Ion Exchange

Ion exchange is a process during which ions are exchanged between two electrolytes or between an electrolyte solution and a complex, often for the purpose of decontamination, separation or purification. The ion exchange process uses resin beads that trap and exchange ions. There are two types of ion exchange resins: cation resins, which are used for the purpose of trapping positively charged ions; and anion resins, which exchange negative ions. For example, ion exchange can be used to soften hard water. Cation resins are used to exchange the sodium for the calcium in order to produce softened water. Mixed bed resins, or the combination of cation and anion, are used for the purpose of achieving purified water. This is an efficient ion exchange method for exchanging positive and negative ions simultaneously.

Deionization

Ion exchange plays a large role in industrial water treatment. Production of deionized (DI) water, water for injections (WFI), and ultra pure water (UPW) is weightily utilized by deionization with ion exchange resins and continuous electrodionization cells. In general, the deionization process is the removal of negatively and positively charged ions (salts and minerals) from a solution. The positively charged ions are removed in exchange for the chemical equivalency of hydrogen ions (H+), and negatively charged ions are removed in exchange for a chemical equivalency of hydroxide ions (OH-). The hydrogen and hydroxide ions unite to form water molecules (H++OH-=HOH or H2O).

Ion Exchange Water Softeners

Ion exchange is used in a variety of applications, but it is the most common method of water treatment for softening household water for dish washing, laundry, and bathing. Water softeners are needed for household water to remove minerals, such as calcium and magnesium, from hard water. Water softening reduces limescale, calcium buildup, and water spots on dishes and bathroom fixtures.

Scale prevention is another household water treatment problem that ion exchange can resolve. Hard water minerals that flow through household appliances such as dishwashers, water heaters and washing machines can create scale buildup and eventually diminish the performance of the appliances. Ion exchange removes the hard minerals from tap water, extending the life of household appliances.

Ion Exchange and Industrial Water Treatment

Ion exchange is used in managing a number of water treatment problems in a variety of industries. Biochemistry and pharmaceuticals manufacturing are other applications that rely on ion exchange. For example, ion exchange chromatography is the process in which molecules are separated based on the charge of the proteins. In this context, ion exchange is useful when extracting amino acids and DNA. Ion exchange is also used in industrial laboratories for producing pure water, while mixed bed resins are typically used in smaller laboratories.

Ion exchange can also be used to recover valuable metals from water streams, including copper, silver and gold. This is a critically important use of ion exchange for industries mandated to remove dissolved minerals from waste water. Metal finishing and semiconductor manufacturing are typical applications for the use of ion exchange in waste water treatment.

Ion exchange is a powerful water treatment technology for many water treatment problems that require the removal of metals and other elements from water, in a wide variety of applications, including industrial, pharmaceutical, biochemistry and residential.