

Best Practice in a Chlor-Alkali Industry in Tamil Nadu

Chemplast Sanmar Limited

MEMBRANE CELL PROCESS IN CHLOR ALKALI PLANT



CHLOR ALKALI PLANT METTUR



Plant-III Chlor-alkali Plant, Mettur Dam-3



A. INFORMATION ABOUT THE COMPANY

Chemplast Sanmar – over forty years old and the flagship company of The Sanmar Group – is a major manufacturer of PVC resins, Caustic Soda, Chlorochemicals, Refrigerant gas and Industrial Salt. The manufacturing facilities are located at Mettur, Cuddalore, Panruti and Vedaranyam in Tamil Nadu and Karaikal in the Union Territory of Puducherry.

The Chloralkali Plant of Chemplast Mettur is known as Plant-III located at Raman Nagar, Mettur Dam having 116 Acres with 550 employees including 300 contract employees.

The Chloroalkali division of Chemplast, a result of backward integration by the Group, manufactures a wide range of products using a highly integrated manufacturing process. These downstream products are either chlorine derivatives or chlorine users in the production process.

The salt needed for chlorine manufacture is supplied by Chemplast's salt fields at Vedaranyam. The power-intensive electrolysis process of manufacturing chlorine is served by Chemplast's own power plant.

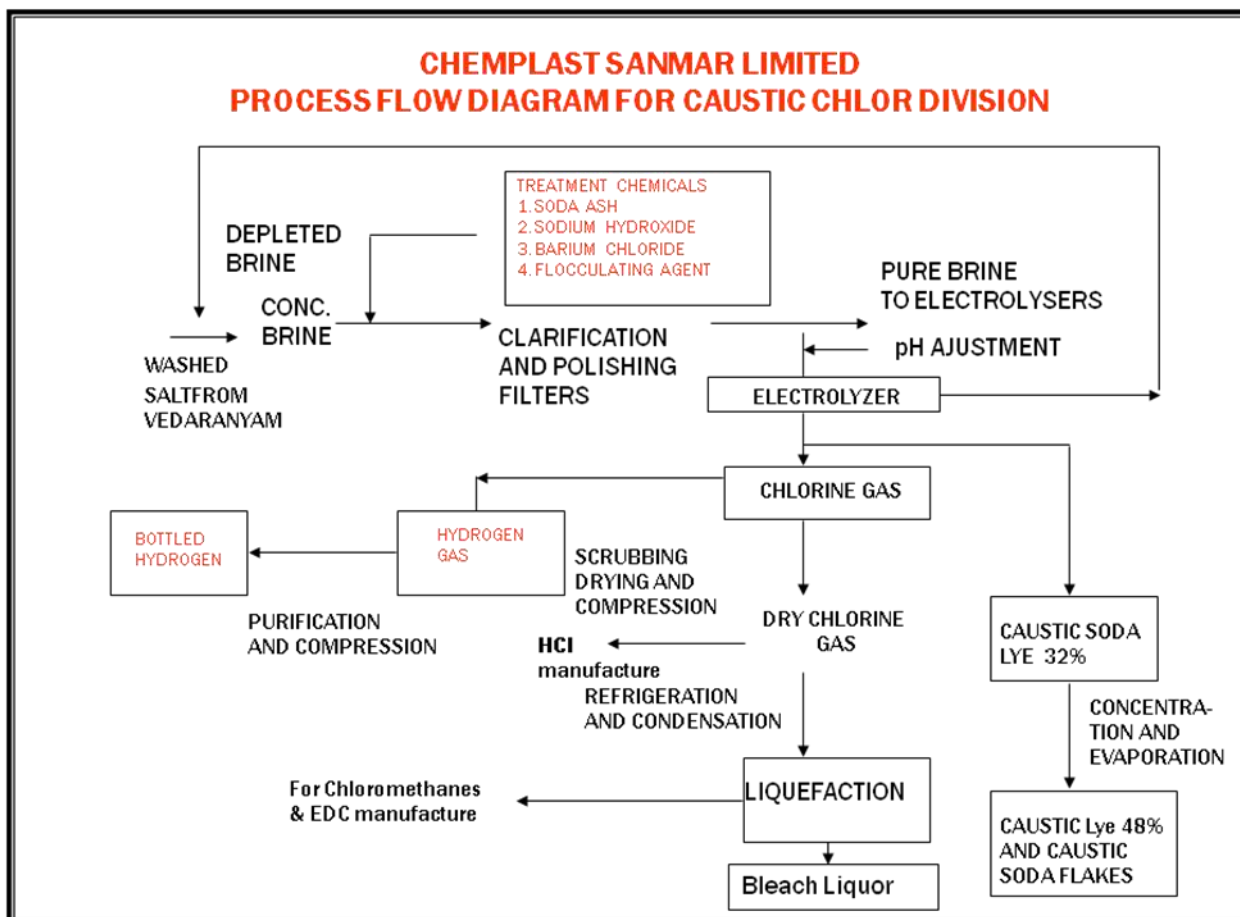
Company has changed over from mercury cell to Membrane Cell Technology from 2007 for caustic soda manufacturing with the know-how from AKCC, Japan.

