Welcome to the presentation on Sustainability of Chlor-Alkali Industry: Chlorine Derivatives

Ram D Sao

ADITYA BIRLA GROUP

GRASIM INDUSTRIES LTD - CHEMICAL DIVISION

BALBHADRAPURAM
EAST GODAVARI, A.P

The Aditya Birla Group is 100 Billion US Dollar conglomerate, spread over 6 continents and 36 countries having 130 + state of the art manufacturing units which are in operation globally involving 160,000 employees belonging to 100 nationalities.

ABG is known for

No.1st in Aluminium Rolling,

No 1st in recycler of Aluminium,

No 2nd in Carbon Black manufacturing,

No 2nd in Staple fibre and

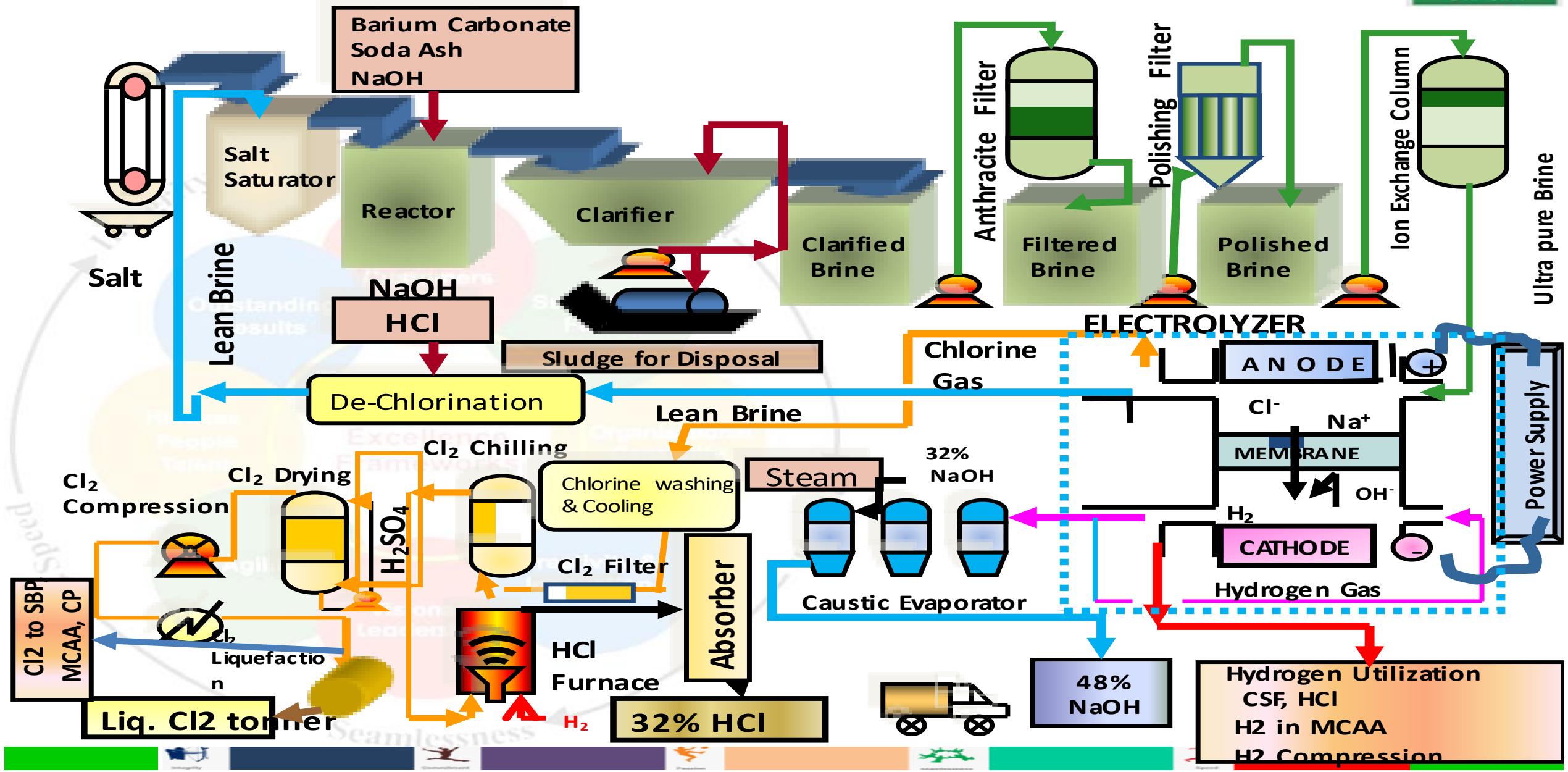
No 3rd in Cement manufacturing globally (excluding China) & 1st in India

