Total Water

5002 World Dairy Dr.
Madison, WI 53718

(608) 221-2236
(800) 929-2236
Fax (608) 221-7328

pH of High Quality Deionized Water

The acidity of a water normally can be thought of in terms of the concentration of hydrogen ions present in it. This can vary over a wide range of low concentrations and expressing it in logarithmic terms results in a reasonable range of numbers. pH is defined as $-\log_{10}$ hydrogen ion concentration. Thus the more acid a solution, the larger the hydrogen ion concentration and the lower the pH. Pure water contains both hydrogen and hydroxide ions at concentrations of 10^{-7} mol/l. It thus has a pH of 7. A more acid water has a pH of less than 7 and a more alkaline water, more than 7. The pH of water, and the ease with which this is changed by the addition of acids or alkalies, depends on the relative and total concentrations of the different substances already present in the water.

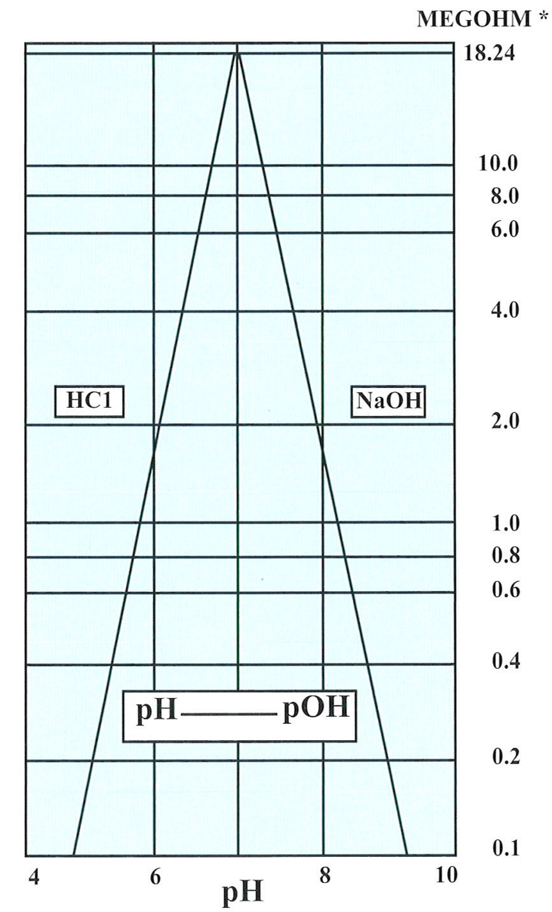
It is generally accepted that pure water is "too pure" to indicate an ionic reaction measurable by potentiometry and the meter of a pH instrument is very unstable when the attempt is made. The use of pH papers is unreliable; values may differ from a meter by as much as 2 units. If a drop of neutral salt solution, (such as the saturated potassium chloride used in a reference electrode), is added to the test water, a completely reliable pH can be determined by potentiometry and readings are stable and reproducible. pH may be measured on any instrument used for aqueous pH measurements if the instrument is standardized against a pH 7.0 buffer just before use. A 100 milliliter sample beaker is rinsed three times with the test water and 0.30 milliliters of saturated potassium chloride is added to the solution in the beaker. The test water should be added to the beaker without agitation and the pH measured immediately.

Very high quality deionized water may produce a pH measurement of 6.0 to 6.4 following this test procedure. This is due to exposure to the atmosphere, absorption of gases (primarily CO_2), the formation of carbonic acid, and the lack of buffering salts (whereby minute amounts of carbonic acid will produce a sizeable pH change). When testing very high quality DI water, it is critical that the sample have reduced exposure to the atmosphere and the test be performed immediately.

The pH test is one of the most widely used tests in the water industry and is also the least understood.

