Industrial filtration

Bubble removal from aqueous streams using Liqui-Cel SP membrane contactors

Introduction

Many manufacturing processes, analytical measurements, and other industrial processes that involve aqueous solutions are adversely affected by bubbles in the fluid stream. Thermo Scientific™ Liqui-Cel™ SP Membrane Contactors provide a very simple, cost effective solution to help eliminate bubbles from such processes.

Background

When liquids and gases are brought into contact with each other, mass transfer between the two phases will occur. The concentration of gas dissolved in the liquid will continue to increase until equilibrium is reached, after which the concentration remains. The liquid is said to be “saturated” at this stage, which is reached quickly under most conditions. Therefore, design engineers must assume that a liquid stream is saturated with any gas with which it has come in contact



Figure 1. Thermo Scientific™ Liqui-Cel™ SP Membrane Contactors

Bubble formation

Once a liquid process stream has become saturated with a given gas or gas mixture, the concentration of the gases in the liquid will remain constant until equilibrium conditions change. For example, an increase in system pressure will cause more gases to dissolve into the liquid stream, while a decrease in system pressure will cause gases to be released.

When gases are released, bubbles form in the liquid, creating potential problems for manufacturing processes. For example, if the liquid is used in a cleaning or coating process, bubbles can adhere to product surfaces and cause defects that significantly reduce yield.

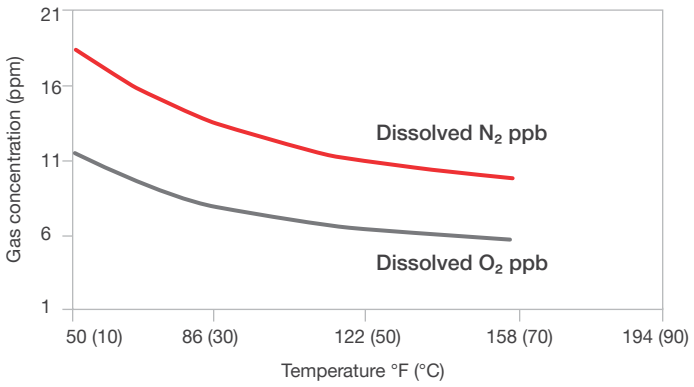


Figure 2. Dissolved gas concentration in water at atmospheric pressure

Bubble prevention and elimination

Liqui-Cel SP membrane contactors offer a cost-effective and simple way to prevent and eliminate bubble formation. Listed below is one example that demonstrates the effectiveness of Liqui-Cel SP membrane contactors for yield improvement.

Application

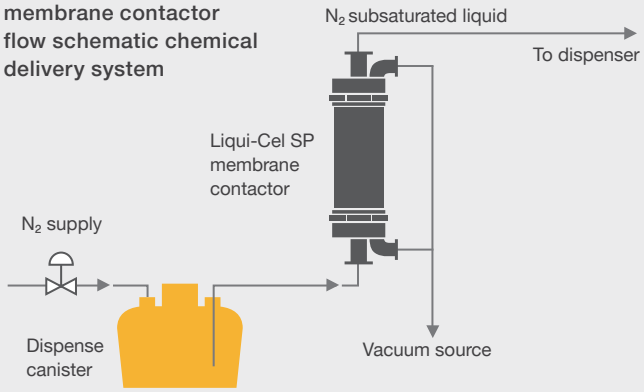
A customer is processing a coating solution that is prepared at 68*F (20°C) and then heated to 140*F (60°C) prior to application. The heating step causes significant offgassing of the solution.

Venting the solution removes some excess gas, but is ineffective at maintaining dissolved gases at a consistent level during manufacturing runs. As a result, product yields vary over time.

Solution

The difficulty with simply venting excess gas is that the coating solution is still saturated with gases. Any further pressure reductions and/or temperature increases create additional bubbles. Placing a Liqui-Cel SP membrane contactor inline before the heater minimizes any bubble formation. Figure 2 shows the gas content of the liquid at 68°F (20°C) and 140°F (60°C). By knowing the gas concentration of the fluid at 140°F (60°C), a Liqui-Cel SP membrane contactor system can be designed that reduces the gas concentration well below any process condition where gas could develop. This can completely eliminate the possibility of bubble formation. Due to the high efficiency of Liqui-Cel SP membrane contactors, a single membrane contactor will be adequate to reduce the gas concentration to satisfactory levels. In Figure 3, a process flow schematic of a typical system designed to eliminate bubbles is shown. Bubble removal systems utilizing Liqui-Cel SP membrane contactors offer several distinct advantages over existing technologies.

Figure 3. Liqui-Cel SP membrane contactor flow schematic chemical delivery system



Modularity

Membrane contractor systems are inherently modular, which means that they can be easily and economically adjusted to accommodate process changes.

Small footprint

Liqui-Cel SP membrane contactors can be packaged into compact configurations. In addition, systems can be custom designed to fit into existing space constraints. Point-of-use systems can also be designed.

Ease of operation

With almost no instrumentation, Liqui-Cel SP membrane contactors are very simple to operate.

Consistency

Gas content in liquid process streams can be maintained very precisely even with simple process control systems.

Application engineering

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