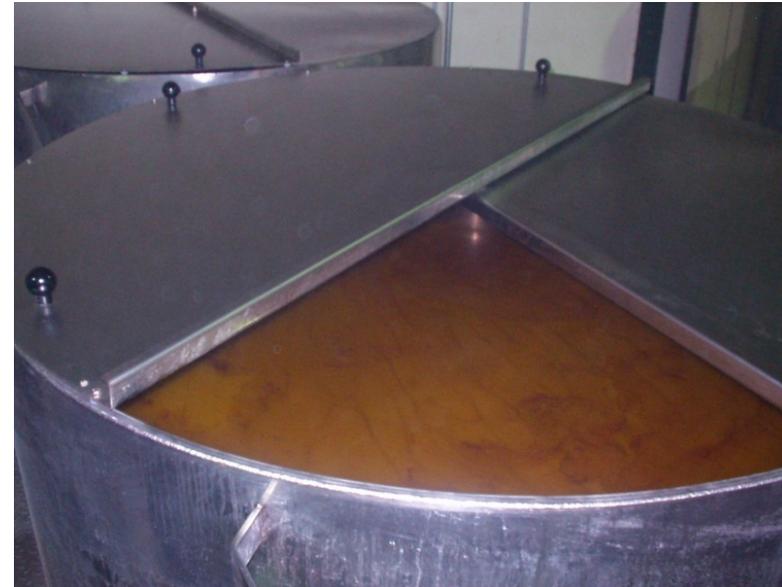


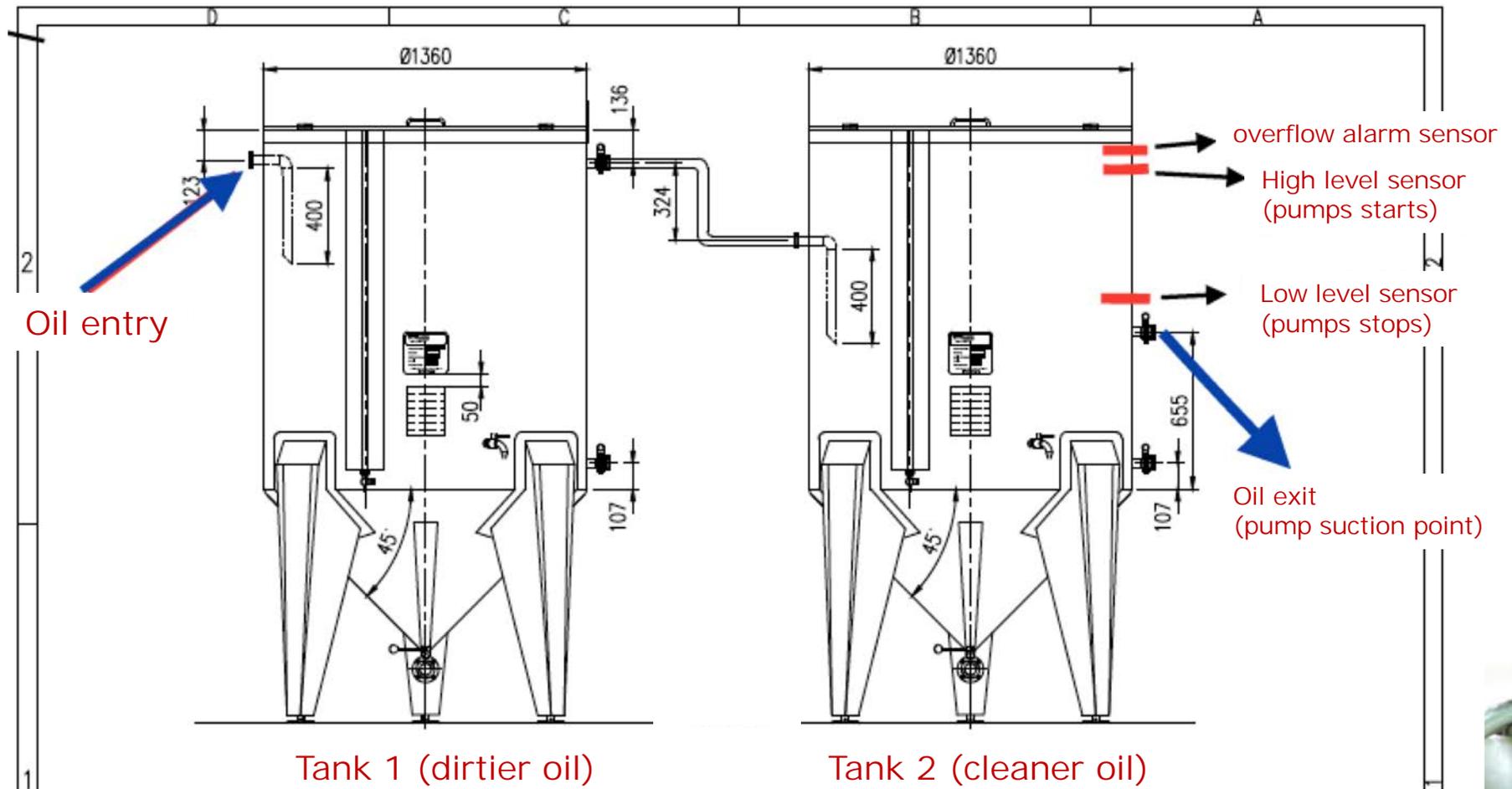
Oil storage management & filtration



Sedimentation



Sedimentation



Sedimentation



Sedimentation

- ✓ Oil temperature: 25-26°C. Tanks must be in processing room.
- ✓ Sediments removal every 4 hours, if working continuously.
- ✓ Foam removal from tank top.
- ✓ Natural elimination of air bubbles.
- ✓ % of sediments removed. 1.0% maximum rule.
- ✓ Do we adjust the vertical centrifuge? (or the decanter).
- ✓ More water than mud/sludge: Phases inverted inside the centrifuge (water comes out through the oil outlet).
- ✓ More mud/sludge than water: Oil excessively dirty from decanter, or centrifuge plates excessively dirty.
- ✓ The intensity of the winery aroma in the sediments removed gives an indication of the sludge/water/oil contact time.



Intermediate tanks



Intermediate tanks

- ✓ Tanks of intermediate holding capacity between sedimentation and storage tanks.
- ✓ Tanks sizing: Sto50/Sed25, Sto100/Sed50, Sto100/Sed25
- ✓ Tank design: Same as storage tanks.
- ✓ Oil temperature: 20-25°C.
- ✓ Maximum oil stay: 48 hours.
- ✓ At the end of the 48 hours stay the oil should have reached a temperature < 20°C. This will reduce the speed of primary and secondary oil oxidations.
