



Cork Taint and Closure Trends in Washington

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Northwest Wine Report

Background

- First started writing about cork taint in 2010
- Have written over two dozen articles on the subject for my site and for *Wine Enthusiast*
- My hope is 1) to make wineries aware of the size of the issue and 2) to eradicate cork taint



Why?

- As a wine lover and buyer, cork taint decreases people's enjoyment of wine at best. It ruins their experience at worst.
- When you have a corked bottle of wine, it can be a BIG DEAL (relatively speaking).
- As a critic, I consider cork taint is a threat to my career.

Data

- Collecting data on number of cork tainted wines since 2010
- Collecting data on closure type since 2016
- Compile this information annually
- Data presented are from my tastings at Wine Enthusiast (2013-2022) and Northwest Wine Report (2023)



Assumptions

- I define natural cork as:
 - Natural cork
 - Twin top corks/1+1 corks
 - Micro-agglomerative corks that are NOT certified to be TCA free
- I put the following into separate buckets:
 - TCA-free micro-agglomerative corks (most prominently Diam)
 - Screwcaps
 - Synthetic corks (such as Nomacorc)
 - Others (glass stoppers, crown caps, cans, bag in box, etc.)



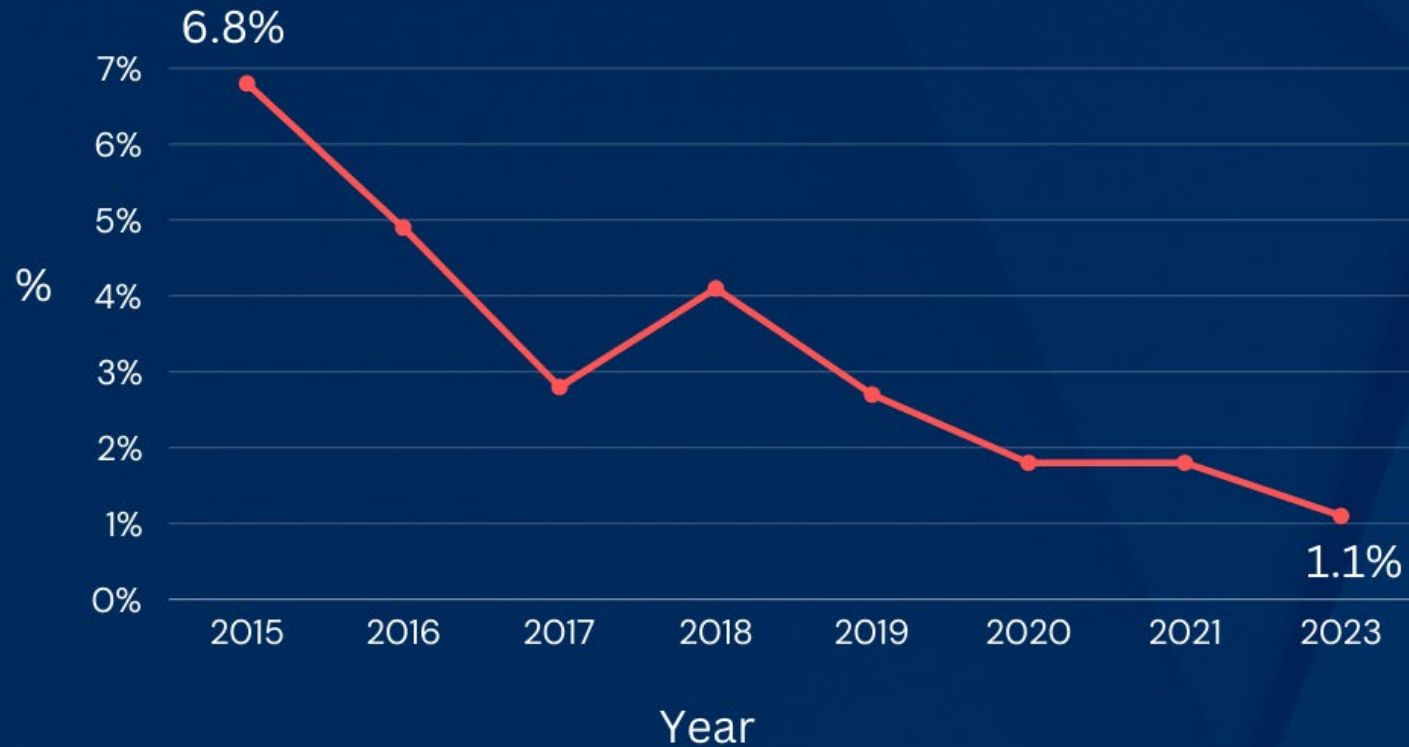
Caveats

- Tainted bottles only identified by sensory analysis
- Wines not confirmed by laboratory analysis
- ALL taint confirmed by second person
- ONLY referring to wines with a musty odor/flavor caused by TCA and another moldy contaminants
- NOT referring to ANY other issues (brett, VA, smoke impact, oxidation, etc.)



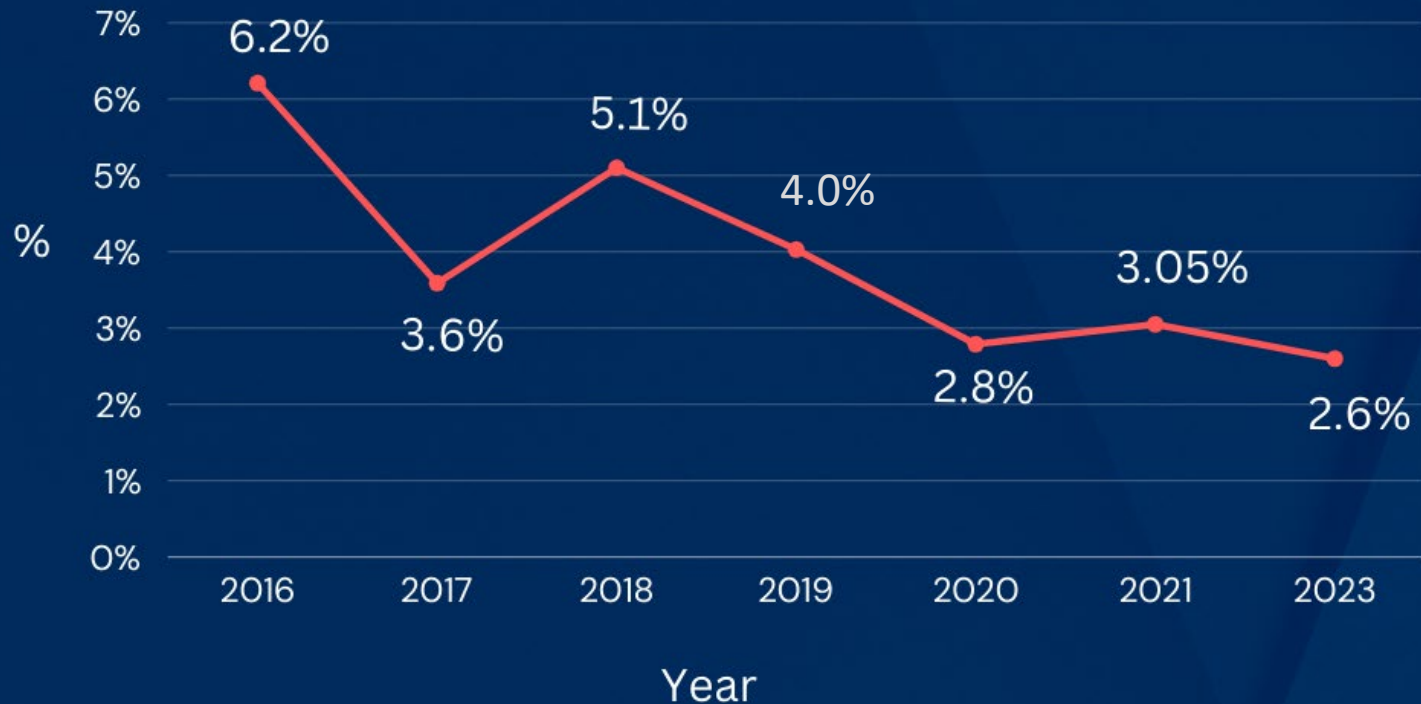
Is cork taint decreasing?

