Volume 3 : Edition 4 – Innovations & Ideas May 01, 2023

Dear Water Warriors,

Innovation simple for a cause!!

Water & Waste Water Treatment is complex subject with various unit operations, bio-chemical process, chemistry neatly integrated with each other to produce a solution.

This issue of 'Waughter', we cover some of the simple innovations that are to be tried in future with lab trials & piloting".

Nidhi Jain – Civil Engineer

Listing & Prioritizing

The innovation would be possible when some existing practices would be questioned:

1. Dosing Stations – eliminate 1W + 1S Concept - focus capex saving and better operational control, space saving.
2. Removal of Bi-valent ions Ca & Mg, right at WTP stage for ZLD projects - Better RO operation, No scaling control needed for Utility, better MEE performance.
3. SiO_2 removal in ZLD - Electrocoagulation Option
4. SiO_2 removal in ZLD - $MgCl_2$ & NaOH Treatment
5. Textile Waste Water - Use of Cooling Tower as Trickling Filter & Sump as Aeration Tank Reactor

All of above is not implemented, but as we say, designer need to keep in mind that innovation would arrive only if it leads to savings: Money or Time or both.

Defining Innovation?

No organization ever created an innovation. People innovate, not companies.

Thus, we encourage our entire 'Readership' to aspire and accept ideas, challenges put forward in this edition.

Dosing Stations

In most of the plants, customer usually ask for 1W + 1S dosing stations with an idea to use 1 system for chemical preparation and another for dosing. In a typical project shown below the requirement was as defined below:

Sr No	Decription	Unit	Value
1	Inclined Plate Clarifier - Lamella	m3/h	650
2	Alum Dosing	mg/l	50
3	Lime Dosing	mg/l	30
4	Polymer Dosing	mg/l	2
5	Solution Concentration_Alum	%	10
6	Solution Concentration_lime	%	6
7	Solution Concentration_PE	%	1
8	Feed Pump_Alum	lph	325
9	Feed Pump_lime	lph	325
10	Feed Pump_PE	lph	130
11	Shift Operation	h	8

This design would require 3 systems each comprising of 2 tanks, 2 stirrers, 2 Pumps and necessary piping etc. Which is normal and we would do it project by project without questioning it.

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Dosing Station..2

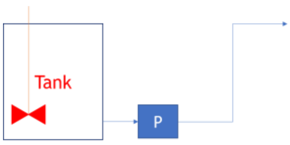
When we apply our operational experience, we check the preparation time for the chemicals – the time required to prepare solution for next batch typically is

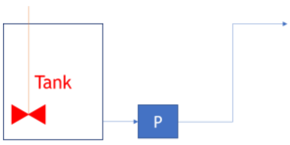
Alum – 60 min
Lime – 60 min
Polyelectrolyte - 120 min

So, we wish if our tanks could have a small compartment where we can store that extra volume of 1 – 2 hrs and use the same for dosing, while the tank is busy for preparation of chemicals for the next batch. Is it possible?

Yes !! look at the two options below:

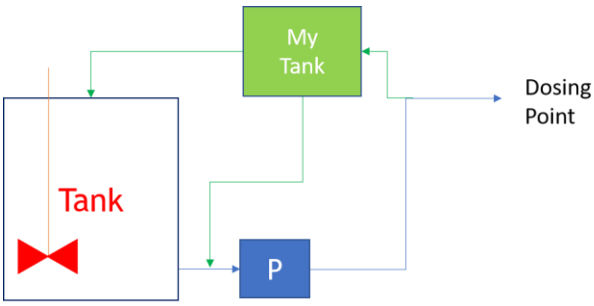
Conventional:





1 Working 1 Stand by

Innovation:



The above innovation is achieved by filling a tank using a higher-capacity dosing Pump. Once the preparation tank is empty, this fill tank provides continues supply of chemical to process for next 60 – 120 mins as the case may be. Results in Saving of:

3 additional Tanks and agitators
Required electrical connections
Lot's of space

Simple but effective. Try it in your next project.

Ca & Mg Removal

Ca & Mg often are problem material in ZLD projects. Designers are expected to remove them to avoid scaling of RO membranes and MEE.

They are also the problem material for Cooling water application and operators need to rely on either low pH operations in cooling tower (Maintain – Ve LSI) in recirculating water or use Dispersant and antiscalant products (High Opex).

