors mounted in by-pass loop
- 400 µm filter to reduce solids in flow stream
- Restrictor to reduce turbulent flow and bubbles
- Local data management station to process sensor outputs
- Samples taken daily by lab for reference analysis



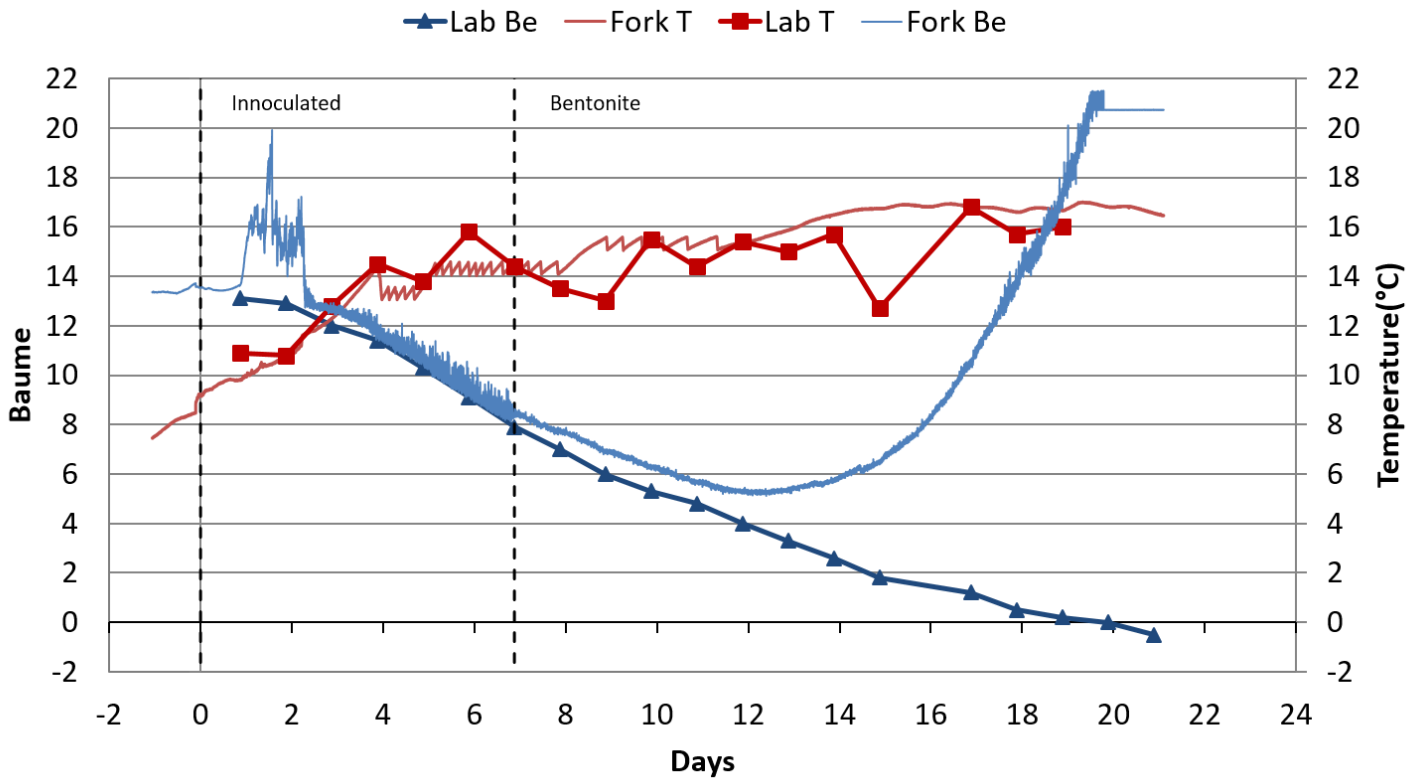
Vibrating fork data – white ferments

