The advantages of MP² technology in porometry

How does pressure step stability method in porometry work?

In the pressure step stability method, the pressure increases stepwise and the porometer keeps the pressure stable until all the pores with the same diameter have opened, and thus the flow becomes stable. Only then, the porometer will accept a datapoint. In this way, the tortuosity of the sample is taken into account. Because of this, the pressure step stability method is often referred to as the most accurate approach for measuring the pore size distribution of through pores.

Challenges in the classical pressure step stability method

The measurement of the pore sizes with the pressure step stability method can be demanding for very opened and porous filter media or for highly selective membranes. During the measurement of such opened filter media, a smooth pressure increase as well as prevention of a pressure drop, might be challenging. This pressure drop occurs when the instrument intends to go to the next pressure stabilization step, and most of the pores are opened at the same time. In this case, as seen in Figure 1, a smooth pressure increase can be difficult or even impossible to achieve.

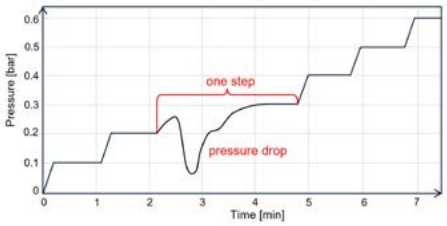

Figure 1 - Graphical visualization of pressure steps during testing of a highly selective membrane with pressure drop caused by the rapid pore opening

However, with the aid of our new patent pending MP² technology, these challenges can be easily overcome.

What is MP² technology?

MP² stands for Multistage Pressure Process. This innovative technology ensures a smooth pressure increase during the measurement and speeds up the process of reaching flow and pressure stability.

As shown in Figure 2, the MP² technology assures that the pressure increase gradually slows down, right before the selected pressure point is reached. In this way, the data points are accepted at the right time, at the right pressure.

This advanced pressure build-up process makes it possible to do the measurement with smaller, and perfectly uniform pressure steps. Additionally, pressure increase intervals can be controlled by 1 mbar steps and thus deliver pore size results with ultra-high resolution.

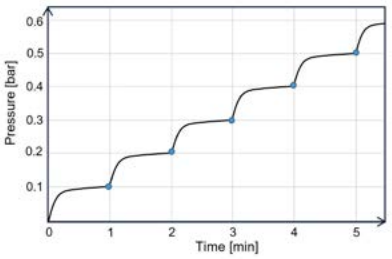

Figure 2 - Well-controlled pressure steps with the MP² technology

POROLUX™ Revo

The POROLUX™ Revo is our gas-liquid porometer, based on the pressure step stability method. The instrument is equipped with our patent pending MP² technology, delivering the most accurate and reproducible pore size measurements, in the highest resolution.

The instrument can measure pore sizes in the range of ca. 13 nm up to 500 µm and has a standard pressure range from 0 – 34.5 bar (500 psi) with flow rates of up to 200 l/min.

The POROLUX™ Revo measures ao. the largest pore (bubble point), mean flow pore size (MFP), smallest pore (SP), pore size distribution and gas permeability. Thanks to our enhanced mathematical model, the following additional results can be obtained:

- Total pore number (-)
- Total pore area (% and µm²)
- Open Porosity (%)
- Calculated permeability (Darcy)

Advantages of MP² technology

1. Most accurate & reproducible pore size results

Because the MP² technology allows for perfectly uniform pressure steps, the instrument can register the pressure and flow at exactly the pressure point requested by the user. This leads to more accurate and more reproducible results, as shown in Table 1.

Table 1- Track-etched membrane measurements on the POROLUX™ Revo, repeated 10 times

Measurement	Bubble point pore size (µm)	Mean Flow pore size (µm)	Smallest pore size (µm)
#01	1.192	1.02	0.8226
#02	1.192	1.022	0.7952
#03	1.192	1.055	0.8227
#04	1.192	1.043	0.8224
#05	1.192	1.059	0.7945
#06	1.192	1.05	0.8294
#07	1.192	1.091	0.9184
#08	1.192	1.055	0.7946
#09	1.192	1.057	0.8109
#10	1.192	1.061	0.8558
Average	**1.192**	**1.051**	**0.827**
St. Deviation	**0.000**	**0.020**	**0.037**

2. High resolution

Thanks to a better control of the pressure increase intervals (down to 1mbar per step), it is possible to achieve a higher resolution of the pore size measurements.

