Get Corked:
The intricacies of cork and alternative closures
To cork or not to cork? In reality, the question is what should a closure’s ideal characteristics be?

- in the past that was not even a question – cork was it.

- with all the current options, wineries must decide between the advantages/disadvantages of these alternatives

- all closures are relative effective, at least in the short term (1–2 yrs)
  - they protect the wine from exposure to air-borne spoilage organisms &
  - limit the rate of $O_2$ uptake (oxidation) and slow the escape of $SO_2$, $CO_2$, and fat-soluble flavorants
- these basic requirements are sufficient for most consumers: the “buy & drink” crowd, with ease of removal (and possibly reinsertion) presumably of importance
- for the winemaker, it is a cost/benefit question & what ‘image’ does the intended buyer expect, the aficionado seeing in cork a symbol of prestige, offers the removal ritual, and has the stamp of approval (tradition)
- for the environmentalist cork is a renewable resource and is biodegradable (albeit slowly), whereas glass stoppers and screw caps have a large carbon footprint (but are recyclable), and plastic is inexpensive, easily moldable and can be colored, but may not be recyclable
- new closures, being man-made are highly consistent in their attributes (something not possessed by cork, being a natural product
- more intractable are issues as to what are the in-bottle conditions optimal for aging, as well as what does optimal aging actually mean, of these issues of gas permeability top the list:

- need of $O_2$ for color stability (red wine), but limitation to avoid early browning (white wine), fragrance degradation, and limit microbial degradation
- retain the antioxidant value of $SO_2$, but avoid development of a obvious reduced odor (shrimp, cabbage, rotten egg, struck flint)
- retain $CO_2$ (for effervescence in sparkling wines)
- retain fat-soluble volatiles vital to the wine’s desirable fragrance
- importance relates to winemaker desires, the wine style intended, the cultivar, and consumer’s wine-aging intentions
Closure Options: Natural Cork

750 ml bottle

- vary in width: 24 (22–26) mm
  & length: 45 (40–55) mm
- vary in quality (porosity and lack of fissures)
- fin of cork growth rate (and # of growth rings in the cork)
- standard number ~8 (6–15)
- vary in coloration/bleaching
- lower grades are colmated,
- may be chamfered
Cork options:
- made from cork chips glued with a polyurethane adhesive
- agglomerate (larger chips),
- microagglomerate (µ chips)
- Twin top (two natural cork discs on both ends)
- champagne: thicker versions used for sparkling wines, with two discs on the inner side, glued with a polyurethane or polyvinyl adhesive
Closure options:

- produced from polyethylene injected (into a mold) or cut (from an extruded tube)
- the latter often have a harder outer coating marked and colored to resemble natural cork

- another version possesses a removable strip: for table wines, resemble a T-cork, or for sparkling wines, superficially resemble a champagne cork
- easily reinserted

Synthetic corks
Closure options: Screw cap

- an aluminum roll-on closure: easy to remove and reattach
- possesses a liner consisting of a spongy portion next to the aluminum (2 mm polyethylene) and a 19 µm inner portion (Saran) component, with or without an innermost 20 µm tin foil layer
- these are respectively called Saranex or Saratin liners
- they differ markedly in their permeability to gases, thus giving the winemaker an option in this regard
Closure options: Glass stopper and Crown cap

- glass stoppers resemble T-corks and seals to the bottle with a inert silicone o-ring

- crown caps are metallic closures familiar due to their use to close soft drink bottles
- only used to close sparkling wines for their in-bottle second fermentation
- replaced post-degorgement by an agglomerate cork with two natural cork discs on the inner end
Cork Origin

- cork is the outer bark of a smallish oak tree that grows in savanna-like regions of the Mediterranean
- it can live to ~500 yr, but its most productive phase is from 50–250 yr
- stripping of bark occurs about every 9 yr (but based on growth rate that can go up to 15 yr)
- it occurs in late spring when new (soft) cells permit easy separation
- bark slabs need to be 3 cm thick
- only bark from the 3\textsuperscript{rd} stripping and onwards is of uniform structure adequate for producing corks
Processing of Cork

- the bark is boiled to permit flattening before maturation for several months
- subsequent additional boiling, cutting into strips, and punching out
- the corks are washed, surface sterilized (peracetic acid), rinsed and dried down to ~ 5–8% RH
- coated with paraffin (to replace waxes lost in processing) and silicone (ease insertion)
- finally sorted into grades (based on porosity), placed in plastic bags (with some SO₂) and stored in boxes
Positive attributes of cork

- compressible without lateral expansion
- resilience (rapid rebound, high elasticity)
- chemical inertness (e.g., acids)
- impervious to liquids
- slow diffusion of gaseous compounds
- high coefficient of friction
- minimal transfer of compounds into or out of the wine
- resistant to microbial decomposition
Negative attributes of cork

- unpredictable permeability to gases and fat-soluble compounds (variable porosity)
- potential source of off-odors
- need for a cork screw or other device for extraction
- difficulty in reinsertion (unless chamfered)
- need to lay the bottle on its side to retain cork’s elasticity
- slowly degrades with long contact with wine acidity (crumbles on removal)
Issues re closure selection: Taints

- the prime issue recently has been the ‘corked’ off-odor, due to 2,4,6-trichloroanisole (TCA)
- although associated with cork, it and related taints can be absorbed from cooperage, taints being absorbed by oak or alternative closures from the winery environment
- indications suggest TCA contamination is less common today, the source (PCP) being no longer used in cork forests
- however, subthreshold TCA can selectively suppress the odor perception (notably fruity flavors)
Issues re closure selection: Oxidation

- most concern related to premature browning (white wine) and rancio (oxidized) odors in red wines
- the origin(s) of excessive O₂ uptake is contentious: porosity, cavities, residual bleaching agents, from cork cells, issues with poor insertion
- concern rests on the belief that such changes are relevant to consumer choice
Issues re closure selection: Reduced odors

- Concern about low $O_2$ uptake on production of reduced sulfur odors
- Usually ascribed to $H_2S$, disulfides, mercaptans (e.g., MeSH)
- Most associated with Sauvignon blanc wine, but also in others
- Significance to consumers questionable
Issues re closure selection: Reduced odors
Summary
- it’s clear that the choice of closure can, and likely will, affect the characteristics of the wine as it ages

- there is no ‘best’ closure under all circumstances, even various versions of each type usually have different sealing properties

- the cultivar and style of wine, legal constraints, the aging-potential desires of the winemaker and intended consumer are important factors needing to be taken into consideration

- ideally the producer should do his/her own studies on the effects of those choices that initially seems the most appropriate

Or
“You pays your money and you takes your choice”

The closure show
Historical origins of closure usage

Egyptian

Etruscan, Greek, Roman
Influence of rediscovery of cork circa 1600

-with a switch from wood to coal for melting, glass absorbed sufficient sulfur to become much stronger, permitting the insertion of a tight-fitting cork closure (and color)
- this lead to an evolution in bottle shape - generation one that could laid horizontal, and capable of withholding 6 ATM CO$_2$
A few asides re closures