

## Application Note

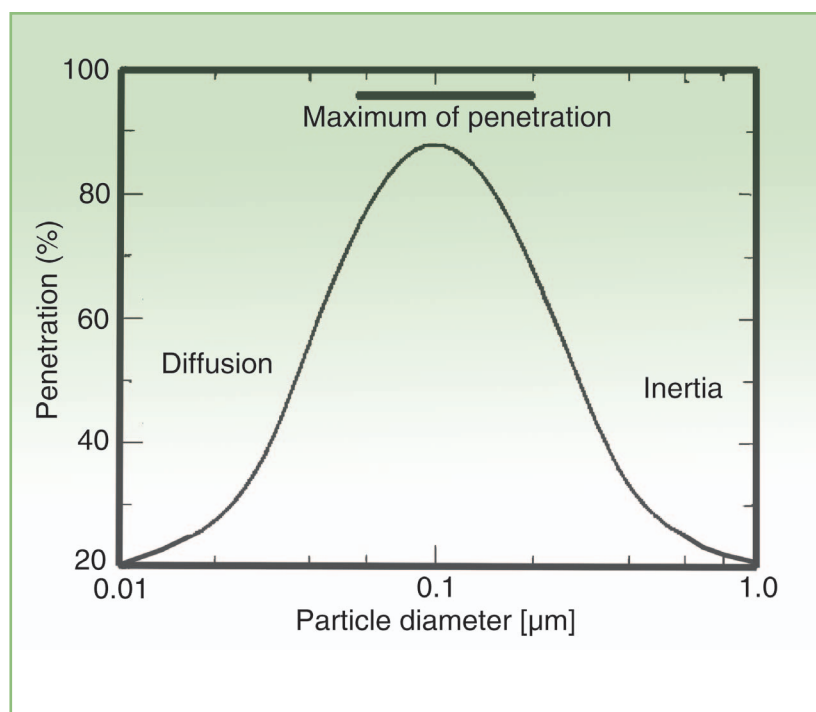
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# Comparative Investigations On The Blocking Efficiency Of Filter Pipet Tips

Woody Moser

## Introduction

The blocking efficiency of filter tips is investigated using airborne particles. Filter tips seated on air displacement pipettors are used to prevent potential contamination of the pipettor tip cones (i.e. DNA fragments). The more effective the filter is, the more risk of contamination is



**Figure 1.**

reduced. This is of utmost importance for preventing false-positive results, especially in sensitive PCR experiments. In this investigation, TipOne 200  $\mu$ l filter tips have been compared with those of other manufacturers.

Double-stranded DNA, i.e. the main product of PCR, is very long-lived, and one central issue for the laboratory using PCR procedures has to be the effective avoidance of contamination. It seems obvious that in the PCR procedure, pipetting of the PCR product (DNA) is one of the most sensitive steps. Cross-contamination occurs if improper pipetting causes splashes or drips. Even if

pipettors are handled properly, aerosols can be generated that contain DNA molecules and can contaminate the pipettor and subsequent pipet products. This demands increasing efforts to reduce the penetration of contaminants by means of filter tips.

## Measurement of blocking efficiency of filter tips: particle sizes used for the test

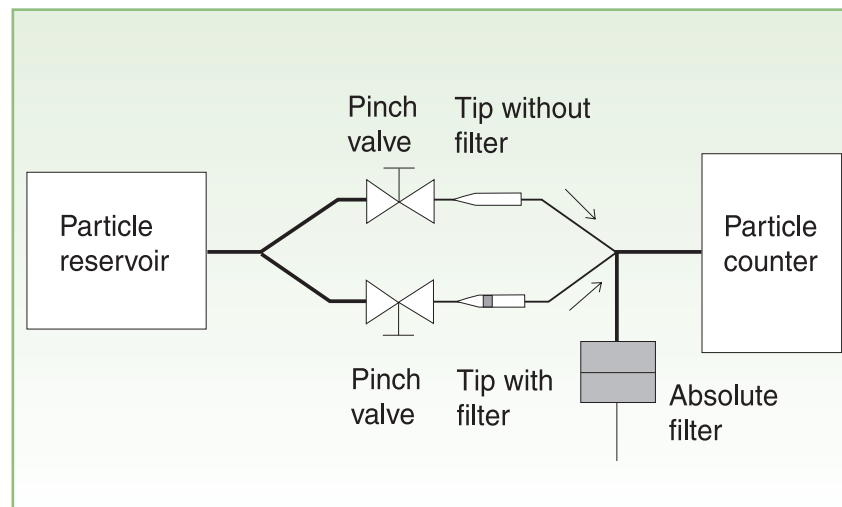
Contamination is believed to occur mainly by airborne particles or macromolecules; therefore, it is

Contamination is believed to occur mainly by airborne particles or macromolecule; therefore, it is appropriate to use airborne particles for testing.<sup>(1)</sup> The filter matrices used in pipet tip filters were tested with regard to their blocking efficiency using airborne particles in a size range corresponding to maximum penetration probability<sup>(2)</sup> (compare Figure 1) of the filter tips. This makes the tests as rigorous as possible.