The Australian Wine Research Institute



Vibrating fork data – white ferments

The Australian Wine Research Institute

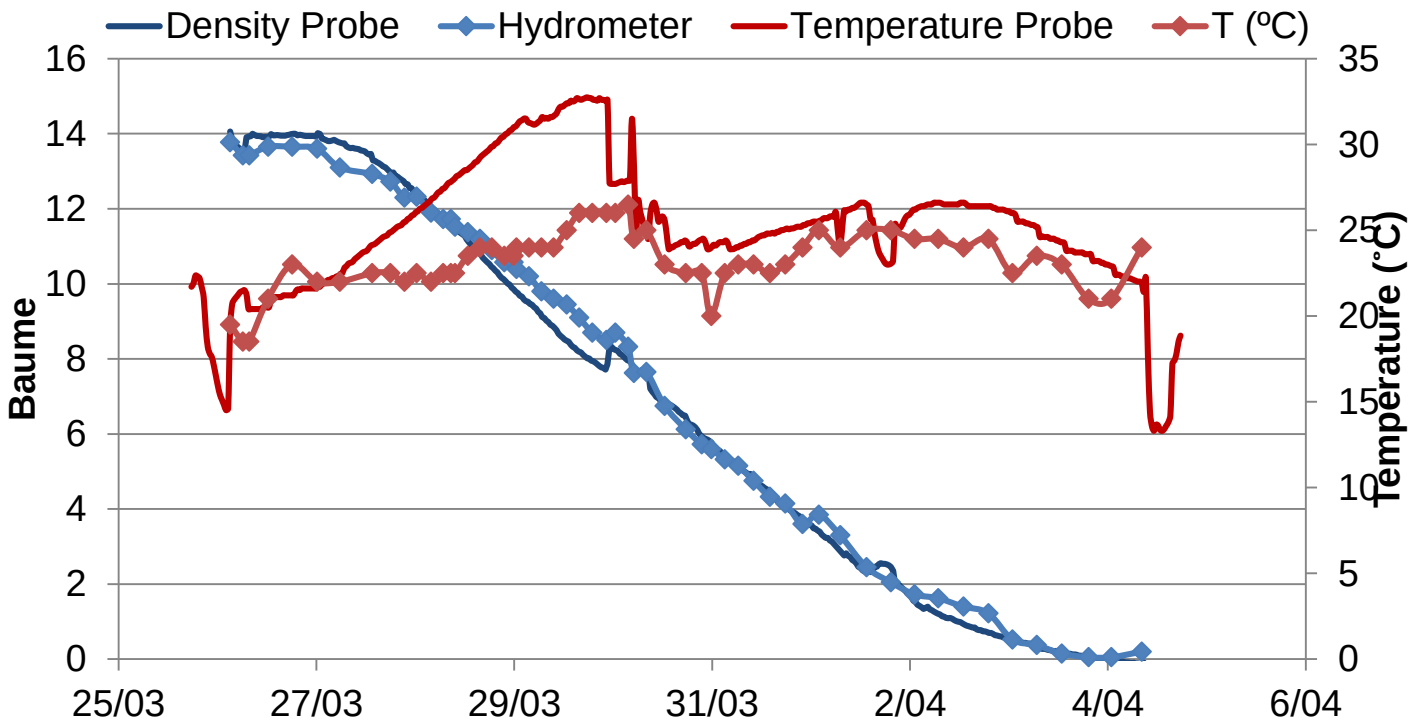


Vibrating fork data – white ferments

The Australian Wine Research Institute

Vibrating fork – red ferments YALUMBA

The Australian Wine Research Institute



