

# Ultrapure Water for Electrolysis Unit Operations

| Process   | Function  | Impurity Removal  |
|---|---|---|
| Mechanical grate  | Remove large debris   | Solid debris is physically removed from the grate to be disposed of   |
| Raw water intake  | Draw seawater or river water  | N/A   |
| Prechlorination and flocculation                                  | Chlorine and $Al_2(SO_4)_3$ precipitate heavy metal ions  | Flocs are removed in the multimedia filter bed  |
| Multimedia sand and gravel bed                                    | Remove mud, sludge, sand, algae & flocs   | Backwash with air and water   |
| Activated carbon filter   | Chlorine and dissolved organic compound removal   | Spent activated carbon filter cartridge is replaced and disposed of   |
| Water softening   | Replace $Ca^{2+}$ and $Mg^{2+}$ hard water ions with $Na^+$ ions  | Backwash with brine   |
| Low-pressure reverse osmosis (LPRO)*                              | Remove mono- and multi-valent ions and microbes   | Backwash with water frequently, backwash with chemicals occasionally  |
| Pure water buffer tank  | Intermediate storage of water   | Microbes multiply during storage and ions can dissolve into the water   |
| Electro de-ionisation (EDI)                                       | Polishing to remove traces of ions  | Ions build up in the concentrate discharge  |
| Ultraviolet (UV) sterilising lamp                                 | Kill bacteria and other microbes  | Dead organisms are removed during ultrafiltration   |
| Ultrafilter   | Remove dead organisms   | Backwash with water frequently, backwash with chemicals occasionally  |
| Degassing   | Remove dissolved nitrogen and $CO_2$  | Gases are vented to the atmosphere  |
| Introduce water to electrolyser water / lye recirculation circuit | Top up water in the electrolyser to enable hydrogen and oxygen generation   | Degassing, EDI and filtration may be used in the electrolyte recirculation circuit to remove impurities generated in the electrolyser |
| EDI and degassing   | Pure water purification in the PEM water recycle loop to remove dissolved ions from corrosion and $CO_2$ from dissolved hydrocarbon decomposition on the electrolyser | As above  |
| Filtration and degassing  | Lye filtration to remove precipitated carbonates formed by reaction of $CO_2$ with lye, $CO_2$ degassing  | Lye filter backwash to water treatment plant  |

\* Thermal desalination may take place here, if required or the reverse osmosis may be operated as high-pressure sea water reverse osmosis (SWRO or HPRO) if desalination is required