Cork taint has dropped dramatically looking at % of all wines.



Is cork taint decreasing?

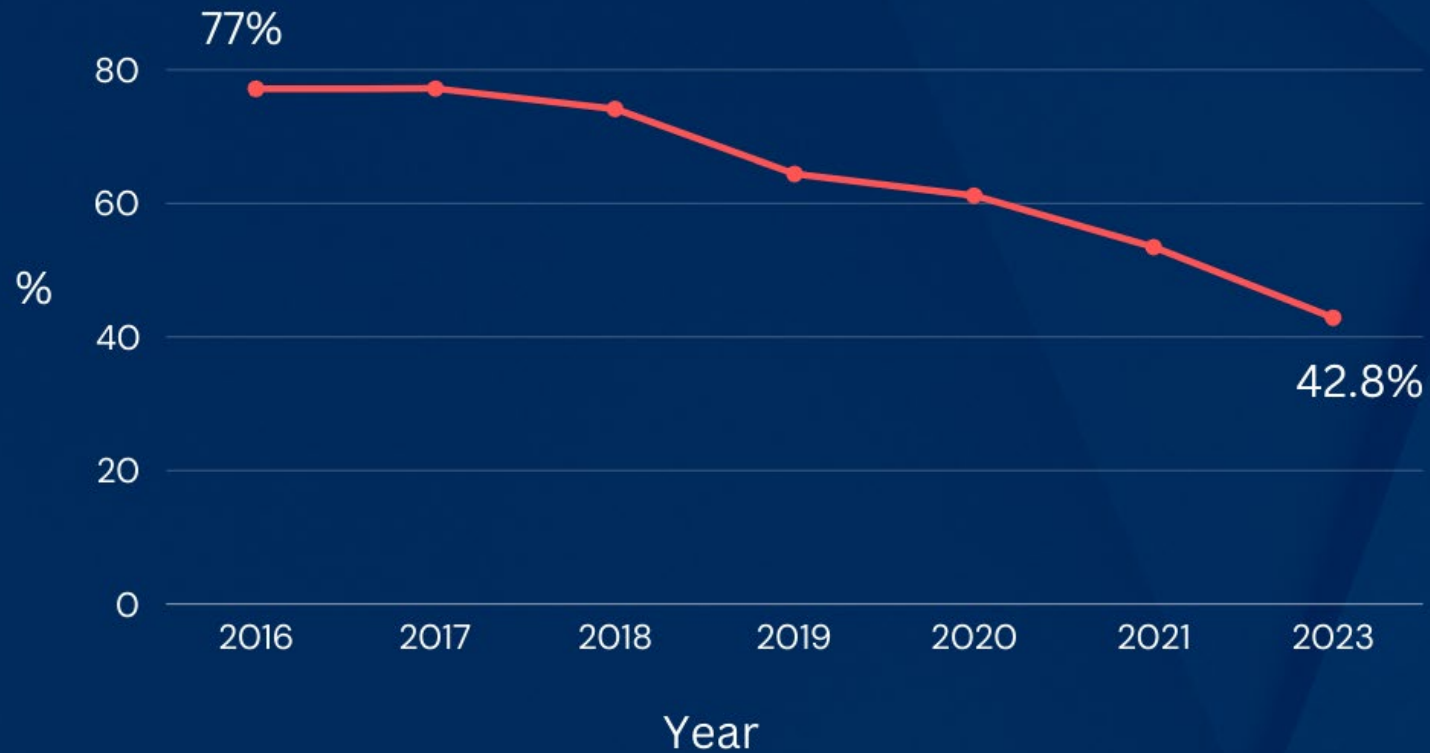
Improvement less impressive focusing only on wines using natural cork.



Why does cork taint appear to be going down dramatically when recent changes are actually more modest?

