Volume 3 : Edition 9– Pharmaceuticals High Purity Water Sep 30, 2023

Dear Water Warriors,

While everyone wants pure water, pharmaceuticals production has special importance of it as the approving authorities such as USP, EU Pharma, IP etc. wish to ensure that a specific pharma produce is manufactured using specified quality of water.

High Purity water is also needed for Photo Voltic (Solar), Microelectronics (Chips) and that would also need attention in times.

Purified (PW) and WFI water production is a vast subject and in this issue of 'Waughter', we cover the basics. More specific advice, knowledge is available on request.

Nidhi Jain
Civil Engineer

What we Look For?

Purified Water, the most used name for high purity premium grade water must be produced through good quality drinking water. So, to start production of "Purified Water", the source shall be a qualified source as "Drinking Water", WHO, IS or any such guidelines as applicable to project location.

The agreed specification for Purified Water:

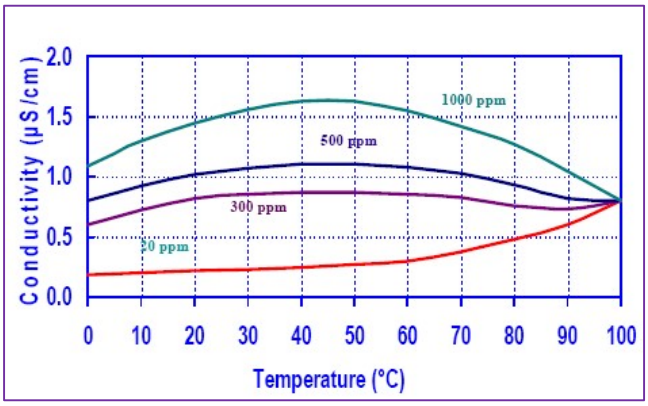
Parameter	Unit	USP	EU Pharma	General Guide
pH	-	Not Specified	Not Specified	5-7.5
Conductance	µS/Cm @ 25^{0}C	1.3	4.3	1.3
Bacterial Count	CFU/ml	100	100	100
Total Organic Carbon	µg/l	500	500	500
Nitrates	mg/l	Not Specified	0.2	Not Specified
Heavy Metal	mg/l	Not Specified	0.1	Not Specified

The above meets >85 % of requirement, however there are more stringent requirements for more class of water e.g. highly purified, Water for injection(WFI) etc.

Conductivity – CO2 & Temperature?

Electrolytes in water read different conductance at different temperatures and thus sample temperature is very important point of consideration.

Further the atmosphere has enough CO2 that ingresses in water during testing. See below:



Relevance of Codes & Standards? VALIDATION

Use of water for any Bulk Drug, Pharmaceuticals production or in general a product that comes in human contact needs surety & vigilance. Several codes and standards thus are available for guidance to engineers:

Pharmacopeia – Indian, European, US, Japan etc.
FDA Code of Federal Regulations 21CFR210 and 21CFR211
ISPE Baseline Guide Vol4,5,8
GAMP5: Guideline for the validation of automated systems
etc.

above help the idea is to establish documented proof that provides an assurance that the selected process will consistently produce a product meeting its specified quality. This exercise is termed "Validation" and is the integral part of "Water Business" in Pharmaceuticals high purity applications.

Volume 3 : Edition 9– Pharmaceuticals High Purity Water Sep 30, 2023

Water for Injection – More Stringent

Bacteria, more specifically the Microbial in any form are big concern for PW as well as WFI, being more stringent for WFI quality water:

Parameter	Unit	USP	EU Pharma	Japan Pharm
Conductance	µS/Cm @ 25^{0}C	1.3	4.3	1.3
Bacterial Count	CFU/100 ml	10	10	10
Total Organic Carbon	µg/l	500	500	500
Endotoxins	IU/ml	0.25	0.25	0.25

Endotoxins (also called Lipopolysaccharides) are the components of outer membrane of gram-negative bacteria. Their presence in blood stream can cause septic reactions with symptoms such as fever, nausea or shivering.

Thus, production of WFI starts with producing and storing PW properly and then apply right technology to reach lower levels of Bacterial Count and Endotoxins.