The Chloralkali Plant of Chemplast Mettur is certified for ISO-14001 and OHSAS-18001 certifications for HSE management. Recently, ICC has awarded to use "Responsible Care" logo after an extensive audit at site.

B. PROCESS & TECHNOLOGY

Following is the brief outline of the overall process of Caustic Chlor manufacturing :
It essentially comprising of the following stages:

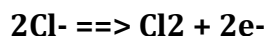
1. Preparation of Saturated Brine (usually around 310-320 GPL of salt solution)
2. Pre-treatment of Brine to remove the undesirable impurities namely Calcium, Magnesium, Sulphate and others through Chemical, ion exchange and other filtration process
3. Electrolysis of Brine in the membrane cell to produce Caustic, Chlorine and Hydrogen
4. Depleted brine is recycled back to the process for preparation of saturated brine
5. Chlorine gas is getting liquefied by compression after removal of moisture and then stored under pressure



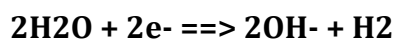
6. Hydrogen is utilised as a fuel for boiler and also used in HCl production apart from bottling

7. Caustic lye generated from the process is around 32% which is getting converted in to saleable 48% lye after processing through caustic concentration unit. It is further concentrated in Flakker unit to 100% and sold as Caustic flakes.

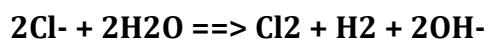
Electrochemical Reactions at Membrane cell:



ANODIC REACTION



CATHODIC REACTION



OVERALL IONIC REACTION



PRETREATMENT AREA OF CHLOR ALKALI PLANT



MEMBRANE ELECTROLYSER OF CHLOR ALKALI PLANT



PROCESS CONTROL WITH COMPREHENSIVE SAFETY INTERLOCKS THROUGH DCS

C. ADVANTAGES OF MEMBRANE TECHNOLOGY:

Chemplast Sanmar, had proactively embarked in an ambitious program of converting the mercury cell process in its caustic soda manufacturing facility into a state-of-art , environmental friendly , membrane cell process in August 2007 ; The membrane cell process is highly energy efficient and the project was implemented well ahead of the MoEF stipulated time . The technology has supplied by the world renowned, Asahi Kesai, Japan. After embracing the new membrane cell technology Chemplast’s caustic soda process is now recognized at par with that of developed countries in terms of environmental compliance in all respects.

ADVANTAGES OF MEMBRANE TECHNOLOGY AT CHEMPLAST SANMAR:

1. Pollution free process

This process is environment friendly since the membrane cell process is devoid of mercury, it is considered to be totally pollution free process. Brine sludge generated from the membrane process is free of mercury & classified as “Non-hazardous”.

2. Trouble free operation

This process is considered to be trouble free for operation as it is highly automated

3. Purity of the product

The membrane process offers higher quality product than the mercury process, giving

low sodium chloride content in caustic soda and a high purity of chlorine gas

4. Reduction of power consumption

Less power intensive technology and hence reduction of power consumption to the tune of 30 %

5. Reduction of operational area of the Plant

Membrane process requires only one third space compared to mercury cell process of same capacity

6. Maintenance free production process

Membrane process is associated with significantly less maintenance issues. So, the continuing capability of the process equipment leads to increased operational hours thus increase in productivity

7. Reduction in operational man power

As the membrane process is highly automatic in nature and with DCS, there is a considerable reduction in man power for its operation.

