

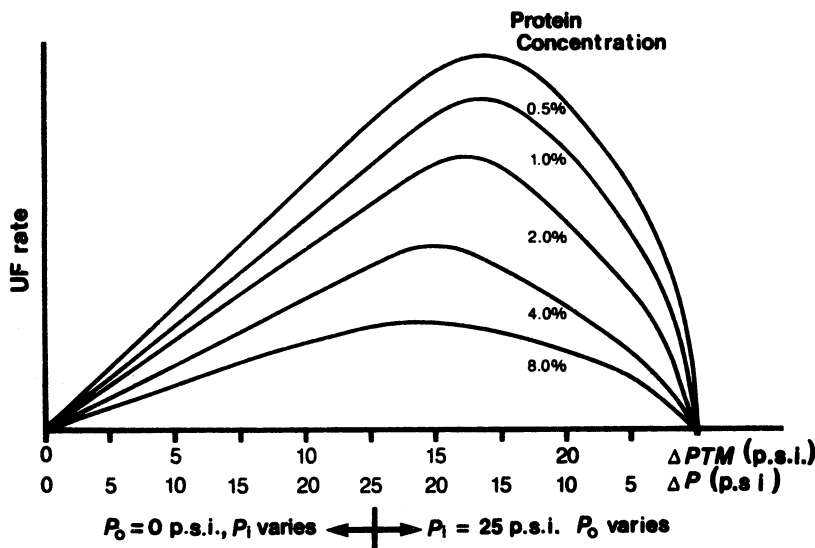
branes, it may be possible to push  $P_i$  to high levels. Therefore, at low  $\Delta P_M$  values, flux increases with  $\Delta P_M$ ; however, at high  $\Delta P_M$  values, filtration flux drops as a result of the decrease in velocity. Figure 11.23 describes optimal values of  $\Delta P_M$  resulting in the maximum UF or MF rate for various solute concentrations.

In the absence of gel formation, the filtration flux increases linearly with  $\Delta P_M$ . Figure 11.24 depicts the variation of filtration flux ( $J$ ) with  $\Delta P_M$ . At low  $\Delta P_M$  values,  $J$  increases linearly with  $\Delta P_M$  because of the absence of gel polarization. However, at high  $\Delta P_M$ , gel formation takes place, and gel resistance ( $R_G$ ) increases with increasing  $\Delta P_M$ , resulting in a constant filtration flux ( $J$ ) over a large range of high  $\Delta P_M$  values. At higher solute concentrations, flux levels off at lower  $\Delta P_M$  values.

The *rejection coefficient* of an ultrafilter is defined as

$$R = \frac{C_B - C_F}{C_B} = 1 - \frac{C_F}{C_B} \quad (11.73)$$

where  $C_F$  is the concentration of the solute in the filtrate. When  $C_F = 0$ , only water passes through the filter and  $R = 1$ , which is complete solute rejection. If  $C_F = C_B$ , complete solute transfer to the filtrate takes place and  $R = 0$  (no rejection). Usually,  $0 < R < 1$  and is closer to 1 (i.e.,  $R \approx 0.95$  or  $0.98$ ). The value of  $R$  is a measure of the selectivity of the membrane for certain solutes. Selective separations of various compounds can be achieved using membranes with the right molecular-weight cutoff. Figure 11.25 depicts the variation of the rejection coefficient ( $R$ ) with MW of the solute. For  $MW > 10^5$  and  $MW < 10^3$ ,  $R = 1$  and  $R = 0$ , respectively. That is, the membrane allows complete passage



**Figure 11.23.** Filtration flux optimized as a function of transmembrane pressure at varying solute concentrations and fixed maximum inlet pressure. (With permission, from R. S. Tutunjian, in M. Moo-Young, ed., *Comprehensive Biotechnology*, Vol. 2, Elsevier Science, London, 1985.)