Zero alcohol wine – The principle of Reverse Osmosis

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Basic Wine

31 May 2023

With health risks awareness, consumer preferences are shifting toward new product offerings and alternatives. This has boosted non-alcoholic wine production and sales, with many industries and researchers already abreast with different production techniques at the various stages of winemaking. Dealcoholized wine can be produced using physical dealcoholization methods. The Spinning Cone Column vacuum distillation equipment (see blog post) and the Reverse Osmosis system are the most utilized systems in the industry. In this blog post, **the principles of Reverse Osmosis will be briefly explained**.

Reverse Osmosis

Reverse Osmosis which is also commonly referred to as RO is a type of **membrane separation technique** used for the removal of molecules and ions from a solution. The technique is most commonly known for its use in drinking water purification, particularly with regard to removing salt and other effluent materials from water molecules. But the technique is also used in die food and beverage industry such as to concentrate sap before making maple syrup, the concentration of egg whites, fruit juices and gelatins and the removal of bacteria and brine in meat. **In the wine industry, the technique can be used to remove alcohol, to remove water and to remove unwanted aromatic compounds.**

Wineries apply Reverse Osmosis to reduce ethanol content by one or two alcoholic degrees in order to obtain more balanced wines. However, new consumption habits and alcohol safety laws have induced the global wine industry to produce new products in the form of non-alcoholic or low-alcohol wines.

Reverse Osmosis for the dealcoholization of wine

During Reverse Osmosis wine molecules passes through a semipermeable membrane from a more concentrated solution to a less concentrated solution (therefore in the opposite direction of natural osmosis) when **subjected to a hydrostatic pressure greater than the osmotic pressure**.

A demonstration of the Reverse Osmosis process can be viewed here:
https://www.youtube.com/watch?v=4RDA_B_dRQ0&ab_channel=SAWaterCorp
In this demonstration the salt water represents wine.

Stage 1: Separation

Wine is pumped past a **semi-permeable membrane**. **Pressure is applied on the wine's side** of the membrane. Lightweight molecular compounds consisting mainly of **water, ethanol**, some acids and ions **permeate through the membrane**. The higher molecular weight compounds (larger compounds) such as compounds responsible for **pigment, flavour and aroma cannot cross the membrane** and will remain on the pressurised side. The process takes place in a closed circuit and the wine continuously

passes the membrane until the desired alcohol level is reached. The "wine" is now concentrated with specific amounts of ethanol and water removed.

Stage 2: Distillation

The separated **water/alcohol mixture is processed through a distillation column**, where it is separated into an alcohol distillate and pure water.

Stage 3: Reconstitution

The **retained water from the distillation is then added back into the wine** (retained from the separation step). Theoretically, this will result in the original wine minus the alcohol. However, results from research studies are contradicting with **certain studies reporting a significant change in the wine composition and sensory qualities after alcohol removal** using Reverse Osmosis[1], while **other studies reported no negative effect** on the main aroma compounds and a similar taste and aromas to "normal" wines[2,3].

Reverse Osmosis can be operated at **low temperatures** and meets the requirements for a clean technology, as it can recover and reuse ethanol from the dealcoholization byproduct (water and ethanol solution). However, adding water during diafiltration (a method used to improve the efficiency of the alcohol removal during Reverse Osmosis) is a drawback of this method, as the addition of water to wine is prohibited in some wine-producing countries or regions.

It is important to note that the alcohol removal is not solely responsible for the losses of volatile aroma compounds during the production of lower, reduced, low, and nonalcoholic wines, other factors such as the **type of method used, the operating conditions applied, the type of membrane used** (in the case of membrane processes), the **chemical-physical properties of the volatile compounds, and the nonvolatile matrix of the wine** can also play a vital role[4,5].

References

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