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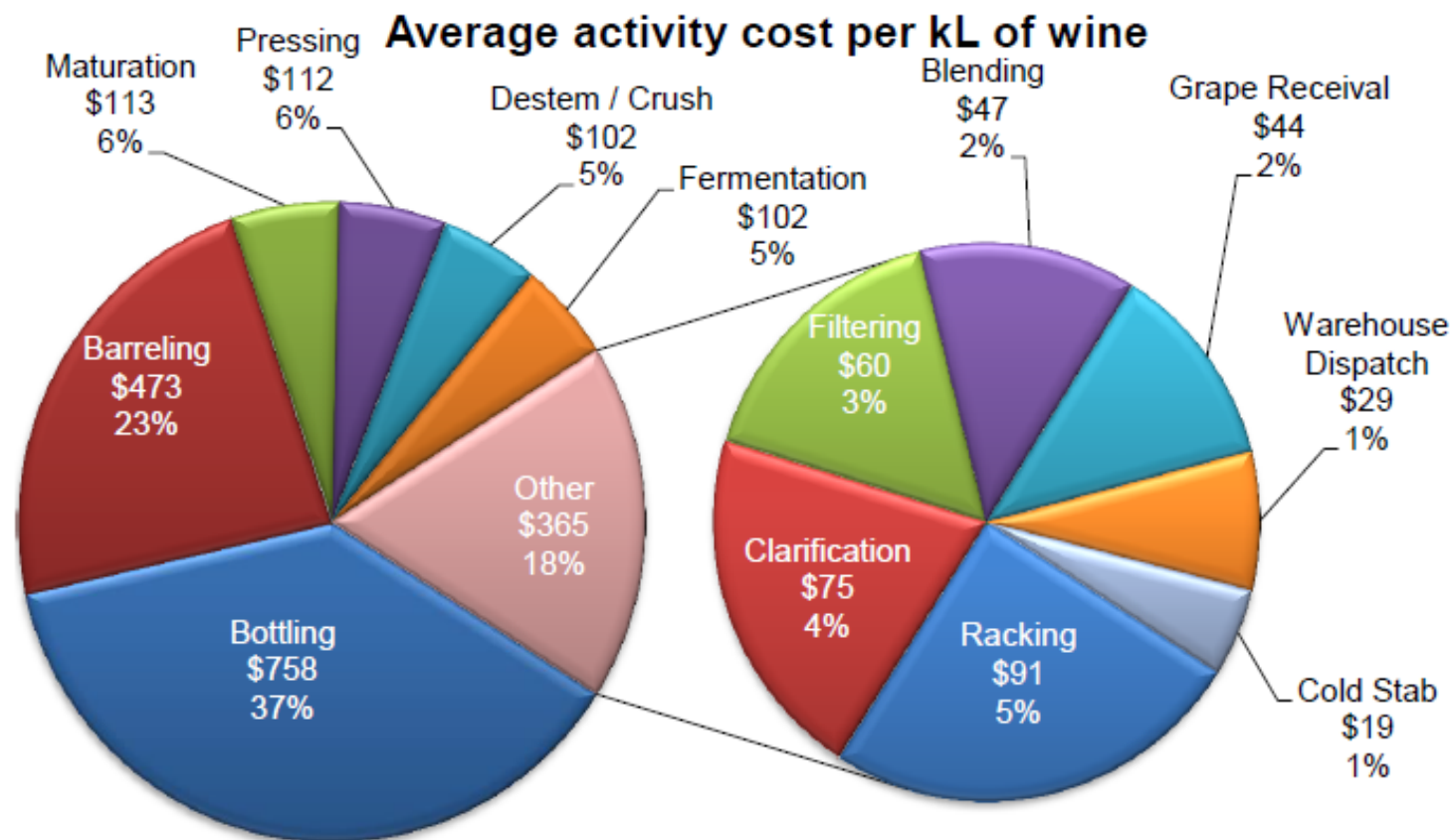
Protecting wine integrity with best practice bottling

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Senior Scientist, AWRI Commercial Services