- ✓ Clean oil to be transferred to the storage tanks from top valve. "Bottoms" to be transferred to a separate tank from lower valve.
- ✓ Oil quality evaluation: FFA, PV and panel test



Storage tanks



Storage tanks

- ✓ Oil temperature: 15-18° C.
- ✓ Once tank is full, sediments removal should be once a day for the next 3 days, then once a week for the first month.
- ✓ It is assumed that the full sedimentation process is complete after 45 days of finishing the tank (providing that the oil temperature has been kept between 15-18° C.
- ✓ Oil temperatures below this range will only make the sedimentation process slower.
- ✓ After 45 days, the clean oil is transferred to a new tank from the top valve. The oil from the bottom is transferred to a new tank where all “bottoms” should be consolidated.
- ✓ A policy of oil consolidations should be considered in order to minimize head space and slow down oil oxidations.
- ✓ Nitrogen/Argon blanketing.
- ✓ Oil quality evaluation: Full analytical and sensorial analysis



Storage time

- ✓ ↓↓ Chlorophylls & Carotenoids
- ✓ ↓↓ Total polyphenols
- ✓ ↓↓ Secoiridoids derivatives
- ✓ ↓↓ α -Tocopherol
- ✓ ↑↑ Off-flavours from non-enzymatic oxidations:
Hexanal, Octane, Penten-3-ol, C8 & C9 compounds,
etc.
- ✓ Sensory profile changes
- ✓ Cloudy oils contain: Polyphenols, Phospholipids,
sugars, lipases, yeasts