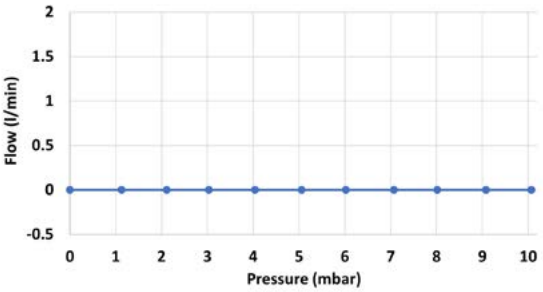

Figure 3 - Pressure built-up in a closed system

3. Smoother wet curve and more detailed pore size distribution curve

Another advantage of the MP² technology is the more gentle approach towards the desired pressure point, making it possible to register a data point even in the pore opening region. The result is visible in the wet curve, as seen in Figure 4, where the flow and pressure increase is a lot smoother. Additionally, more data points in the pore opening region ensure a more detailed pore size distribution curve.

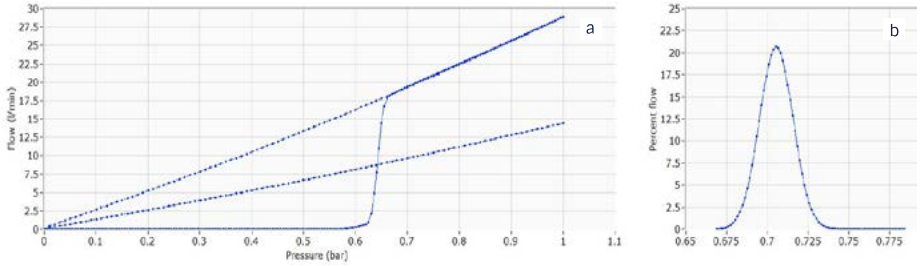

Figure 4 - a) wet, dry and half-dry curve b) pore size (fitted) distribution of a polymeric flat sheet membrane both measured on the POROLUX™ Revo

4. Challenging samples analyzed in minutes

In nonwovens or textiles, the opening of the pores falls in a low pressure and high flow region. For most of the step stability porometers, it is difficult to keep the pressure increase undisrupted in this region. The highly selective media e.g., track-etched membranes are also challenging to measure as the majority of the pores in these membranes open at the same time, leading to a significant pressure drop.

Thanks to the MP² technology, the pressure drop while measuring challenging samples is eliminated. The elimination of pressure drops leads to significantly shorter running time for those types of filter media.

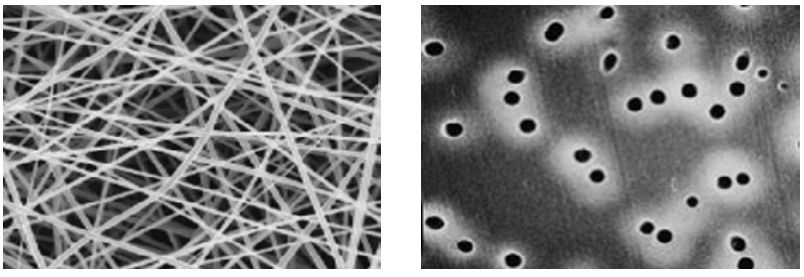

Figure 5 - SEM images of polyamide nonwoven fabric (on the left), and a polycarbonate track-etched membrane (on the right)

5. Wide range of applications

With the MP² technology, a wide range of filtration and separation media can be accurately tested. Figure 6 shows, amonst others, polymeric membranes, porous metals, and nonwoven fabrics, tested on the POROLUX™ Revo.

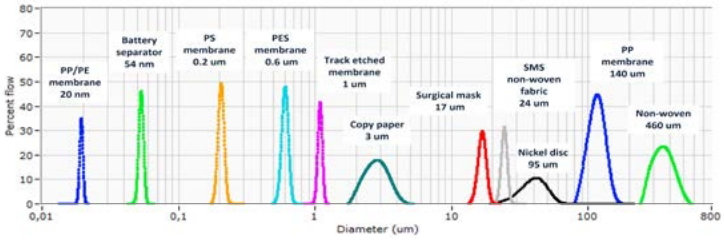

Figure 6 - Pore size distribution of different filter media measured with the POROLUX™ Revo

Conclusion

Our patent pending MP² technology brings the pressure step stability measurement method to a higher level. This innovative technology ensures perfectly uniform pressure steps and a better control of the pressure increase intervals. Next to that, the method guarantees a more gentle approach towards the pressure point and minimizes the pressure drop.

As a result, more accurate and reproducible pore size measurements are generated, and a smoother wet curve and more detailed pore size distribution curve are obtained. Lastly, the MP² technology allows the measurement of a wide range of filter media, in a reasonable amount of time.

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