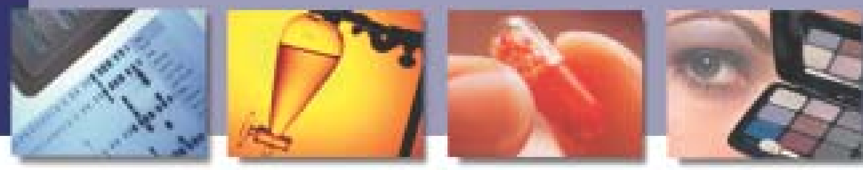


What is Deionization?

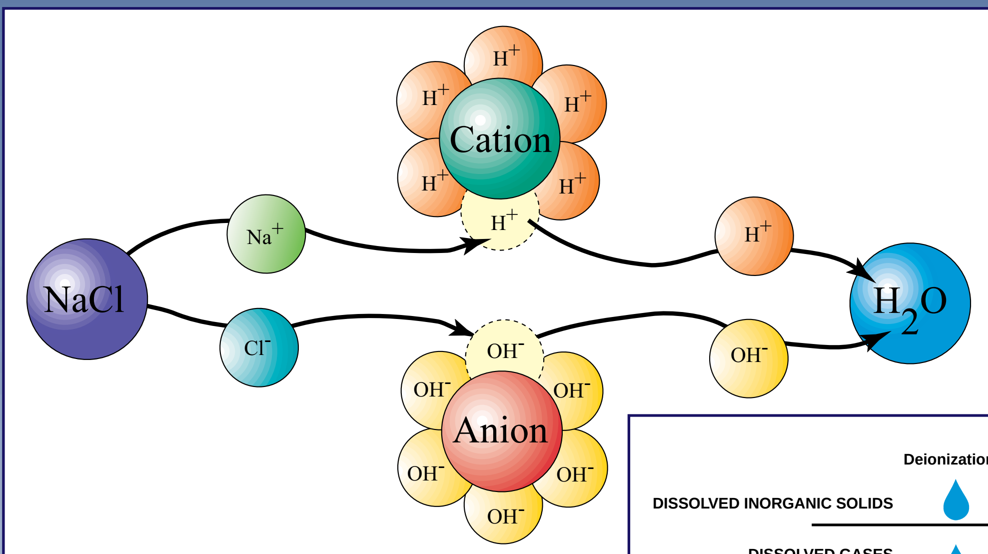
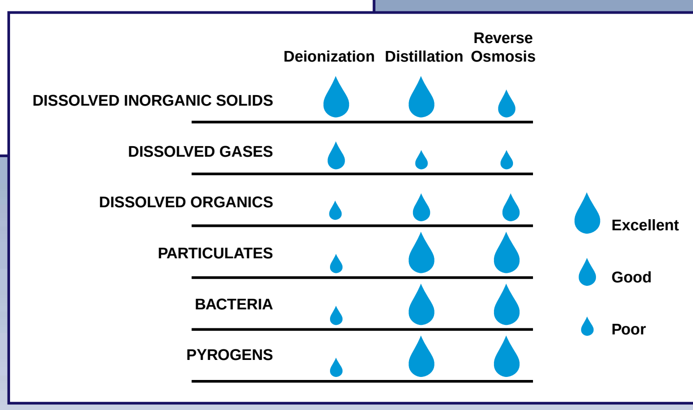


Diagram showing how Cations and Anions are divided



Chart

What are Ions?

Ions are divided into two-groups; cations and anions. Cations have a positive charge and include sodium (Na^+), calcium (Ca^{++}), and magnesium (Mg^{++}). Anions have a negative charge and include chloride (Cl^-), sulfates ($SO4^{--}$), and bicarbonates (HCO_3).

How are Ions Removed from Water?

Ions are removed from water through a series of chemical reactions. These reactions take place as the water passes through ion exchange resin beds. In the regenerated form, cation resin contains hydrogen (H^+) ions on its surface which are exchanged for positively charged ions. Anion resin contains hydroxide (OH^-) ions on its surface which are exchanged for negatively charged ions. The final product of these two exchanges, H^+ and OH^-, form water molecules.