Natural Cork

Use of Natural Cork Has Dropped Dramatically

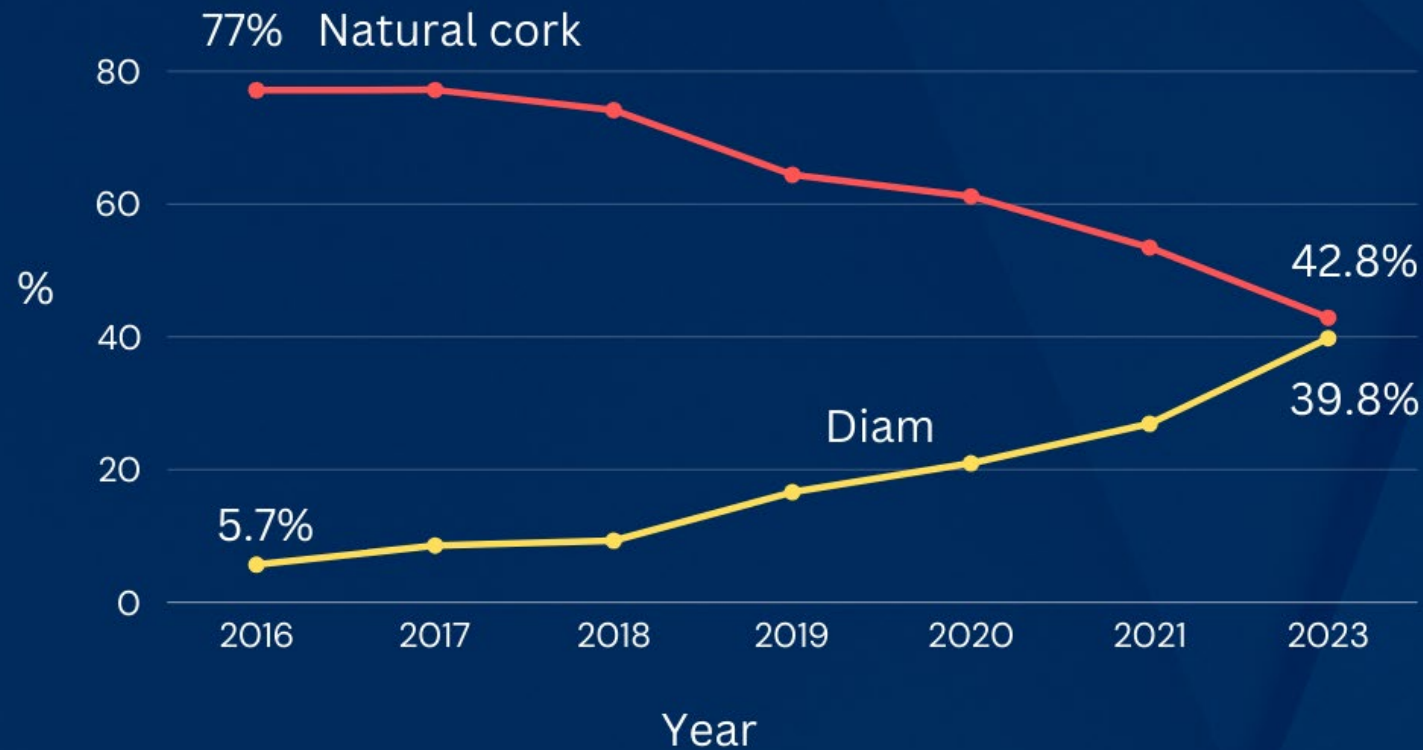


WINEVIT® 2024



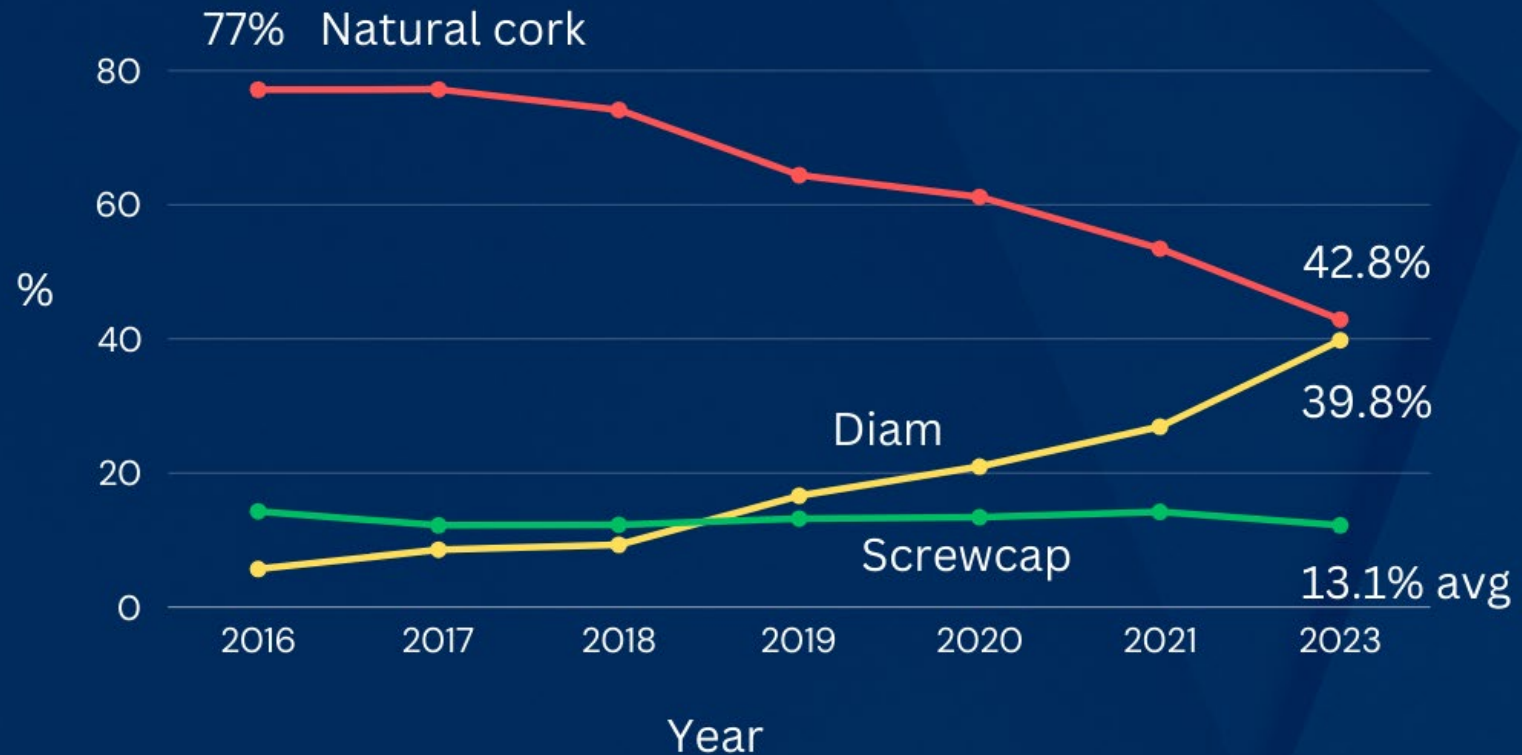
Diam

Use of Diam has Dramatically Increased



Screwcap

Use of Screwcap has Remained Static



Caveats About Closure Data

- Case production not taken into account
- Vast majority of Washington wines still closed by natural cork
- Wines submitted for review might/might not equate to different data set
- 2022 data lost in a hard drive crash
- 2023 data, unlike previous years, include both Washington (75%) and Oregon (25%). Might, or might not, be directly comparable to previous years.



Why is use of Diam & similar going up?

- Competitors/Price
 - There are now competitors to Diam on the market (VINC, others)
 - Some are considerably less expensive
- Aggressive marketing
- Comfort
 - Winemakers more comfortable with technology
 - Closures have been around long enough to show the wines age well, which addresses one concern
- Exhaustion with cork taint?



Bottom line: Is cork taint going down?

- From 8 years ago yes, from 4 years ago, it appears not much
- Incidence of cork tainted wines is unequivocally going down due to an increase usage of Diam and related closures
- But last 3 years are the 3 lowest percentages of last 7 years
- However, rate appears to currently be stuck around 3%



Why would cork taint decrease?

- Micro-agglomerated corks (NOT Diam) previously accounted for a significant portion of tainted corks
- 1+1 (twin top) corks accounted for a significant portion
- Both problems were completely eliminated as of mid-2018
- I have not seen a tainted micro-agglomerated cork since
- 1+1 tainted corks are now rare, driven by the cork ends rather than the micro-agglomerated middle



Why would cork taint decrease?

- Individual cork testing *might* have had some modest impact, though I am skeptical
- My *assumption* is that much of the decrease in cork taint currently seen came from elimination in micro-agglomerated corks and decrease in 1+1 corks



3% contamination isn't that bad, right?

It's terrible! That is a LOT of disappointed customers!

Case production	Corked bottles of wine/ Unhappy customers
300	108
1,000	360
5,000	1,800
10,000	3,600



Predictions for 2024

- Diam usage will surpass natural cork usage in my sample sets
- Cork taint percentage will go down dramatically



Is cork taint about to ↓ dramatically?

- Cork suppliers introduced new procedures in 2021 they claimed would eliminate cork taint
- I believe those processes have true potential
- I expected to see a dramatic decrease in 2022 and 2023 data
- 2023 data did not support that (2022 were lost)
- Why?

