RO Efficiency Rating Certific

Voluntary certification of RO systems can increase safety & substantiate labels claims

By Rick Andrew

Reverse osmosis (RO) systems are water treatment devices that reduce a variety of total dissolved solids (TDS) and other contaminants by reversing the natural flow of water. These systems use reverse pressure to force water through a semi-permeable membrane, so water passes from a more concentrated solution to a more dilute solution. Most RO systems also include pre- and post-filters to keep contaminants like silt and chlorine from damaging the membrane.

While most U.S. states have no specific regulations or requirements governing the use of RO systems, many manufacturers choose to pursue voluntary certifications of their systems to increase safety and substantiate labels claims. NSF/ANSI Standard 58: Reverse Osmosis Drinking Water Treatment Systems covers point-of-use (POU) RO systems that use reverse pressure through a semi-permeable membrane.

NSF/ANSI 58 establishes minimum requirements for the materials safety, structural integrity, product literature, TDS reduction and additional contaminant reduction claims of POU RO systems. Certification to NSF/ANSI 58, as well as to other NSF/ANSI standards for drinking water treatment systems, ensures consumers that:

- Contaminant reduction claims are true.
- The system does not add anything harmful to the water.
- The system is structurally sound.
- The product advertising, literature and labeling are not misleading.
- The product materials and manufacturing process used at the time of certification do not change over time, or, if they change, the new versions are recertified.

NSF/ANSI 58 addresses RO drinking water treatment systems that are designed to be used for the reduction of specific substances that may be present in drinking water supplies (public or private) considered to be microbiologically safe and of known quality.

TDS & Contaminant Reduction

Based on maximum contaminant level standards established by the U.S. Environmental Protection Agency and working within the consensus standards development framework defined by the American National Standards Institute (ANSI), the NSF Joint Committee on Drinking Water Treatment Units set the requirements for RO water treatment systems. RO systems certified to NSF/ANSI 58 undergo a TDS reduction test that includes determination of the daily production rate, percent recovery and efficiency of the system. The standard requires RO drinking water treatment systems to reduce the influent challenge level of 750 ± 40 mg/L TDS by at least 75%.

The most common elective contaminant reduction claims chosen for RO systems certified to NSF/ANSI 58 include fluoride, nitrate/nitrite, lead and mechanical ation

filtration claims such as cyst and turbidity reduction. The standard also includes requirements for testing and certification of reduction of any combination of the following contaminants: pentavalent arsenic, asbestos, barium, cadmium, chromium, copper, radium 226/228, selenium, perchlorate and volatile organic compounds. Table 1 shows the specific TDS and contaminant reduction requirements.

In addition to requirements for testing and verifying TDS and contaminant reduction claims, NSF/ANSI 58 includes criteria for testing and establishing recovery and efficiency ratings for systems with storage tanks and automatic shutoff valves.

Recovery & Efficiency

Efficiency is the percentage of water entering the RO unit that is available as treated (product) water under normal usage conditions while the storage tank is being filled. Recovery is the percentage of water entering the RO system that is available as product water operating with the faucet open so the storage tank is not being filled.

Recovery is equal to or greater than efficiency because the storage tank produces back pressure that reduces the flow rate of product water into the tank (which reduces the amount of product water produced compared to water coming in), whereas the flow rate of the water going down the drain does not change.

Storage tanks in RO systems typically have an air bladder that provides the pressure to force the water out of the faucet. The air bladder creates back pressure when the faucet is closed.

Recovery & Efficiency Rating Claims

Under NSF/ANSI 58, claims of recovery and efficiency ratings must be equal to or less than the specific rating determined when the system is tested in accordance with the procedures in the standard. This applies to claims made in advertising or marketing materials; in installation, operation and maintenance instructions; and on the data plate or in the performance data.

Systems equipped with both an automatic shutoff device and either a pressurized or a non-pressurized storage tank must report an efficiency rating and may optionally report a recovery rating. All other systems may report a recovery rating, but no efficiency rating is determined or reported.

Recovery & Efficiency Rating Testing

Efficiency for RO systems is determined by measuring how much water is going into the system tank versus how much is going down the drain. The product performance data sheet is required to state the efficiency rating as a percentage of product water, and certification testing determines and validates this number.

For certification to NSF/ANSI 58, the RO system is tested for TDS reduction in addition to any other chemical or mechanical contaminant reduction testing. Sampling and measurements for determining recovery and efficiency ratings are conducted in conjunction with a TDS reduction test. While a recovery rating may be determined for all types of systems, an efficiency rating only is determined for systems equipped with an automatic shutoff device.

Table 1. NSF/ANSI 58 TDS & Contaminant Reduction Requirements

Contaminant	Individual influent sample point limits (mg/L)	Average influent challenge level (mg/L)	Maximum allowable product water level (mg/L)
TDS	750 ± 20%	750 ± 40	187
Arsenic (pentavalent)	0.050 ± 20%, 0.050 ± 25%	0.050 ± 10%	0.010
Barium	10.0 ± 20%, 10.0 ± 25%	10.0 ± 10%	2.0
Cadmium	0.03 ± 25%	0.03 ± 10%	0.005
Chromium (hexavalent)	0.3 ± 20%, 0.3 ± 25%	0.3 ± 10% (added as hexavalent)	0.1
Chromium (trivalent)	0.3 ± 30%	0.3 ± 10% (added as trivalent)	0.1
Chromium (hexavalent and trivalent)	0.3 ± 25%	0.3 ± 10% (added as 0.15 mg/L hexavalent and 0.15 mg/L trivalent)	0.05 (for each species)
Copper	3.0 ± 20%, 3.0 ± 25%	3.0 ± 10%	1.3
Fluoride	8.0 ± 25%	8.0 ± 10%	1.5
Lead	0.15 ± 25%	0.15 ± 10%	0.010
Mercury	0.006 ± 25%	0.006 ± 10% (added as mercuric chloride)	0.002
Perchlorate	0.10 + 25%	0.10 + 10%	314.0
Selenium	0.10 ± 25%	0.10 ± 10% (added as 0.05 mg/L selenite and 0.05 mg/L selenate)	0.05
Radium 226/228	N/A	25 pCi/L	5 pCi/L

Determining RO System Efficiency

While RO water treatment devices are not regulated nationwide, California regulated the use of shutoff values on RO units about 25 years ago, and manufacturers have essentially accepted the shutoff valve as industry standard design for products that include storage tanks. Instead of water flowing to drain continuously, the shutoff valve automatically prevents water entering the unit when the storage tank is full.

While most U.S. states have no specific regulations or requirements governing the use of RO systems, many manufacturers choose to pursue voluntary certifications of their systems.

While the shutoff valve is a small part of the overall RO system, it has a significant impact on the measured efficiency of the treatment system. If the shutoff valve allows the tank to get really full before it turns off, the higher back pressure from the tank as it becomes full means the tank fills more slowly at the end of the fill cycle, causing a lower efficiency.

Contaminant reduction performance can be impacted as well, because water flows through the membrane more slowly when the storage tank is quite full, but contaminants migrate across the membrane at the same rate, because the rate of osmosis does not change. Water only goes through reverse, but solids go through osmosis.

Therefore, these seemingly minor, low-cost components of RO systems can have a fairly large impact on the efficiency of the system. WQP

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