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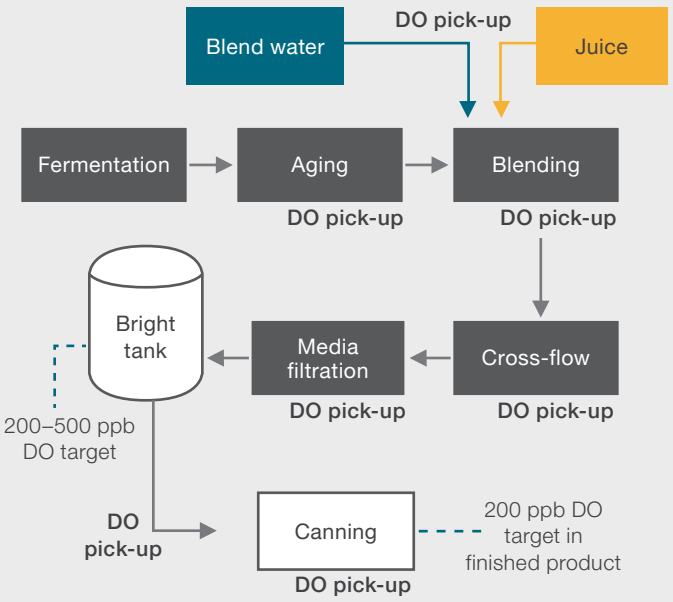
Liqui-Cel membrane contactors provide an easy, flexible solution for managing dissolved oxygen (DO) in hard cider

Introduction

Controlling dissolved oxygen (DO) levels during beverage production is vital for ensuring consistent product quality and shelf life. This is particularly true for canning, where high DO levels can cause breakdown of the can lining, corrosion and even leaking — which in turn can result in product waste and customer dissatisfaction. In some cases, can supplier warranties have exclusions for high DO levels.

According to the Craft Brewers Association, cans have increased their share of craft beverage packaging from 2% in 2011 to 10% in 2014. It's no surprise, then, that craft beverage producers are looking for ways to combat DO during the canning process.

Figure 1. Process flow and potential pick-up points of dissolved oxygen (DO)



"We needed a simple and effective solution for handling oxygen pick-up that was designed around our process needs. Thermo Scientific™ Liqui-Cel™ Membrane Contactor technology helped make this possible."

— Ben E. Calvi, Cider Maker, Vermont, Hard Cider Company

The process

Vermont Hard Cider, maker of the well-known Woodchuck brand of ciders, began experimenting with canning in 2012 at their Middlebury, Vermont facility. In 2014, the company decided to ramp up production of canned cider, but recognized that uncontrolled DO levels posed a threat to a consistent, high-quality product.

Many steps throughout the cider canning process allow for dissolved oxygen pick-up (Figure 1). While some oxygen may be present after fermentation (~50 ppb) with additional pick-up occurring during aging and filtration (500 ppb), the majority of DO is introduced during blending and tank transfer. Additionally, beverage producers using an in-line filler may also see significant DO pick-up in the final canning step unless very careful DO prevention measures are in place.

The problem

Most manufacturers of cans void their warranties if DO levels are above 1,200 ppb in a canned product.

Vermont Hard Cider noticed that even though DO concentration in the bright tank was within specifications at 200–500 ppb, they would occasionally experience DO levels above 1200 ppb in their canned products. The company determined that these DO levels were higher than anticipated because cider does not undergo fobbing (foaming), which is commonly used in beer canning to prevent excess oxygen pick-up.

thermo scientific

The solution

Vermont Hard Cider searched for a solution that, starting with fully oxygenated liquid (8,000 ppb) at a flow rate of 25 gallons per minute (5.68 m^3/h), consistently delivered cider with <200 ppb at outlet. After research and speaking with other industry brewers, the company approached Quantum Flow Technologies, which designs and builds deaeration skids with Liqui-Cel membrane contactors.

Liqui-Cel membrane contactors use a microporous hollow fiber membrane to facilitate degassing of liquids. The micropores in the wall of the hollow fiber membrane provide a massive surface area that allows the contactor to be compact while efficiently deoxygenating large volumes of liquid. The small size of the membrane contactors enables compact systems that can be easily customized and scaled to meet various flow ranges and process configurations. Membrane contactors operate in-line for rapid degassing with low head loss.

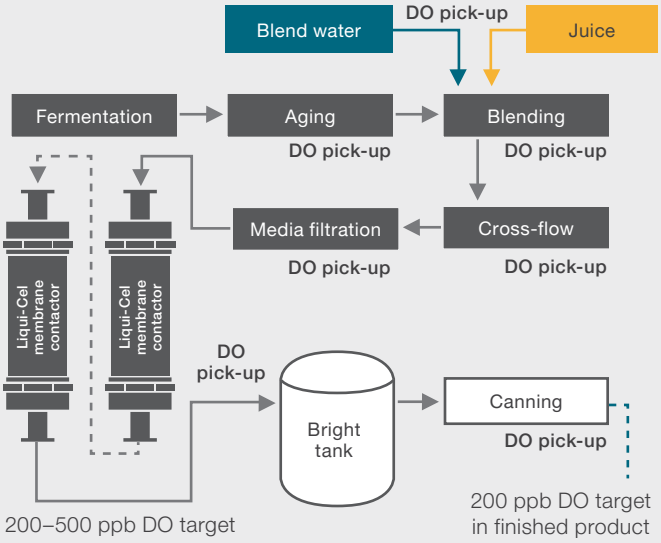
The final skid design incorporated two stainless steel Thermo Scientific™ Liqui-Cel™ EXF-8x20 Membrane Contactors before the bright tank so that oxygen removal took place as close as possible to the final canning step (Figure 2) in order to help reduce the opportunity for oxygen pick-up in downstream steps.

Results

The skid that incorporated Liqui-Cel membrane contactors was installed in 2015. Since then, Vermont Hard Cider has consistently achieved pre-canned cider with DO near 15 ppb, far exceeding the original target of 200 ppb. Moreover, the system functions the same under varying flow rates and is simple to operate and maintain.

To validate that the Liqui-Cel membrane contactors had little to no impact on the cider's flavor profile, retention samples were evaluated at 0, 3, 6 and 12 months. Results showed that the taste profile was consistent with hard cider prior to installation.

Figure 2. Deoxygenation system incorporating two Liqui-Cel membrane contactors



As canning grows in popularity among craft beverage producers, flexible and easily managed DO control solutions will be more important than ever. Thanks to Quantum Flow Technologies and Thermo Fisher Scientific, Vermont Hard Cider has a DO control solution that it can count on — and easily expand — in the years ahead.

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