Separate Bed Reaction

When cation and anion resins are separated, reactions take place independently. This does not allow the ion exchange reaction to reach its completion. For this reason maximum resistivities can not be achieved.

Mixed Bed Reaction

When cation and anion resins are mixed, reactions take place to their completion simultaneously exchanging both cations and anions, providing water that is virtually ion free.

How are Ions Measured?

Electrical conductance or resistance is measured by two in-line electrodes. Electrical current moves through water using ionic molecules as stepping stones. The fewer stepping stones, the more difficult the passage of electricity. This causes less electrical conductance and more electrical resistance. The temperature of the water also affects its conductivity/resistivity. Barnstead electrodes and meters automatically compensate for water temperature difference to ensure accuracy and recognizable readings.




Barnstead understands water and realizes that in order to achieve Type I water, meeting the most stringent requirements of our customers, multiple technologies must be used. It not only is the use of these technologies, but how they are used that are important. The information listed below addresses these technologies and explains their use and function in a Type I system.

Do I Need Water Pretreatment Before Deionization?

Pretreating feedwater by deionization, distillation, or reverse osmosis will extend the life of deionization cartridges. Most feedwater contains non-ionized material that may foul deionization resin. These materials, including particles and organics, are removed using a Barnstead pretreatment cartridge in the first position of deionization systems. The Barnstead W.A.T.E.R.™ program determines if there is a need for pretreatment.

Step-By-Step Technologies Used in Barnstead Deionization Systems

1. Adsorption

Barnstead pretreatment cartridges use activated carbons and a unique macroreticular resin. Together they remove organics, chlorine, colloids, some bacteria, and endotoxins from feedwater. Carbon and macroreticular resin extend the life of deionization resin and are only available in Barnstead pretreatment cartridges. The use of two different carbons promotes the removal of both large molecular weight and smaller volatile organics, providing for lower TOC values in the final product.

2. Two bed deionization

Some Barnstead systems use a cation resin and anion resin in separate halves of a cartridge which remove most but not all ionic impurities.

3. Mixed bed deionization

When feedwater is distilled or deionized and resistivity is greater than 50,000 ohms, and if feedwater alkalinity + CO_2 + silica is greater than 50% of total solids, a two bed cartridge is not useful. We use semi-conductor grade mixed bed deionization resin to achieve maximum resistivity and low TOC. Semi-conductor grade resins provide for quick rinse up and negligible organic carry over.

4. Ultraviolet oxidation (UV)

Barnstead NANOpure® DIamond™ UV and Life Science, EASYpure® II UV, RF/UV and UV/UF include a dual wavelength ultraviolet lamp that oxidize organics and kills bacteria. Product water from these systems can have a total organic carbon (TOC) content of 1 ppb or less. Dual wavelength UV light (185 and 254 nm) kills microbes by disrupting cell metabolism and reacts with dissolved oxygen to create ozone, promoting hydroxyl radical formation which oxidizes organics. By-products of this reaction (ionic species) are removed by the organic free cartridge that follows.

5. Combination mixed bed deionization and adsorption

We use a combination semiconductor grade mixed bed deionization resins and synthetic carbon in a single cartridge to achieve maximum resistivity and low total organic carbon (TOC). With the optional ultraviolet lamp we can achieve 1 ppb or less TOC. Without the optional ultraviolet lamp we can achieve less than 10 ppb.

6. Ultrafiltration (UF)

Ultrafiltration in Type 1 systems are used to remove pyrogens (bacterial endotoxins) and is critical when product water is to be used for tissue culture, cell culture and media preparation. The Barnstead ultrafilter is capable of producing water with a pyrogen (endotoxin) level of less than 0.001 EU/ml and as a system a > 7 log reduction occurs.

7. Membrane filtration

Absolute 0.2 micron membrane filtration is used on the outlet of all Type I systems to remove bacteria or particles that may have passed through the cartridges.

8. 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, DNase as well as DNA when challenged with known concentration. The UV/UF units produce reagent grade water with resistivities up to 18.3 megohm-cm, organics < 2 ppb, pyrogens <0.001 EU/ml and no detectable RNase, DNase or DNA.