The Cost of Bottling



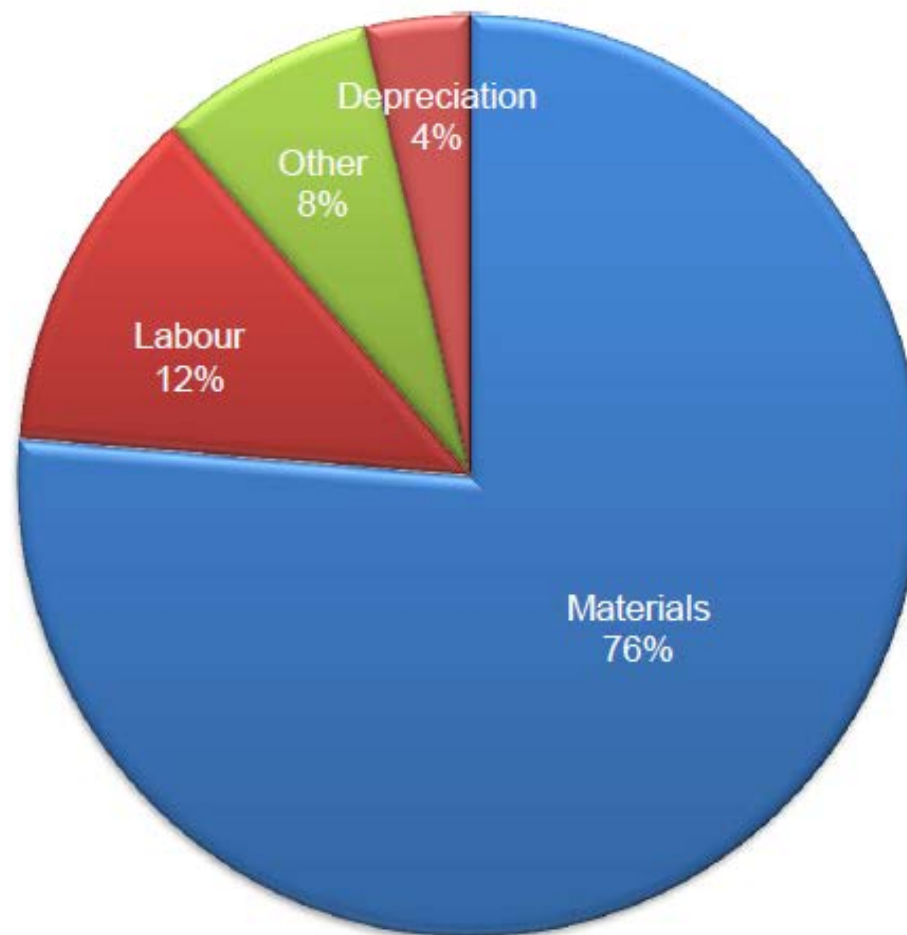
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The Cost of Bottling



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Life Cycle Cost Analysis of Wine Processing: Activity Based Costing, 2015, Wine Australia

What could possibly go wrong?...



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Wine quality



Dry goods (incompatibility)



Incorrect pre-treatment

Contamination



Oxygen



Poor storage/distribution



Wine preparation



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Oxidation – smallest compartment is 1200-1500L

Duration – temperature effects

Contamination – tanker checks

Filtration

sterile filtration into tanker is not 'the final filtration'

take samples to show wine left clean

Guide to filter sheet selection in wine



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Filtration Purpose	Nominal Micron Rating	Cuno Sheets	Seitz Sheets	Ekwip Grade	NTU
Rough/polishing	3.5 μ m		T 1500	Z1	
	3.0 μ m	05H	T 1000	Z2	
	2.0 μ m		K 900	Z3	< 100.0
First racking	1.5 μ m	10H	K 800	Z4	< 60.0
Polishing/Clarity	1.0 μ m	30H	K 250	Z5	12.0 – 35.0
Second racking	0.8 μ m	40H	K 200	Z6	1.0 – 10.0
Final filtration for dry wines	0.6μm	50H	K 100	Z7	
Final filtration for sweet wines	0.45μm	60H	KS 80	Z8	1 – 1.5

Check filter integrity before AND after filling

Pre-bottling adjustment



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- Target DO ideally <0.5 mg/L
Line pick-up CAN be significant (0.5 – 1.0 mg/L)
Sparge with CO_2/N_2 to adjust high O_2 levels
- Beware last-minute adds!
Copper
CMCs
- Headspace mngt
Inert gas pressure/flow
Cap purge
Corker vacuum
- Fill ht adjustment
Compliance
Thermal expansion
- Carbon dioxide (CO_2)
Palate balance (whites 0.8 – 1.3 g/L; reds <0.5 g/L)

Pre-bottling adjustment – SO₂



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Molecular form responsible for anti-microbial properties

- Killing and growth inhibition of unwanted bacteria and yeast

Bisulfite form responsible for anti-oxidant properties

- Reaction with peroxide
- Delays browning

From a micro-perspective:

- White wines: >0.8 mg/L molecular SO₂
- Red wines: >0.6 mg/L molecular SO₂

From an oxidation perspective:

- Neutralise DO
- Capacity to absorb O₂ during bottle ageing

	White table wine	Red table wine
Free SO ₂ mg/L	28-32	28-32
Total SO ₂ mg/L		50-150
Ascorbic acid mg/L	50-100	