Data supplied by Yalumba Wines

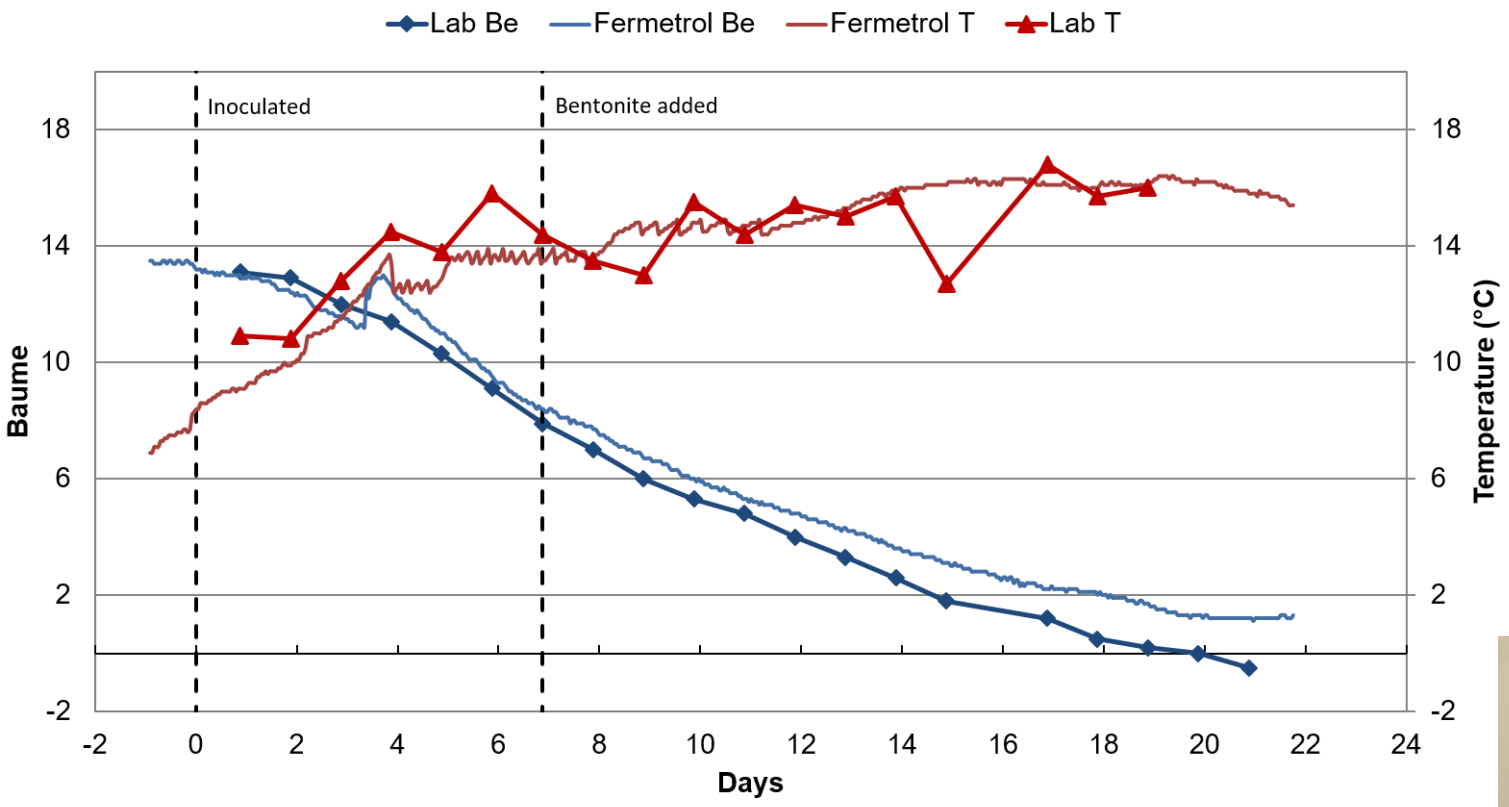
Vibrating fork data – red ferments

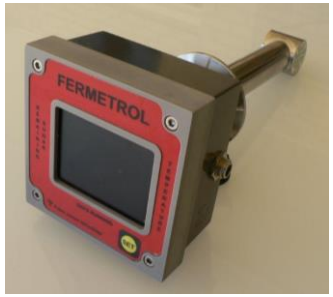
The Australian Wine Research Institute

Image courtesy of Endress/Hauser & Yalumba Wines

Fermetrol data – white ferments

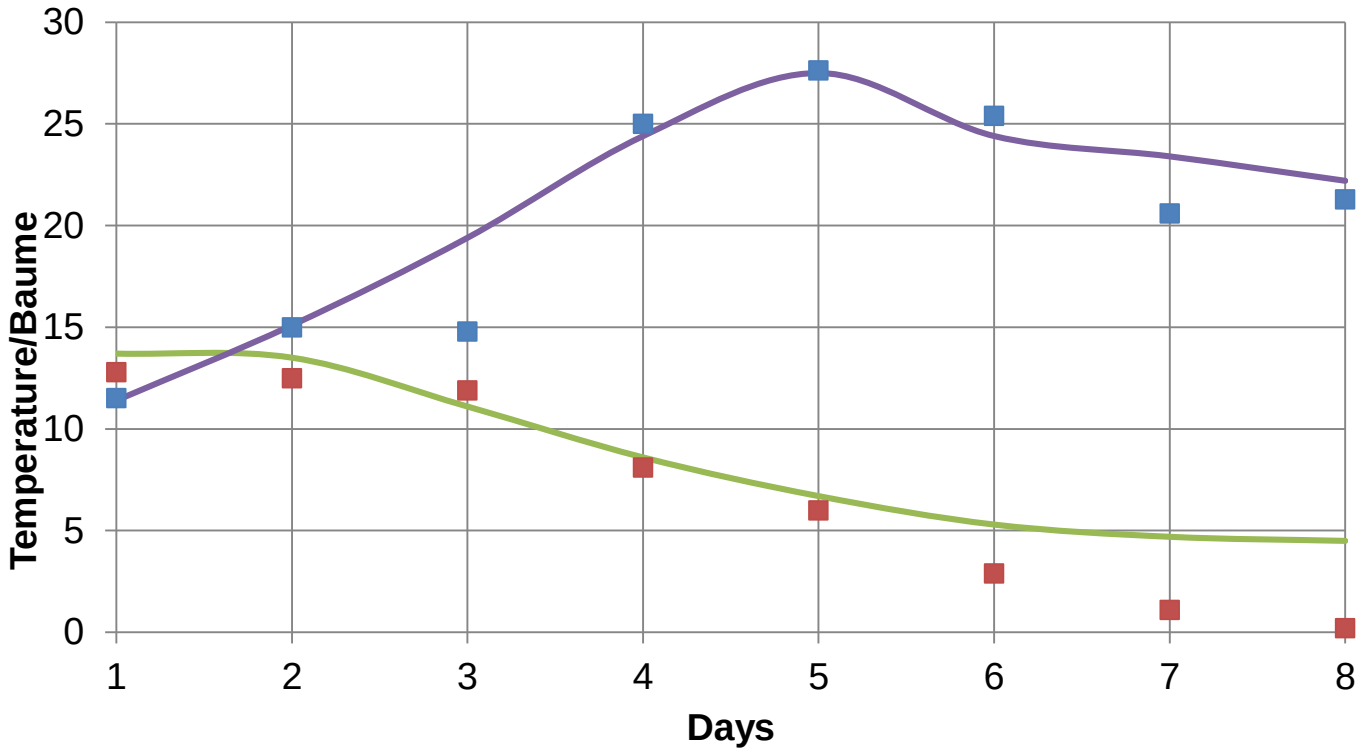
