research review

A Study: Micro porous PTFE successfully degasses air bubbles in microfluidic devices

Air Bubble Formation in Diagnostics Devices

In point-of-care diagnostic testing devices, design limitations can lead to testing errors, resulting in misdiagnosis and potential difficulties in managing patient care.

Air bubble occurrences is considered one of the most common issues in microfluidic devices[1,2] and are typically formed via surface tension irregularities, mixing of liquids, thermal pressure condition changes, and general shaking during device use[3,4,5,6,7].

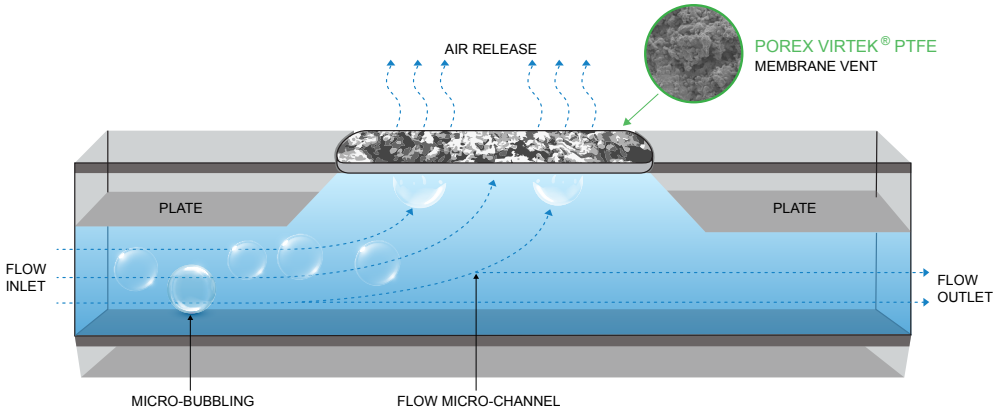
Poor bubble removal within reaction chambers, metering channels, and optical detection areas can severely impact quantitative measurements in microfluidic devices leading to improper measurements or device malfunctions[8].

When mitigating air bubble occurrences is key, a properly vented mechanism and bubble capture design is critical.

The Science Behind it – POREX Virtek® PTFE

POREX VIRTEK® HYDROPHOBIC VENTS are permeable to gas but repel liquids – enabling an effective debubbling mechanism:

- Air and fluid pressure migrate bubbles towards vent membrane
- Bubbles release and break on the membrane surface
- Air passes through, yet sample liquid does not pass



Studies in microfluidics find that vents achieve more than just simply venting air.

They are a versatile function that degasses, and manages flow, pressure, and moisture.

Yet in its basic form is a leak-proof vented seal that paves the way for the portability for the point-of-care device.

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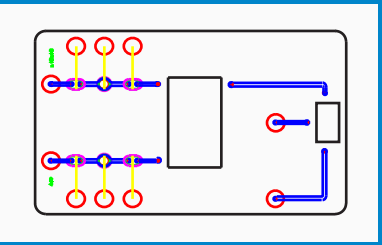
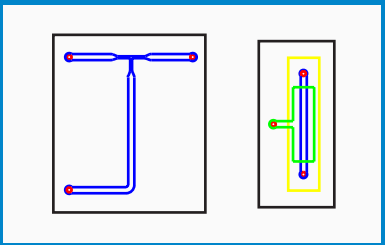
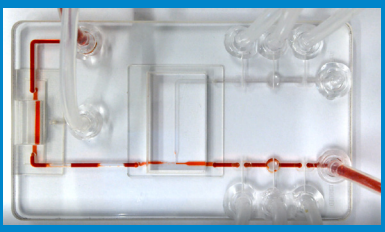
Microfluidic Cartridge Chip



Bubble Trap Cartridge designed with six valves for air and liquid attachments for ADEPT pneumatic pump.



J-Junction geometry bubble creation zone and T-junction vented module with vacuum input valve.



Bubble Trap Cartidge designed by ALine, Inc

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Test Overview

A third-party microfluidic engineering partner custom designed a modular microfluidic cartridge to simulate bubble formation in challenging designs.

A bubble capture zone utilizing a Hydrophobic POREX Virtek® PTFE vent mechanism was added with a vacuum attachment. Liquid and air was pumped via 6 valve inputs into cartidge chip.

Results

According to experts, POREX Virtek® PTFE Hydrophobic Vents successfully removes bubble occurrences even in low vacuum conditions:

- **Assists fluid flow of microchannels that becomes obstructed due to bubble formation**
- **Does not leak in typical vacuum conditions**
- **Porous PTFE membrane keeps liquid inside**

Test 1: Several POREX Virtek® PTFE membranes tested to characterize their ability to successfully remove bubbling in a microfluidic set up.

Table 1: Membrane Characterization

Membrane	Typical Airflow (l/hr/cm² at 70 mbar)	Observed Result (Frequency 4.5 PSI Vacuum and air)
MD10	70 - 107	Bubbles Removed
MD15	45 - 75	Bubbles Removed
MD22	5 - 17	Bubbles Removed
PMA20	2 - 5	Bubbles Removed
MD25	2 - 7	Bubbles Removed

Test 2: Hydrophobic versus Oleophobic POREX Virtek® PTFE membranes tested with varying vacuum pressure frequencies to observe at what limits the vent mechanism will successfully remove bubbling occurrences. No leaks until WEP limit and successfully removed and degassed air bubbles in all conditions.

Table 2: Vaccum Limit

Membrane	Lowest Vaccum (n=5)	Highest Vacuum (n=5)	Water Entry Pressure (WEP)
PMA20 (Oleophobic PTFE membrane)	0.5 PSI	12.4 PSI	≥11.89
MD25 (Hydrophobic PTFE membrane)	0.5 PSI	11.5 PSI	Min 10.8

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Getting Started with Porex

As you think about your design project, consider the below questions and then reach out to us for a design consultation with one of our engineers. It's easy to reach someone at **www.porex.com/ask-an-engineer** or click this QR code.

What is the **function of the part** you are looking for within the application or assembly?

What **formulas / solutions / environment** will the part interact with?

What are the **performance requirements** for function?

What are the **size requirements?**

Are there **manufacturing constraints?**

References

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