Wine analysis – pre-approval



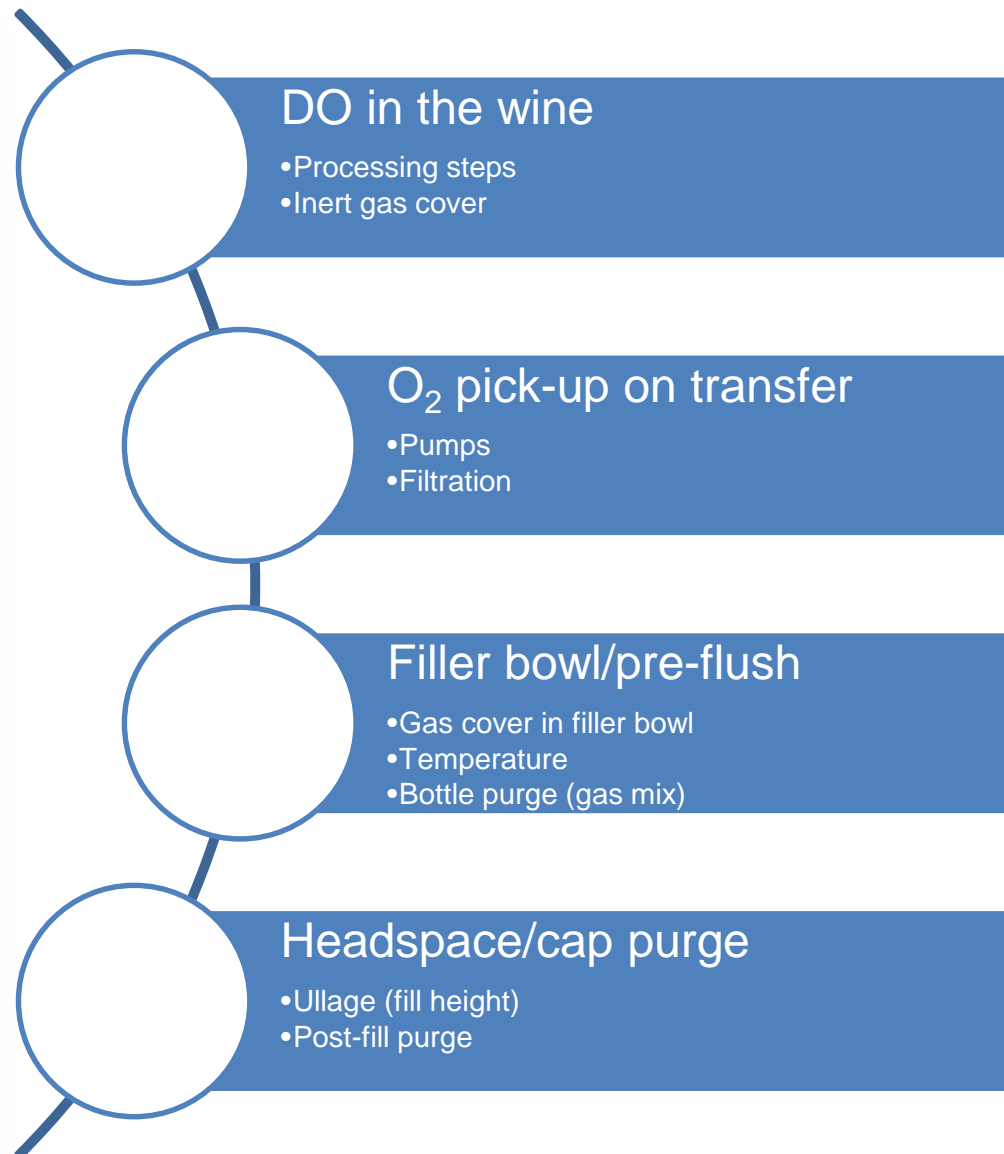
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		Tanker	Pre approval	Bottling tank
Specific gravity			√	√
Free SO₂	mg/L	√	√	√
Total SO₂	mg/L	√	√	√
Ascorbic acid	mg/L		√	√
pH			√	√
TA	g/L		√	√
Alcohol	% v/v	√	√	
Glucose +fructose	g/L		√	
Volatile acidity	g/L		√	
Dissolved oxygen	mg/L		√	√
Dissolved carbon dioxide	g/L		√	√
Temperature	°C		√	√
Turbidity	NTU	√	√	√
Heat stability	pass/fail	√	√	
Cold stability	pass/fail	√	√	
Copper	mg/L		√	
Iron	mg/L		√	
Calcium	mg/L		√	
Taste		√	√	√
Sterility				√

