PT. TIRTAKREASI AMRITA
Newsletter 4E/ IX/ 12

Demin water, Pure Water and Ultra Pure Water

Demin or demineralizer water is used to feed boiler, to wash goods before painted to rinse, optical lenses, to be used in electronic and pharmaceutical industries etc.
It has low TDS or conductivity and is being named as "pure water", since it salt and minerals content has been eliminated.
The process of salt and mineral's elimination is done by ion resin using cation and anion exchanger.
Cation exchanger will reduce "the hardness" of water by adsorbing the soluble calcium (Ca^{2+}) and magnesium (Mg^{2+}) in water. Anion exchanger will eliminate soluble silica (Si O_4^{4-}) in water and also others anions.

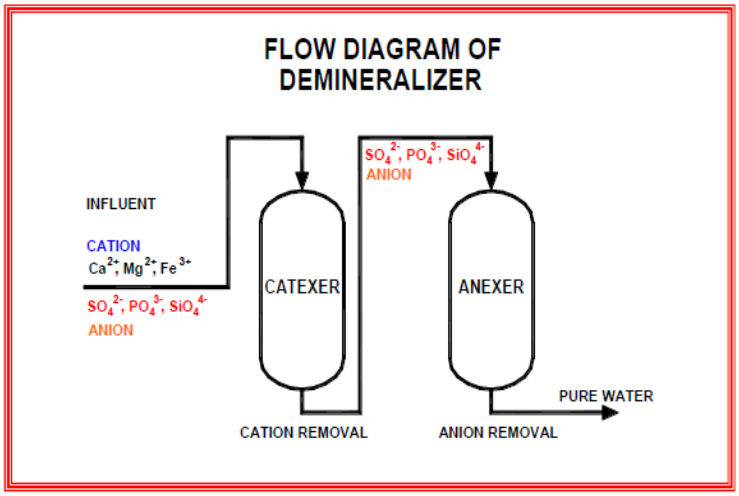
Why hardness and silica content have to be reduced?

Calcium (Ca^{2+}) and magnesium (Mg2+) at high temperature can build scale with carbonate (CO_3^{2-}) ion, which are soluble in water, according to the following equipment :

$$Ca^{2+} + CO_3^{2-} \rightarrow Ca\,CO_3 \downarrow$$
$$Mg^{2+} + CO_3^{2-} \rightarrow Mg\,CO_3 \downarrow$$

$CaCO_3$ and $Mg\,CO_3$ scale can be built inside the boiler or heat exchanger tube and they will be thicker with the time. This scale will hinder the heat transfer. Since scale is a thermal insulation, so the boiler and heat exchanger's efficiency will be decreased. Therefore the boiler and heat exchanger tube shall be cleaned up periodically from scale.
Silicate also creates the same problem. Silicate acid is soluble in water. Salt of silica the silicate will build scale with various minerals such as Ca^{2+}, Mn^{3+}, K^{+} etc to Ca (Si_3 A$\ell 2O_8$), K (Si_3 AℓO_8) Mg_2 (Si O6) etc. Silicate scale will also reduce the efficiency of boiler and heat exchanger.
A simplified process diagram of cation (catexer) and anion (anexer) exchanger can be seen in diagram 1.

Diagram 1
Catexer and anexer flow diagram



Pure water, that is free of salts and minerals is needed for washing and rinsing goods before painting. Salts and minerals, after the water is evaporated, will be sticked on the surface of the goods. They will cause spots under the paint layer and the paint layer can be broken.
Pure water and ultra pure water are also used in pharmaceutical-, electronic-, optical- and others industries.

How can the purity of water be measured?

The purity of water is measured with TDS (total dissolved solid and conductivity):

- TDS (total dissolved solid) is total soluble solid in water such as salt, mineral and other soluble substances.
  Lower TDS means better quality of water. Pure water has very low TDS (near 0). TDS is stated with ppm (mg/liter or gram/m^3).

- Conductivity
  Electrical conductivity (EC) is actually a measure of the ionic activity of a solution in term of its capacity to transmit current.
  Since the electrical current in water is transport by the ions in solution, so the conductivity will increase as the concentration of ions increases.

There is a relation between TDS and EC :
TDS (mg/ℓ) = 0,5 x EC (dS/m or mmho/cm) or
= 0,5 x 1000 x EC (mS/cm)

Typical conductivity of waters :

- Ultra pure water	5,5 10-6	S/m
- Dunking water	0,005 – 0,05	S/m
- Sea water	5	S/m

How can we purify water?

The conventional process to purity water is by distillation or evaporation and condensation.

Therefore there are “bidest” (bidestillation of water) and “tridest” (tridestillation of water).

