Pure Water: The Basics

How Do I Choose the Correct Water Purification System?

Water purification technologies

Water purification is a step-by-step process often requiring a combination of technologies. Barnstead manufacturers a complete range of equipment utilizing all technologies necessary to purify water in your laboratory.

Distillation

Distillation is the most common water purification technology used in laboratories worldwide. Water undergoes phase changes during the process, changing from liquid to vapor and back to liquid. It is the change from liquid to vapor that separates water from the dissolved impurities. Distillation has the broadest removal capabilities of any single form of water purification.

Reverse Osmosis

Reverse osmosis occurs when water is pushed through a semipermeable membrane using external pressure. The membrane has molecular weight cut off in the 300 Dalton range. Most water impurities do not pass through the membrane. They collect on the membrane surface and are flushed to the drain. Reverse osmosis is a popular method of pretreatment to distillation or deionization systems and for purifying water for general applications such as glassware and plasticware washing.

Deionization

Deionization is also referred to as demineralization or ion exchange. The process removes ions from feed water with the use of synthetic resins. These resins have an affinity for dissolved inorganics and are divided into two classifications: cation removal resins and anion removal resins. Deionization is the only technology which produces the resistivity requirement for Type I reagent grade water. In laboratory water systems, cation and anion resins are most often mixed together allowing them to achieve maximum ionic purity.

Filtration

Barnstead offers both depth (nominal) and membrane (absolute) filters. Depth filters are most commonly used as a pretreatment and are manufactured by winding fibers around hollow and slotted tubes. As water passes through the fiber toward the center tube, particles are retained on the fiber. Traditionally this type of filter removes most of the impurities above the rated pore size of the filter. Most often these filters are rated to remove larger particles (> 5 micron) protecting the technologies that follow. Membrane filters are often termed absolute meaning that they are designed to remove all particles above the rated pore size of the filter. These filters use a membrane or fiber and are most often used at the end of a system to remove bacteria or other particles that are not removed by the preceding technologies. Traditionally membrane filters in laboratory water systems have a rated pore size below 0.45 micron, most often 0.2.

Ultrafiltration (UF)

Ultrafiltration membranes are primarily used in laboratory ultrapure water systems to remove pyrogens (bacterial endotoxins) and to aid in the removal of nucleases and DNA. Ultrafilters use a combination of physical and chemical attraction to remove particles. By design, ultrafilters operate similar to reverse osmosis membranes, particles are captured on the surface of the membranes and are flushed from the membrane via a reject stream. Ultrafilters are used at the end of systems ensuring the near total removal of impurities.

Adsorption

Adsorption uses high surface area activated carbon to remove organics and chlorine from feed water. It is used as a first or second step in most water purification systems and may be used as a final step, in combination with ion exchange resins, to achieve ultra low TOC. Organics and chlorine adhere to the surface of the activated carbon and remain attached to the carbon.

Ultraviolet (UV) Oxidation

Photochemical oxidation with ultraviolet light at dual, 185 and 254, nanometer wavelengths can eliminate trace organics, and kills microbes in pure water. When used in a Barnstead reagent grade water system, ultraviolet light can reduce trace organics to less than 1 ppb TOC. Ultraviolet light at a 254 nanometer wavelength is used in storage reservoirs or distribution lines to prevent bacterial growth.

Combination Ultraviolet Oxidation and Ultrafiltration (UV/UF)

The use of ultraviolet oxidation and ultrafiltration technologies in conjunction with adsorption and deionization in the same system produces water free of virtually all impurities. These technologies have demonstrated the ability to remove nucleases such as RNase and DNase as well as DNA when challenged with known concentrations of the material. The UV/UF units produce reagent grade water with resistivities up to 18.2 megohm-cm, organics < 2 ppb, pyrogens <0.001 EU/ml and no detectable RNase, DNase or DNA.