D. BENCHMARK ENVIRONMENTAL & SAFETY PRACTICES FOLLOWED:

Following are the good bench mark environmental practices adopted by Chemplast Sanmar. Chemplast articulated these unique practices and getting shared through Alkali Manufacturer's Association (AMAI) for benefiting others chloralkali Industries:

Best Safety & Environmental Practices Followed:

- Safety interlocks are provided for various process control parameters to sustain the operational process safety integrity thus to eliminate chlorine release
- In case of DCS failure, an alternate hard-wired system is available for safe plant shutdown, thus to eliminate any chlorine release to the atmosphere
- Descote vavles (Bellow seal valve) , recommended by Euro-Chlor , is used for liquid Chlorine Storage tanks and lines in order to improve the reliability, thus to reduce the failure
- Three stage chlorine absorption with stand-by chlorine absorption tower is made available towards additional safety for chlorine absorption
- Chlorine monitor installed at the outlet of the absorption tower & ensuring its operational effectiveness

- 12 Chlorine monitors are installed at Chlorine handling, processing and storage areas of the plant for early detection of chlorine leak & the online data is linked to Care Air Center of TNPCB



- In Chlorine filling, a remote operated valve (ROV) installed on liquid Chlorine filling line to:
 - avoid overfilling of Tonners
 - close ROV if Chlorine sensor activate above 3 ppm in ambient
 - close ROV in case of power failure



- Establishment of Expansion bottles on liquid Chlorine transferring line to downstream plant to eliminate the line failure due to excessive pressure.
- Four layers protection for preventing excess pressure in chlorine storage operations namely automatic loading/unloading for air padding compressor, High pressure alarm, safety relief system, differential pressure quick shut-off system.
- Chlorine Emergency Kit is made available on ready condition to mitigate any leak arising from the Tonner



- Chlorine Suction Hoods are installed throughout the Chlorine handling area for any eventual release of chlorine, which are connected to the scrubber for neutralization



- Online air Breathing mask and SCBA are placed in the chlorine handling and operational areas to mitigate the chlorine emergency by the competent emergency responders
- Movable Water Curtains for blanketing of chlorine to the neighbouring areas
- Plant mock drills are carried out thrice in a year involving at least twice with Chlorine related scenarios to verify the efficacy of the emergency preparedness.
- Specially fabricated clamps of various sizes to suit the process /storage lines for arresting the leak during emergency. This is an integral part of at least one of the mock drill.
- Company is having a system to carry out at least One mock drill during the lean period (holidays/Sundays) and/ or night hours to check the emergency response
- Chlorine Tonners are getting checked at the Petroleum Explosives Safety Organization (PESO) approved testing facility established inside the plant prior to chlorine filling

- Ensuring the availability of at least two Chlorine stewards for 24 x 7 in the chlorine handling /operational area
- Filled Liquid Chlorine Tonners are being dispatched only after 24 hrs observation
- UTG & Hydro testing are being carried out once in 2 years for the Liquid Chlorine storage tanks
- Each storage tanks are provided with 2 numbers of safety valves and tested once in a year by PESO approved competent authority
- At any given time, one storage tank having the highest storage capacity is kept empty for emergency purpose

Six Levels of Power Redundancy for eliminating Chlorine release to the atmosphere:

❖ Power Block-out situation is a common scenario in Indian context. During the Power Block-out situation, chlorine from the process lines needs to be absorbed by the scrubbing system , which require electrical power for its efficient operation. In order to ensure the continuous availability of electrical power to the chlorine absorber system , Chemplast Sanmar has made the following power redundancies:

1. Chemplast Mettur has established its own power plant for its reliable power availability
2. The power to the panels of chlorine absorption system is fed from the captive coal power plant and in parallel with the 110KV TNEB grid. This ensures that even if one of the source fail, the power to the equipments is ensured from the other source automatically
3. 250KVA UPS system is installed to ensure uninterrupted power availability for a time period of 20 minutes even if both the above power sources fail. This UPS system ensures the power supply, without any time delay, within fraction of a second to Chlorine gas absorption system thus eliminating the emission of chlorine to the atmosphere.
4. Emergency DG set (320 KVA) is the next Power redundancy system to provide power automatically after 20 Sec of Power failure.
5. Diesel Driven Pump & Blower , which are connected to the chlorine absorption tower
6. Caustic deluge system to quench the process line chlorine absorption automatically

Chemplast Mettur is the first chloralkali manufacturer to install such facility in India to eliminate the chlorine release due to Power Block-out situation.

The scheme of 6 levels of Power redundancies depicted here:



Power redundancy for Chlorine Absorption System

SIX levels of redundancy:

1. Captive Power from Coal Power Plant (2 x 24.25 MW)
2. TNEB Power
3. 250 KVA UPS for entire MCC panel of Bleach liquor Unit
4. Emergency Auto start 320 KVA DG-set
5. Diesel Driven Blower and pump on auto start
6. Auto draining of Caustic Deluge tank