BRIEF INDRODUCTION ABOUT ADITYA BIRLA GROUP

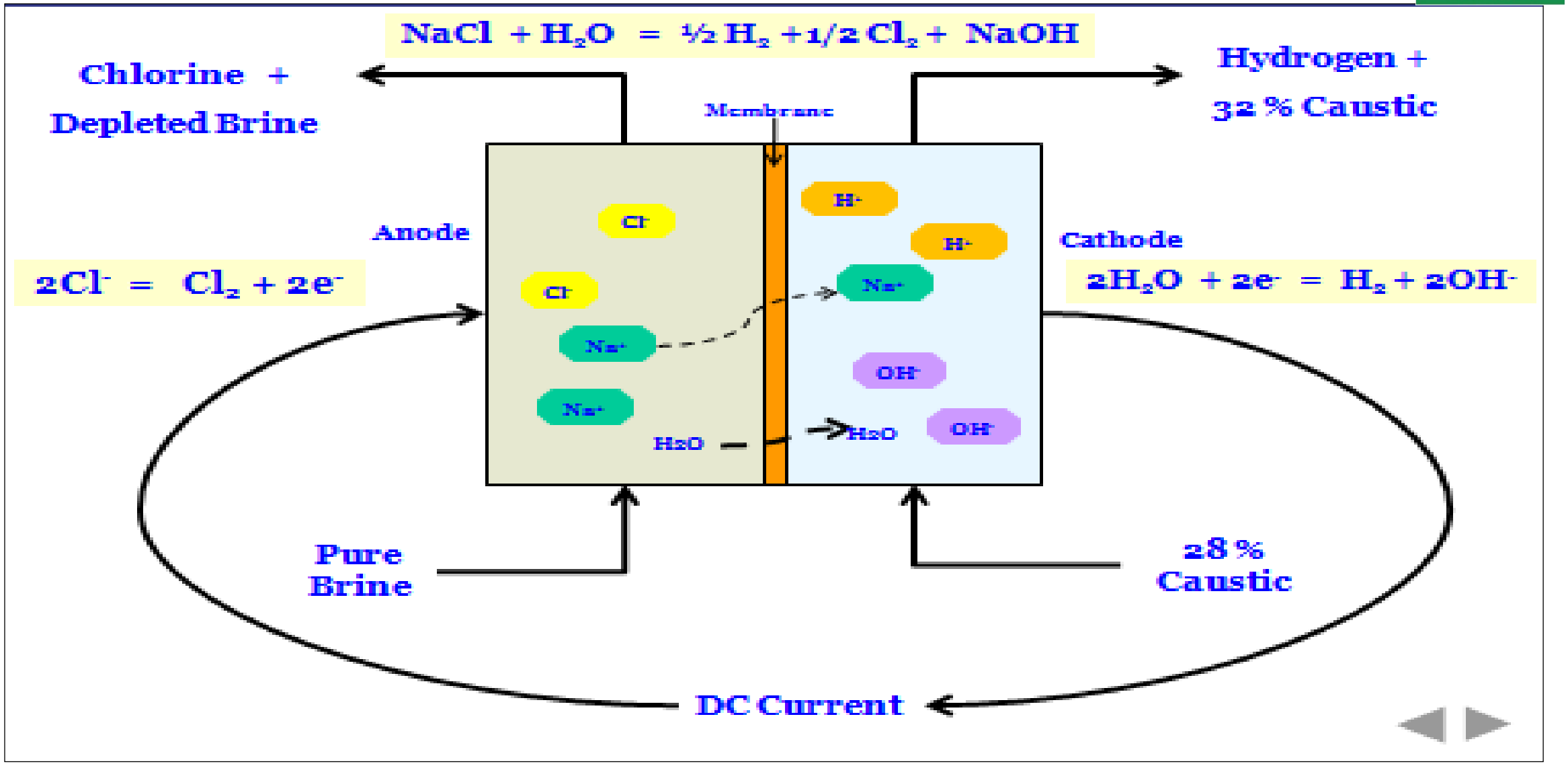
In India, ABG is a leader in various sectors