The Australian Wine Research Institute



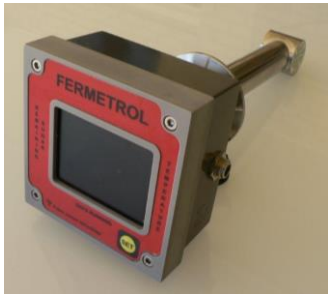


Fermetrol– red ferments ST HALLETT

The Australian Wine Research Institute

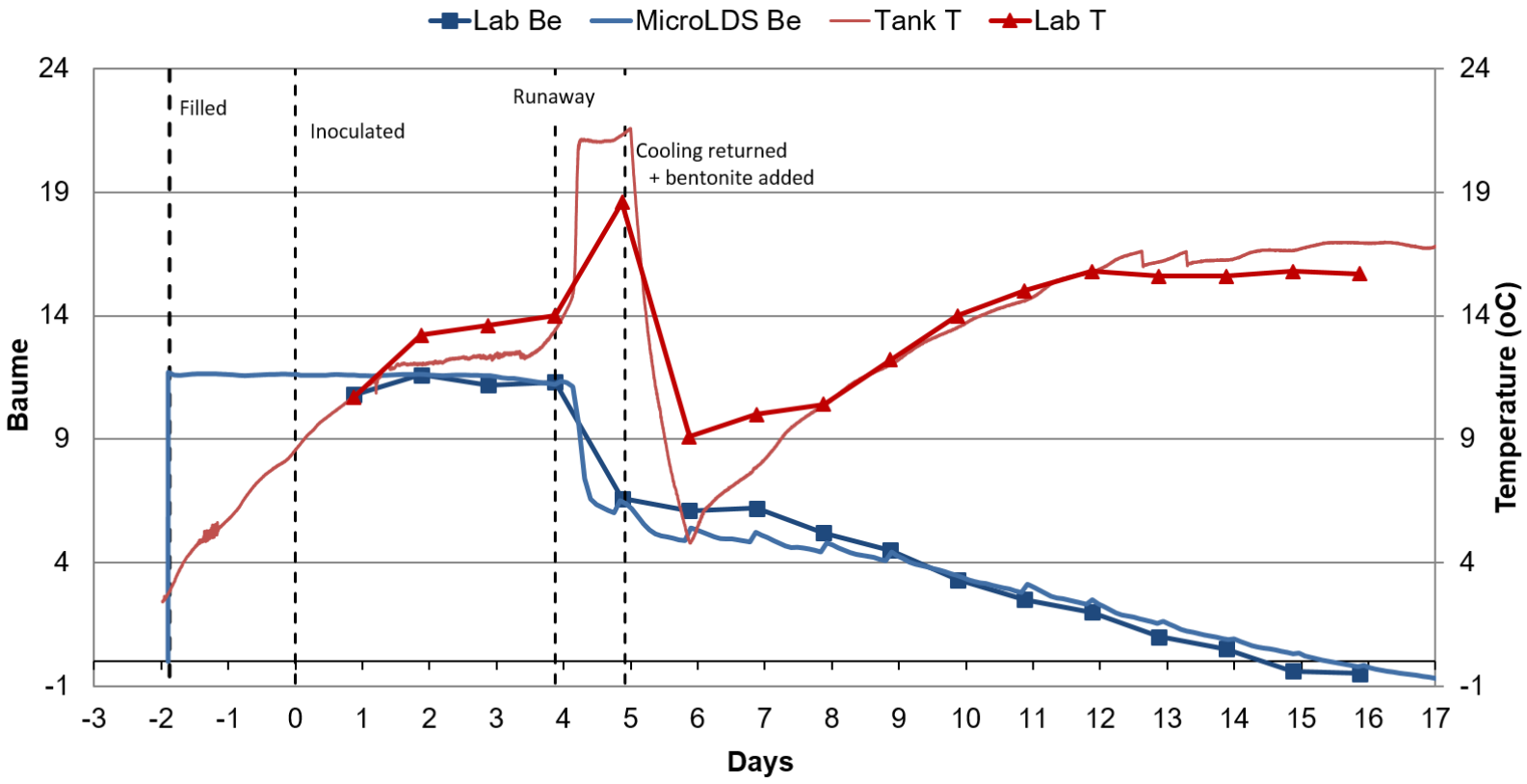


Data supplied by St. Hallett Wines/Psitec



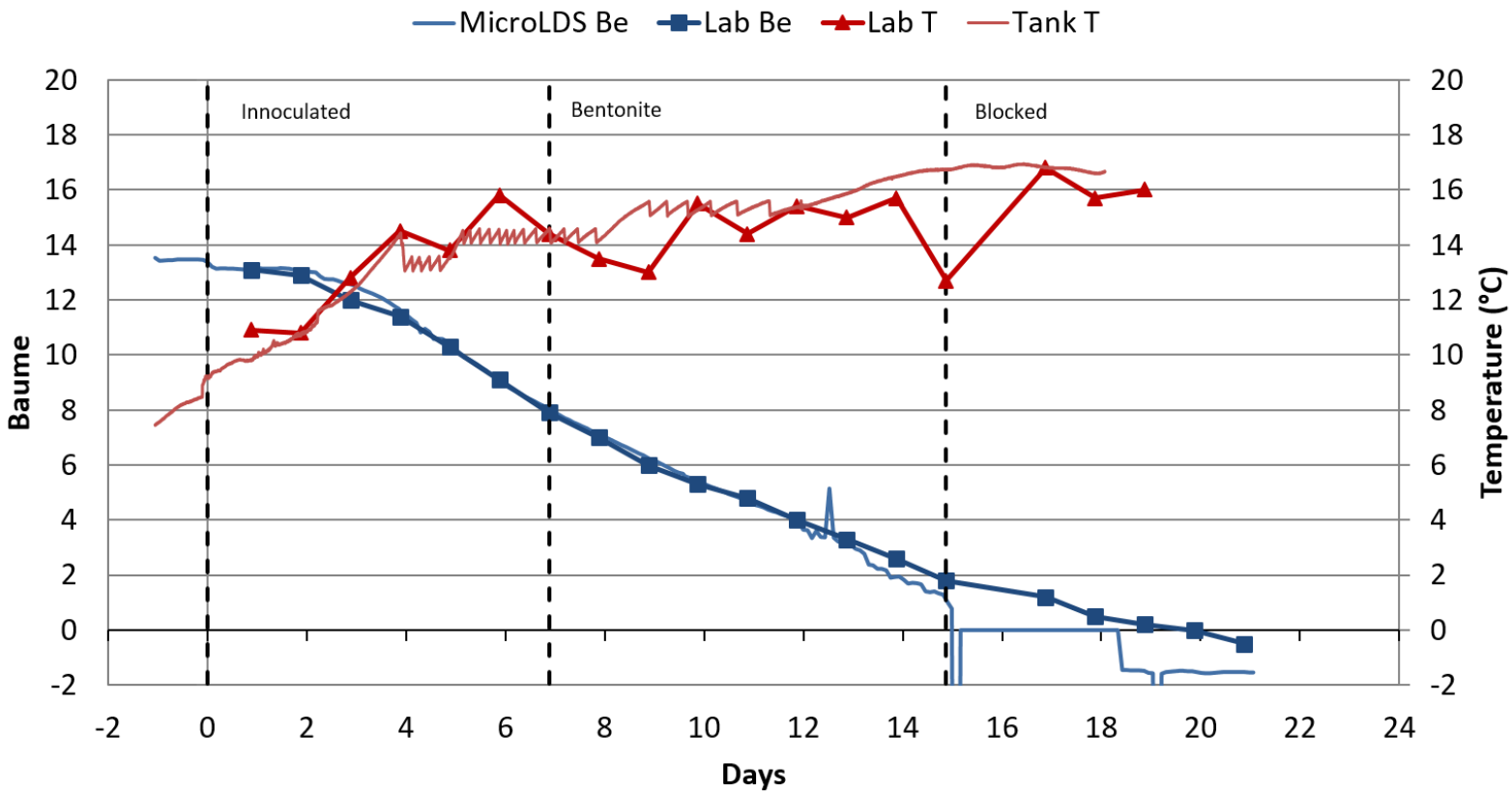
Micro-LDS data – white ferments

The Australian Wine Research Institute



Micro-LDS data – white ferments

The Australian Wine Research Institute



Trial summary

The Australian Wine Research Institute

- Commercial sensors do provide a viable option

BUT

- Implementation is not simple
- Fermentation is a harsh environment
- Solids pose various problems

