



# 3M™ Liqui-Cel™ Membrane Contactors provide an easy, flexible solution for managing dissolved oxygen 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.

## 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.

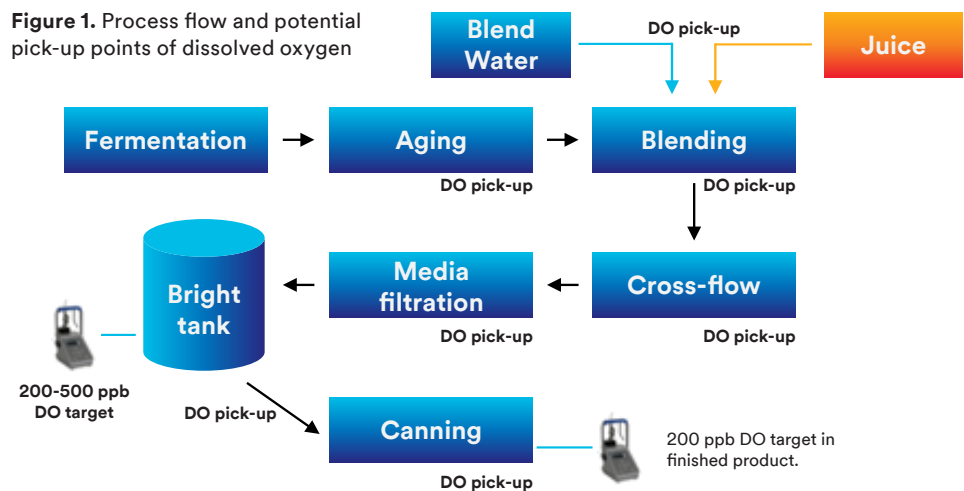
Vermont Hard Cider noticed that even though DO concentration in the bright tank was within specifications at 200-500 ppb, they would occasionally experience DO levels above 1200 ppb in their canned products. The company determined that these DO levels were higher than anticipated because cider does not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

*"We needed a simple and effective solution for handling oxygen pick-up that was designed around our process needs. 3M™ Liqui-Cel™ Membrane Contactor technology helped make this possible."  
– Ben E. Calvi, Cider Maker, Vermont Hard Cider Company*

## 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, 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 3M™ Liqui-Cel™ Membrane Contactors.

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



3M™ 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 3M™ Liqui-Cel™ EXF-8×20 Series 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.

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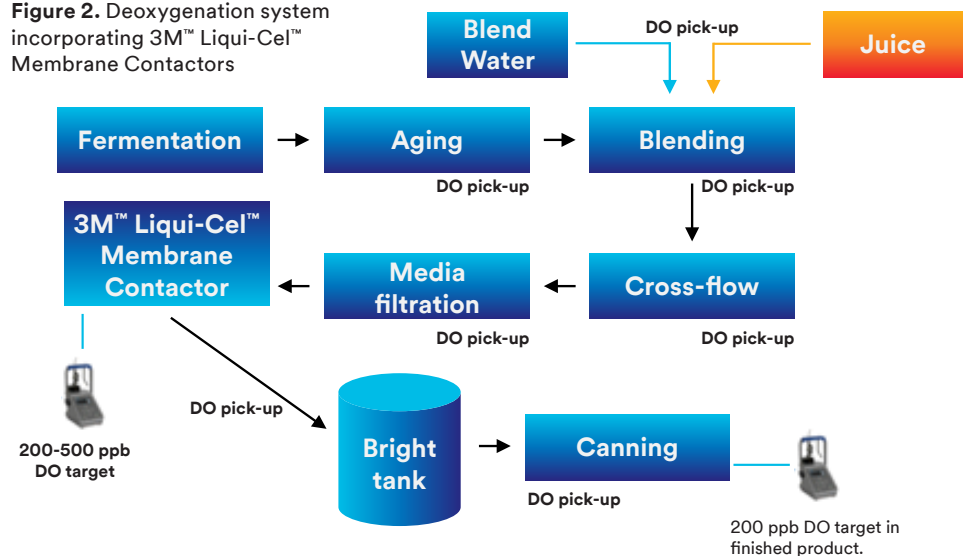
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Separation and Purification  
Sciences Division  
13840 South Lakes Drive  
Charlotte, North Carolina  
28273 USA  
Phone: +1 980 859 5400

3M Deutschland GmbH  
Separation and Purification  
Sciences Division  
Öhder Straße 28  
42289 Wuppertal Germany  
Phone: +49 202 6099 - 0  
Fax: +49 202 6099 - 241

**Figure 2.** Deoxygenation system incorporating 3M™ Liqui-Cel™ Membrane Contactors



To validate that the 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.

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 3M, Vermont Hard Cider has a DO control solution that it can count on – and easily expand – in the years ahead.

To learn more about Liqui-Cel technology and how it can be integrated into existing or new platforms, please contact your 3M representative or visit [3M.com/Liqui-Cel](http://3M.com/Liqui-Cel).

## Contributors

Ben E. Calvi,  
Vermont Hard Cider Company, and  
<http://www.woodchuck.com>

Amar Kapadia,  
Quantum Flow Technologies  
<http://quantumflowtech.com>



ISO 9001

LC-1227  
Rev. 01/2017

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