- ✓ No. 1 in Grey Cement, White Cement and Concrete
- ✓ No. 1 in Fashion Retailer,
- ✓ No.1 in Caustic Soda and Specialty Chemicals
- ✓ No. 1 in Copper and
- ✓ No. 1 in Filament Yarn
- ✓ Linen Player
- ✓ Insulator Manufacturer and world's 3rd largest
- ✓ Life Insurance,
- ✓ Telcom Player

PROCESS FLOW DIAGRAM OF– CHLOR- ALKALI



ELECTROLYTIC REACTION IN ELECTROLYSER



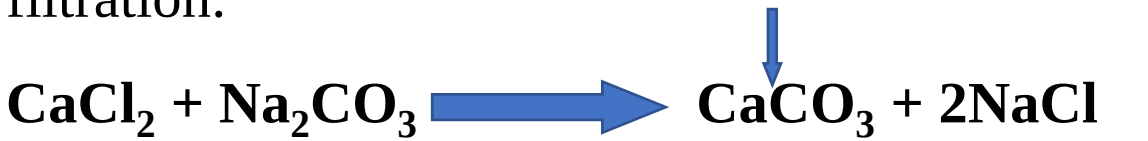
Ref: tkis manual

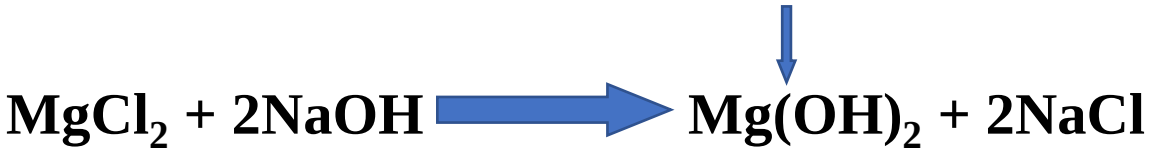
MANUFACTURING PROCESS OF MEMBRANE CELL PLANT

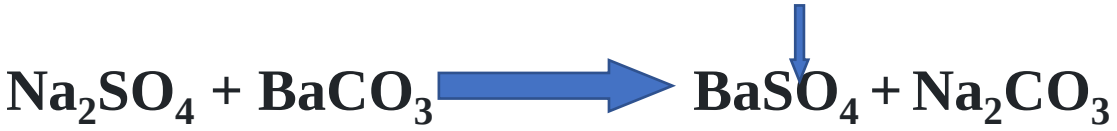
Membrane Chlor-alkali process requires a secondary brine purification process after the conventional treatment. Brine is purified in brine filters and ion-exchange resin columns to get Ultra pure brine.

(a) Primary Brine Purification:

Primary brine purification section consists of salt dissolution , chemical addition, clarification, filtration.







Ref: tkis manual

MANUFACTURING PROCESS OF MEMBRANE CELL PLANT

(b) Secondary Brine Purification:

The dissolved impurities are removed by passing brine through Ion Exchange columns to brine down Ca/Mg level to the tune of nearly 10ppb.

(c) Ion-exchange Columns:

$$2RNa + CaCl_2 = R_2Ca + 2NaCl$$

$$R_2Ca + 2HCl = 2RH + CaCl_2$$

$$RH + NaOH = RNa + H_2O$$

(d) De-chlorination

The depleted brine from the electrolyser contains about 800-1000 mg/1 dissolved chlorine. The dissolved chlorine removed by addition of SBS and sent for resaturation.

Ref: tkis manual

MANUFACTURING PROCESS OF MEMBRANE CELL PLANT

Steps are followed for chlorine treatment.

- Cooling- temp of 14-15 deg C
- Drying,- Moisture level of 70-75 ppm
- Compression- upto 3 bar(g) pressure
- Liquefaction- conversion from Gas to liquid
- Storage and Cl_2 bottling and supply to VAP

