NANOH2O QuantumPure™ IX Resins

Technical Applications Bulletin 901

Realizing the full potential of Conventional Mixed Bed Performance

Engineering guidance on the practical factors that govern achievable mixed-bed effluent quality

Scope. Though production of ultrapure water at the outlet of a mixed bed is technically possible, in the real world there are many aspects, apart from resin performance, that affect performance and quality. This bulletin reviews the mechanical, operational, regeneration, carbon dioxide, and instrumentation factors that determine whether a mixed bed actually achieves its theoretical limit in service.

1. Practical Water Quality Limits

Technically, at the mixed-bed outlet 0.08 µS/cm conductivity is possible, but it is not an unconditional guarantee. 0.08 µS/cm conductivity is approximately equivalent to 12.5 MΩ·cm resistivity at 25°C, and is at the practical limit for a conventional mixed-bed column under well-controlled conditions. A properly designed and operated mixed bed typically gives the water quality shown below.

PARAMETER	TYPICAL PRODUCT WATER QUALITY
Conductivity	≤ 0.08–0.10 µS/cm at 25°C
Resistivity	Approximately 10–12.5 MΩ·cm
Reactive silica	Commonly < 10–20 µg/L as SiO_2, depending on design and feed quality

Note

IX resins do not remove colloidal silica.

Achieving these figures consistently depends on five areas of design, operation, and maintenance discipline, summarized on the following page.

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2. Conditions Affecting Mixed Bed Performance

Five areas that determine whether the theoretical limit is achieved in service

2.1. Mechanical Design

Adequate bed depth of both resins, ideally with 100% clear free board for resin separation, uniform distribution and collection of feed and product, and uniform distribution and collection of regenerants. Adequate safety margins so as not to mix acid with anion resin or alkali with cation resin. Suitable service velocity and spatial velocity must be maintained.

2.2. Operations

The mixed bed must always run at its designed service flow — excessive flow affects the kinetics, and too low a flow causes channelling in the column. Channelling must be avoided, there should be no resin stratification due to density difference, no dead zones, and no air trapped in the column.

- The MB unit should be placed into service only after the target conductivity is achieved and stabilized.
- The MB unit should receive properly demineralized water as feed, typically from a two-bed DM plant or an RO–DM system.
- Resins must be replaced once their stipulated age is over, even if they appear to be working fine.
- Feed conductivity, silica, sodium, alkalinity, carbon dioxide, and organics must stay within the specified design range.
- A mixed bed is not to be expected to correct poor operation of the upstream cation or anion exchanger.

2.3. Regeneration

Resins should be kept free of fines; fines should be removed regularly and top-up performed as needed. The correct grade of strong-acid cation resin and strong-base anion resin in OH^- form shall be used, both in the original charge and in any top-up.

- All regeneration steps must be carefully followed — steps such as the middle-collector wash shall not be bypassed, nor required timings compromised to save time.
- Ensure proper separation of both resins during backwash; backwash flow and timing shall be strictly observed.
- Adequate regeneration level, concentration, and contact time shall be maintained as designed. Slow rinse shall run for a minimum of 30 minutes, or the injection time, whichever is longer.
- During injection, upflow or downflow shall be properly maintained so that acid does not enter the anion bed, or alkali the cation bed; the middle collector shall be adequately sized to drain excess acid or alkali across the full cross-section of the resin column.
- Resins must not be fouled by iron or organics in the feed water, and there should be no sudden osmotic shocks.

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2.4. Carbon Dioxide Control

CO_2 leakage or absorption from air can produce carbonic acid and raise conductivity, especially at very low conductivity. The sample line should be short, closed, clean, and designed to prevent atmospheric contamination, and its materials of construction shall not add contaminants to the sample. Exposure to atmospheric CO_2, poorly controlled sampling, or a small amount of ionic leakage will increase the reading.

2.5. Instrumentation & Measurement

Use a calibrated, low-conductivity cell — preferably, 0.01 cell constant — with a suitable transmitter from a reputed manufacturer; only top-of-the-line instruments can ensure correct measurement. Measurement shall always be compensated and reported at 25°C, since uncompensated conductivity varies significantly with water temperature.

- Calibrate the online instrument with properly prepared step by step calibration protocol involving Electronic calibration of transmitter, factory certified cell constant, temperature sensor calibration and system loop verification.
- Conductivity at such low levels cannot be measured with a portable instrument, as some ingress always occurs during sample collection and measurement.
- Sampling contamination, dirty cells, incorrect cell constants, and poor temperature compensation will all lead to apparent poor results.

Summary

Achieving 0.08 µS/cm conductivity is not a function of resin alone — column design, operation and maintenance, and instrumentation are equally important.

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