Material Brief: Through Pore Size Distribution of a Lead Acid Battery Separator – Porometer 3G zH

Separators are used in lead acid and other batteries to prevent shorts between electrodes. As worldwide battery technology manufacturers explore through pore technology to improve separator materials, they are finding that the Porometer 3G zH can help.

1 Introduction

Lead acid batteries are used in the ignition systems of automobiles, to power smaller electric vehicles, and to store reserved energy when power failures occur. To avoid short circuits, separator membranes are used to keep the positive and negative plates separate but still allow charge to flow. Older sintered PVC separators are being replaced with PE (polyethylene) or modified PE separators that improve physical properties such as electrical resistance, thermal stability and acid wetting time. Smaller mean through pores sizes reduce and prevent dendrites from forming across the membrane, causing a battery short circuit.

The Porometer 3G zH enables battery researchers and manufacturers to measure materials for through pores that are small enough to prevent dendrite penetration, yet allow easy migration of the charges.

2 Experimental

Sample Preparation

A PE membrane with ribs was placed between two sheets of paper (protect surfaces) prior to being cut out with a 25 mm diameter hollow punch. The sample was placed into the standard 25 mm flat sheet sample holder above a sintered metal disc with the ribbed supports facing downward. The sample was wetted with Porofil prior to placing the O-ring on top of it followed by enclosing the sample within the holder setup.

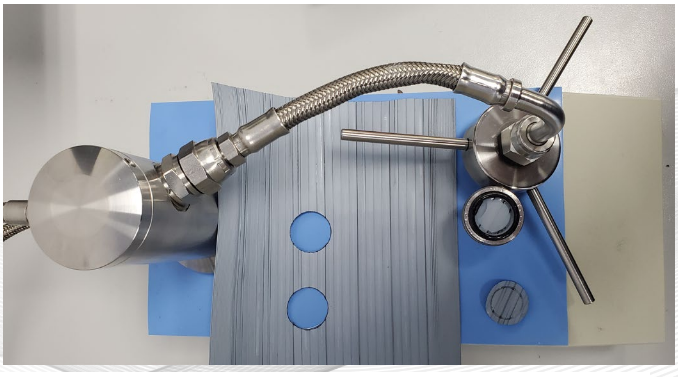

Figure 1: Porometer 3G zH setup

Sample Analysis

The sample was measured in the *Wet-to-Dry mode* to save analysis time and user intervention between wet and dry analyses. The sample was measured in the range from 0.094 µm to 0.028 µm (6.8 bar to 22.85 bar). The measurement was performed using the second low flow sensor (10 L/min) for better sensitivity to flow.

3 Results

Figure 2 shows the wet and dry data curves as a function of pressure. A threshold flow of 0.01 L/min was set to determine the largest through pore (bubble point) of the membrane. The largest through pore was observed at a pressure of 8.5466 bar. This pressure corresponds to maximum through pore size of 0.0749 microns as calculated using Washburn's equation for capillary flow [1]. Figure 3 shows the measured data converted into *Cumulative Pore Flow %* and *Differential Flow %* values versus through pore diameter. The mean flow pore size value of 0.0392 microns represents the pore size at which 50% (largest to mean value) of the total flow is attributed, according to ASTM F316-03 [2].

4 Conclusion

This membrane and other, similar membranes can be analyzed using the Porometer 3G zH and other models (Porometer 3G Micro and Porometer 3G z) to investigate physical characteristics such as the engineered though pores that can correspond to the material's electrical resistivity and susceptibility to short circuits.

5 References

1. Washburn, E.W., 1921. The dynamics of capillary flow. Physical review, 17(3), p.273.
2. ASTM F316-03(2019), Standard Test Methods for Pore Size Characteristics of Membrane Filters by Bubble Point and Mean Flow Pore Test, ASTM