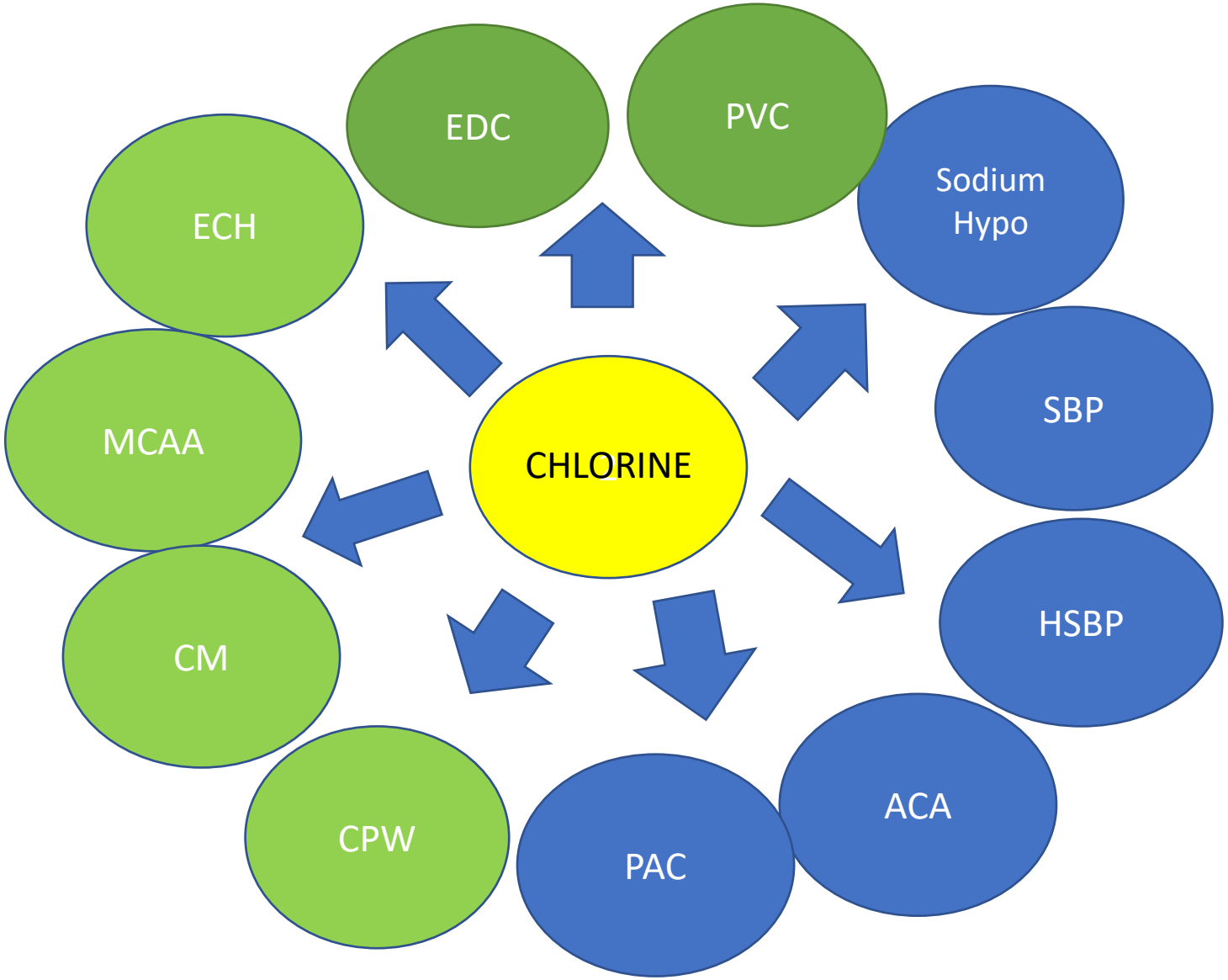
Waste Air Dechlorination: The waste gases having little quantity of Cl2 is neutralized with 18% caustic Soda forming Sod Hypochlorite (NaOCl)

Hydrogen: H2 also that comes out of the electrolyser is treated by cooling, Filtration, Compression for the outside and internal supply.

Caustic Soda : 32% Caustic which comes out of the electrolyser is further heated indirectly by steam at multistage evaporator where caustic concentration is increased from 32% to 48%.

Ref : tkis manual

CHLORINE CONSUMPTION PATTERN



Cl_2 Atom Economy
Specific Consumption of Cl2
EDC – Ethylene Dichloride 1.27
PVC--- Polyvinyl Chloride, 1.5
MCAA--- Monochloro Acetic Acid- 0.88
CPW – Chlorinated Paraffin Wax- 1.2
CM– Chloromethane- 0.98
ECH– Epichlorhydrin. 1.1