Oxygen at Bottling



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QA checks - wine analysis



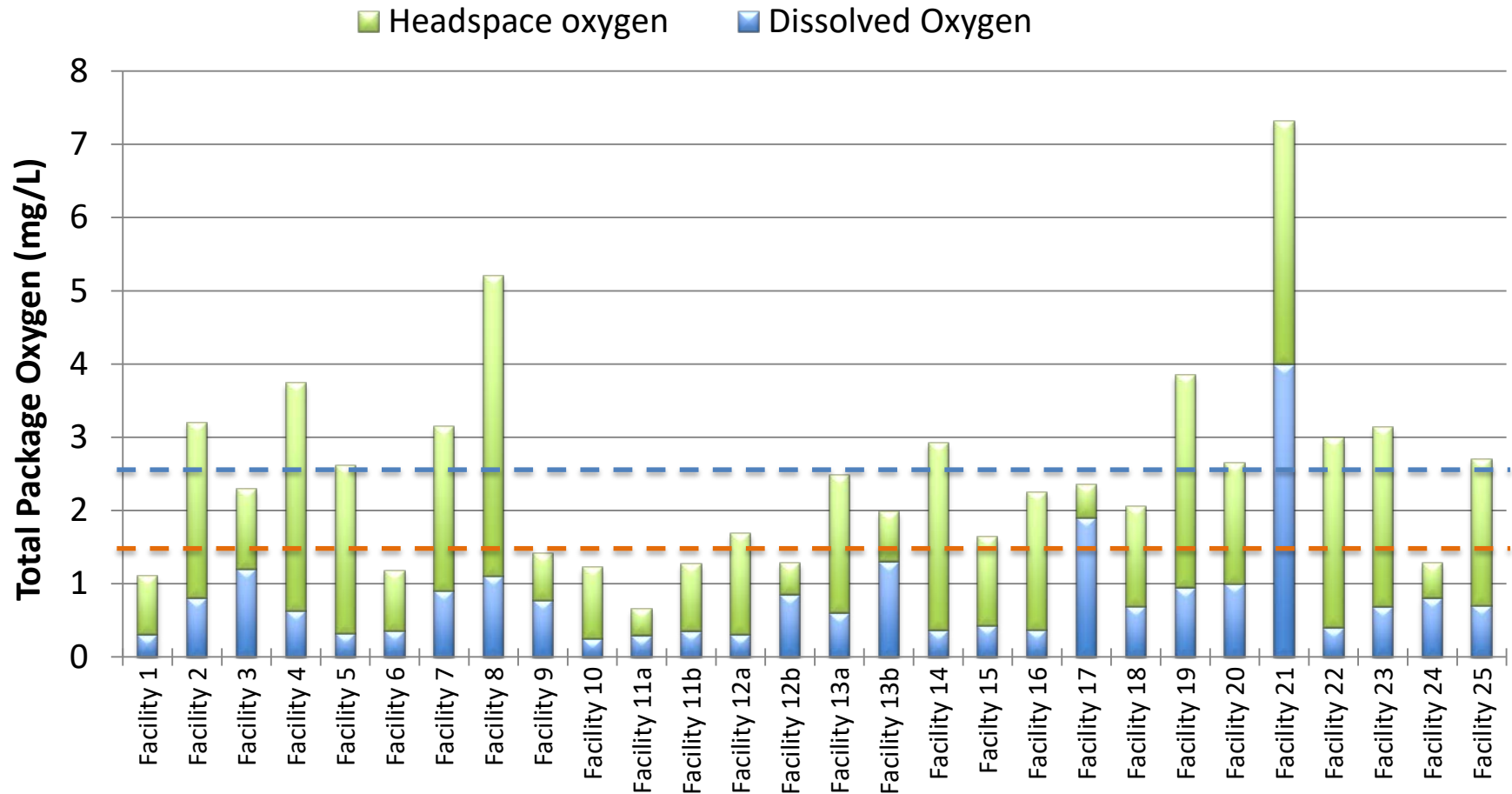
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		Bottling tank	First fill	½ hour
Specific gravity		√	√	√
Free SO₂	mg/L	√	√	√
Total SO₂	mg/L	√	√	√
Ascorbic acid	mg/L	√		
pH		√		√
TA	g/L	√		√
Alcohol	% v/v		√	√
Glucose +fructose	g/L			√
Volatile acidity	g/L			√
Dissolved oxygen	mg/L	√	√	√
Dissolved carbon dioxide	g/L	√	√	√
Temperature	°C	√		
Turbidity	NTU	√		
Heat stability	pass/fail			
Cold stability	pass/fail			
Copper	mg/L			
Iron	mg/L			
Calcium	mg/L			
Taste		√	√	√
Sterility		√	√	√

QA checks - Total Package Oxygen (TPO)



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Measured TPO levels in wines packaged using Australian bottling lines:
HO and DO contributions to TPO

QA checks – closure application



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Correct application

Incorrect compression

Wavy tamper evident groove

Thread cut through

Cut through at tamper evident groove



leakage and mould growth

denting around redraw

chips

scratches on liners

Microbial spoilage of bottled wine



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Problems include:

- Gas/spritz
- Re-fermentation
- Haze/deposit
- Volatility
- Oxidation
- Bitterness
- Metallic
- Volatile phenols
- Geranium character
- Reduced acidity

Controlling micro-organisms

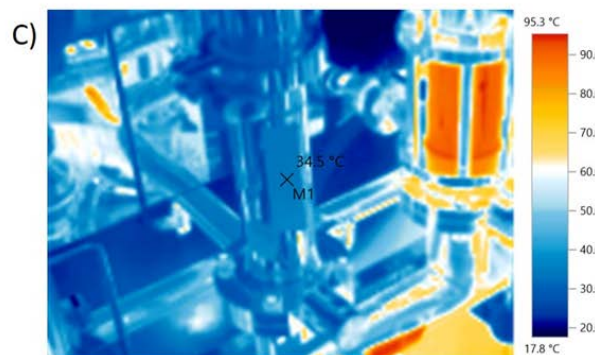
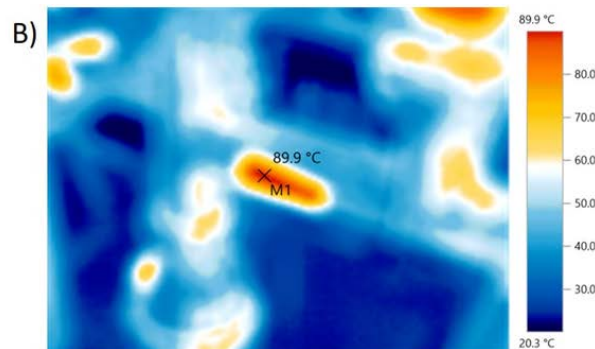
- Filtration
- SO₂
- pH
- Dimethyl dicarbonate (DMDC)
- Sorbic acid

Bottling line sanitation



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Caustic/citric/hot water
Hot water sterile 80°C/30 minutes



Frequency
Daily

Packaging order

Low risk – dry whites

Low risk – dry reds

High risk – Sweet whites

- A) The bulk tank return line is separated from the post-filtration line heading to the filler
- B) Thermal camera image showing post-filtration line reaching 90°C during sterilization
- C) Bulk tank return line sitting at 34°C during sterilisation

Things to keep an eye on



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- Cleaning procedures
- Filtration
- Testing of inputs (incl. water)
- Routine maintenance and mods
- Biofilms
- Acceptability of micro 'pass' results