2023 Cork Taint Numbers

- 14 cork tainted wines in 2023 (for perspective, 73 in 2016!)
- 3 bottles from same producer, same shipment. That is *extremely* unusual unless:
 - a) there is a production problem, systemic problem or
 - b) something happened during storage or shipment
- Second samples, sent separately, were fine
- In 2 bottles, first and second sample both tainted, indicating a possible production issue



Hypothesis

- 5 bottles might have been contaminated from a source other than the cork (dangerous assumption!)
- If so, cork taint percentage would be 1.9%
- This would be more like the dramatic decrease I expected to see
- We'll see what 2024 data reveal



Cork Taint Facts

- Most industry people assume if a bottle is cork tainted, they will detect it. This is incorrect. Sensitivity varies manifold.
- There is *always* someone who is more sensitive to cork taint than you are
- Even if you don't notice a bottle is TCA-tainted, it can substantially decrease your enjoyment.
- TCA inhibits olfactory signal transduction.



Cork Taint Opinions

- Cork taint is a winemaking choice
- The acceptable percentage of cork taint is zero
- I don't believe there is a perfect closure. They all have tradeoffs.
- Wineries shouldn't pay extra from cork companies for corks that are guaranteed to be TCA-free.

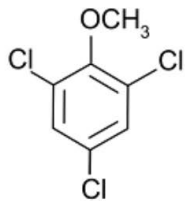


Summary

- Use of Diam and related closures is dramatically increasing
- Use of other closure types remains static
- Cork taint has gone down but *appears* to be stuck around 3%
- It might be about to go down significantly

Additional Resources

CORK TAINT RESOURCES



Cork taint is a contaminant found in a percentage of natural cork. It is most commonly caused by trichloroanisole (TCA), pictured at left.

At higher levels, TCA can make a wine smell lightly, or strongly, like a moldy basement, ruining the experience. At lower levels, TCA mutes aromas and flavors, substantially decreasing enjoyment even when one is not necessarily aware of its presence.

In addition to wine, TCA also commonly contaminates fruits and vegetables. Baby carrots, for example, have widespread TCA contamination issues.

When a wine is contaminated by TCA or another moldy contaminant, it is often referred to as 'corked.' Note that this term should not be used to describe other wine faults. It specifically refers to the wine being contaminated by TCA or a related compound.

In my experience tasting wines for review from 2015 to 2022, between 3-6% of wines I have tasted that were closed by natural cork showed signs of TCA taint or some other moldy contaminant. These findings are largely consistent with those from the [Cork Quality Council](#), which found an average of 3% of corks contaminated through September 2021 using GCMS testing (numbers were higher in some previous years). As of Q1 2023, the group reports seeing an average of 1%.

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CORK TAINT RESOURCES



Additional Resources

“Everything you ever wanted to know about cork taint”

“Why you should smell the cork when opening a bottle of wine”

“My Top 10 all-time cork taint stories”

“How much cork taint comes from sources other than the cork?”



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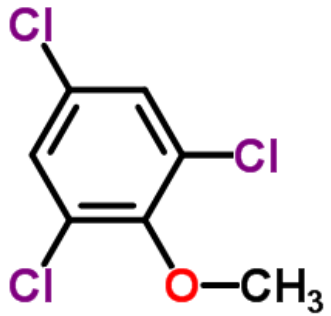




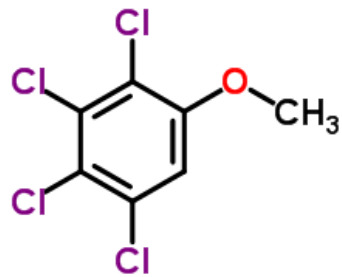
Sources of Trichloroanisole (TCA) and detecting defects in corks

Thomas Collins, PhD

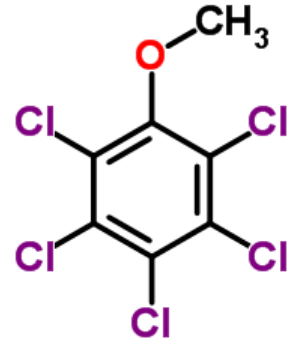
Haloanisoles



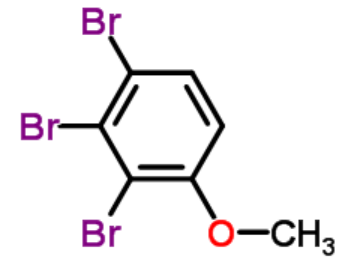
2,4,6-trichloroanisole



2,3,4,5-tetrachloroanisole

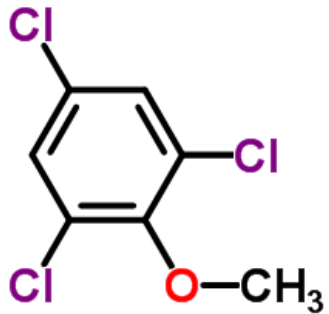


2,3,4,5,6-pentachloroanisole

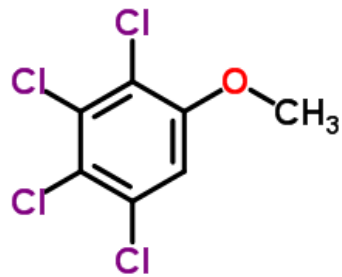


2,3,4-tribromoanisole

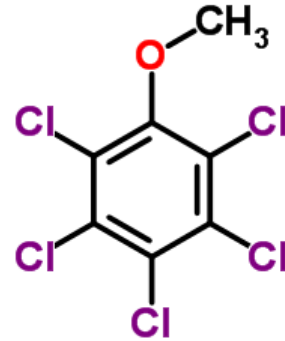
Haloanisoles



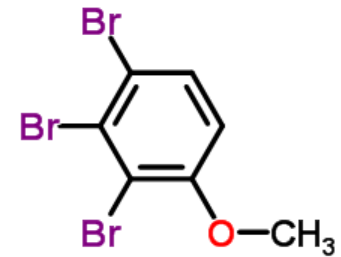
2,4,6-trichloroanisole



2,3,4,5-tetrachloroanisole



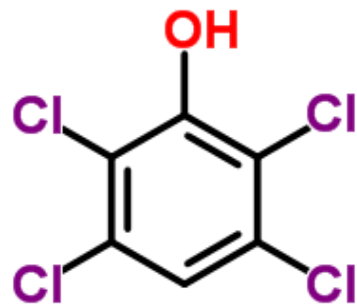
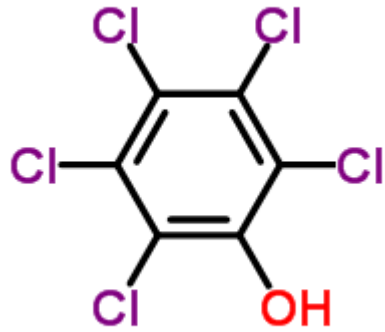
2,3,4,5,6-pentachloroanisole



