Millipore®
Preparation, Separation,
Filtration & Monitoring Products

Application Note

Bed Volumes of SureWick® Pad Materials

Introduction

SureWick® pad materials comprise a group of filtration matrices made from glass fibers or cellulose and are intended for utilization in lateral flow test strips. Typically, a glass fiber (Figure 1) material is used for the diagnostic or conjugate pad while a cellulose (Figure 2) material is used for the sample and absorbent pads. These materials are critical to the performance of lateral flow test strips because they are impregnated with chemistries that are essential to functionality and they determine the volume of sample that will be analyzed. Their thickness is also important, especially when the test strip is confined within a plastic housing.

An important attribute of a pad material is the bed volume, which is defined as the maximum amount of liquid that can be absorbed. Relative to lateral flow test strips, bed volume is expressed as $\mu L/cm^2$. Since the sample pad and conjugate pad are often treated with reagent solutions, bed volume can be used to calculate the total volume of reagent that will be required for a manufacturing run. When test samples are analyzed, summing the bed volumes of the pad materials provides a close estimate of the maximum sample volume that can be absorbed into the test strip. The data presented in this technical note summarize the bed volumes measured on the SureWick® products currently available.

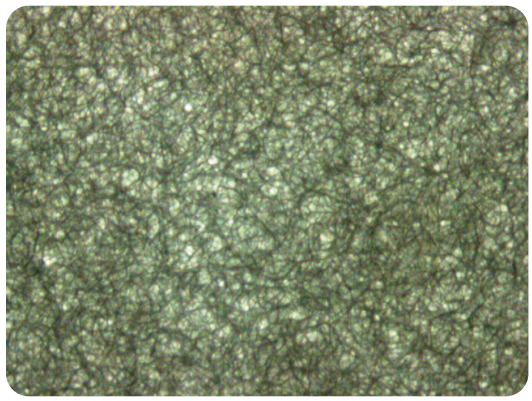

Figure 1: Glass Fiber Diagnostic Pad (6.3x)

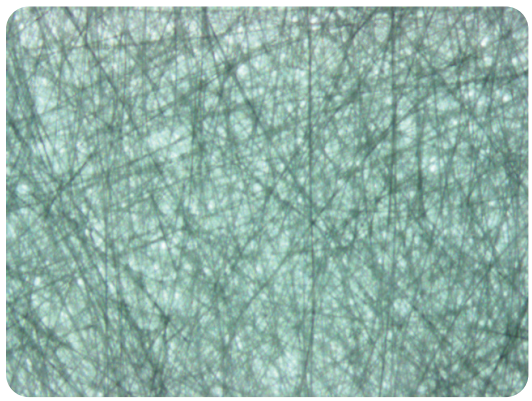

Figure 2: Cellulose Absorbent Sample Pad (6.3x)

Methods

SureWick® materials were supplied in sheet form. For each grade of material, a 47 mm die was used to cut out three disks. Using an analytical balance accurate to 0.1 mg, the mass of each disk was determined in the dry state. One edge of the disk was placed into contact with a reservoir of Milli-Q® water, which was allowed to wick to the top edge of the disk until it was saturated. Using filter forceps, the disk was removed from the water; and the edge that was in contact with the water was carefully blotted to remove any surface liquid. The disk was weighed a second time, and the amount of water absorbed was calculated.

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Results:

SureWick® Code	Composition	Mean Bed Volume (µL/cm²)	CV (%)	Thickness (mm)
C024	cellulose	19	7.4	0.24
C042	cellulose	16	0.1	0.42
C048	cellulose	48	2.3	0.48
C068	cellulose	58	3.2	0.68
C083 (CFSP)	cellulose	83	1.1	0.83
C095	cellulose	79	2.0	0.95
C182	cellulose	195	2.9	1.82
C248	cellulose	224	1.5	2.48
CG104	cellulose/glass	85	4.3	10.4

Table 1. Bed Volume of SureWick® Cellulose Fibre Pads

SureWick® Code	Composition	Mean Bed Volume (µL/cm²)	CV (%)	Thickness (mm)
G027	glass fibers	54	1.1	0.27
G032	glass fibers	31	0.3	0.32
GFDX	glass fibers	59	2.3	0.43
G066-41	glass fibers	69	1.0	0.66

Table 2. Bed Volumes of SureWick® Glass Fibre Pads

Discussion

Part of the lateral flow test strip manufacture requires diagnostic (conjugate) pads and sample pads to be impregnated with reagent solutions. Using the bed volume for a coupon of known size, an approximation can be made for the amount of reagent solution that will be required to process the material through a manufacturing run. In finished test strips, the bed volumes of the pad materials can be used to calculate the amount of sample required to saturate the porous materials. For strips contained within a plastic housing, the amount that is absorbed may be reduced from the calculated value if the pad materials have been compressed significantly. If the amount of sample absorbed into the test strip is significantly above the total calculated bed volume, the excess volume may actually be flooding the interior of the device. This can compromise performance significantly.

Therefore, knowing the bed volume of a pad material is important for completing the manufacturing process and predicting test strip performance. While bed volumes of the cellulose fiber pads ranged from 16 to 224 µL/cm^2, bed volumes of the glass fiber pads ranged from 31 to 97 µL/cm^2. In general it was observed that bed volume increased with thickness for the cellulose fiber pads. Notable exceptions were grades C042 and C095. The trend was not as prominent with the glass fiber materials.

The observed coefficients of variation were low, based on the measurement of the 47 mm disks. By using 47 mm disks, the data are more reflective of the average bed volume of the material. It is also considerably easier to handle 47 mm disks than the small coupons used in test strips. The total surface area of a 47 mm disk is 17.35 cm^2, which is many fold greater than the size of the typical pad material in a test strip (generally <1 cm^2 for cellulose fiber pads and <0.5 cm^2 for glass fiber pads). It can be anticipated that coefficients of variation will be higher when the size of the coupons used is reduced, as the effect of localized variations in thickness and fiber density will become more pronounced.

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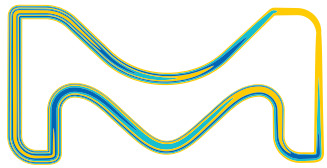

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