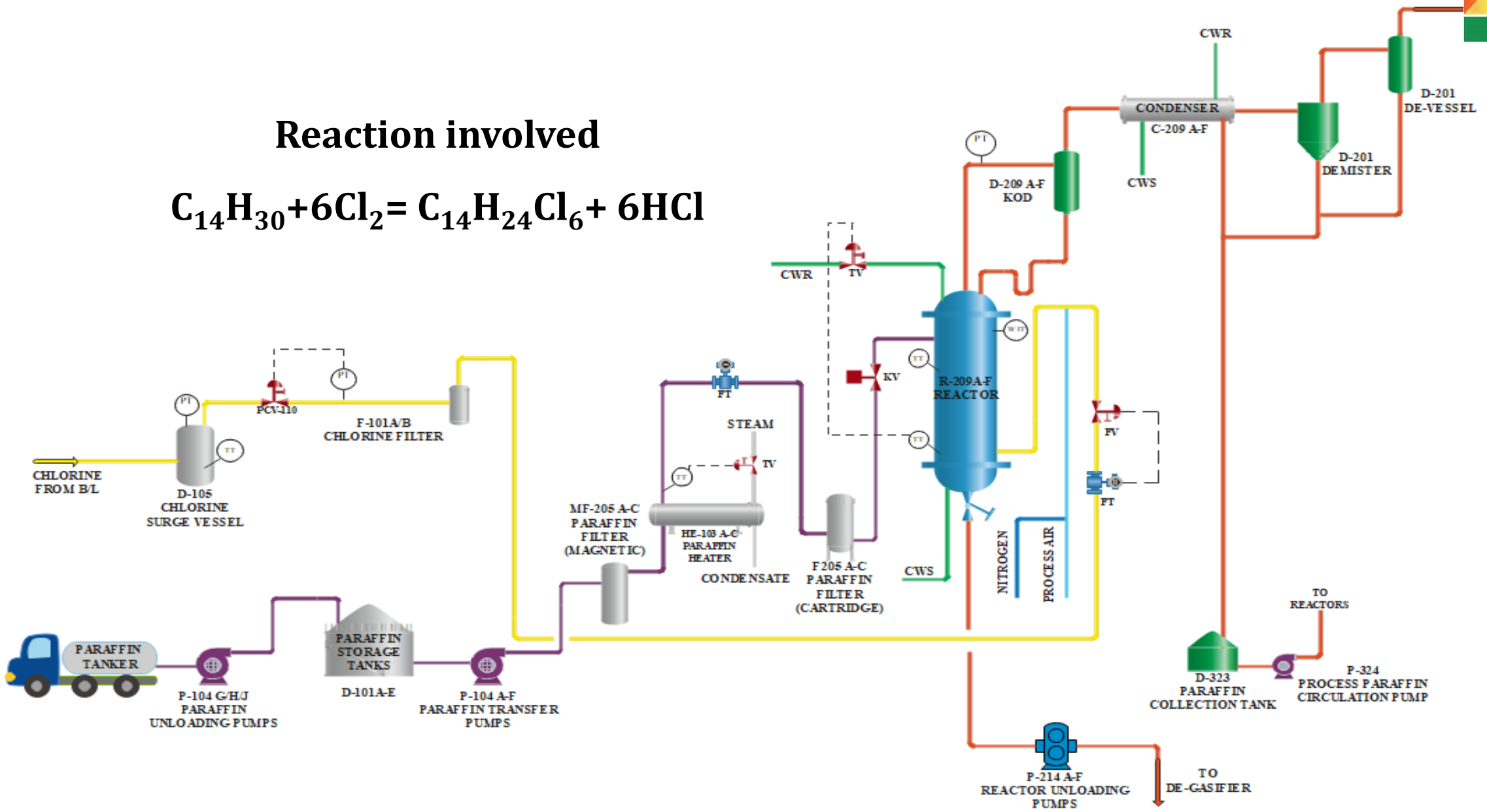
Sodium Hypo – Sodium Hypochlorite- 1.02
SBP– Stable Bleaching Powder- 0.41
PAC – Poly Aluminum Chloride, 0.12MT at 10%
ACA– Aluminium Chloride Anhydrous- 0.8
HSBP lime 0.68 MT/MT, Cl2-- 0.98