6 Equations, Figures, and Tables

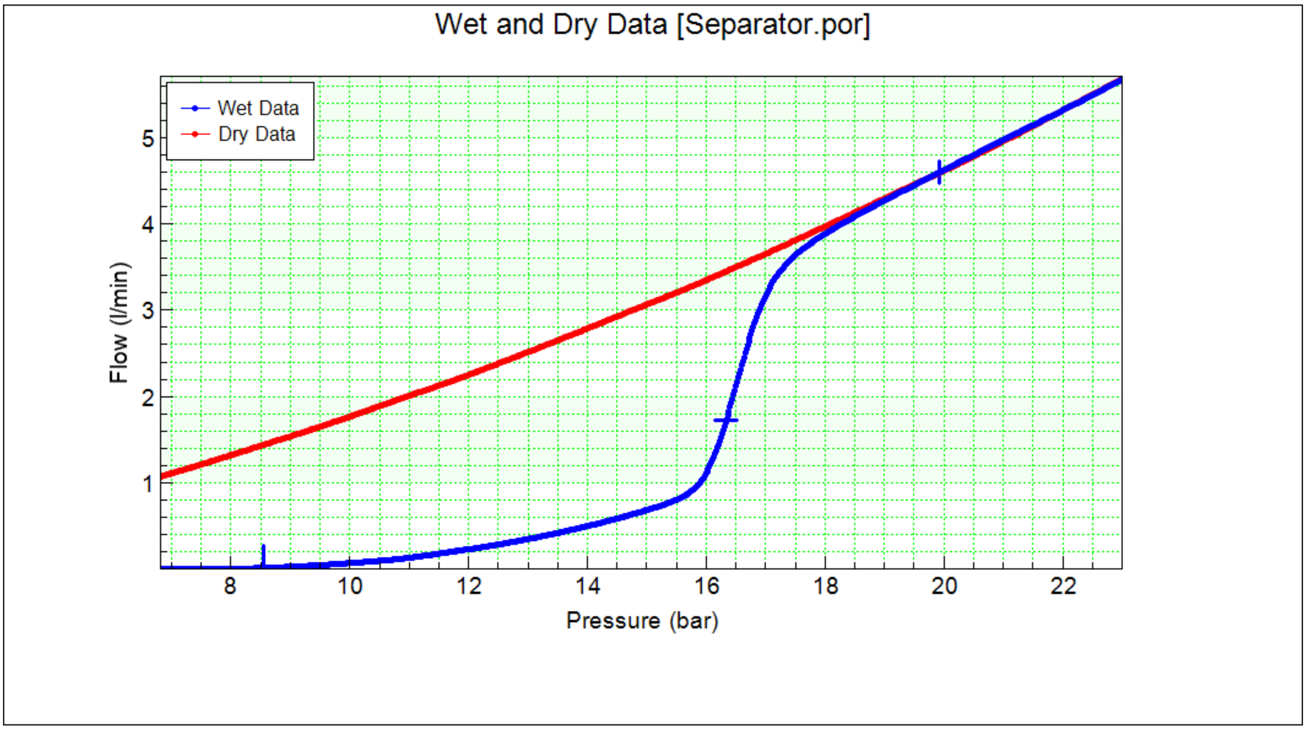

Figure 2: Wet and Dry flow curves versus pressure

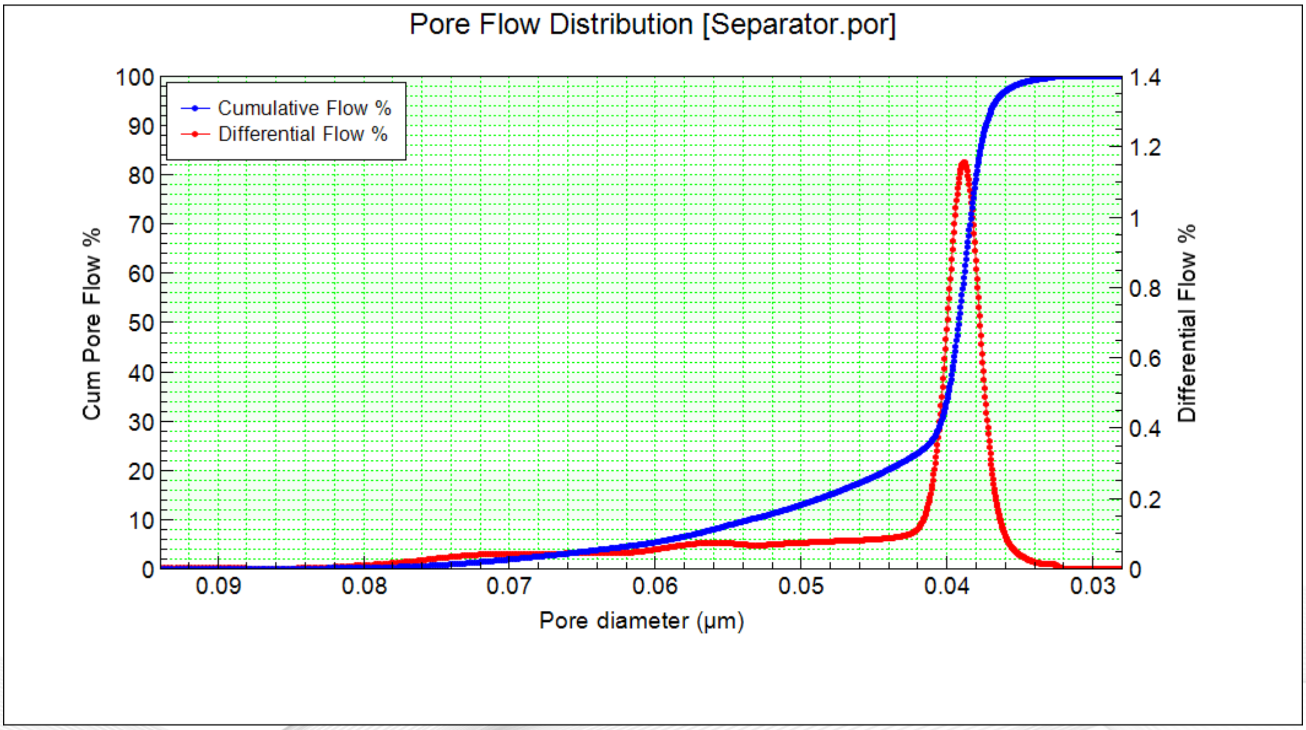

Figure 3: Cumulative Pore Flow % and Differential Flow % versus pore diameter

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