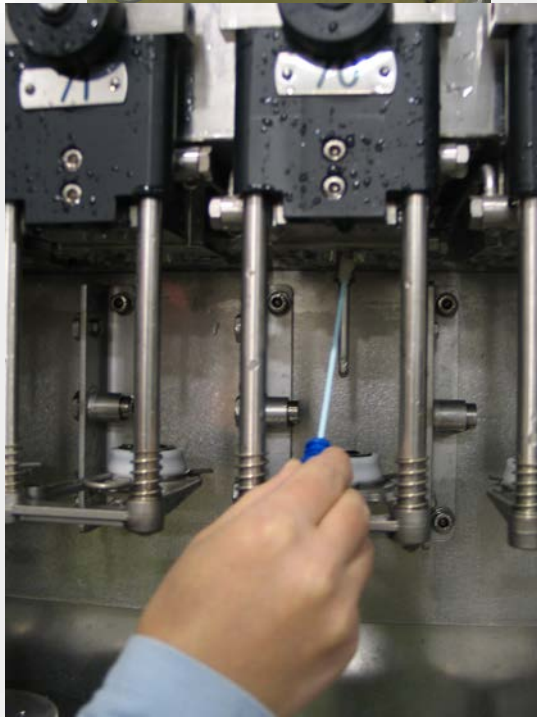
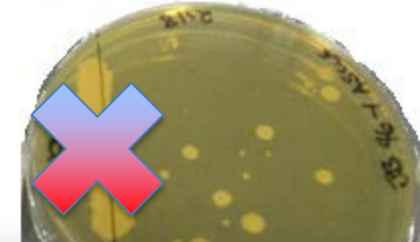
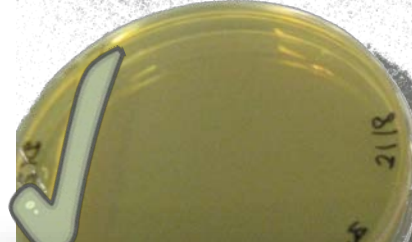
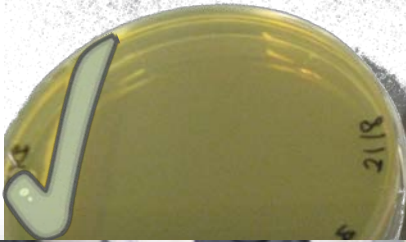
Watch for:

- Corker (grease in jaws)
- Dead spots in valves (Micro, biofilm build-up)
- Hoses connected to vacuum pumps
- Condition of rinsing water (Blue, yellow, or micro)
- Quality of compressed gases
- Ease of plumbing / fixed lines
- Periodic inspection of filling bowl
- Carry out regular servicing

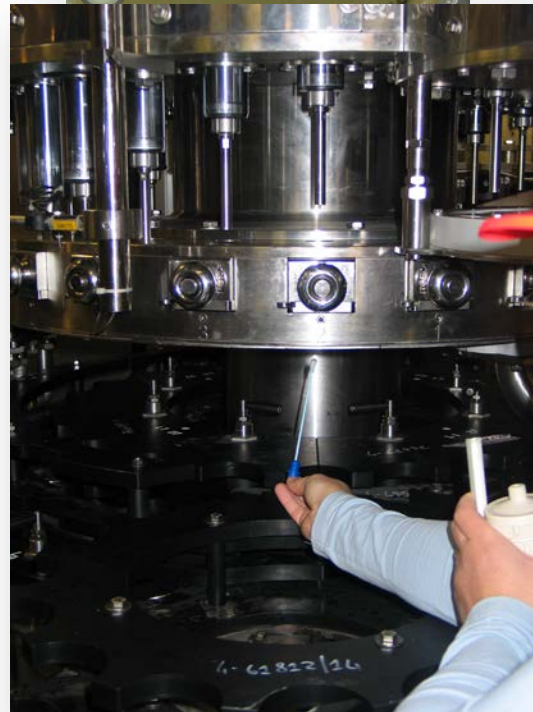
Swabbing



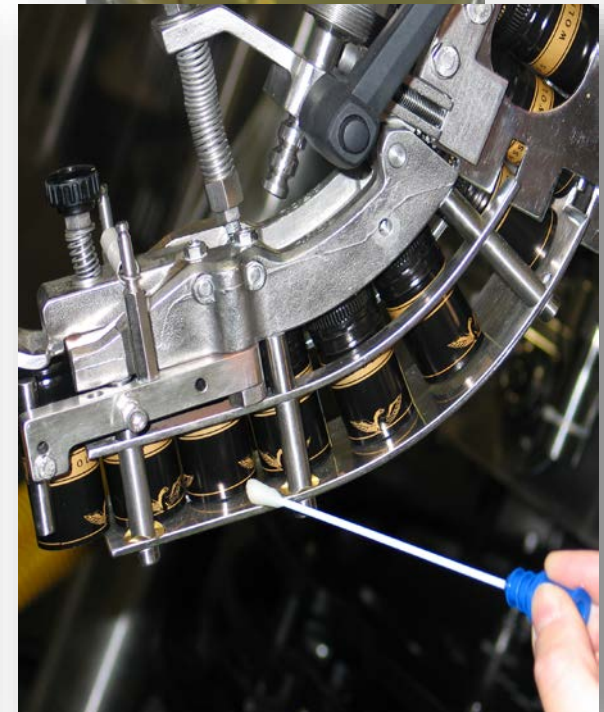
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Filler



