

High Purity Water

Highly purified water (HPW), high purity water or ultrapure water is necessary for various applications including dialysis, pharmaceutical and electronics rinse water. Highly purified water is a commonly used term to emphasize the fact that the water is treated to the highest levels of purity, including the removal of: organic and inorganic compounds; dissolved and particulate matter; volatile and nonvolatile, reactive and inert; hydrophilic and hydrophobic; and dissolved gasses.

While each industry uses what it calls “highly purified water”, the quality standards vary, meaning that the highly purified water used by a pharmaceutical plant is different than that used in an electronics plant, semiconductor fabrication plant or a power station. For example, pharmaceutical facilities will use highly purified water as a cleaning agent as well as an ingredient in products, so they require water free of endotoxins, microbials and viruses. Electronics and semiconductor plants use highly purified water as a cleaning agent, so it is important that the water not contain dissolved contaminants that may precipitate or particles that may lodge on the circuits and cause microchip failures. The power industry, on the other hand, uses highly purified water as a source to make steam to drive steam turbines.

A number of organizations and groups develop and publish standards associated with the production of highly purified water. Pharmaceutical plants follow water quality standards as developed by pharmacopeias, including the United States Pharmacopeia (USP), European Pharmacopeia (EP), British Pharmacopeia and Japanese Pharmacopeia. The most widely used requirements for highly purified water quality for electronics and semiconductor fabrication are documented by the American Society for Testing and Materials International (ASTM International) and Semiconductor Equipment and Materials International (SEMI).

A typical highly purified water system has three stages: a pretreatment stage to produce purified water, a primary stage to further purify the water, and a polishing stage, often the most expensive part of the treatment process. The usual treatment scheme comprises of reverse osmosis, electrodeionization and then ultrafiltration. Today, ion exchange (IX) and electrodeionization (EDI) are the primary deionization technologies associated with highly purified water production, in most cases following reverse osmosis (RO). Depending on the required water quality, highly purified water treatment plants often also feature degasification, microfiltration, ultrafiltration and ultraviolet irradiation. Ultrafiltration (UF) is commonly used after EDI to remove microbial contamination that may get generated due to the presence of anion resin inside the EDI unit. Reduction values for a 10,000 Dalton (Da) molecular weight cut-off (MWCO) membrane have been summarized in Table 1 below.

TABLE 1. LOG REDUCTION VALUES BASED ON A 100,000 DA MWCO UF MEMBRANE.

Component	Log Reduction Value
Giardia	6
Cryptosporidium	6
Bacteria	6
Viruses	5
Endotoxins	4

HIGH PURITY MEMBRANE ELEMENTS

TurboClean® High Purity elements and TurboClean® High Purity Heat Sanitizable elements are ideal for applications which demand ultrapure water such as dialysis, pharmaceutical and semiconductor rinse water. TurboClean elements feature a unique, sanitary, patented hard-shell construction that offers better value than other sanitary elements.

TurboClean® High Purity RO elements, TurboClean® High Purity Low Energy RO elements and TurboClean® Low Fouling RO elements may be used to produce high purity water.

TurboClean® High Purity Heat-Sanitizable RO elements may also be used to produce high purity water. These elements are typically operated at temperatures between 10-15°C (50-59°F) and are sanitized using a heat-sanitizing procedure at up to 80-90°C (176-194°F).

TurboClean® High Purity UF elements and TurboClean® High Purity Heat-Sanitizable UF elements may be used after the RO system to further polish the water.

ULTRADYN™ Hollow Fiber UF modules, specifically ULTRADYN™ FS10 FS FUST653 and ULTRADYN™ FS10 FC FUST653 modules, may also be used after the RO system to further polish the water. The modules with the 6,000 Da and 10,000 Da MWCO are most commonly used for high purity water applications. These modules are also heat-sanitizable up to 98°C (208°F).

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