Reverse osmosis (RO), the first cross-flow membrane separation process to be widely commercialized, removes all organic compounds and ions. A large selection of reverse osmosis membranes is available to meet varying water quality requirements. RO meets most water standards with a single-pass system and the highest standards with a double-pass system. RO rejects 99.9+% of viruses, bacteria and pyrogens. Pressure, on the order of 200 to 1000 psig, is the driving force of the RO purification process. It is much more energy efficient compared to heat-driven purification (distillation) and more efficient than the hazardous chemicals involved in ion exchange.

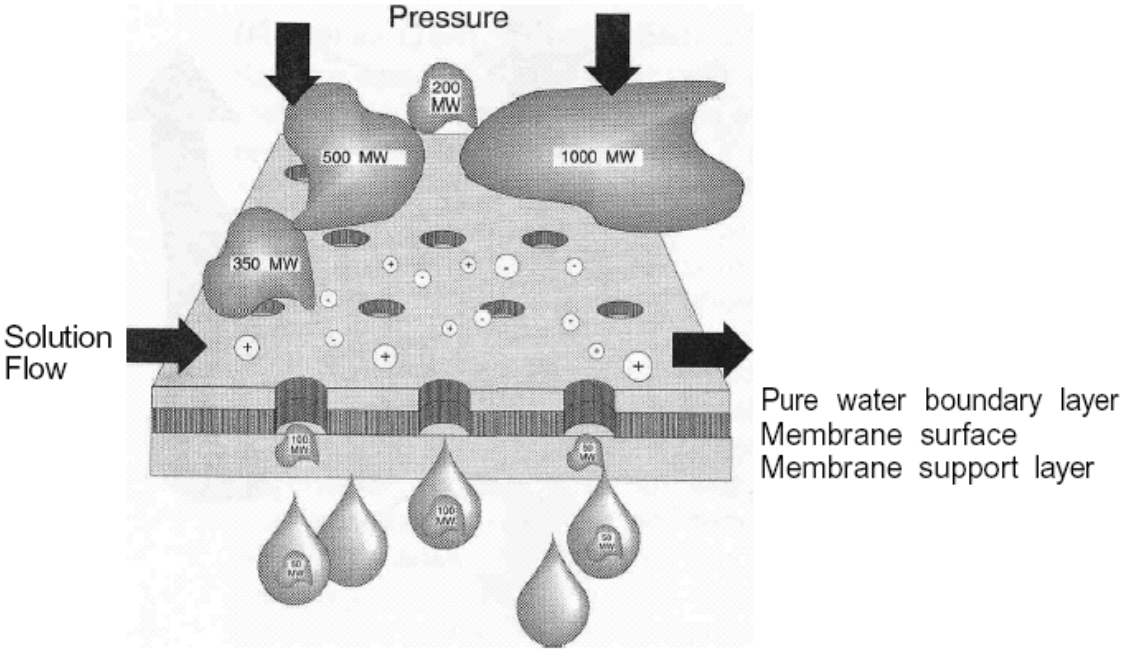

Figure 24 - Reverse Osmosis

Controlling microorganism colonies is important in maintaining the performance of all water systems, especially ultra-pure systems where bacterial fouling is the leading cause of contamination. Regularly monitored bacterial control equipment is a necessity.

Disinfection may occur on a continuous or a periodic (shock) basis. Continuous disinfection is preferable to keep bacterial populations from reestablishing themselves. Shock treatments are used when continuous biocide would be harmful to the end user. In shock treatment, the biocide

and its by-products are flushed from the system prior to re-start.

Shock treatments generally remove a bacteria population but do not prevent it from recurring. Two important considerations when using biocides are 1) concentration and 2) dwell time. The higher the concentration, the shorter the dwell time needed for effective disinfection.

Other factors that affect biocide effectiveness are pH, temperature, water hardness, chemical compatibility and cleanliness issues. Most systems require cleaning before disinfection. Cleaning removes most surface bacterial film but they quickly re-establish themselves (see Disinfection).