Need to be willing to spend the time to get it right

Cost benefit analysis

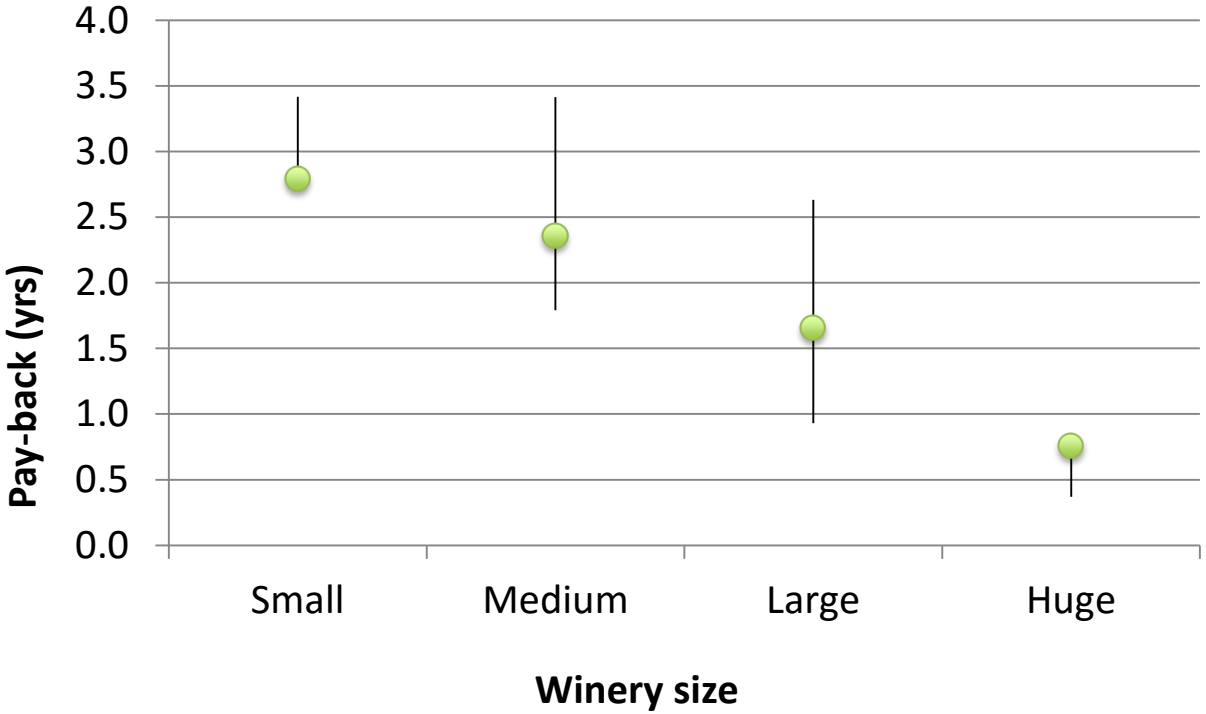
The Australian Wine Research Institute

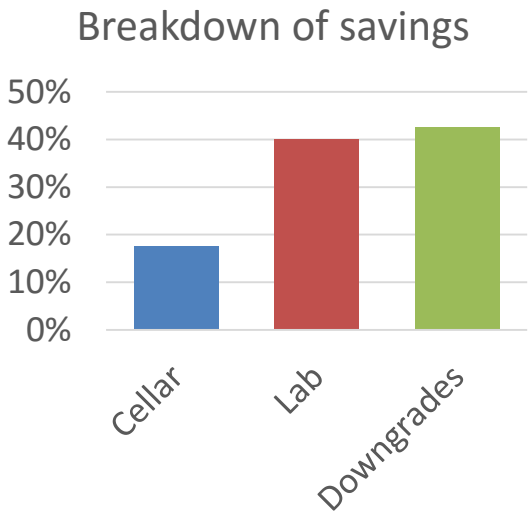
Winery size	Crush (t)	Approx. no. tanks	Total no. ferments/vintage	Tank size (average kL)	Av. kL processed
Small	<500	10	30	7.5	225
Medium	500-2,500	25	75	15	1,125
Large	2,500-50,000	50	150	50	7,500
Huge	>50,000	100	300	250	75,000