An article appeared in the publication "American Laboratory" that established a sure-fire method of determining the minimum and maximum pH values possible at known specific resistance values. The article discusses various causes of erroneous pH measurements and concludes that from specific resistance readings one can accurately determine the pH range of the water being tested. This graph is provided to plot minimum and maximum pH values possible at any known specific resistance value up to 18 megohms. The following graph depicts this relationship:

Limiting theoretical pH values of traces of HC1 and NaOH in pure water.



This graph shows the pH of deionized water with a specific resistance of 10 megohms-cm at 25°C can not have a ph lower than 6.7 or higher than 7.3. The pH will diminish to 7.0 at 18.24 megohm/cm at 25°C.

* Specific Resistance - Megohm / cm @ 25°C

Total Water

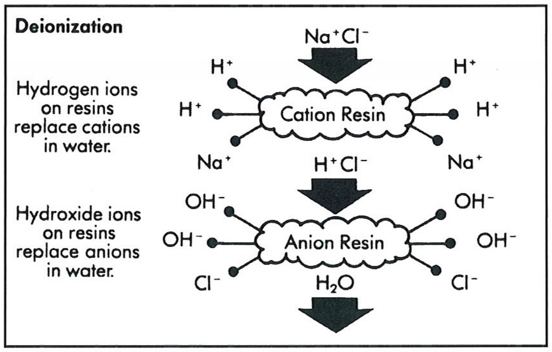
5002 World Dairy Dr.
Madison, WI 53718

(608) 221-2236
(800) 929-2236
Fax (608) 221-7328

SERVICE DEIONIZATION

DEIONIZATION?

Deionization is one of the most efficient processes known for removing ionic dissolved salts and minerals



from water. The deionization process uses synthetic ion exchange resin to remove dissolved solids from water by ion attraction and exchange. This synthetic resin is charged with either hydrogen (H^+) or hydroxide (OH^-) ions which causes the resin to release their ions in exchange for the positively charged cations (Mg^{+2}, Ca^{+2}, Na^+, etc.) which may be present in the raw feed water supply.

Two types of deionizers are commonly used, mixed- bed and separate bed. A mixed-bed deionizer combines both cation and anion resins in a single vessel. Mixed-bed deionizers can produce very high quality water that approaches the theoretical limits of purity (18.24 megohm-cm resistivity at 25°C) and a neutral pH of 7.0. A separate bed system consists of separate vessels of cation and anion resin. Separate bed deionizers have the economical advantage of 16-40% greater exchange capacity than an equivalent amount of mixed-bed resin. However, the water produced by separated bed deionizers is lower in quality than by mixed-bed deionizers and may require the use of a mixed-bed polisher if higher quality water or a neutral pH is needed.

SERVICE EXCHANGE DEIONIZATION?

Service exchange deionization uses this ion exchange resin in movable tanks or cylinders. These tanks are typically lined, fiberglass pressure vessels of varying sizes (usually volumes of 0.25 ft^3 to 3.6 ft^3). Each size will accommodate specific total production capacities and flow rates to fit various situations precisely. Service deionization is a clean and simple way to produce purified water. All of the equipment, regeneration, maintenance and repair is provided by the service company. The deionizers are installed on your tap water and operate on line pressure to provide ionic contaminant removal. Eventually the ability of the deionizers to remove ionic impurities becomes "exhausted" and the service exchange company sends a serviceperson to remove the tanks on site and replace them with freshly regenerated units.

Regeneration

When most of the available hydrogen (H^+) and hydroxide (OH^-) ions attached to the ion exchange resin during the initial regeneration cycle have been exchanged for ionic impurities in the water, the resin tank is "exhausted" and requires replacement. The exhausted deionizer is brought back to the service facility for regeneration.

During regeneration, an acid solution is drawn through the cation resin and a caustic solution is drawn through the anion resin. The cations and anions previously removed from the water supply are released by the resin in exchange for H^+ and OH^- ions present in high concentrations in the regeneration solution. A proper regeneration process is critical. Improper regeneration will result in reduced deionizer exchange capacity, lower total volume output and lower water quality.