2,3,4-tribromoanisole

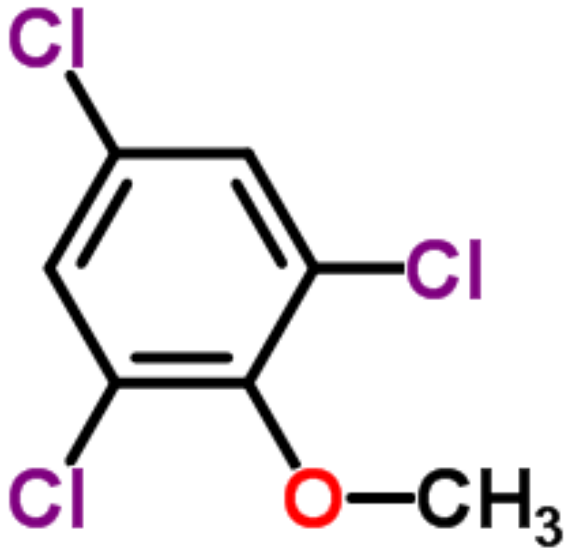
Aroma thresholds range from <1.0 ppt to ~10 ppt in wine; in water, the threshold for TBA has been reported to be 20-30 ppq (pg/L)

Conversion of halophenol to haloanisole



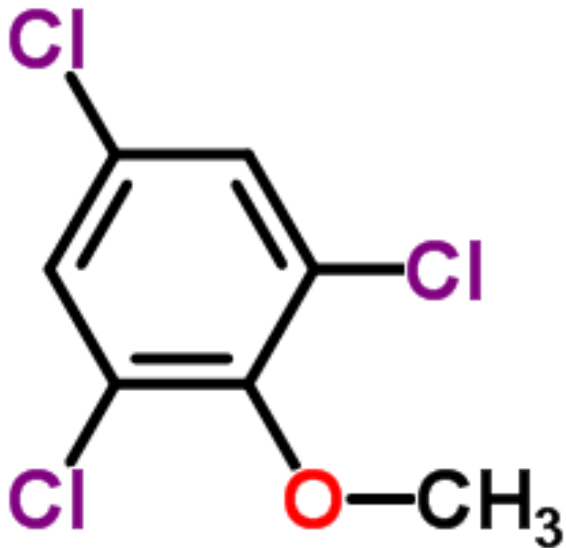
- Many fungal species can convert the phenol to the corresponding anisole
- Anisoles are more volatile
- The anisoles are less toxic
- Some bacteria can produce the anisoles as well

Formation of TCA in cork production



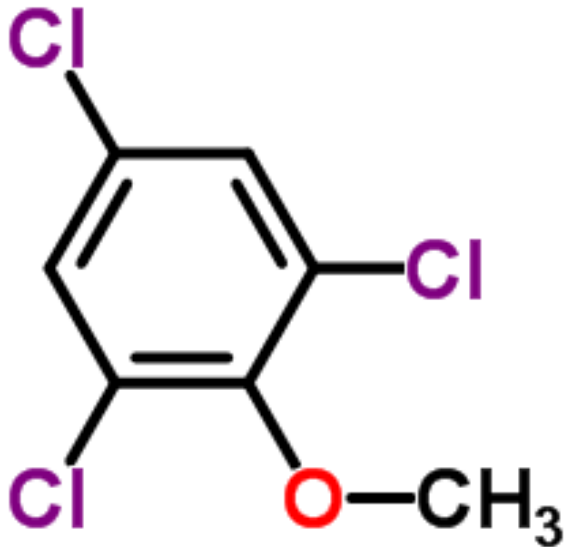
- TCA is *one* of the compounds responsible for cork taint
- Cork bark was bleached with hypochlorite to lighten color
- Hypochlorite reacts with phenols in wood to create chlorophenols
- Subsequent growth of fungus on cork bark leads to formation of anisoles

Reduction of TCA in cork production



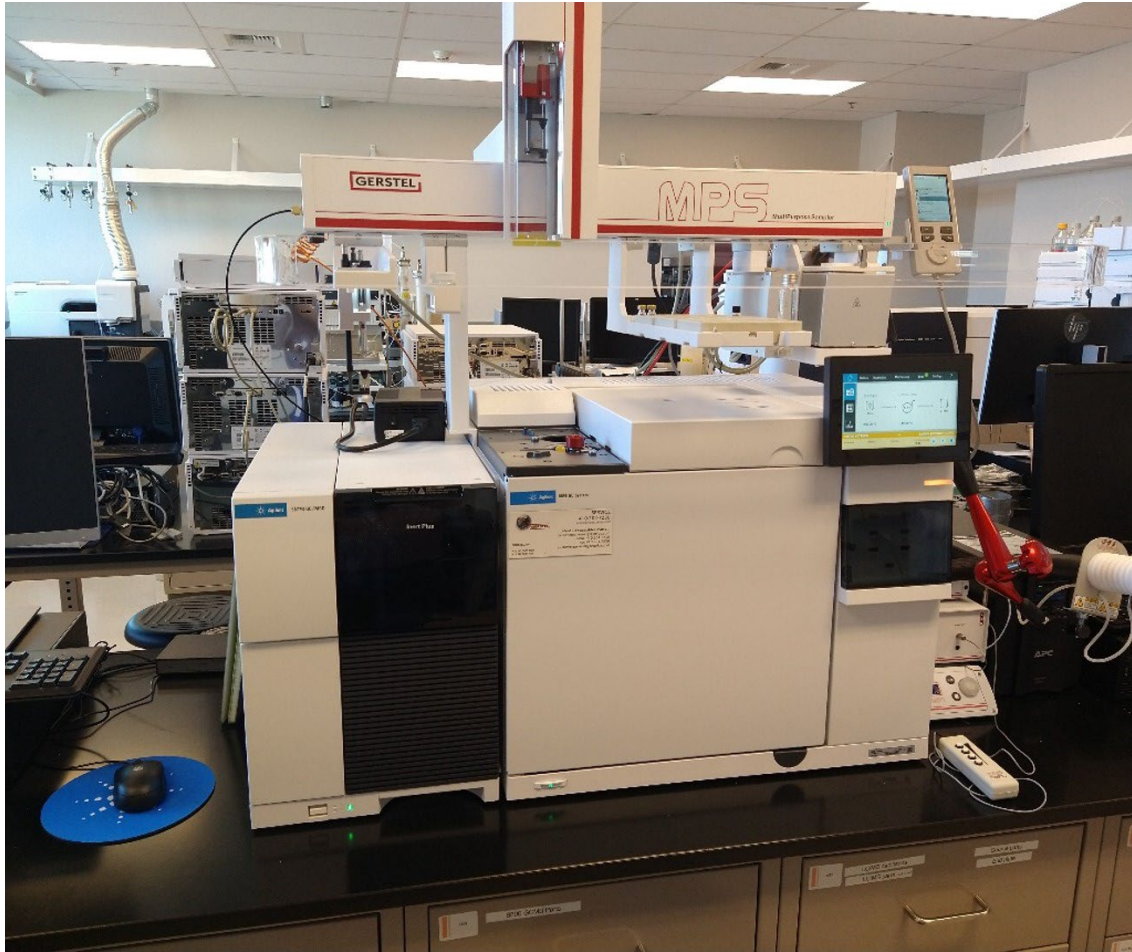
- Consumers prefer lighter colored corks
- Cork suppliers have shifted away from bleach (hypochlorite) to ozone or peroxides
- Bleaching without the chlorine can reduce the formation of chlorophenols
- Without chlorophenols, chloroanisole formation is minimized

Other ways to reduce TCA in corks



- Extraction of TCA is easier with smaller particles—it is very difficult to remove TCA from intact natural corks
- Microagglomerate corks are produced using ground cork particles
- Producers can extract TCA more readily from the ground cork particles
- Not fool-proof, but should help