Following experiments described in the literature, the flow rate through the tips was set to 1 ml/sec. To determine the blocking efficiency of the filter tips, the total number of particles penetrating through a tip with a filter is compared to the corresponding total number penetrating through a tip without a filter during a defined peri-

## Experimental setup and determination of blocking efficiency

Sodium chloride particles were generated by dispensing an aqueous sodium chloride solution and subsequently drying it. A suitable concentration of the solution was chosen to generate particles with a mean diameter of approximately 100 nm. These particles were passed through a filter tip and the penetrating particles were counted (Figure 2). Comparing measurements with and without filters inserted in the tips provides total retention of particles in the filters.



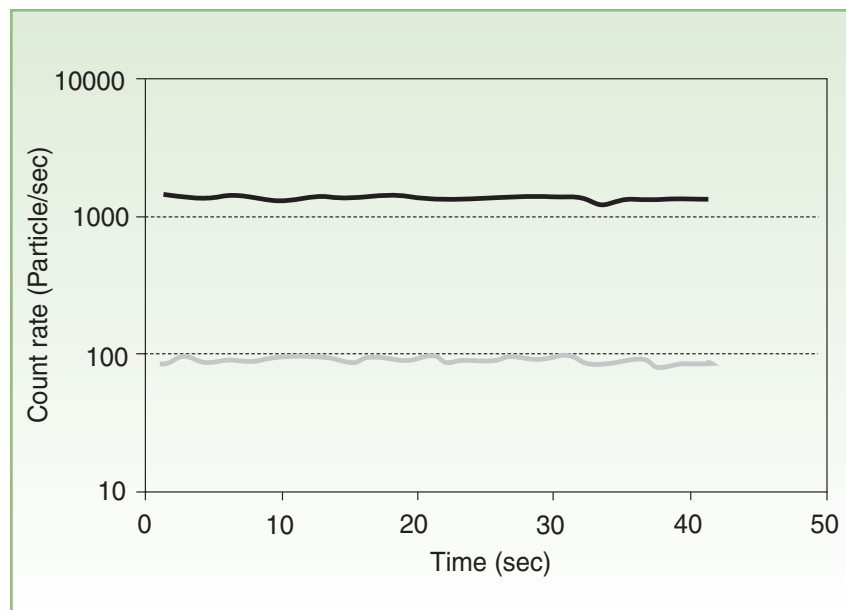
**Figure 2.** Setup for the measurement of the particle retention.

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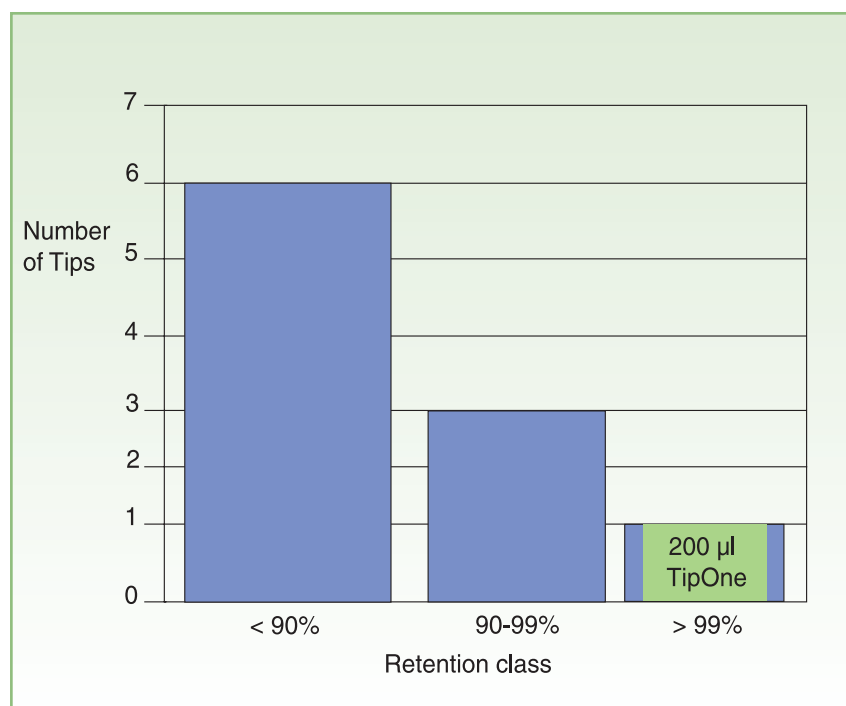
od of time. If  $N_{F, \Delta T}$  is the number of particles penetrated through the tip in the time period  $\Delta T$  and  $N_{W, \Delta T}$  is the number of particles penetrated through the tip without a filter in the same time period, the particle blocking is defined as:

$$R = 1 - \frac{N_{F, \Delta T}}{N_{W, \Delta T}}$$

Since the particle concentration in the reservoir is not constant during



**Figure 3.** Typical shape of count rate curves measured resulting in retention of  $R = 93\%$ . The upper curve represents the tip without filter, lower curve tip with filter.