Corker



Screwcap chute



Coding of individual bottles and/or cartons –
traceability

Hold-back samples

Appropriate dry-goods storage conditions and
quarantine periods

Dilution checks

QA Systems/Framework



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Closure choice



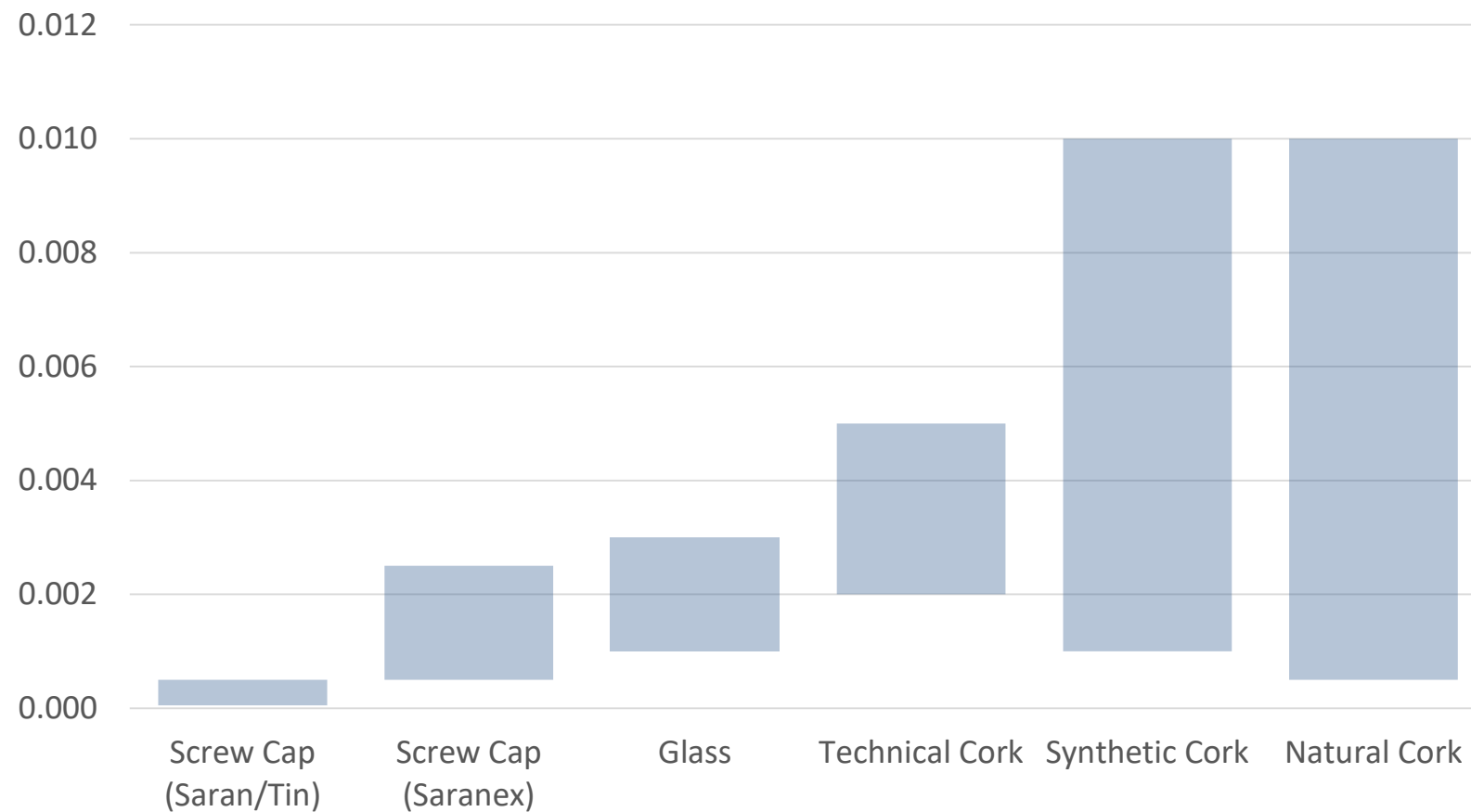
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cc O₂ / day

Indicative Closure OTR Ranges



1999 White wine closure trial

- Every closure technology produced a different wine
- Range of colour at 28 months