Measuring TCA and other haloanisoles



Usual method is GC/MS

Many systems have detection limits less than 1 ppt

Most commercial wine labs can run the analysis

Sensory screening can be done—
common method for corks

Sensory thresholds not well established

TCA can quickly fatigue panelists

Samples with high levels can “blind”
panelists to subsequent samples

Haloanisoles in barrels

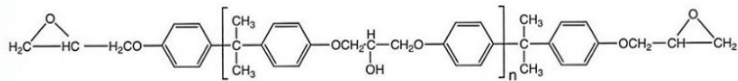
- Sensory evaluation of barrels prior to pump-out
 - Testing of barrel staves usually found low levels in the wine and in most staves
 - Almost always one stave was much higher than others
 - TCA was usually localized to one part of the stave
 - In almost all cases, the affected stave was from the barrel head
- Less commonly, barrels were affected by tetra- or penta-chloroanisole
 - Shipping pallets
 - Flooring in shipping containers

Haloanisoles in the winery

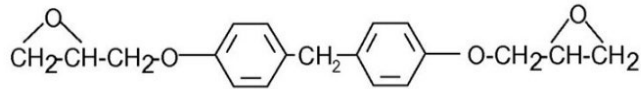
- Haloanisole formation requires a source of phenols
 - Wood—barrels, support beams
 - Wine
 - Epoxy resins
- Haloanisole formation requires a source of chlorine or other halogens
 - Cleaning products (including chlorine dioxide), biocides, chlorinated water
- Haloanisole formation requires capable fungi or bacteria to methylate the halophenol—these are present in cellar drains in almost every winery

Sources of phenols in the winery

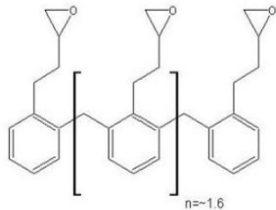
Figure 1. Epoxy Monomers



Bisphenol A Diglycidyl Ether



Bisphenol F Diglycidyl Ether



Epoxy Novolac Resin

Epoxy liners on mild steel tanks

- Many epoxy resins contain phenolic monomers, including some which contain halogens
- As the resins are degraded they can release phenols and/or chloro- or bromo-phenols

Sources of halogens



Use of chlorinated cleaning products

- Bleach

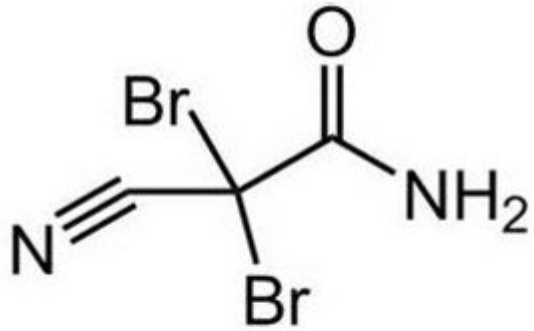
- Chlorinated TSP

- Iodophore

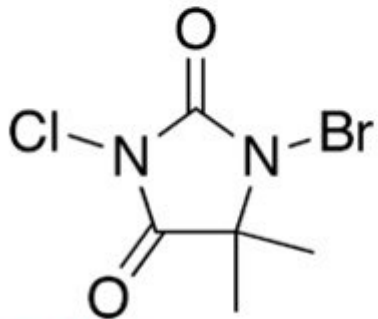
Cooling towers

- Biocides used in the water often contain bromine or chlorine

Sources of halogens: biocides



DBNPA



BCDMH

Hypochlorite (good for 6.0-7.5 pH water)

Hypobromite for higher pH systems (up to pH 9.0)

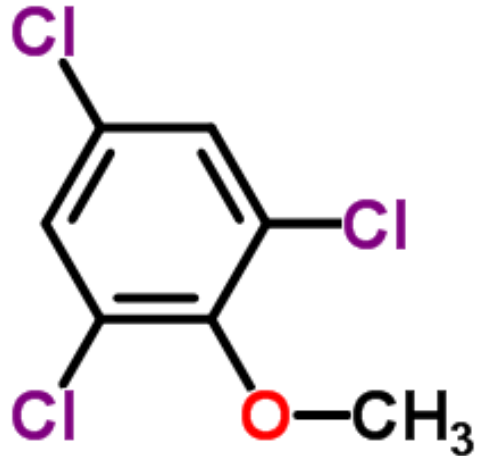
2,2-dibromo-3-nitrilopropionamide (DBNPA)

Bromochlorodimethylhydantoin (BCDMH)

Avoiding haloanisoles in the winery

- In older cellars, decades of chlorinated sanitizers have left a legacy of halophenols in drains, wood structures, etc.
- Haloanisoles are volatile, so contamination can spread from drains to other parts of the winery
- Many wine additives can adsorb haloanisoles from the air
 - Bentonite, for example, is used as an atmospheric trap for measuring airborne TCA

Not all TCA in wine comes from corks!



- Cork products can be a source of TCA
- TCA and other haloanisoles can come from other sources in the winery
- How we perceive TCA is not dependent on whether it came from a cork or from another source in the winery!
- If there is a small background level of TCA in the wine, the safety margin with testing of corks will be smaller!