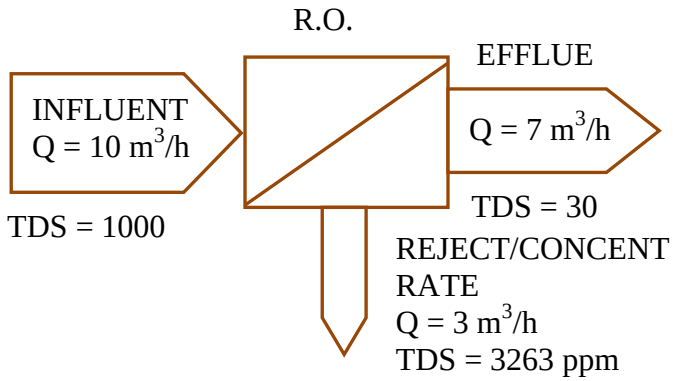
Then the ion resin’s process replaces the distillation and water is purified by demineralizer plant using cation exchanger and anion exchanger (twin bed). Purifying water using distillation or thermal energy is expensive and the cost with the ion exchanger technology is cheaper.

It used strong acid and strong alkali to regenerate the ion resin, when they are exhausted. For pure water mixed bed demineralizer will follow the twin bed.

The membrane technology (reverse osmosis or R.O.) is also used to reduce TDS and purify water. Also R.O. is used to desalinate sea water, now brackish water R.O. is applied to purify water prior to demineralizer plant and mixed bed.

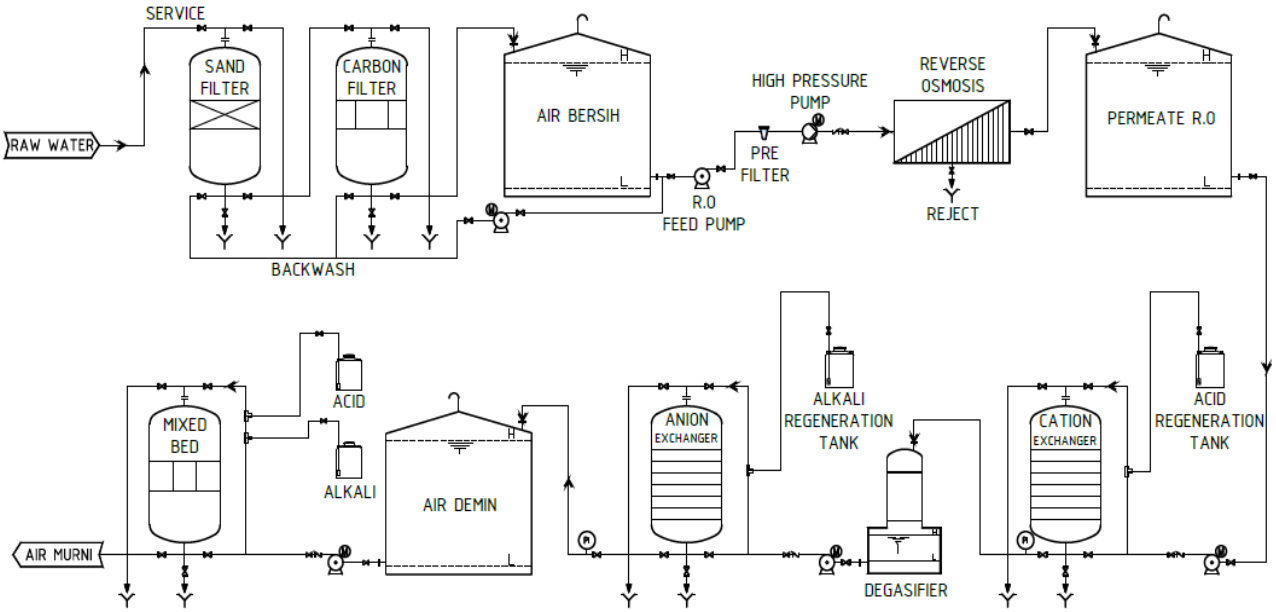
R.O. reduces TDS up to approximately 97% and the product is called permeate. TDS of raw water is accumulated in the reject or concentrate. In diagram 2 the RO process is shown.

Diagram 2. R.O. proses



R.O. system is widely used to purity water prior to demineralizer plant.
In diagram 3 the process of producing pure and ultra pure water by R.O., twin bed demineralizer and mixed bed is shown.

Diagram 3



Demin water, pure water and ultra pure water are requested for boiler feed water, washing/rinsing, solution in the pharmaceutical industry and other used.

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PT. Tirtakreasi Amrita is the expert to produce demin water, pure water and ultra pure water.

Some of recent references are :

- Year 2012 : PT. Sugar Labinta, Lampung
  Processing with ; CF, RO and mixed bed
  Capacity : 45 m^3/jam
- Year 2012 : PT. Trisula Abadi, Balaraja
  Processing with; CF, RO and mixed bed
  Capacity: 60 m^3/jam
- Year 2011 : PT. Asahimas Chemicals (Asc), Cilegon
  Processing with; SF, CF, RO, catexer, degasifier and anexer
  Capacity : 56 m^3/jam

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