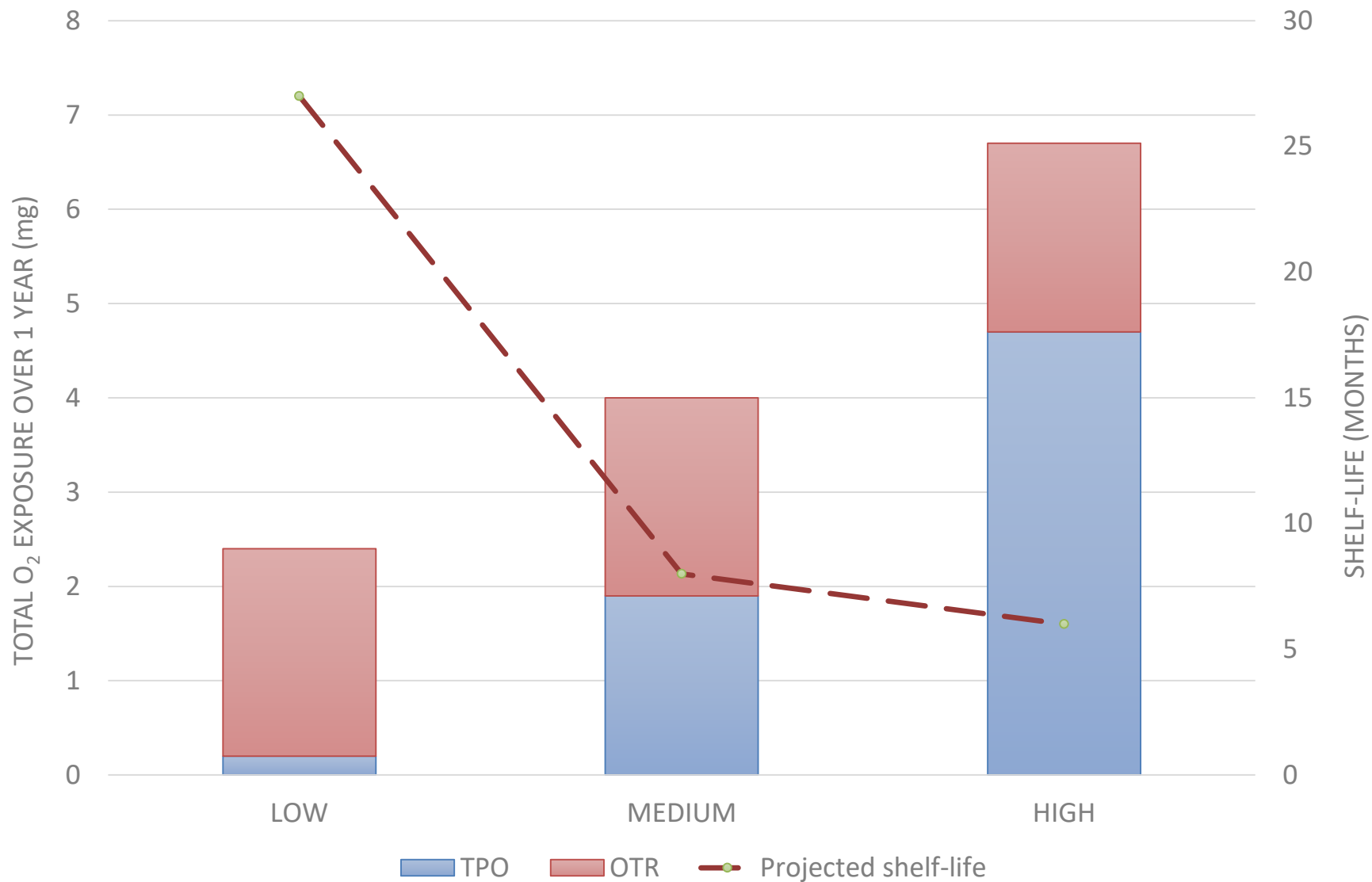


Godden et al 2001 Aust. J. Grape Wine Res.

Impact of TPO & OTR on shelf-life



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Post-bottling considerations – Storage temperature



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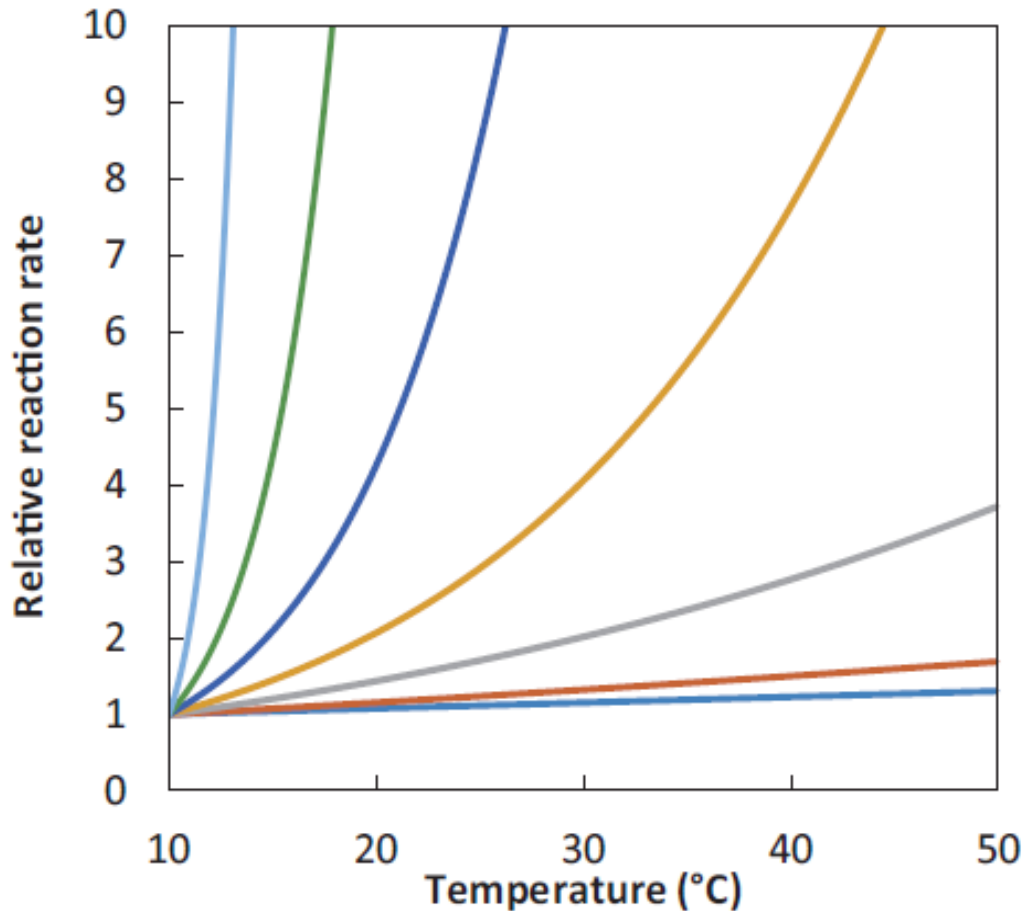


Figure 1. Influence of Arrhenius activation energy on relative reaction rate. Reaction rates relative to those at 10°C for the Arrhenius activation energy 5 kJ (dark blue), 10 kJ (red), 25 kJ (green), 50 kJ (purple), 100 kJ (teal), 200 kJ (orange) and 500 kJ (light blue).