Impurities of Attention

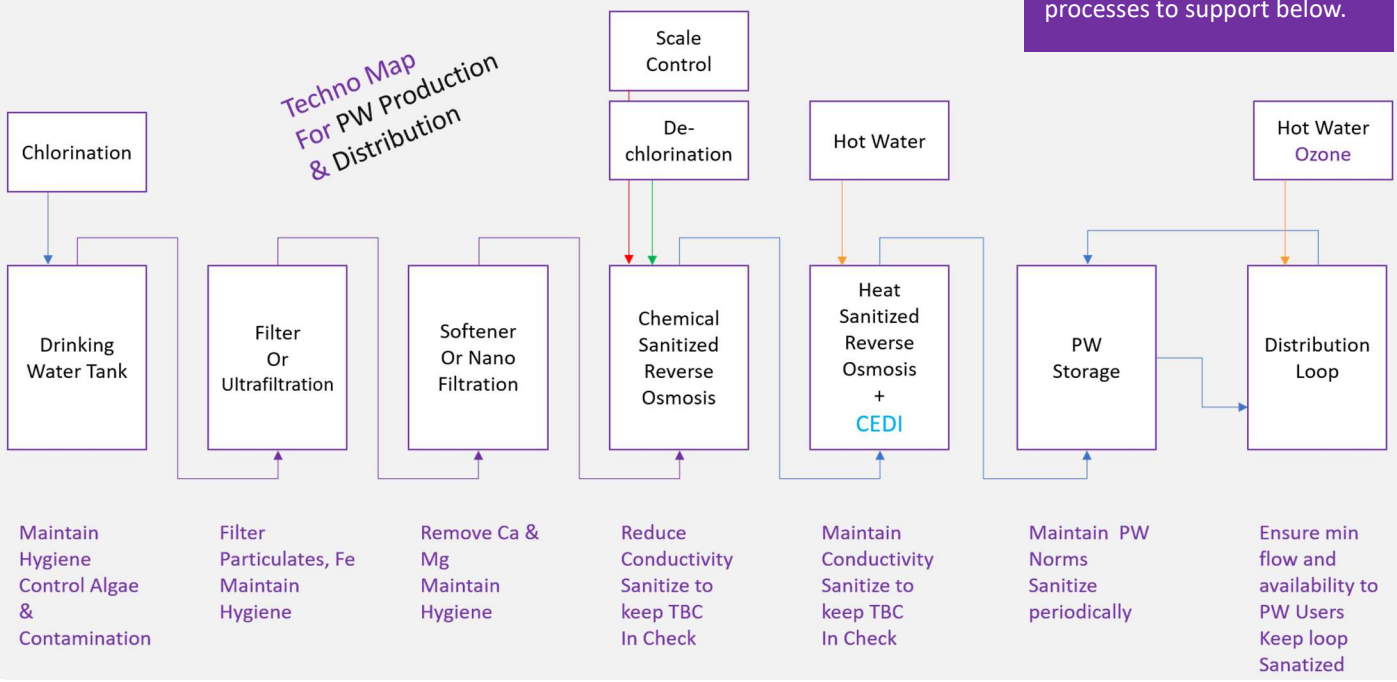
While inorganics lead to conductivity, the bacterial growth depends upon several factors such as:

- Contact Surface Finish
- Oxygen Content
- Temperature
- Air ingress and contamination through Air born bugs
- Under deposit biofilm formation in crevices in a water treatment process e.g., filter, membrane
- Dead zones and prolonged water storage
- Weld joints etc.

Thus, a designer needs to have equal focus on Purifying Water as well as ensuring contamination post purification is minimized. Remember, the purest water is “Hungry” and can even dissolve tough materials. e.g., HDPE will leach TOC and increase TOC beyond permissible limits.

Choice?

In further chapters we will understand limitation of other processes to support below.



Volume 3 : Edition 9– Pharmaceuticals High Purity Water Sep 30, 2023

Why Chlorination?

The use of chlorine and keeping a FRC level ~0.3 mg/l till entering CSRO is to avoid microbial activities. Chlorine is a low cost microbiocidal and its presence avoids any microbial growth in "Pre-treatment" of water, prior to using TDS removal technologies.

IX Softener in pre-treatment converts all hardness cation to Na. This avoids any Scale formation on RO membranes, as scale could be a potential place where bacteria can grow.

It's against the IX knowledge to keep oxidizing substance present while passing water through softener. The de-crosslinking of Resin reduces it's life but the designers knowingly adopt this scheme as they can not risk Microbial growth.

Why we use expensive RO-EDI?

Ion Exchange plant + Mixed bed were an acceptable technology to produce PW water till membranes were commercially available. In early days some designers used RO for build TDS control and Mixed bed for conductivity control.

The MB quality wrt to Conductance is highly acceptable but the air used for mixing cation & anion Resin post regeneration was a step prone to bringing in bacterial growth.

This means a concern on TBC as well as TOC for PW production and thus use of Mixed Bed gradually faded and today non-existent. Some designers however still rely on a similar scheme RO,RO,Catpol, where only a cation column is used not MB

Why No Activated Carbon Filter?

The activated carbon filter use chemically or heat activated carbon the has many pores. These pores arrests organics from feed water by process of adsorption.

Power Plants, F&B Industry where "Organics" removal is priority to keep TOC under check always have an ACF in their schemes.

TOC is a concern in PW production as well. However, we have a bigger challenge to deal; Bacteria. The porous surface of carbon bead is an excellent place for bacteria to grow and thrive. Further more the carbon neutralizes the oxidant (FRC) thus the water after ACF is dechlorinated and does not offer benefits of FRC till Reverse Osmosis entry.

Further Considerations?

The engineering design of a PW system needs a little more simple considerations that the engineers must learn through experience and interactions with customers and vendors:

- Complete drainability of System – zero dead lags.
- No weld marks and burr deposits on side surface of pipe.
- No rough internal surface
- Periodic Sanitation
- Drain Pipe not touching water level – Air Gap
- Sloping horizontal Pipes – Not horizontal straight
- Loop length, user points, maximum use and minimum return water line consideration
- Spray ball in PW tank to ensure fully wet tank from inside
- N2 blanketing of PW tank (Optional)
- Zero dead lag valves
- Full drainability of instrument

PURE WATER

Zytex Better Technology. Better World.

