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# Membrane Testing Using Polymeric Dyes

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# NOTE

# Membrane Testing Using Polymeric Dyes

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**Abstract**

Membranes for use in ultrafiltration are manufactured to obtain a defined pore size which will retain particles, colloids, and soluble polymeric materials with molecular weights above a critical value. The presence of pores or defects which are larger than the desired size will have a deleterious effect. The use of a polymeric dye with a defined molecular weight distribution allows a detection of these oversized pores. The method described is simple, rapid, and nondestructive.



Ultrafiltration membranes are usually characterized by a pure water flux under defined operating conditions and a molecular weight cut-off. The latter is normally defined as the molecular weight at which a high rejection coefficient, $\sigma$, greater than 0.95 is observed. During manufacture, shipping, or in use situations, pores of defects may be introduced which are larger than those desired. Thus an anomalously high flux may be observed and the desired retention reduced.

Synthetic polymeric dyes have been developed (*1*) which are intended for use as food additives (*2, 3*) Their mode of manufacture (*4*) ensures that they are essentially free of low molecular weight organic species, and importantly they contain no low molecular weight polymer. These polymeric dyes are readily soluble in cold water and are stable to heat, light, extremes of pH, and are resistant to bacterial action.

The polymeric dye may be used to test the integrity of the membrane and, by a suitable choice of concentration, will at the same time allow a quantitation of the water flux of the membrane. Figure 1 shows data for the flux obtained at various polymer concentrations under defined operating

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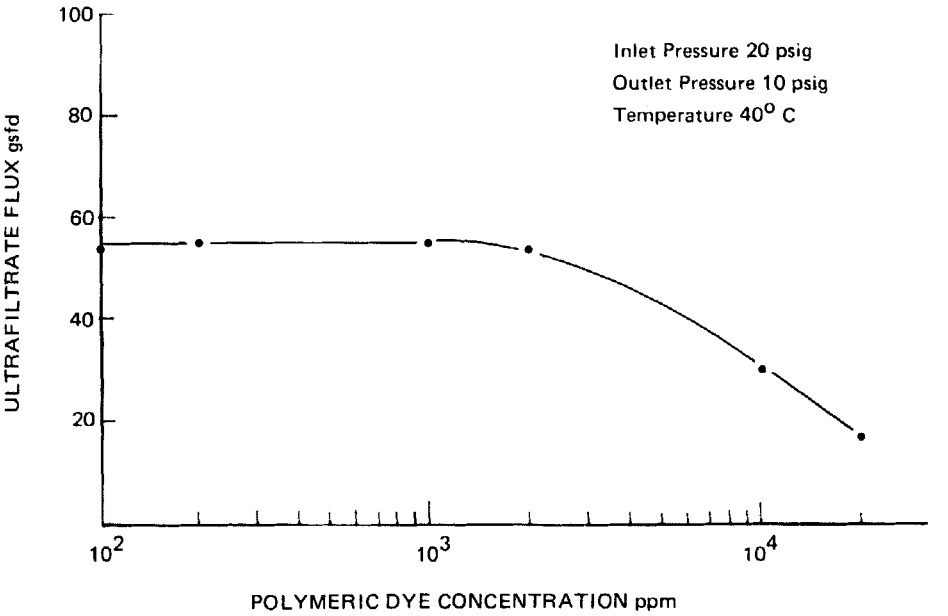


FIG. 1. Ultrafiltrate flux (gsfd) as a function of polymeric dye concentration for a Romicon PM10 hollow fiber.



conditions. The membrane employed was a Romicon hollow fiber, PM10. At polymeric dye concentrations up to 1000 ppm the flux is independent of dissolved solute concentration. The flux and retention measurments were made after recycling the feed and ultrafiltrate to the feed tank for 15 min. These polymeric dyes may be readily quantitated spectroscopically at concentrations above 1 ppm. [These dyes (Poly R-481 and Poly R-478) may be purchased for application testing from the Aldrich Chemical Co., Milwaukee, Wisconsin.] At 1000 ppm feed concentrations and ultrafiltrate concentrations of 1 ppm, rejection coefficients of 0.999 may be quantitated. If the membrane is visible, it is possible to see if the polymeric dye transport is general or localized. This polymeric dye, when tested at 1000 ppm, was not present in the ultrafiltrate at greater than 1 ppm for the following Romicon hollow fibers: PM5, PM10, PM30, and PM50.

We have employed this method as a quality control test for new membranes to determine modes of membrane failure during use and to monitor flux changes under various operating conditions.

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