Winery size	Crush (t)	Total initial investment ($)	Operating expenses ($ p.a.) initial year	Operational savings ($ p.a.) initial year	Payback period (years)
Small	<500	22,500	272	15,367	2.79
Medium	500-2,500	56,250	672	36,542	2.36
Large	2,500-50,000	112,500	1,338	118,084	1.66
Huge	>50,000	225,000	2,665	461,168	0.76

Payback Period

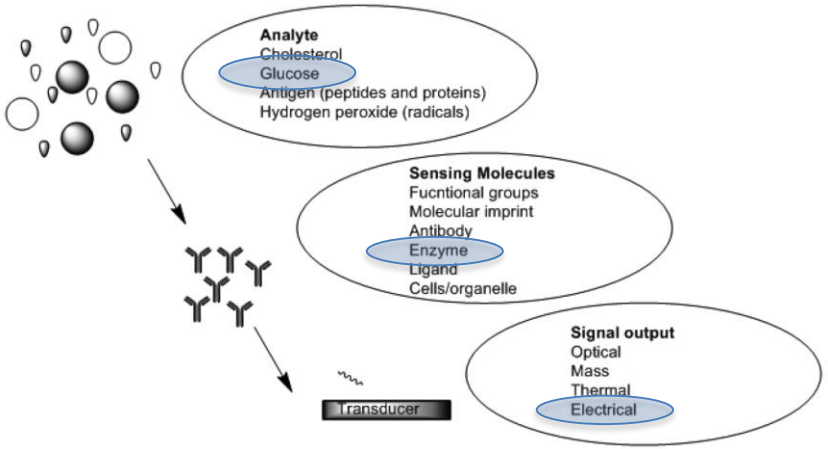
The Australian Wine Research Institute

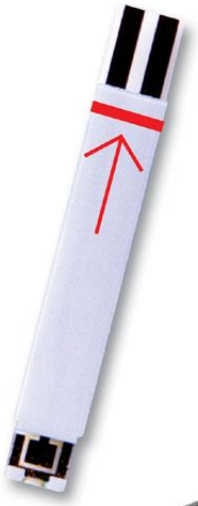


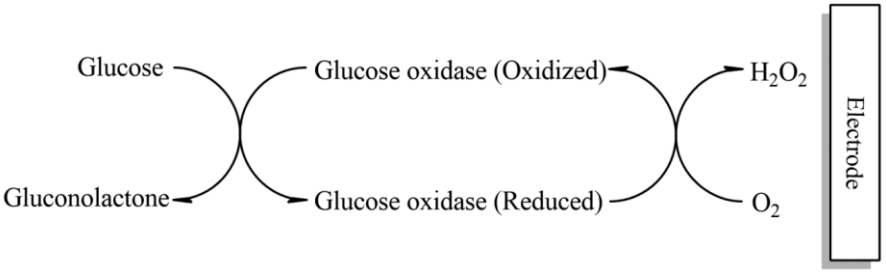


The future?

