

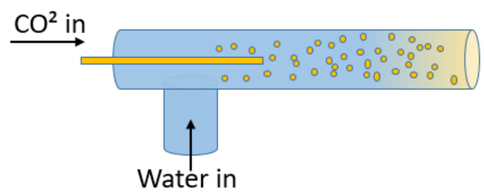

Using Membrane Contactors to Carbonate or Nitrogenate Liquids

Gas control is an important concern in the beverage industry. Whether producing soft drinks, tea, coffee, juices or beer, excess gas can negatively impact the flavor and shelf life. Oxygen in the water can oxidize flavor components and shorten the shelf life. Carbon dioxide can also impact the taste and change the pH of the product. A few examples:

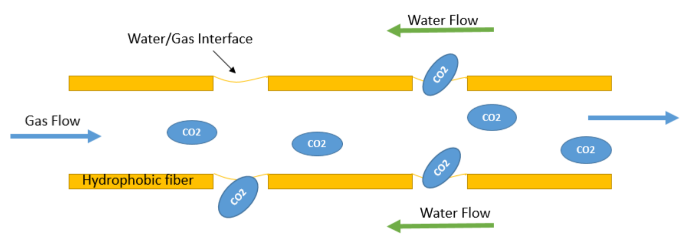
- In brewed coffee and teas, flavor is improved if the water is deoxygenated prior to brewing and packaging
- Water blended with concentrated fruit juices should be oxygen free to improve shelf life and maintain flavor
- Natural fermentation creates carbon dioxide in beer which impacts taste and the head of the beer
- Stout beers frequently add nitrogen to provide a unique mouth-feel and improve the foam head
- Well water may contain hydrogen sulfide which must be removed to avoid negatively impacting flavor

Dispersive vs Non-Dispersive Methods

Typical dispersive methods of introducing either carbon dioxide or nitrogen into a liquid utilize either an in-line injection system or diffuser/carbonating stone. In this system, one must first disperse small bubbles into a flowing liquid and then force those bubbles to be absorbed into the liquid through pressure, temperature, surface exposure and time.



Non-dispersive methods use a hollow fiber membrane technology. In this application, the gas is instantaneously transported into solution by absorption at a molecular level. The hollow fiber membrane is composed of a microporous hydrophobic polymer which provides a “bubbleless” gas transfer into the liquid.



This technology found early application in medical applications where blood oxygenation had to be “bubbleless” and extremely efficient. Since that time, use of non-dispersive membrane contactors has expanded to semiconductors, power generation, solar panels, food and beverage, pharmaceuticals, photography and many other applications. Even though other degassing technologies, such as vacuum towers, have existed for years, these methods are being displaced by membrane contactors. Contactors offer advantages including a smaller footprint, lower installation costs, and are modular in nature. Systems can easily be combined and piped together to meet growing capacity after initial

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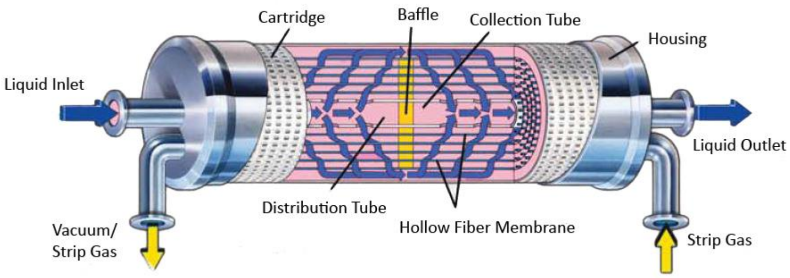
installation. Non-dispersive carbonation also improves product stability by eliminating the problem of foam-generating undissolved CO_2 micro-bubbles which can occur with dispersive injection or carbonation tank systems.

How Membrane Contactors Work

To add or remove gasses from liquids, the hollow membrane is knitted into an array and wrapped around a center tube inside the contactor housing. During typical operation, liquid flows over the outside of the hollow fiber while a vacuum or strip gas (or both) is applied to the inside of the fiber. Since the membrane is hydrophobic, it acts as an inert support that allows direct contact between a gas and liquid phase without dispersion.



Applying a higher pressure to the liquid stream relative to the gas stream creates the driving force for dissolved gas in the liquid to pass through the pores in the membrane. The gas is then carried away by the vacuum pump or strip gas. Water does not enter the micropores but are held back due to the hydrophobic nature of the polymer and the surface tension across the membrane.

The high surface area/volume ratio yields an extremely efficient system and one that is capable of achieving accurate control of the gas in the liquid - <1 ppm CO_2, <1ppm N_2 and <1 ppb O_2. Beverage companies have reported improved accuracies of their CO_2 set points. With membrane contactors, typically 0.25% CO_2 is a set point; a significant improvement over other carbonation technologies that report accuracies ranging from 1.0%-2.5% of CO_2 set point.

Different membrane sizes allow companies to achieve a wide range of flows, from as little as 5-10 gpm to over 1000 gpm. Additionally, the system can be combined with mass flow measurement and PLC control to provide accurate blending of gas synchronized with the product flowrate. These systems meet and often exceed compliance to FDA, NSF or other industry standards.

To learn about the technology, email us at sales@mgnewell.com or call us at 336-393-0100 to see if this type of system will provide benefits to your process.