Emerging Trends in Wine Closures

Wine Closure Options

Closure Types

Natural Cork



Technical - 1+1



Technical - Microagglo



Synthetic



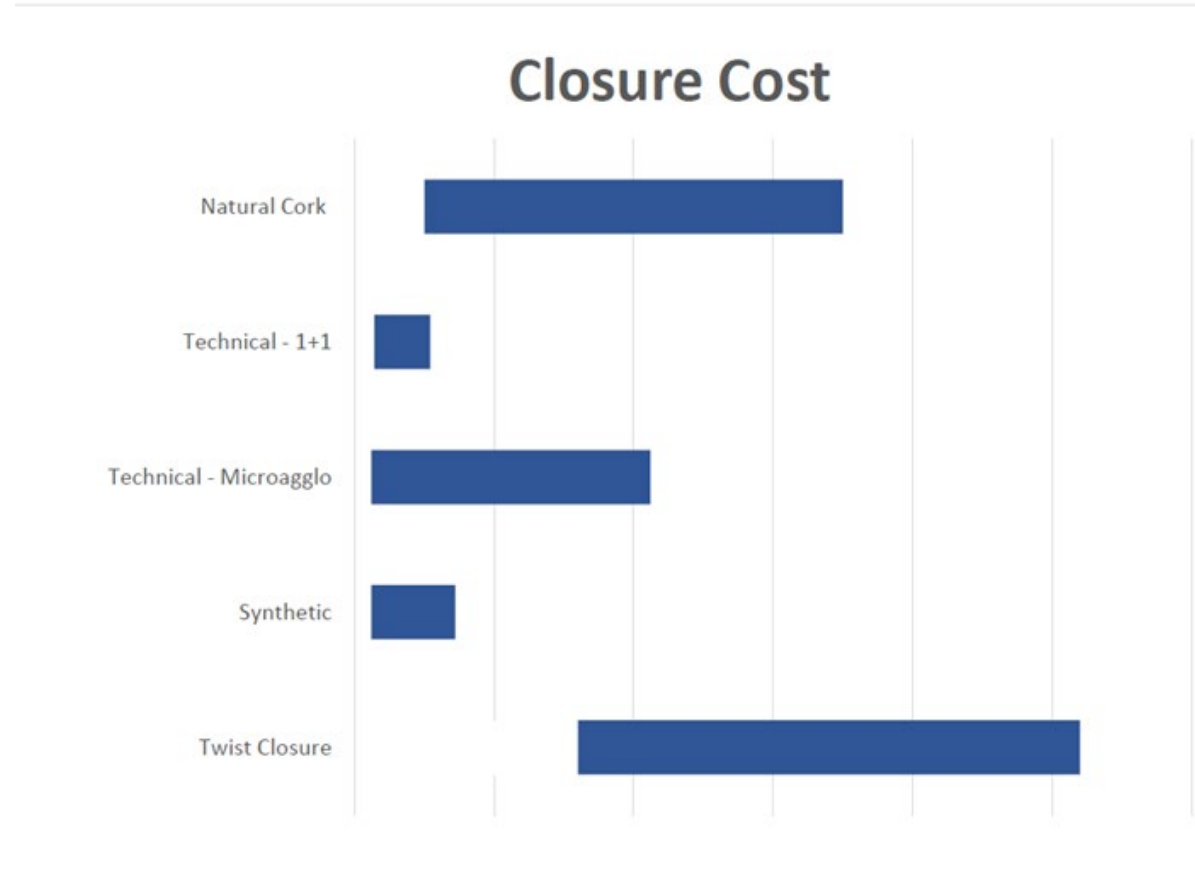
Twist Caps



Other



Closure Cost



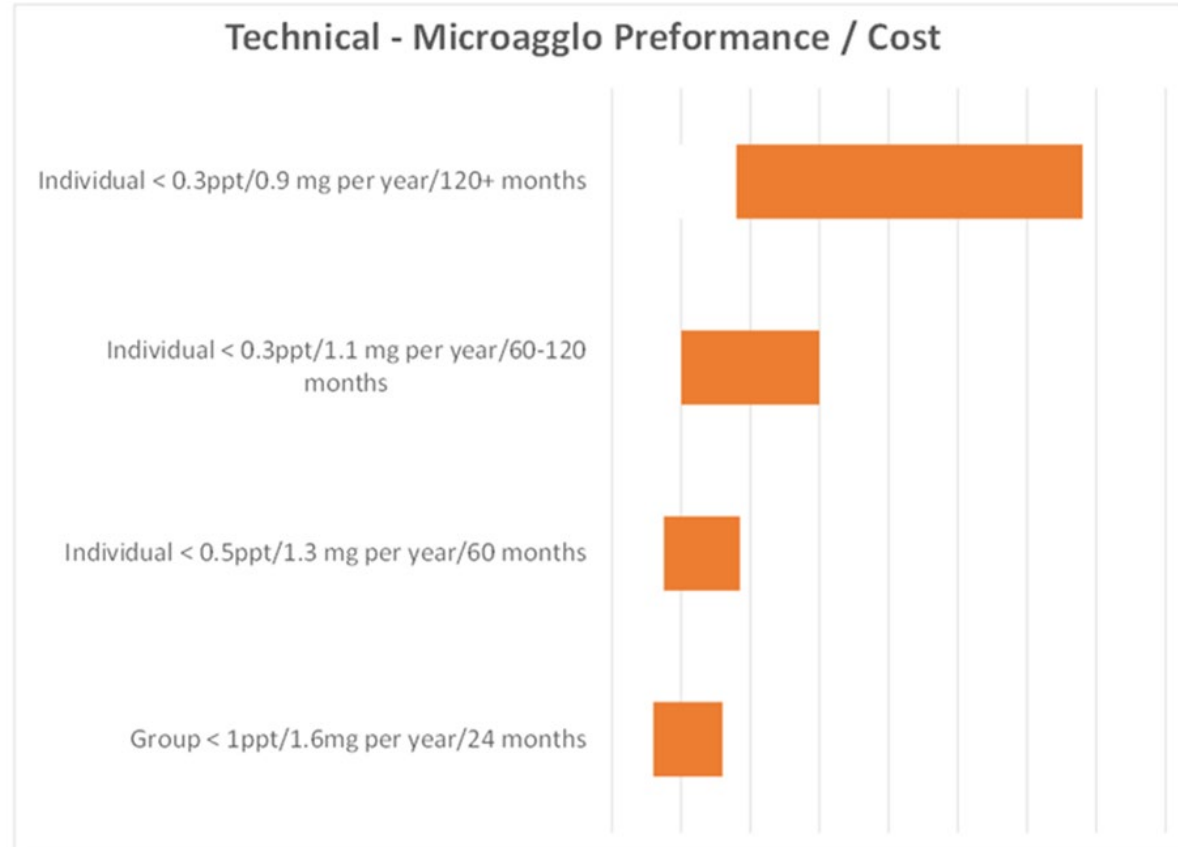
Closure Attributes & Guarantees

- TCA: < 1ppt, < 0.5ppt, <0.3ppt, Group Soak or Individual Soak
- Oxygen Ingress / OTR
- Functional Warranty - Months In Bottle
- Application & Removal
- Environmental Impact – Sustainability
- Design and Print Quality



Technical – Microagglo Example

- TCA
- Oxygen Ingress / OTR
- Functional Warranty - Months In Bottle



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Emerging Trends in Wine Closures: A Risk-Based Approach for Choosing the Correct Closure

Winemakers Perspective: Pros/cons of different closures

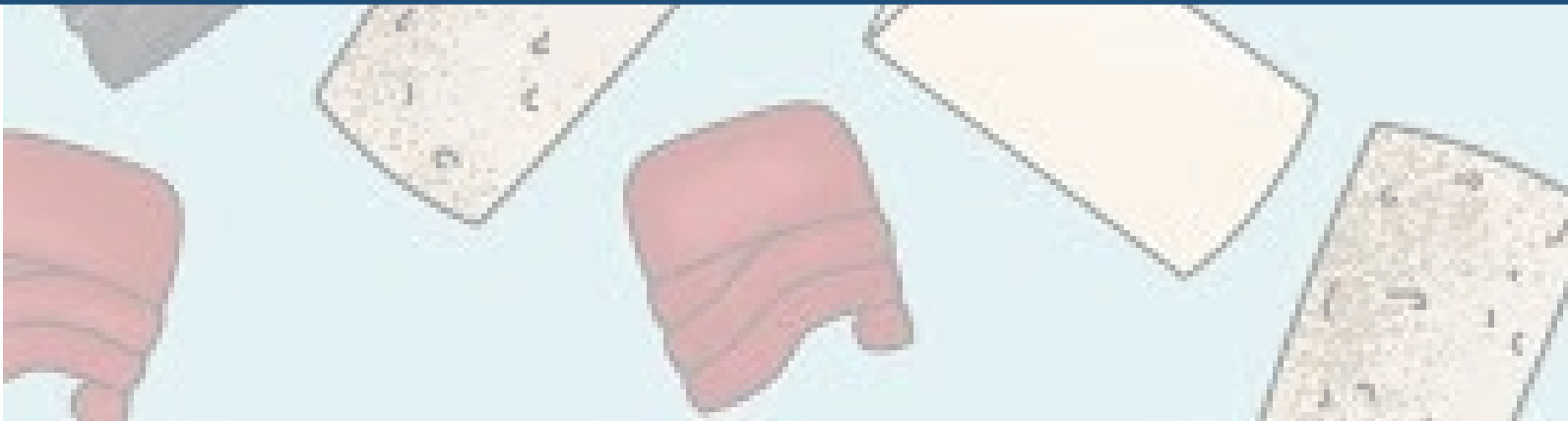
Taylor Butterfield

White Winemaker, Chateau Ste. Michelle

Start with the conclusion...