Oil turbidity

- Oil turbidity can be explained by:
 1. High oil moisture ($>0.2\%$), though any excess will eventually settle down
 2. Low oil temperature, which solidifies waxes and palmitic acid
 3. High level of particles in suspension in the oil mass
- The particles in suspension matrix is a colloidal mix of water and organic matter (pulp fractions) that trigger fermentations in oil and modify its chemical and sensorial quality



Oil turbidity

- ✓ If turbidity does not disappear within 45 days, oil filtration should be considered to avoid future quality issues
- ✓ Based on analytical experience, cloudy oils tend to decline in quality after 4 months of being made
- ✓ It is possible to offer **unfiltered oils** to the market providing that we have a proper sedimentation system in place at our facilities

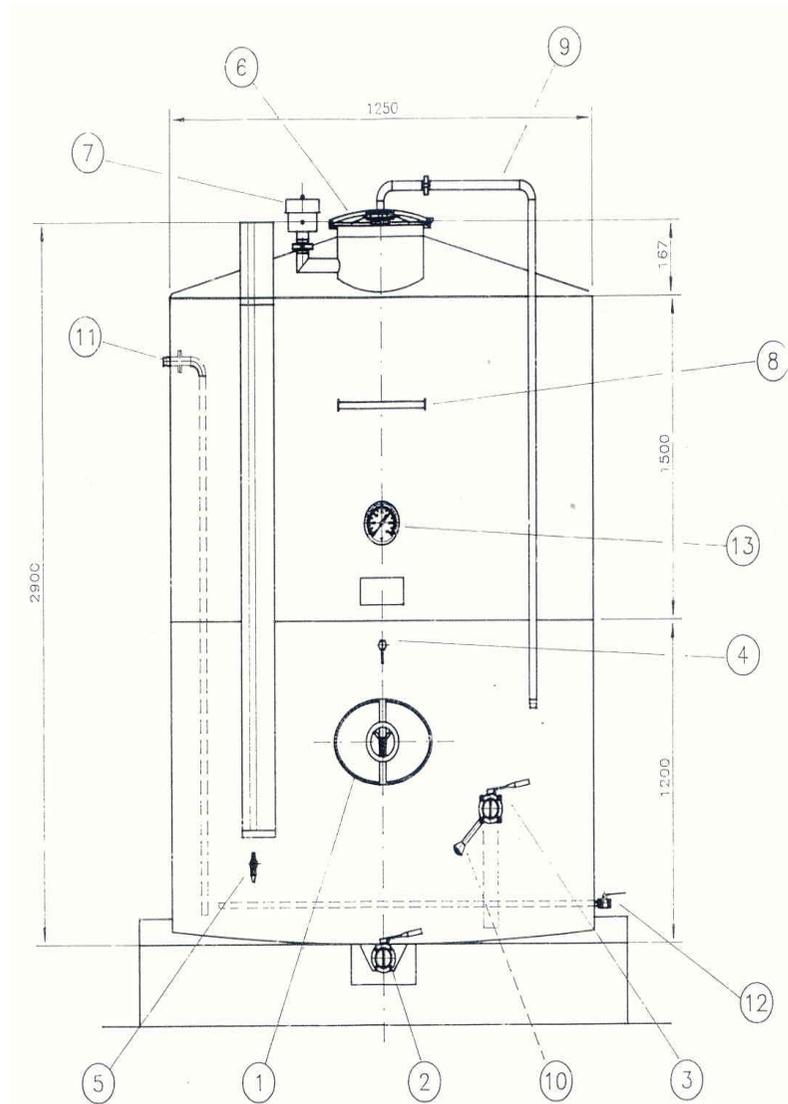


Storage essentials

- ✓ Temperature: 15 – 18°C
- ✓ No light.
- ✓ Settlings drained regularly.
- ✓ Nitrogen: Max. = [4.0%] of O₂
- ✓ Minimise head space