Ref: Industry Experience

CHLORINATED PARAFFIN

Reaction involved

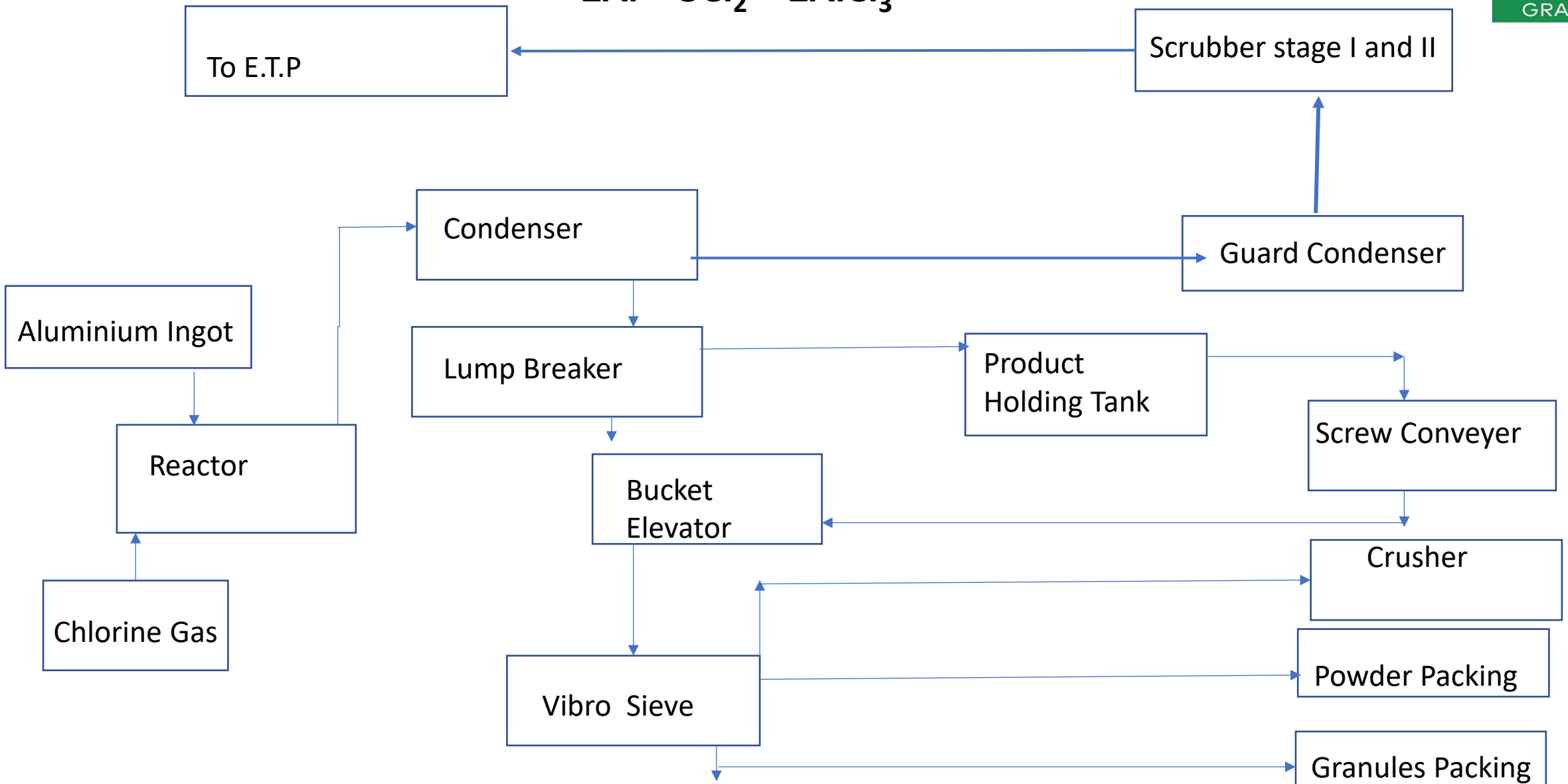
$$C_{14}H_{30}+6Cl_2= C_{14}H_{24}Cl_6+ 6HCl$$