PureBact™

Aerobic Bacteria Culture

LOOKING FOR TECHNICALLY COMPETENT AND COMMERCIALLY SOUND PARTNERS TO WORK WITH ACROSS THE WORLD.

We at Pure Water Enterprises have recently partnered up with Zytex Biotech, a 75 year old industry leading enzyme and bacterial strain manufacturer based out of Mumbai. Together, we are very excited to introduce our very own brand of bacteria culture offerings for ETPs and STPs, **PureBact Bacteria Culture**.

OUR COMMITMENT TO **EXCELLENCE**

EXPERIENCE -
More than 75 years of Industry leadership

TRANSPARENCY -
Complete CFU count disclosure on every pack

PROVEN & TESTED -
Thorough testing under stringent conditions

TESTING FACILITIES -
2 state of the art lab testing facilities for trials

OUR **PRODUCT RANGE**

Our PureBact Bacteria culture range of products help our customers tackle numerous challenges that they face at their ETPs and STPs.

All our products come with the CFU (Colony Forming Units) count disclosure on each packet. What you see is what you always get!

Our always available technical team will help you choose the most efficient and cost-effective product, tailored to your needs.

PURE WATER ENTERPRISES PVT. LTD.
308, Matharu Arcade, Subhash Road, Vile Parle East, Mumbai - 400056.

www.purewaterent.net +91 9820173817 info@purewaterent.net

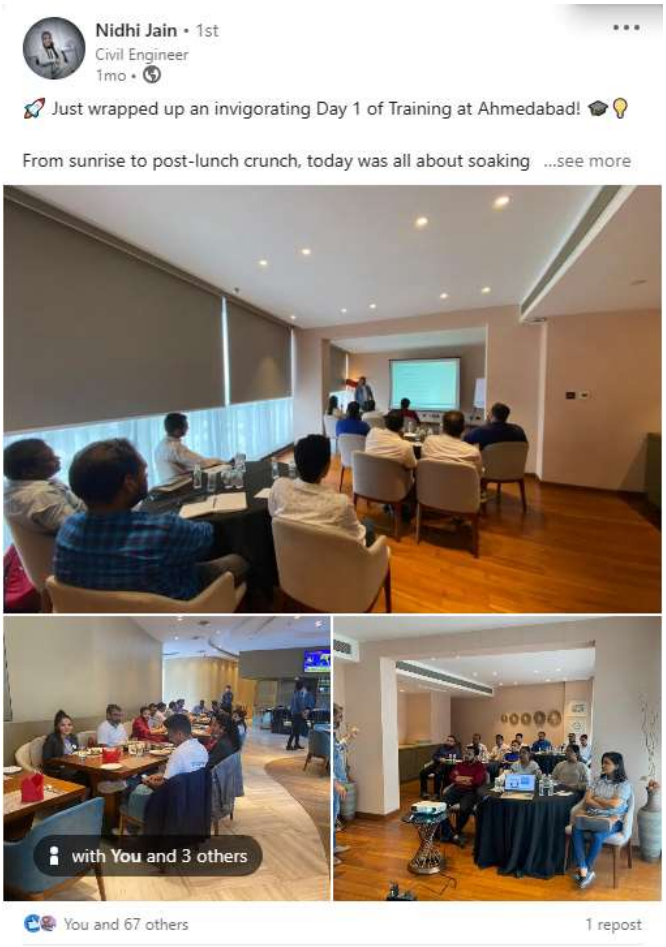
Waughter

AKTION CONSULTANCY

Volume 3 : Edition 9– Pharmaceuticals High Purity Water Sep 30, 2023

जल जीवन जननी !!

Water is life. We are happy to be in a business that's vital for people life and survival of this planet.



A 2 days training program organized at Ahmedabad was an opportunity for us to share what we know. It was both learnings as well as an opportunity to know what are the current challenges in waste water management.

Highlight of the Month

In this section, we shall highlight the new achievements of our team. In case you wish to have more details on the same, please let us know:

- Automation of UF Design with Auto BOQ generation
- Dosing Calculations for SiO2 Reduction
- Optimization of H2O2 Dose for Fenton process
- Design on new MBR system with external modular type housing for Technorbital
- Training to operators on O&M of MBR Plant

Our World is Waughter

The technical knowledge share attempt of Aktion Consultancy and the contents in the magazine shall be qualified by Sanjeev Srivastava our Technology Lead. The purpose is purely education and empowerment of engineers.

Our next edition focuses on: "New Technologies visible in IFAT 2023 at Mumbai"

Please feel free to contact Ms Nidhi Jain 95128 55227 or write to us at nidhi.jain@aktionindiaa.com

Aktion Consultancy
C 1305, Rajyash Rise
New Vasana,
Nr Vishala Circle,
NH-08,
Ahmedabad - 380 051
Bharat (India)

Alka Srivastava – Founder