Key: Tank design



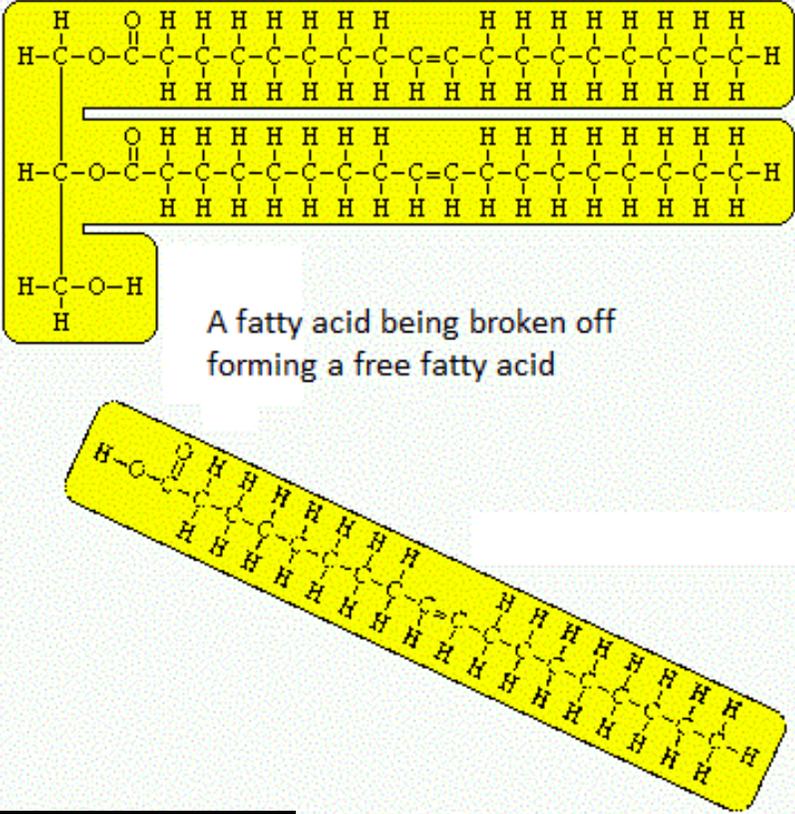
Key: Tank design



Sediments removal



Sediments removal



FFA formation



Sediments removal



Volatiles formation



Muddy

Clostridium
anaerobic

- 6-methyl-5-hepten-2-one
- 2-butanol
- Heptan-2-ol
- 1-penten-3-one



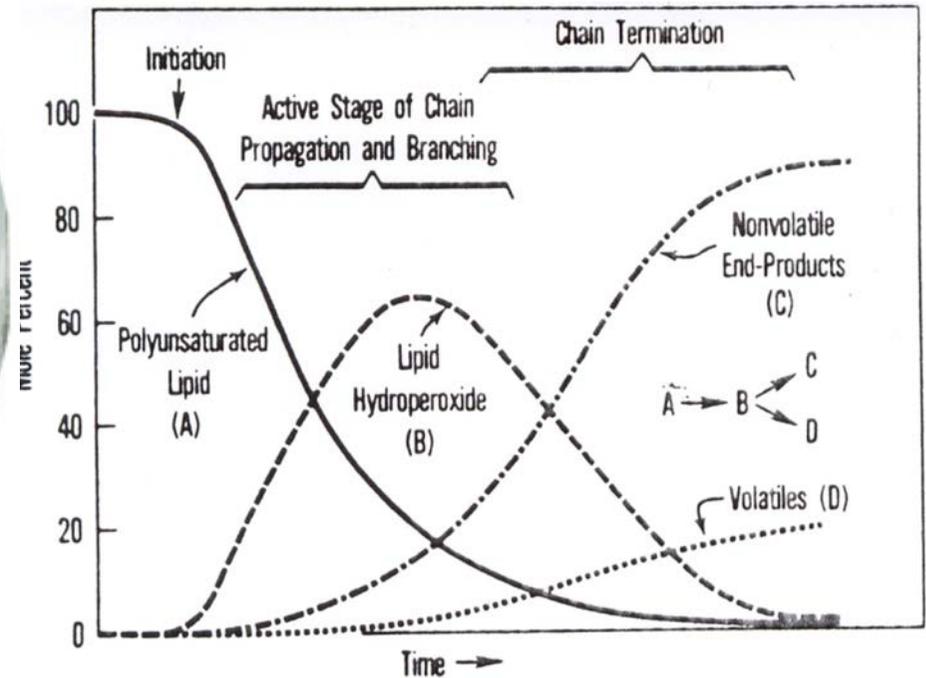
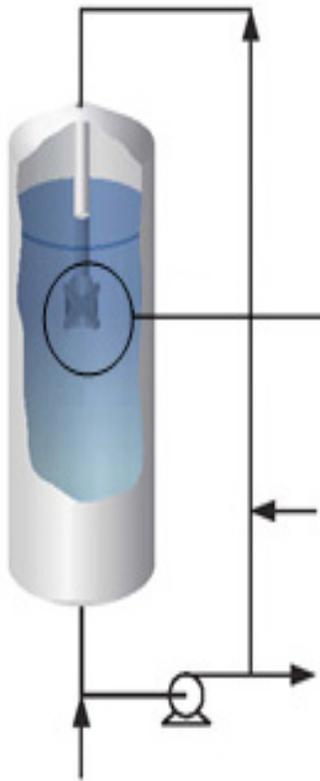
Winey