Ref; Industry experience

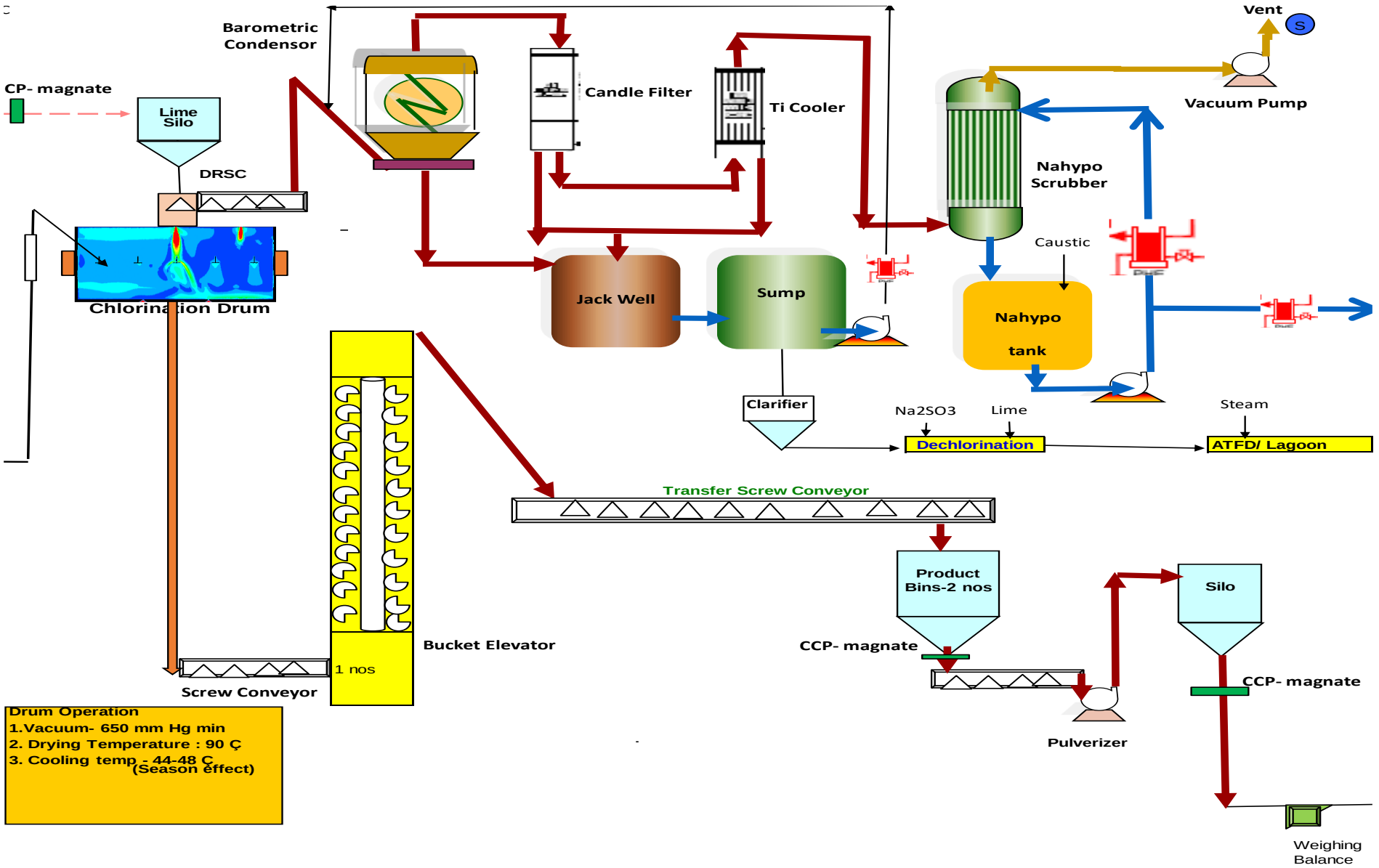
PROCESS FLOW DIAGRAM OF ALCP

$$2Al + 3Cl_2 = 2AlCl_3$$



Ref : Industry exeperience

PROCESS FLOW DIAGRAM OF SBP



Ref:Industry experience

HIGH STRENGTH BLEACHING POWDER PLANT

High strength bleaching powder (**HSBP**) is a white **powder** and contains a greater concentration of chlorine than ordinary bleaching **powder** - typically 65 to 70 per cent.

It is more stable.

Calcium hypochlorite has been widely used as disinfecting agent for different sectors like, Municipal Sector, Industrial Sector, Wastewater treatment as slime control as well as commercial sector Raw Water disinfection, Hygienic sanitisation.

Ref:Industry experience

PROCESS DESCRIPTION

Manufacturing process is by sodium method

Raw materials:-Sodium hydroxide ,Cl2 gas and Hydrated lime.