**Figure 4.** Summary of retention measurements. 60% of the filter tips investigated belong to the class below 90% retention. 30% show retention values between 90% and 99% and only one filter tip, the USA Scientific TipOne 200  $\mu\text{l}$  tip, shows values better than 99%. The individual results are listed in Figure 5.

the measurement, the two types of tips are alternatively measured several times. This procedure is repeated three times for every type of tip.

### Results

Figure 3 shows typical count rate curves measured for tips without filters (upper, black) and with filters (lower, gray). The retention ( $R$ ) measured for the different filter tips covers a wide range. Filter tips, therefore, were classified into three different retention classes depending on their blocking efficiency: a lower retention class containing all filter tips with retention values smaller than 90%, a medium class for all filter tips with retention values between 90% and 99%, and a class summarizing all tips with values better than 99%.

Figure 4 summarizes the results of

the measurements. 60% of the filter tips investigated belong to the class below 90% retention. 30% show retention values between 90% and 99% and only one filter tip, the USA Scientific TipOne 200  $\mu\text{l}$  tip, shows values better than 99%. The individual results are listed in Figure 5.

### About the author

Woody Moser is a Senior Product Manager with USA Scientific, Inc.

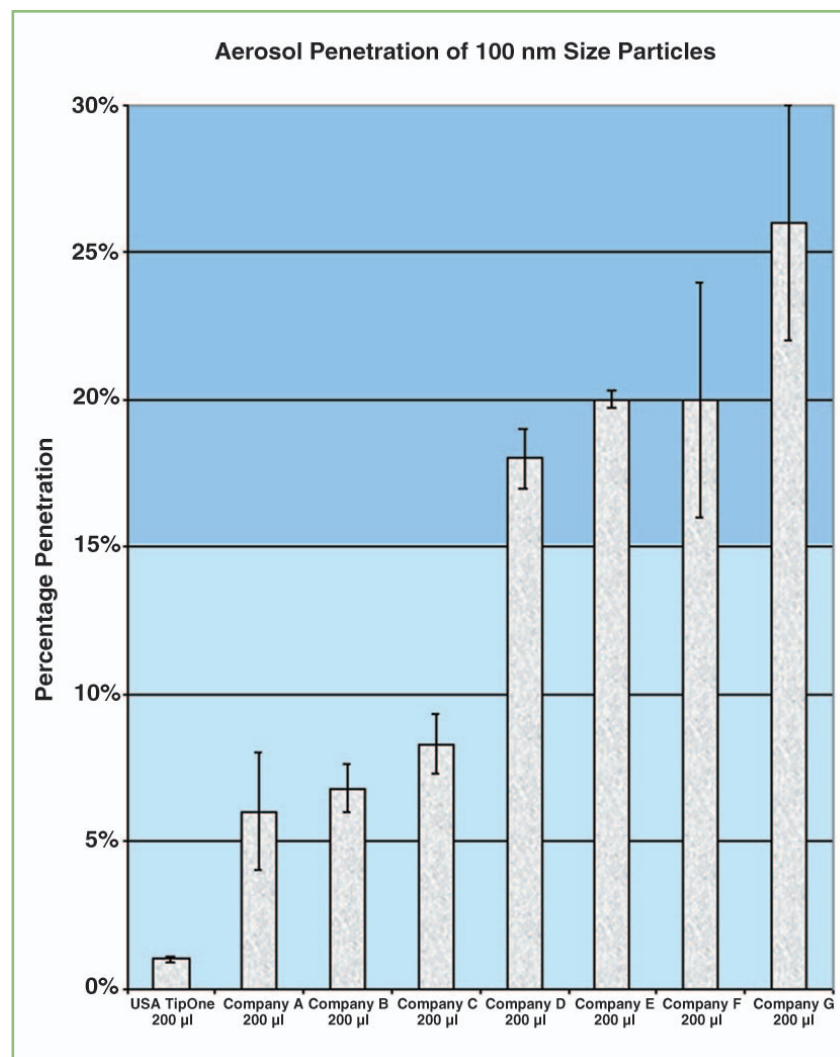
■ **USA Scientific Inc.**

**800-522-8477**

**www.usascientific.com**

### References

1. Hinds, W. C. *Aerosol Technology*, 2nd edition. John Wiley & Sons, New York (1999).
2. Brown, R. C. *Air Filtration*, Pergamon, Oxford (1993).



**Figure 5.** Particle penetration through various filter tips.