

## A NEW PARADIGM : CEDI

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With the development of cogeneration power plants and the industries quest to be self reliant for the power, de mineralization became an essential process to utility managers in power industry. Unlike mega sized power plant, cogeneration requires compact and well designed systems to ensure lower manpower for power plant operation. The above challenges were adequately addressed by water treatment engineers by using RO plus IX Technology and a new choice now is CEDI, Continuous electro-deionization. Because EDI's continuous electrochemical regeneration offers a constant water quality. EDI is a low maintenance process requiring minimal operator intervention. EDI can provide low product water conductivity, of much better quality then would be possible with RO + Mixed Bed schemes. EDI utilises chemical-free regeneration. This means a no handling of hazardous acid and caustic. The additional advantages are lower effluent, small foot print, lower operating costs. A combination of Reverse osmosis and CEDI therefore provides a good choice in future.

**Key words:** Water treatment, De-mineralization, Electro deionisation, Chemical free Regeneration, DC Current, Cogeneration.

Today, the critical nature of the power plant feed water requirement motivated the utility managers to look for newer options to meet the stringent quality requirements with certainty.

Some of the critical parameters that need to be monitored by utility mangers in DI water include:

pH	>	7.5–8.0
Conductivity at 25deg C	<	0.2 micro siemens/Cm
Silica as SiO2	<	0.02 ppm

With a new entrant to the above list as Colloidal silica, the primary reason for glass like deposits on the turbine blades, the water management became further critical.

The above challenges were adequately addressed by water treatment engineers by designing schemes that included membrane barriers, typically MF/UF in combination with reverse osmosis to remove bulk of the dissolved impurities. For polishing of the water to desired quality, one has to still rely to the old age technology of IX process, until now:

CEDI, Continuous electro-deionization (EDI) employs a combination of ion exchange resins and membranes, and DC current to continuously deionize water without the use of regeneration chemicals.



The principle behind ion exchange is that polymeric resin beads have functionality to provide either positive or negative charge that attract and remove certain contaminant ions from the water. Conventional ion exchange technology can remove dissolved inorganics such as minerals and salts and some dissolved organics. Cationic resins remove positively charged ions such as calcium, magnesium and sodium, replacing them with hydrogen (H<sup>+</sup>) ions. Anionic resins remove such negatively charged ions as chloride, nitrate and silica and replace them with hydroxide (OH<sup>-</sup>) ions. The hydrogen and hydroxide ions then unite to form water molecules.

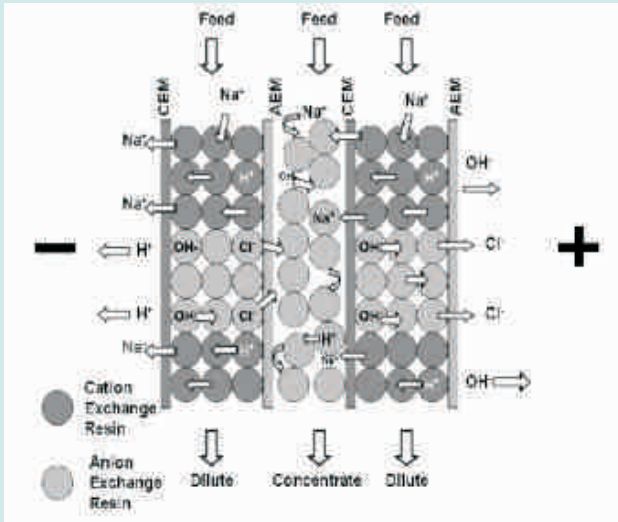
When the water passes through a tank containing a mixture of both cation and anion exchange resins, the process is called mixed-bed ion exchange. Mixed-bed systems can produce very high-quality water with resistivity up to 5-10 megohms-cm.

CEDI, involves three simple steps in purification of water:

- A. Exchange of ion over respective resin.
- B. Transportation of ion from a dilute chamber towards a

concentrate chamber across a ion selective membrane, that allows a selective ions to pass and not the counter ion. The transportation being controlled via application of DC potential to attract an ion.

- C. Continuous in-situ regeneration of resin by splitting of water molecule in  $H^+$  and  $OH^-$



AEM: Anion Exchange Membrane CEM: Cation Exchange Membrane  
(Photo Courtesy : CEDI University)

EDI's continuous electrochemical regeneration provides a constant water quality with no "leakages" of ions. EDI is a low maintenance process requiring minimal operator intervention. EDI can provide low product water conductivity, of much better quality than would be possible with RO + Mixed Bed schemes.

EDI utilises chemical-free regeneration. This means a no handling of hazardous acid and caustic. There are no waste

neutralization or disposal issues and no need to invest in bulk acid and alkali handling equipment. The advantages of EDI over conventional IX resin based de-ionizers are tabulated in table 1.

EDI has significantly lower operating costs (typically approx 250 Watts/m<sup>3</sup> for a Feed Conductivity Equivalence <50 microsiemens/cm) than conventional ion exchange processes. The lack of acid and caustic regeneration means less operator attention and lower labor costs. Capital costs can also be expected to be lower, especially because no chemical storage, pumping and neutralisation equipment is required.

Additionally, EDI has a significantly smaller footprint than conventional ion exchange processes. This means less plant space will be required to provide the same quantity of water.

While the EDI advantages are very lucrative to utility managers, the use of EDI requires proper care in terms of monitoring feed water limiting conditions and protections against unwanted variations in power supply. Prolonged ignorance to feed water limiting conditions may result in irreversible fouling and ultimately premature failure of the system.

A combination of reverse osmosis and CEDI therefore provides for an attractive alternative to utility managers and must be explored for setting up new projects.

Concluding Remarks:

While in India, power plants are beginning to look at EDI technology only recently; however India's Pharmaceutical industry has been using EDI for generating purified water since many years. Approximately there are over 100 EDI systems currently operating within India. Considering its various advantages, it's only a matter of time that this technology will dominate the water treatment scenario in coming years.

Sr.	ELECTRO DEIONISATION SYSTEM (EDI)	IX PROCESS BASED PLANTS
1	Regeneration is Automatic	Regeneration is to be done Manually or in Auto Plants through various Auto Valves
2	Regeneration is by Electric current (By using Electrodes)	Regeneration is done by Chemicals
3	No Chemicals are required for Regeneration	Chemicals are required for Regeneration
4	Since no chemicals are required storing and handling is not required	Since HCL and NAOH is required , the Storage and Handling facilities of same is also required
5	System can be operated continuously	System needs stoppage for Regeneration
6	No Effluents generated	Effluents are generated which needs to be handled

Sr.	ELECTRO DEIONISATION SYSTEM (EDI)	IX PROCESS BASED PLANTS
7	No chances of Bacterial growths	Chances of Bacterial Growth
8	System simple to handle	System complicated to handle
9	No Air requirements	Air is required for separating the Resins in Mixed Bed.
10	TOC is not generated in the system	TOC may be generated by Ion Exchange Resins
11	Lower Maintenance	Higher Maintenance
12	System is simple, Compact and operator friendly	System is bulky

