High Purity Water Mistakes Common Ones to Avoid

Questions to ask your vendor
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Industry Issues

- Short response times
- Vendor influenced specifications
- Performance specs and equipment specs are not compatible
- Reliance on old technology
- Evaluating offers

Factors Easily Overlooked Water Quality

- Is the data used for design an average, best case, or worst case?
- Does the source vary by season?
- Is the design based on one sample?
- Does the vendor have local knowledge of water sources?
- Is it Ground water or Surface water?

Know Your Water Source

- **Types of water sources supplies**

- Well Water
  - hardness (high)
  - particles (low)
  - iron (high)
  - turbidity (iron)
  - organics (low)
  - temperature (consistent)
  - chlorine/chloramines (municipal/potable, pH dependent)

Surface Water
  - hardness (low)
  - particles (high)
  - iron (very low)
  - silt (high)
  - organics (high)
  - temperature (varied)
  - chlorine/chloramines (municipal/potable, pH dependent)

FEED WATER CHEMISTRY

CATIONS	RESULT	UNITS	ANIONS	RESULT
Calcium (Ca)	196	mg/I CaCO3	Bicarb (HCO3)	264.5
Magnesium (Mg)	116	mg/I CaCO3		
Sodium (Na)	49.7	mg/I CaCO3	Chloride (CI)	44.6
Iron (Fe)	0.834	mg/I	Sulfate (S04)	57.8
Manganese (Mn)	0.200	mg/I	Silica (SiO2)	6.90
Strontium (Sr)	2.05	mg/I		
OTHER PARAMETERS	**RESULT**	**UNITS**		**RESULT**
pH	7.94		Total Hardness	312.63
Turbidity	14.0	NTU	TOC (C)	4.07
Conductivity	704.9	uS	Free (CO2)	6.9
Total Chlorine	2.0	mg/l	Free Chlorine	1.5

Factors Easily Overlooked
Water Temperature

- Effects backwash of pretreatment
- Effects Membrane Performance
- Accelerates biological growth
- What temperature is the system designed for?
- What are the extremes?

Factors Easily Overlooked
Water Quantity

- Is there enough flow and pressure to run the system?
- Are requirements submitted by component?
- What happens when the filter, softeners, or carbons all go into backwash?
- Will the city supply vary based on time of day?

Factors Easily Overlooked
Footprint and Access

- Will it all fit?
- Is there service access?
- Is the plot plan still functional?
- Skids? We all like them but...
- Can the skid fit through the access?
- Electrical clearances?

Factors Easily Overlooked
Drains

- Are they big enough?
- Where does it go and is a permit required?
- What if???

Pretreatment Equipment for silt removal

- Multimedia is used instead of sand because the particles get filtered throughout the entire bed, with larger particles filtered out at the top and smaller particles filtered in successive layers. Multimedia filters at best are efficient down to 10 microns

- Therefore, multimedia filters provide

- Lower pressure drop
- Longer filtration run
- Better particle removal

- Anthracite
- Sand
- Small garnet
- Larger garnet

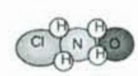
Pretreatment Equipment for chlorine and chloramine removal

- Potable water usually contains either chlorine (hypochlorite) or chloramines

- Both can damage RO membranes and resin beads

- Chlorine

- RO membranes



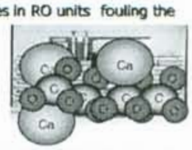
- Chloramines

- Resin beads

Pretreatment Equipment for Hardness (Calcium)

- The Problem with Hardness

- Hardness, which is (usually) 75% calcium and 25% magnesium, is present in almost all waters. The real problem is the calcium
- Calcium carbonate concentrates in RO units fouling the RO membranes.



Hardness fouling

Pretreatment considerations

- Other mundane questions - SPAD
- Is there enough of Space in the area provided?
- Is the feedwater pipe big enough, and is there enough feedwater Pressure?
- Can you get Access to the area where the pretreatment equipment is to be installed?
- Can the Drain handle the backwash flow?

Loop Designs

- **Loop Flow Rate Calculation**
  - Best Pipe Material: PP
  - Sinks(8) 1.0 gpm D-factor 25% Flow = 2.0 gpm
  - L-washers (2) 4.0 gpm D-factor 50% Flow = 4.0 gpm
  - Enzymase (1) 5.0 gpm D-factor 100% Flow = 5.0 gpm
  - Sum of all flows.. Flow = 11.0 gpm
  - Velocity goal for this client: 3 ft/sec

Loop Designs

- Loop Flow Rate Calculation :
- A: Pipe material PP Diameter 1.25" or 40mm — Flow too low!
  - Loop Feed: 20 gpm, velocity is 4.89 ft/sec
  - Loop Return: 10 gpm, velocity is 2.44 ft/sec

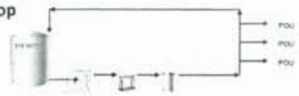
B: Pipe material PP Diameter 1.00" or 32mm — High velocity, but high friction loss. Good for short loop.
  - Loop Feed: 20 gpm, velocity is 7.72 ft/sec
  - Loop Return: 10 gpm, velocity is 3.86 ft/sec