Yeast, acetobacter
aerobic

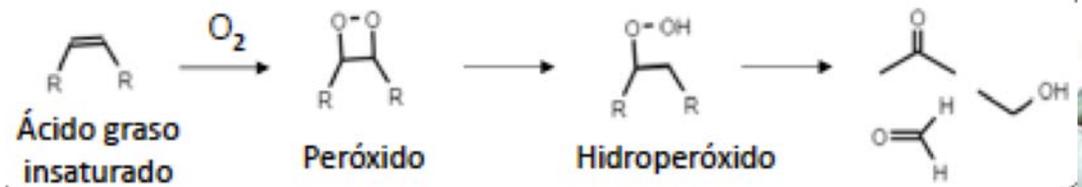
- Ethanol
- Ethyl Acetate
- Acetic acid
- 3-methyl-1-butanol



Oxygen displacement

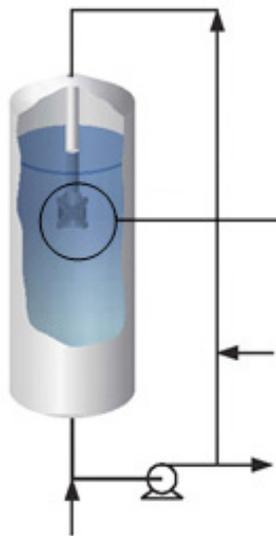


Hidropéroxidos formation



Oxygen displacement

Volatiles formation



Rancid

oxygen
temperature
light
metals

- Hexanal
- Nonanal
- Heptanal
- Pentanal
- Hexanoic acid
- e-2-heptenal
- e-2-decaenal



