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Ultra-Pure Water Requirements: Green Hydrogen

White Paper

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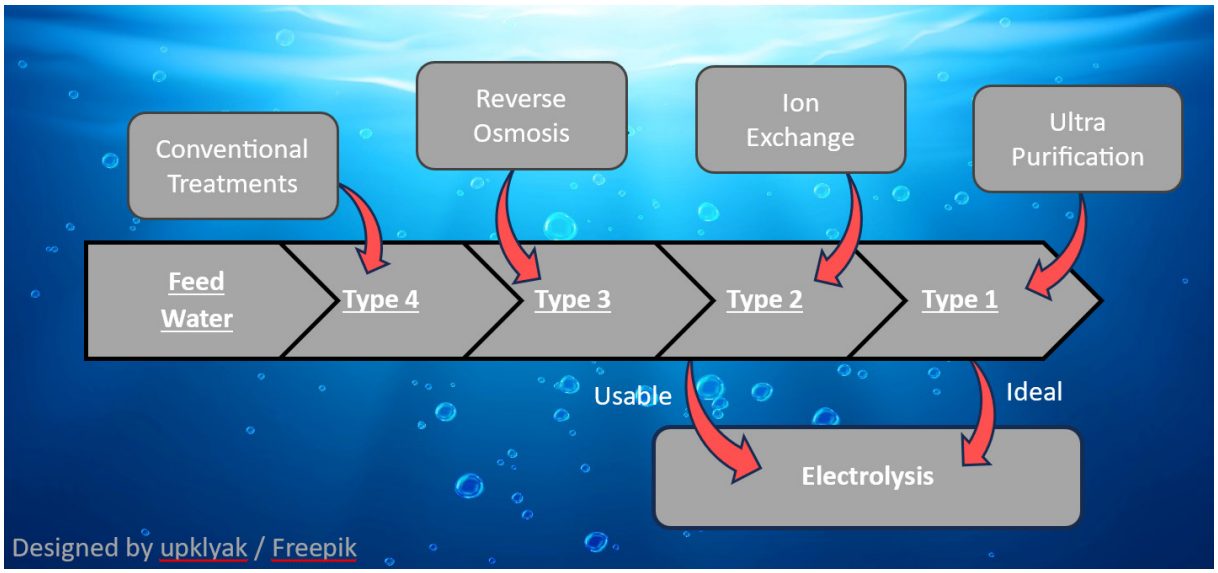
WHAT IS THE PROBLEM?

With the growing interest in decarbonizing the economy and renewable energy, the production of hydrogen through electrolysis has become an increasing priority. Not only does the electrolysis convert the intermittent power to readily accessible chemical energy, but also increases the versatility of the energy, where the hydrogen can be used in hydrogen fuel sources and chemical applications.

However, the immense water requirements for electrolysis make it a cornerstone of the process, where ten to eleven litres of ultrapure water are required per kilogram of hydrogen. Most electrolyser technologies require Type II water, characterized largely by having a resistance greater than 1 MΩ-cm, it is the second most stringent water quality defined by the American Society for Testing and Materials (ASTM). This means that common feedstocks such as brackish water or seawater need to be substantially treated to remove contaminants prior to use.

Additionally, contaminants can enter the system from the degradation of the equipment itself. Depending on the chosen process, the system can be highly acidic or alkaline and can operate at high temperatures and pressures. This puts substantial strain on the materials both inside the electrolyser and elsewhere in the system and causes the leaching of contaminants into the water after primary treatment.



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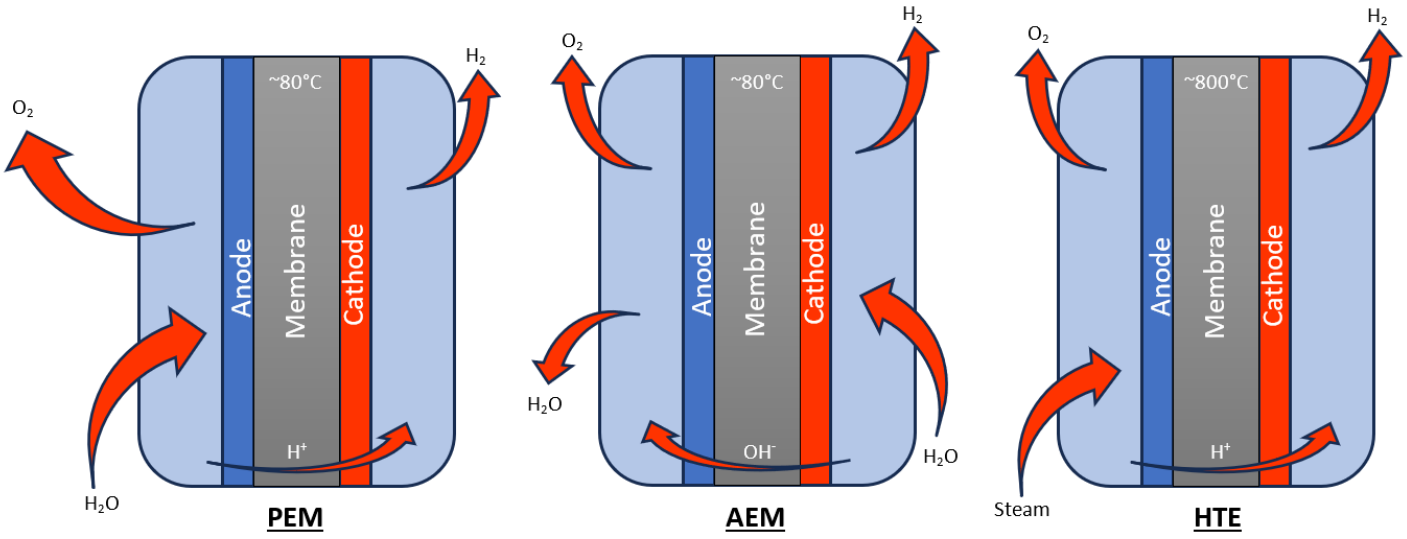
WHAT IS THE SOLUTION?

