THE CORRELATION OF HYDROPHILE - LIPOPHILE BALANCE OF FILTERS WITH VIRUS DESORPTION

Patricia A. Shields¹, Samuel R. Farrah* and Dinesh O. Shah²

Departments of Microbiology and Cell Science¹, Chemical Engineering² and Anesthesiology², Center for Surface Science & Engineering, University of Florida, Gainesville, Florida 32611

ABSTRACT

The rise of water and rise of carbon tetrachloride on positively charged microporous filters were determined. The percentage of rise of carbon tetrachloride/rise of water was determined after both solutions had risen for 4 minutes. The values obtained were found to correlate well with previous measurements of the contact angle of carbon tetrachloride on water saturated-filters and with results of studies on the effect of detergents on elution of viruses adsorbed to the filters. With relatively simple measurements, it is possible to determine the relative hydrophylic-lipophilic balance of microporous filters.

*Corresponding author
FILTERS WITH VIRUS DESORPTION

Micro Corp., Cortland, N.Y.; Seitz 5 (asbestos-cellulose), Republic Filters, Milladore, Conn.

Capillary Rise Measurements. Filters were cut in strips measuring 20 x 1 cm. These strips were then dipped in distilled water or carbon tetrachloride to a depth of one cm. The time at which the strip was dipped in the liquid was taken as the zero reference time. The rise of liquid on the filter was measured at one minute intervals for 10 to 12 min. The ratio of the distance travelled by carbon tetrachloride over that of water was determined for values taken after the liquids had risen for 4 minutes. The values shown in figures 1 and 2 represent the mean values of at least three trials for capillary rise of water or carbon tetrachloride in four different positively charged filters.

Statistical analysis. Correlation coefficients (r values) were determined between the physical measurements of the filters (contact angle of carbon tetrachloride and the ratio of the rise of carbon tetrachloride/the rise of water) and measurements of virus desorption (the concentration of Tween 80 required for > 50% of virus elution and the percent of viruses eluted with 0.1% Tween 80).

RESULTS AND DISCUSSION

All filters can be considered as composites of hydrophilic and hydrophobic sites. The relative number of these sites influences the capillary rise of water and hydrophobic liquids on the filters. Water rose at different rates on the four filters tested (Figure 1). The relative order of the filters (highest to lowest rise of water) was as follows: Virosorb 1 MDS > Zeta plus C-30 > Seitz S > Posidyne N66. These results suggest that the 1 MDS filters are the most and the Posidyne N66 filters the least hydrophilic of the filters tested. Carbon tetrachloride also rose at different rates on the filters (Figure 2). The relative
Water on positively charged filters.

The rise of carbon tetrachloride was as follows:
- Virosorb 1 MDS > Posidyne N66. Since the rise of carbon tetrachloride are determined by the relative hydrophobicity of the filters as well as differences in porosities, we decided to compare the values of these filters for the height of the carbon tetrachloride. The rate of rise had reached a plateau (4 min) after that time. It was assumed that by taking the rise of two liquids on the same filter, the porosity of the filter would be eliminated. Porosities and permeabilities could then be compared on the basis of their interaction with water and a nonpolar liquid such as carbon tetrachloride.

Values for the ratios of the rise of carbon tetrachloride/rise of water are given in Table 1. These results show that this ratio was greatest for the Seitz filter (1.33) and lowest for the 1 MDS filter (0.44). Values for the Posidyne N66 and the Zeta plus C-30 (0.50 and 0.76, respectively) were intermediary between the values for the Seitz and 1 MDS filters. These results indicate that the Seitz filters are the most and the 1 MDS filters the least hydrophobic filters among the filters used in this study. The Posidyne N66 and Zeta plus C-30 filters were less hydrophobic than the Seitz but more hydrophobic than the 1 MDS filters.
res of carbon tetrachloride on water -
and for the influence of detergent
adsorbed viruses were obtained (6). It can be
seen for the filters is almost the same for
the one with carbon tetrachloride; ratio of rise
of water; the effect of detergent
adsorbed viruses, and the amount of virus
in a 0.5 M EDTA. It appears that the greater the
contact angle of a filter, the lower the contact angle of
the ratio of capillary rise of carbon
tetrachloride, and the greater the concentration of
adsorbed viruses. With a fixed surfactant
in a 0.5 M EDTA solution, the elution of
contact angle and capillary rise measurements

The measurements of virus desorption are
contact angle of carbon tetrachloride and the
ratio tetrachloride/rise of water. Higher
difference found between the measurements of virus
rise of carbon tetrachloride/the rise of
measurement may be substituted for the more
contact angle of a liquid on a filter in

Measurements on the charge on a filter and the
charge on the filter, the ratio of rise of a nonpolar
tetrachloride/rise of water on microporous filters is
or characterizing the HLB of filters. The
certify our hypothesis that hydrophobic
interactions are important in certain virus-filter associations (8).
The desorption of viruses from filters appears to depend upon the HLB of
the filters, which is determined by the chemical composition of the
filters.

ACKNOWLEDGEMENTS

This work was supported by the U.S. Environmental Protection Agency
grant number R810126-01-0 and by the Center for Natural Resources,
Institute of Food and Agricultural Sciences, University of Florida, as
well as the National Science Foundation Grant # CPE-8005851.

REFERENCES

1. Gerba, C.P. Applied and Theoretical Aspects of Virus Adsorption to

2. Sobsey, M.D., Wallis, C., Henderson, M., Melnick, J.L. Concentration
26: 529-534.

Viruses from Large Volumes of Tap Water Using Pleated Membrane

4. Kessick, M.A., Wagner, R.A. Electrophoretic Mobilities of Virus

5. Sobsey, M.D., Jones, B.L. Concentration of Poliovirus from Tap Water

Comparison of Positively Charged Membrane Filters and Their Use in

Novel Approach for Modifying Microporous Filters for Virus
Concentration from Water. Appl. Environ. Microbiol. 1988; 54: 1325-
1329.

Antichaotropic Agents on Elution of Poliovirus Adsorbed on Membrane