C: Pipe material PP Diameter 1.25" or 40mm — High velocity, high POU flow, but high friction loss. Good for short loop.
  - Loop Feed: 30 gpm, velocity is 7.44 ft/sec
  - Loop Return: 15 gpm, velocity is 3.67 ft/sec

D : Pipe material PP Diameter 1.5" or 50mm — Good velocities and low friction loss, best for long loop!
  - Loop Feed: 30 gpm, velocity is 4.75 ft/sec
  - Loop Return: 20 gpm, velocity is 3.12 ft/sec

Loop Design – Types of Loops

- **Simple Serpentine Loop**
  - Most Common Type
  - All POU in Series
  - Simple Design
  - Limited Loop Length

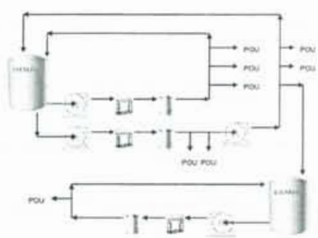


Typical Serpentine Loop

Pressure Control Valve at End of Loop

Loop Design - Types of Loops

- **Modified Serpentine Loop**
  - Multiple Loops/Tank
    - POU in different directions/levels
  - Boost Pumps
    - Long Loops >2000 Ft.
  - Subloops
    - Common in UPW
    - Useful for expansion of existing loops

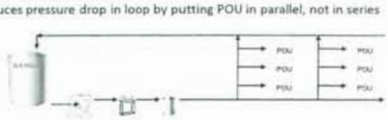


Multiple Loop System

2nd Loop with Boost Pump and Subloop

Loop Design – Types of Loops

- **Ladder Loop**
  - Mains/Rungs
  - Each rung may be a different tool, production area or building level
  - Rungs usually smaller diameter than mains
  - Rungs may have different flow rates
  - Reduces pressure drop in loop by putting POU in parallel, not in series



Ladder Loop with Two Rungs Shown

Each Rung May Have Separate Pressure & Flow Controls

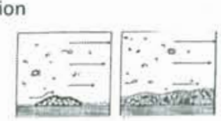
Start Up

- Media
  - Has it been loaded?
  - Has it been loaded without damaging the laterals?
  - Has every layer been leveled?
  - Has the vendor supplied start up filters

Start Up

- Cleaning
  - Has the supply line been flushed?
  - How long has it been a dead leg?
  - Has all of the cleaning solution been removed?
  - Has the system and POU's been hydro tested?

Loop Sanitization



- **WHY DO WE SANITIZE?**
  - **ALL distribution systems form biofilm**
  - **New Piping installation – cleaning of debris/foreign matter**
  - **Removal of Biofilm**
  - **Reduction of bacteria**
- **WHAT IS THE PROCESS OF SANITIZATION?**
  - **Choosing the "right" Sanitant" for the application**
  - **Calculating the amount of Sanitant**
  - **Time/Concentration/Frequency matters**
  - **Sampling Measurements – Residual & Effectiveness**

Loop Sanitization

•**Methods**

– Sodium Hypochlorite (Bleach) – 300 – 500 PPM
– Hydrogen Peroxide – 3 – 5%
– Paracetic Acid/Peroxide (Minncare) 100 PPM – 1%
– Formaldehyde – 2% (not normally used)

•**Other Methods (non-chemical)**

– Heat /Steam
– Ozone

Loop Sanitization

•**Chemical Sanitization Procedure**

1.Determine Holdup Volume - Consider all equipment, piping, etc
2.Calculate volume of Sanitant
3.Isolate and notify end-users of Procedure
4.Inject & Recirculate for specified amount of time
5.Open all sample, use point valves - Test for residual sanitant
6.Rinse Step – open all valves - Test for residual
7.Sample for Bacteria (typically use HPC Total Count MHPC10025)

•Options:
•Static soaks
•Surfactant applications – severe biofilm removal
•Repeat sanitant steps

Start Up

- Now run the system
- Document the performance of each component as well as the system
- If the system will not be running it should be laid up properly
- Train the owners of the system and hand it off
- Warranty notification

Bid Evaluation

- Pretreatment
  - Size and configuration
  - Scope of supply, media loading, internal inspection
  - Chemical, carbon, or UV dechlorination
  - Backwash tanks, reuse tanks, booster pumps as alternates
  - Make up water quality analysis

Bid Evaluation

- Reverse Osmosis
  - Operating temperature design
  - Calculated flux
  - Percent rejection
  - Percent recovery
  - Type of membrane supplied
  - Soft start or VFD, PLC, HMI, etc.

Bid Evaluation

- Post Treatment
  - Pump skid configuration and controls
  - Tank materials, type and controls, overflows and vent filters
  - Final filter configuration
  - DI polish cost estimates for exchange
  - CEDI Training and operational supervision

Summary

- Time Pressure
- Performance Pressure
- Communication
- Assumptions
- Expectations
- As an Industry we need your help