Oxygen displacement



Oxygen displacement



Oxygen displacement



Oxygen displacement



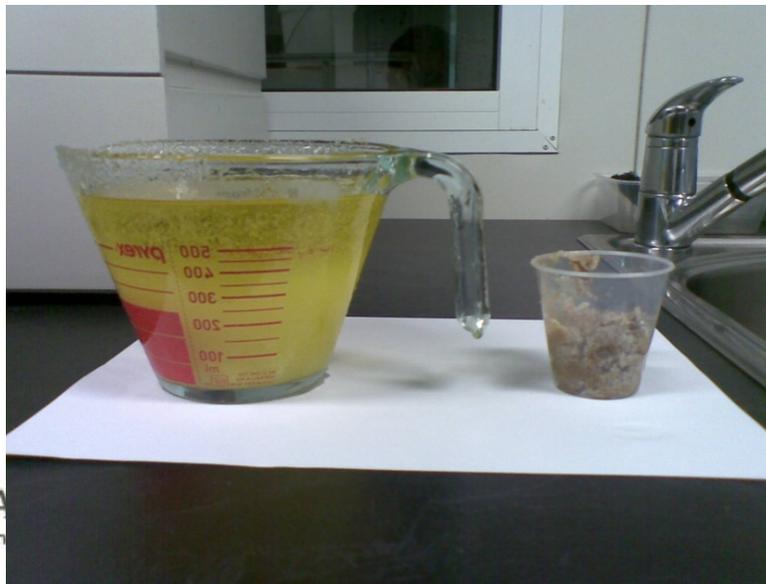
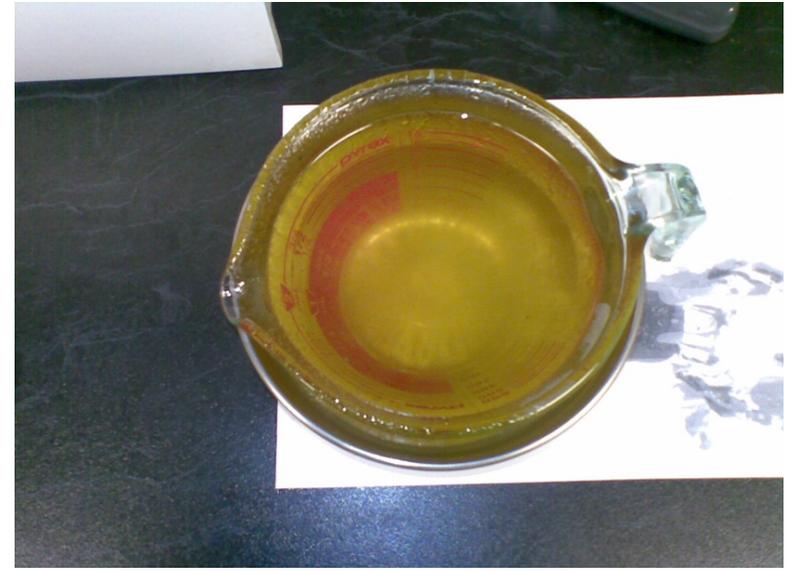
Poor temperature control



Poor temperature control

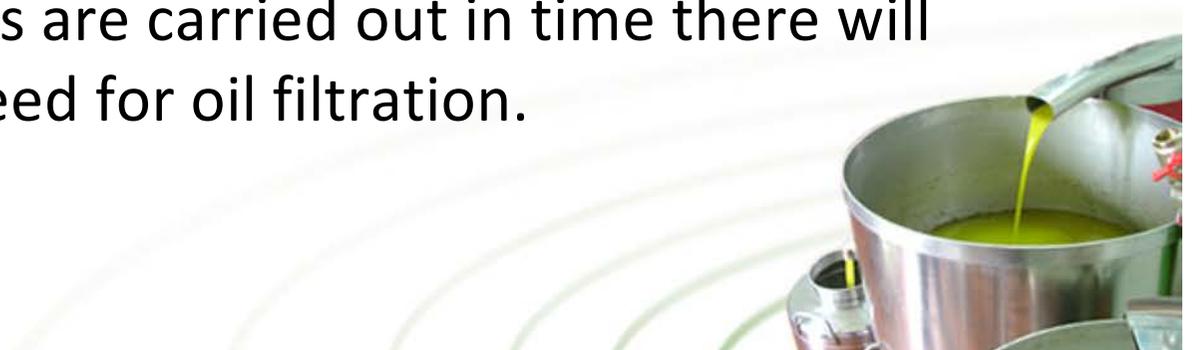


Poor temperature control



Filtration

- A processing tool to be used **only** when needed
- There are pros and cons to oil filtering depending on the quality of the oil to be filtered and the filtering media utilized.
- It is more likely that filtering will help improving low quality oils than high quality oils.
- There is a vast body of research papers that do not agree on the benefits/setbacks of oil filtering.
- If the plant has a proper oil sedimentation process and the oil movements are carried out in time there will probably be no need for oil filtration.



Filtration

Particles in
suspension
composition

Micronized water droplets
Air
Proteins
Low density enzymes
Pectins
Mucilaginous matter
Waxes