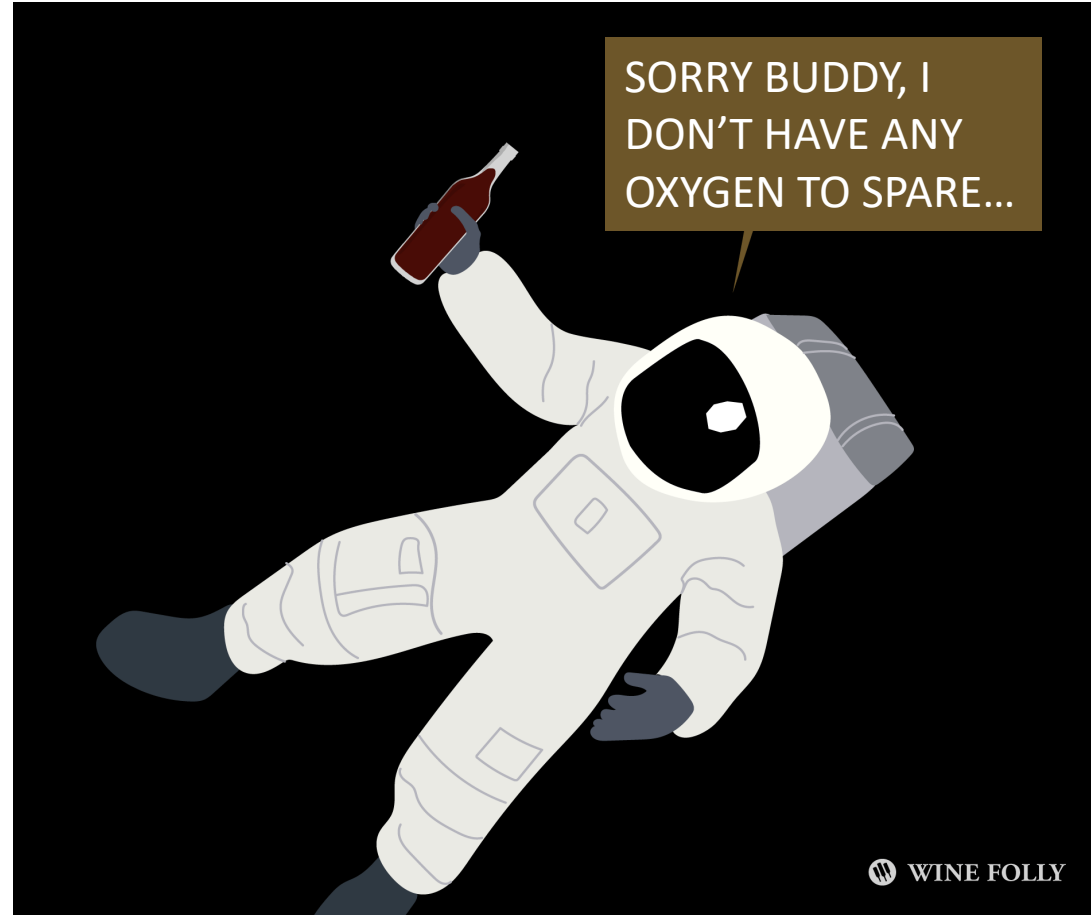
There is not a single “right” closure.



Product Ageability

Oxygen affects the color, aroma and mouthfeel.

- **Color** – Too much oxygen can promote premature browning.
- **Aroma** – Helps development and lessen reduction in young wines but also can cause oxidation.
- **Mouthfeel** – Oxygen can enhance the palate by softening, especially in tannin-rich wines.



Natural Cork



PROS

- General consensus good ageing potential
 - Tiny pores = minuscule amount of air
 - Transform aroma and flavor
- Seems best for big, tannic reds
- Broad consumer acceptance
- Renewable

CONS

- Natural material susceptible to TCA
- Variability
 - Some more porous than others
 - Inconsistent ageing
- Fragility
 - Dry and crumble without proper storage

Technical Cork (Agglomerated Cork)



PROS

- *Some* are “guaranteed” TCA-free
 - DIAM / supercritical CO2
 - Alternative process: steam
- Different levels of permeability available
- Consistent performance

CONS

- Low-end and mid-range options could be TCA affected
- Potential for chemical odor
 - “Agglomerates” because the corks are composed of tiny cork particles glued together.
- Appearance (subjective)

Synthetic Cork



PROS

- Consistent performance
- Predictable Oxygen transfer rates
 - Higher OTR than other closures
- Different rates of oxygen transmission available

CONS

- Chemical Odor
 - Some can detect odor in wine
 - Most noticeable in lighter white and red wines
- Aroma loss
 - Scalping of several volatile compounds
- Appearance (subjective)

Screw Cap



PROS

- TCA free
- Options for variable permeability
- Best for freshness
 - Aromatic whites
 - Light/fruity reds

CONS

- Prone to reduction
 - Rotten egg, onion aromas
- Unproperly sealed during the bottling process
- Consumer assumption of “lesser quality”

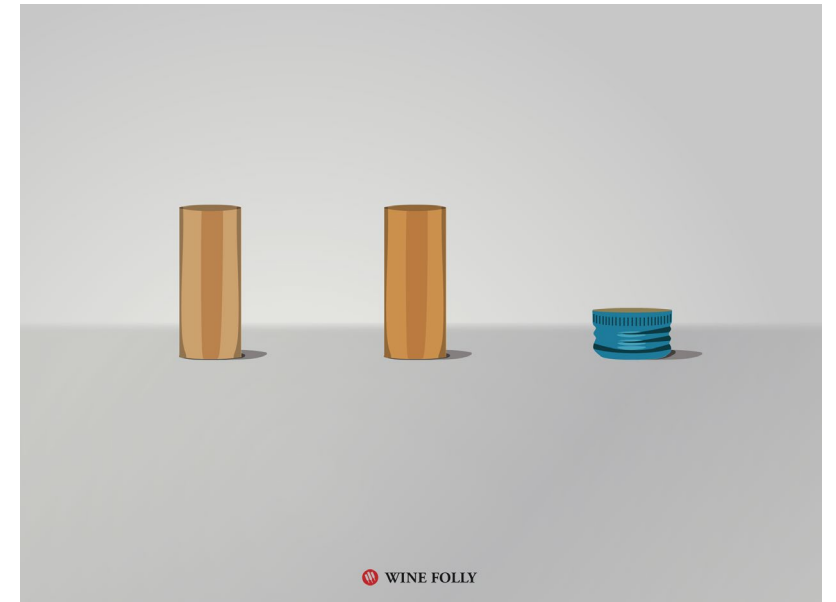
Choosing a Closure

Optimum drinking window

- When do you want your wine to be consumed?
- Shelf life

Wine style

- Fresh and aromatic
- Concentrated with more tannin



Thank you!