The Australian Wine Research Institute

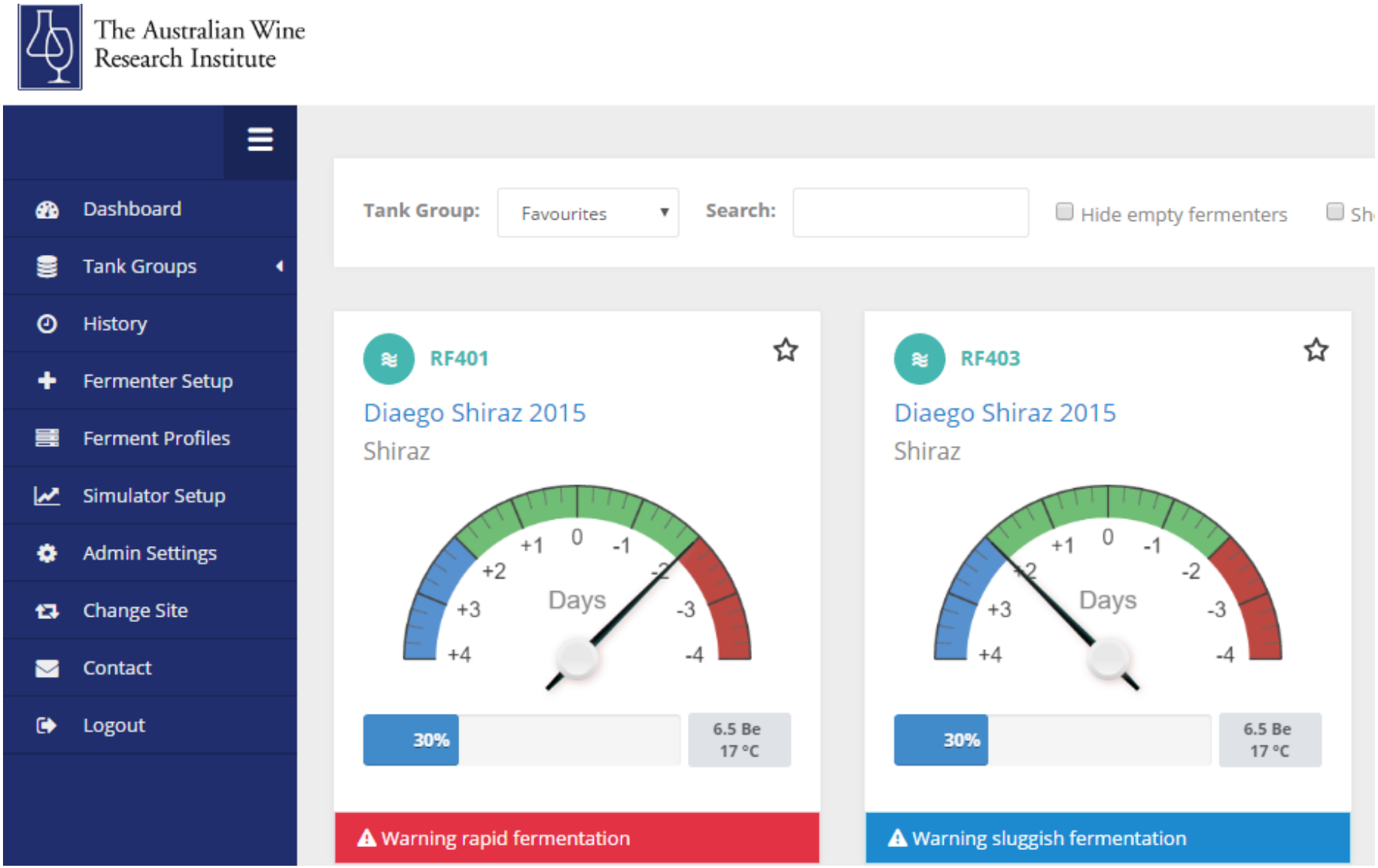






Ferment Simulator 2017

The Australian Wine Research Institute



Acknowledgements

The Australian Wine Research Institute

Wine Australia for Australian Wine

PETALUMA AUSTRALIA

ESTD 1849 YALUMBA AUSTRALIA'S OLDEST FAMILY OWNED WINERY

St Hallett BAROSSA

ESTD 1928 De BORTOLI FAMILY WINEMAKERS

ISS INTEGRATED SENSING SYSTEMS

Endress+Hauser

ΨPsitec Advanced Sensor Development