Before the necessary level of water treatment can be determined, the electrolysing process must first be selected. Several electrolyser technologies exist and have different levels of industrial maturity. Some examples include proton exchange membranes (PEM), anion exchange membranes (AEM), and high temperature electrolysis (HTE), which all operate in substantially different conditions and present unique design challenges. PEM electrolysis operates at highly acidic conditions, transferring hydrogen ions across the membrane, and have strict material requirements. AEM electrolysis instead operates under alkaline conditions, transferring hydroxide ions across the membrane, and allows for the use of more scalable materials such as nickel, rather than the platinum or iridium catalysts required for PEM electrolysis. HTE operates at temperatures up to 800°C rather than the 60-80°C seen for other electrolysis technologies. This allows HTE to both require less energy overall and provide recoverable heat for peripheral systems.



Once the required water quality has been determined from the electrolysis technology, several processes can be employed to reach it. Some proven and developing water purification processes include reverse osmosis (RO) and

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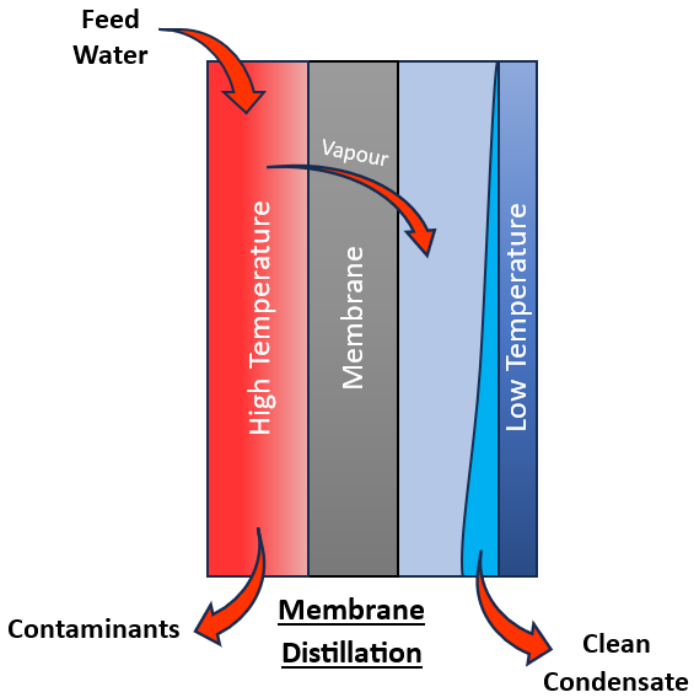
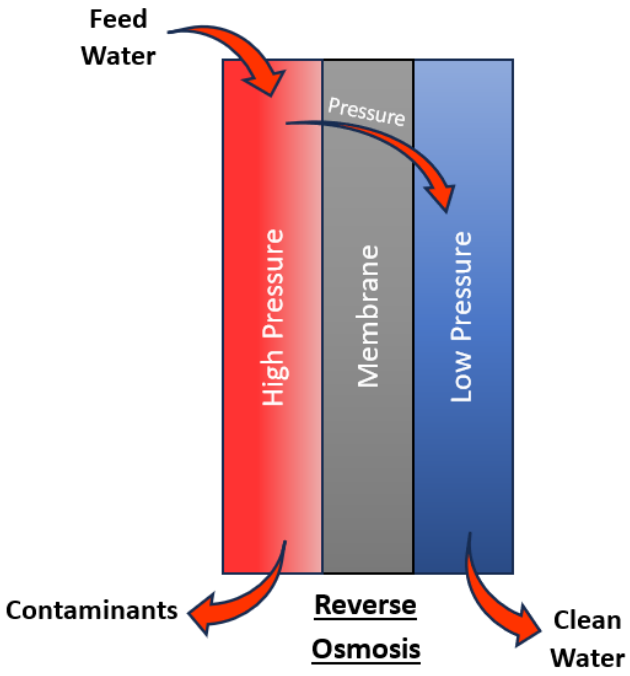
membrane distillation (MD). Reverse osmosis is highly commercialized and employs pressure as the driving force to push water through a membrane that most contaminants cannot pass through. However, to ensure that the membrane's pores do not become clogged with the contaminants, several pretreatment and posttreatment steps are required and add additional costs. Membrane distillation, by contrast, is a less mature process that has been estimated to have lower overall costs. The lower costs result from utilizing evaporation and thermal energy recovered from systems such as the electrolysers as the driving force to purify water across the membrane.





WHAT VALUE DOES CLEARBAKK BRING?

As a fully integrated engineering, procurement, construction, management company with a presence around the world in the ALSYS Group, ClearBakk will not just sell you a technology, but will provide you with a complete and technology agnostic solution optimized to your system. If your system presents a unique opportunity to implement novel technologies, ClearBakk will not only be able to provide a technological breakdown but will also be able to assist with lab testing to pilot testing to provide the guarantee and confidence required.

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IMAGES

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