Browning reaction rates in
white wine:

2.5 – 3x faster at 20°C
than at 10°C

15–20x faster at 40°

SO₂ loss: red wine
generally more robust BUT
more sensitive to warmer
conditions



Increase in temperature \Rightarrow increase in pressure

- decrease in CO_2 solubility, increase in vapour pressure of ethanol, water and CO_2
- Increase in pressure with increase in %ethanol

Thermal expansion of wine: heat 20–40°C \Rightarrow loss of headspace of 6 mL for 750 mL bottle

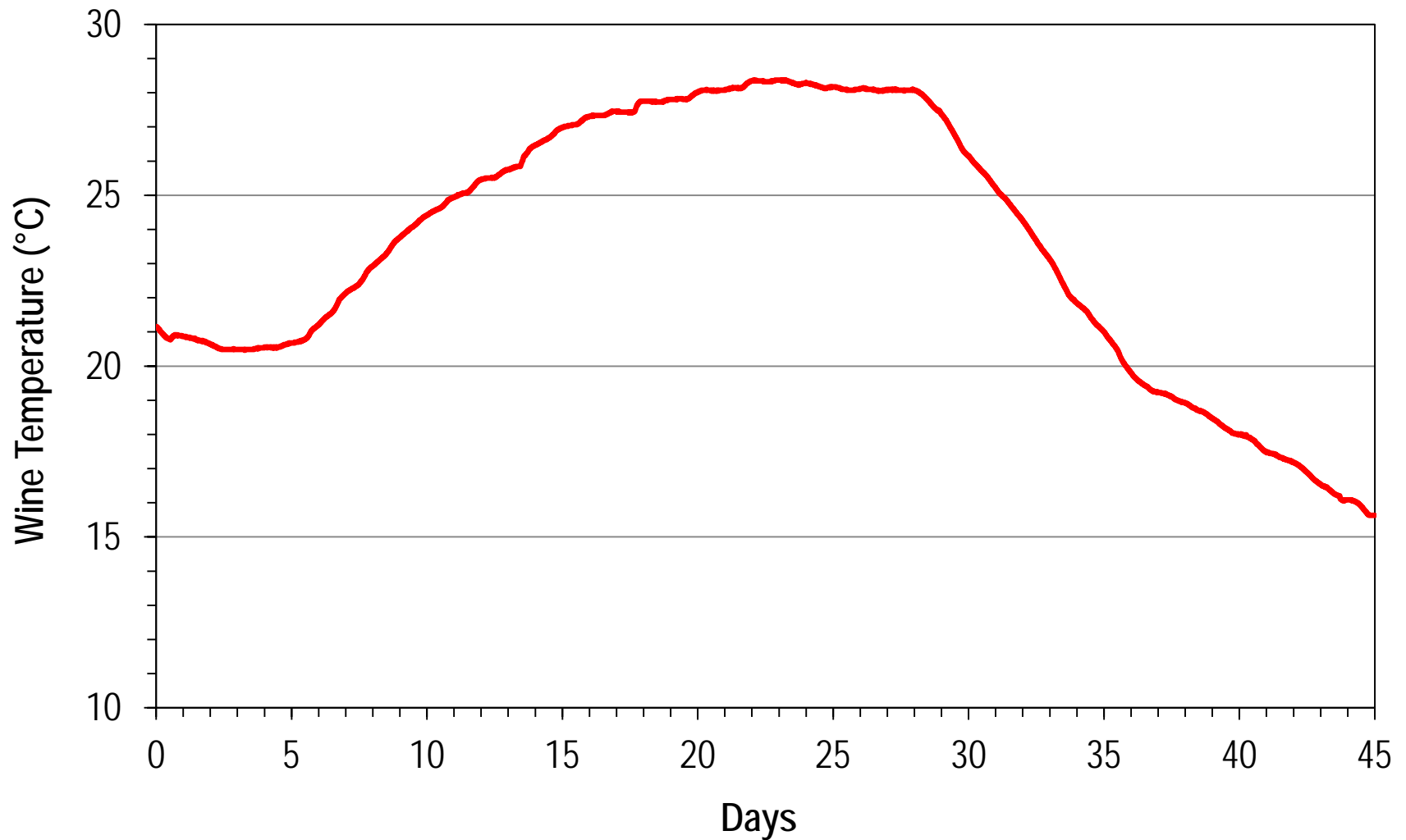
If leave bottles upright (upright storage):

- need high %RH (>80%), otherwise corks dry out
- dry corks allow more oxygen ingress \Rightarrow greater SO_2 loss
- oxygen ingress \Rightarrow microbial growth (spoilage)

Transporting wine



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- Use rigorous sanitation procedures
- Be wary of last-minute-adds
- Control oxygen
- Apply appropriate QA checks
- Storage and shipping temperatures can be significant