There exist three new routes employing Markel Eclipse Membranes® in the Chlor Alkali Market: Brine filtration, Brine Re-concentration and Chlorine Dioxide Production. For 5 years Eclipse Membranes have been sold globally through our partners in the form of brine filtration candles. Brine Re-concentration and Chlorine Dioxide production, both achieved via Osmotic Membrane Distillation Processes, are not yet commercial and are being explored with partners having proprietary systems and processes.

Brine filtration or brine polishing filtration refers to the filtration process in the Chlor Alkali chemistry that reduces total suspended solids (TSS) in the incoming brine feedstock to a defined level. As the Chlor-Alkali production is one of the most commercially significant processes in the chemical industry and the only commercially viable source for two industrially important families of chemicals, much rides on the reliability of the filtration system. It is an expensive process to operate with a very costly electrolysis cell at its heart that the filtration system is there to protect.

This use of Markel’s Eclipse PTFE tubular membranes in the form of brine filtration candles is pre-existent in China and Europe. There are relatively few membranes producers serving this market and they have not demonstrated the willingness to advance designs of either system or membrane. Through partnerships with our systems producers, Markel will provide both custom membranes and module design technologies to meet our partners existing and improved filtration system requirements. Contact Markel Eclipse Membranes® group to discuss your specific needs in brine filtration. We will be happy to work with you and connect you to our current systems providers.
Chlor-Alkali Processes

The Chlor-Alkali process is a broad label applied to several processes involving the electrolysis of sodium chloride (or other salts to a lesser degree) into industrially useful components, notably chlorine, sodium hydroxide, sodium hypochlorite, sodium chlorate, and in certain cases the potassium or calcium derivatives of these same products. The output of the process yields caustic and chlorine in roughly equal parts and their production is closely linked with each other's market. These facilities may be stand-alone, i.e., the products are chlorine, caustic, hydrogen, etc., or may be sub facilities in larger chemical plants. For example a pulp and paper mill may have its own chlor alkali process for generation of bleach.

Since chlorine is not easily stored, shifts in the chlorine market will influence production of sodium hydroxide. Chlorine is tied into the production of a variety of industrial chemicals and industrially important plastics such as PVC, etc. as well as use in a variety of sanitizing agents.

Sodium hydroxide (also known as soda ash or caustic) is second only to sulfuric acid in worldwide production of inorganic chemicals. A pie chart showing the breakdown of major uses is presented below in Figure 1.

![Figure 1: Use Distribution for NaOH](image)
The basic chemistry of the electrolysis process is shown in Figure 2 (borrowed from Wikipedia). Brine solution enters the cell and through the electric potential between the anode and the cathode, decomposes into elemental chlorine and sodium ions. The co-products are chlorine, concentrated sodium hydroxide, and some hydrogen (from the decomposition of water). A dense membrane separates the anode from the cathode, allowing only the transport of ions across the interface, keeping the brine solution separate from the generated caustic. Chlorine and caustic are produced in a ratio of 1 ton of chlorine, 1.1 tons of caustic. This consumes 1.75 tons of salt, and is referred to as one ECU (electrochemical unit). An additional schematic from the Japan Soda Industry Association (Figure 3) shows the various steps for the treatment of the raw materials as well as treatment of the various product streams.
One hears much about membranes for the Chlor Alkali industry, but generally these are the electrolysis membranes. The membrane employed in the *electrolysis cell* is a dense membrane and is not made by Markel. The process is extremely energy intensive; one figure cited is that West Germany consumed 4 billion kilowatts for chlor-alkali generation in 1985.

Besides being energy intensive, the Chlor-Alkali processes consume significant amounts of real estate and create potential waste issues. As can be seen from the diagram above, saturated salt water (brine) is fed to the cell and depleted salt water is returned from the cell. The depleted salt must either be brought back up to the saturation point (done by adding additional salt, additional filtration, mixing, etc.) or must be disposed of, an expensive and daunting task considering the volumes.

Purification of the brine as shown in Figure 3 and is commonly known as brine polishing filtration.