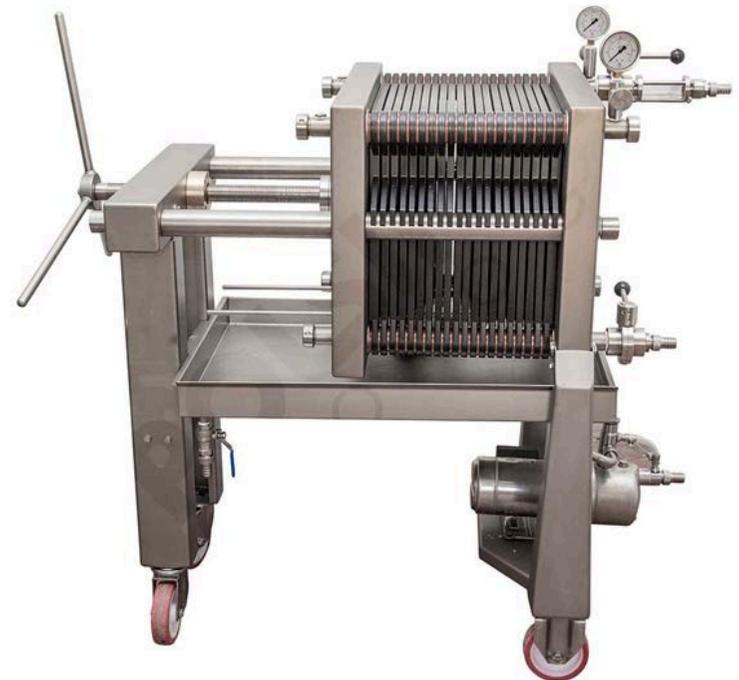


Filtration

Parameter	+ Positive Effects	- Negative Effects
Stability	Increases oil stability by reducing moisture and free fatty acidity.	Decreases oil stability due to the removal of suspended solids and exposure to oxygen during filtration.
Phenolics	Decreases the rate of secoiridoid hydrolysis that can affect shelf life over time.	Decreases water-soluble phenolic content and antioxidants that help prevent oxidation.
Volatiles	Eliminates undesired volatile compounds that affect the aroma of the oil.	Eliminates desired volatile compounds that affect the aroma of the oil.
Sensory	Reduces rancidity of the oil and removes the muddy sediment defect.	Decreases positive attributes (fruitiness, bitterness, and pungency).
Appearance	Contributes to transparent and clear appearance.	Contributes to lighter appearance and lower intensity of the green color.
Pigments	Decreases pigment concentration and reduces susceptibility to oxidative reactions when exposed to light.	Decreases pigment concentration and limits the ability to capture free radicals in the dark.
Shelf life	Prolongs shelf life by lowering free fatty acidity, water activity, hydrolysis and sediment fermentation, especially if the oil is stored in a higher than ideal temperature.	Reduces shelf life due to decrease in phenolic content.



Press filters



Bag filters



Diatomaceous earth filters



Filtration

- **Press filters (through cotton, paper or paper + Na₂SO₄):** Commonly used for **moisture removal**. Cotton seems to perform better than paper, and the addition of Na₂SO₄ improves paper performance.
- **Cellulose fiber filters:** Optimal for **suspended solids removal**. They allow for high working capacities.
- **Membrane filtration:** Another option for **suspended solids removal** and high working capacities. Low impact on oil quality.
- **Inert gas filtration (Nitrogen or Argon):** The oil circular movement created by the bubbling of gas helps settling **suspended solids** as well as **water**. As **oxygen** is also displaced, the oil ends up under an inert atmosphere.
- **Filter bag system:** For **suspended solids removal**. Very versatile, as different filtering media can be used or combined to improve filtration.
- **Diatomaceous earth filters:** Most common means of filtering in large companies in Europe. Excellent for **suspended solids removal**. Allow for high working capacities. Negative impact on oil aroma.



Filtration

- Turbidity measurement: Nephelometric Turbidity Unit (NTU)
- Nephelometer: It measures the scattered light that is created after a white light beam (400-680nm) meets particles in suspension in a liquid.
- Fresh oils straight from Separator have approximately 850-1000 NTU of turbidity.
- Filtration requirements for oils that go into a bottle in Europe: 11-25 NTU.



Filtration

FILTER IF

- No vertical centrifuge
- No sedimentation system in place
- Unacceptable cloudiness
- Excessive solids in suspension or settled
- Oil moisture is higher than 0.2%
- Rancidity needs to be lowered or removed
- Fermentative defects need to be lowered
- The oil is too fresh and needs to be bottled urgently

DO NOT FILTER IF

- Oil is of good quality
- Storage conditions are good
- Oil settling system at the plant is good
- The oil will be consumed/sold quickly
- Solids and moisture are low in the oil