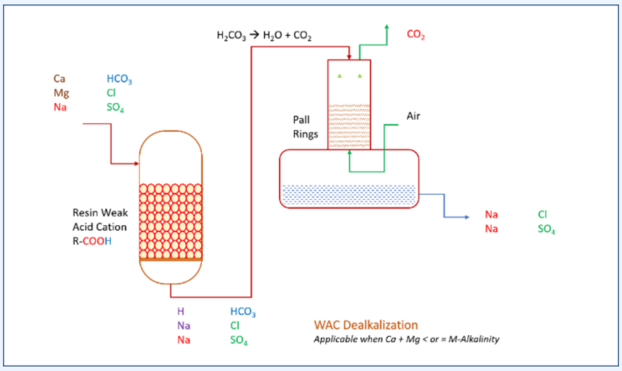
What if we remove them right at source? And how? This idea is further developed by looking at a process that's neglected for several years. Dealkalization

Dealkalizations removes Cation as well as Anion and thus the TDS is reduced in this process to an extent of Temporary Hardness (Alkalinity + Ca, Mg). This Process is also known as "Partial De-ionization" and can be achieved by various methods:

1. Weak Acid Cation Resin based Softening + De-gasification

2. Split Stream DE alkalization followed by DG

Depending upon the Water analysis, Level of Temporary hardness and Permanent Hardness and treated water quality required, the engineer may wish to design any of the below processes.



Picture above Depicts how one can achieve Temporary Hardness removal along with Alkalinity Removal.

We have already covered above in Waughter Volume 2 Edition 5, May 31, 2022.

Ca & Mg Removal - Dealkalization

Now let's see its relevance in a ZLD project. In a ZLD project our focus is to remove solids as:

- Ca, Mg and SiO_2 are removed a Precipitates of $CaCO_3$, $Mg(OH)_2$ & $Mg(OH)_2.XSiO_2$
- Na and other monovalent are removed as crystals – Cl, or SO_4

Here in WAC Exchanger the Ca & Mg associated with HCO_3 (Temporary Hardness) is arrested and available in WAC Exchanger. If we regenerate this exchanger with H_2SO_4 at lower concentration, we get all the Ca back in drain sump in form of $CaSO_4$ at low pH.

To this waste, addition of $Ca(OH)_2$ will result in $CaSO_4$ precipitation, that can be flocculated and up to 99% $CaSO_4$ can be settled out.

In second tank we add NaOH to precipitate $Mg(OH)_2$ or Lime and the excess Ca can be precipitated by addition of Na_2CO_3.

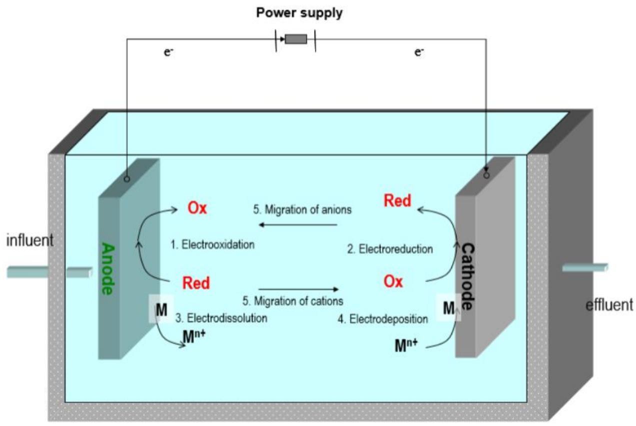
In short, we apply same age-old precipitation technique but at the source water itself rather than before RO or MEE. The advantage of doing this is:

1. Our Treated water in plant has only monovalent Cations; means no use of antiscalant in Cooling water or in RO saving a lot of money.
2. DE alkalized water means reduced TDS to high COC in Cooling Tower resulting in huge savings in Corrosion control products and biocides.
3. Higher recoveries in RO and hence water savings.
4. Lower system capacity for thermal facilities MEE, ATFD etc. as part of solids are already reduced.
5. Reduced Sludge volume. As Sludge formed by $CaCO_3$ is not to be considered – remember we have alredy lost CO_3 as CO_2 in Degasser.

Limitation of this design is SiO_2 and if the same is high, we may need MgO addition to precipitate SiO_2 before 2nd or 3rd Stage of RO. (When SiO_2 > 280 mg/l in RO feed)

SiO_2 Removal – Electro Coagulation

Conventional coagulation involving high dose of Alum in pre-treatment along with polyelectrolyte for Reactive SiO_2 removal was practiced for several years.



Electro coagulation with Al Electrodes, that combines oxidation and reduction in the same unit operation is an effective way to remove dissolved and colloidal SiO_2 from feed water containing high Silica in waste water from CW Blow down or RO Reject.

The process will also remove Temporary Ca Hardness as well as SiO_2 and SiO_2 levels < 20 mg/l are easily achieved.

SiO_2 Removal – $MgCl_2$ & NaOH Dosing

Sludge Management these days is a big issue. Dolomite lime though provides Mg necessary for SiO_2 precipitation is responsible for excessive sludge production, in some case the Sludge may be as high as 3-4 times.

NaOH though expensive does not create problem of managing Ca Sludge formed due to dosing of lime. Thus it is a better choice in projects that are small to medium capacity. As such the water characteristics of RO reject necessitate the use of Na_2CO_3 along with lime or dolomite lime. Na_2CO_3 is reasonable expensive and in overall expense estimation considering below three points would indicate use of NaOH & $MgCl_2$ in most ZLD cases.

1. Sludge Management Cost
2. Dilution water needed for Lime Solution 6%
3. Increase in plant capacity for production of dilution water.

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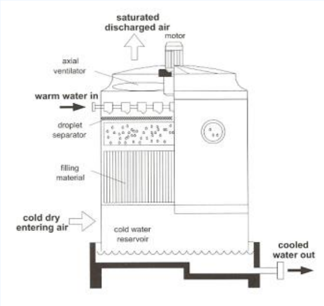
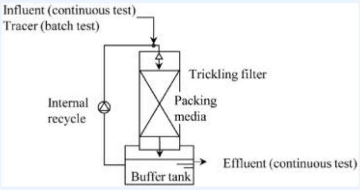
Textile Waste water - Innovation

The High Temperature of Textile waste water is often problem and we need cooling of effluent before Primary (for better settling) and Aeration Tank (Better Biology).

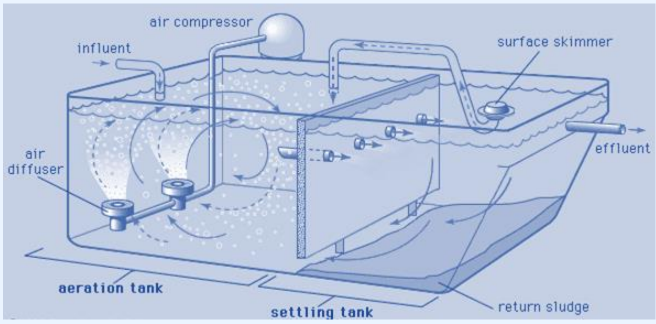




Trickling Filters are very close to cooling towers, so we have to design a cooling tower that encourage microbial growth on its packing. We will have 2 advantages"

1. Achieve Cooling
2. Reduce COD in Cooling Tower as in a Trickling Filter

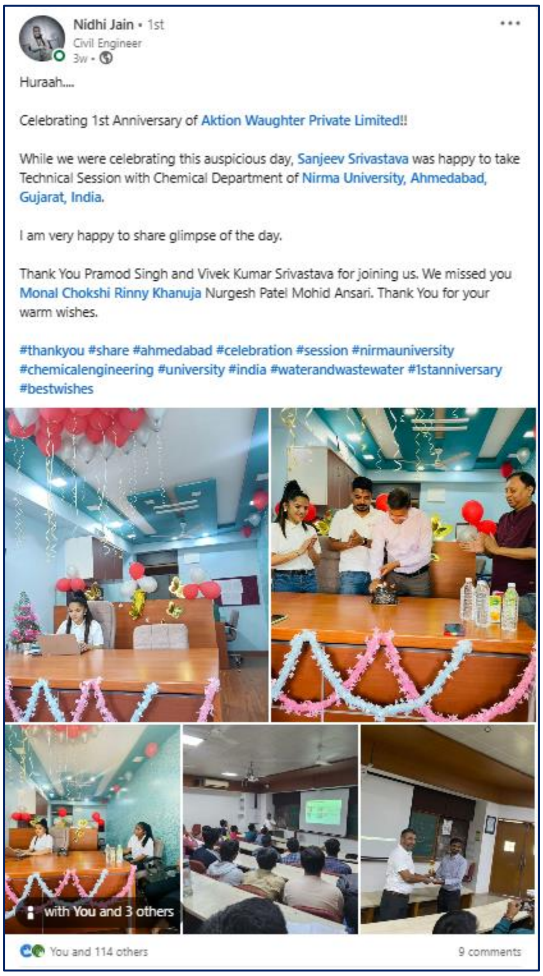
The basin of Cooling tower can be eliminated and the CT shall sit on top of an Aeration Tank:



In this design the engineer shall work properly with Cooling Tower Suppliers as we need to take care few points:

1. RAS shall be returned to CT top deck, so high dia nozzles shall be used.
2. Feed Also shall arrive at Top deck, so it is advisable to use 200µ & 50µ Auto self cleaning Filter to ensure fibres and microfibers are removed prior to biology.
3. Colour removal chemicals and Flocculant shall be used on secondary treated waste as "Primary" is completely eliminated.
4. Adjust pH of Aeration Tank by adding Acid in Feed.

जल जीवन जननी !!


Nidhi Jain • 1st
Civil Engineer
3w •

Huraah....

Celebrating 1st Anniversary of Aktion Waughter Private Limited!!

While we were celebrating this auspicious day, Sanjeev Srivastava was happy to take Technical Session with Chemical Department of Nirma University, Ahmedabad, Gujarat, India.

I am very happy to share glimpse of the day.

Thank You Pramod Singh and Vivek Kumar Srivastava for joining us. We missed you Monal Chokshi Rinny Khanuja Nurgesh Patel Mohid Ansari. Thank You for your warm wishes.

#thankyou #share #ahmedabad #celebration #session #nirmauniversity #chemicalengineering #university #india #waterandwastewater #1stanniversary #bestwishes

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.

Our next edition focuses on: "Internal Conditioning – Role of Chemicals in Water Management"

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