Utilities:-Cooling water, compressed air, steam, chilled water, chilled brine

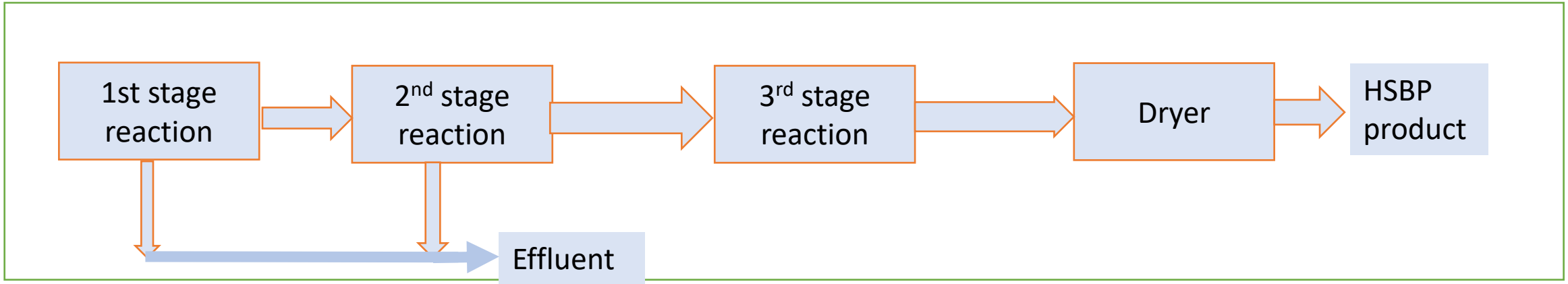
Chemical reaction :-

$$2Ca(OH)_2+2Cl_2 \rightarrow Ca(OCl)_2+CaCl_2+2H_2O$$

$$2NaOH + Cl_2 \rightarrow NaCl + NaOCl + H_2O$$

$$2NaOCl + CaCl_2 \rightarrow Ca(OCl)_2 + 2NaCl$$

- **Chemical Formula**: $Ca(OCl)_2$.
- **Molecular Weight**: 142.98 g/mol.
- **pH**: Typically alkaline; solutions have a pH around 10-12
- **Strong oxidizing**



Ref: Industry experience

Calcium Hypochlorite Market

ADITYA BIRLA
GRASIM

Market Drivers

- Rise in prevalence of waterborne diseases
- Increase in investment in water treatment

By Form

- Powder
- Pellet
- Granule

US$ 5.8 Bn

In 2022 (A)

Market Revenue

CAGR (2023–2031)

3.5%

By Application, 2022

- Water Treatment
- House Cleaners & Detergents
- Agrochemicals
- Pulp & Paper
- Food & Beverage
- Others

Key Players

- China Petrochemical Corporation (SINOPEC)
- Tosoh Corporation
- Lonza
- Nippon Soda Co., Ltd.
- Westlake Chemical Corporation
- Aditya Birla Chemicals (Thailand) Pvt. Ltd.
- Sree Rayalaseema Hi-Strength Hypo Ltd.
- Tianjin Kaifeng Chemical Co., Ltd.
- Yuzhoushi Weilite Chemical Co., Ltd.

By Region

- Asia Pacific
  - Largest market share in 2022

Ref:www.transparencymktresearch.com

MANUFACTURING PROCESS OF PROCESS OF CHLOROMETHANES

Introduction:-Chloromethanes are a group of chemical compounds that include chloromethane (methyl chloride), dichloromethane (methylene chloride), trichloromethane (chloroform), and tetra-chloromethane (carbon tetrachloride).

Capacity:- Plant Capacity is 150 TPD ,where Cl_2 consumption 147 MT per day.

Production Process:

Chloromethanes are typically produced through chlorination of methane or by reacting methanol with hydrochloric acid or chlorine.

The process often involves controlled reactions to minimize byproducts and maximize yield. Byproduct is 31 % HCl. Where 3 to 4 % caustic effluent is generated during treating organic acidity.

Ref: Operation Manual -JOC

MANUFACTURING PROCESS OF CHLOROMETHANES

Raw Materials: Methanol and Chlorine

Reactor Units: High-pressure reactors for the Chlorination process.

Distillation Columns: For separating different Chloromethanes based on their boiling points.

Cooling Systems: Essential for maintaining temperature control during reactions.

Applications:

Chloromethanes are widely used as solvents, refrigerants, and in the production of other chemicals.

Also serve as intermediates in the manufacture of pharmaceuticals, agrochemicals.

Ref: Operation Manual - JOC

Reactions Involved

Hydro Chlorination

$CH_3OH + HCl = CH_3Cl + H_2O$

Thermal Chlorination

$CH_3Cl + 2Cl_2 = CH_2Cl_2 + HCl,$

$CH_2Cl_2 + 2Cl_2 = CHCl_3 + HCl,$

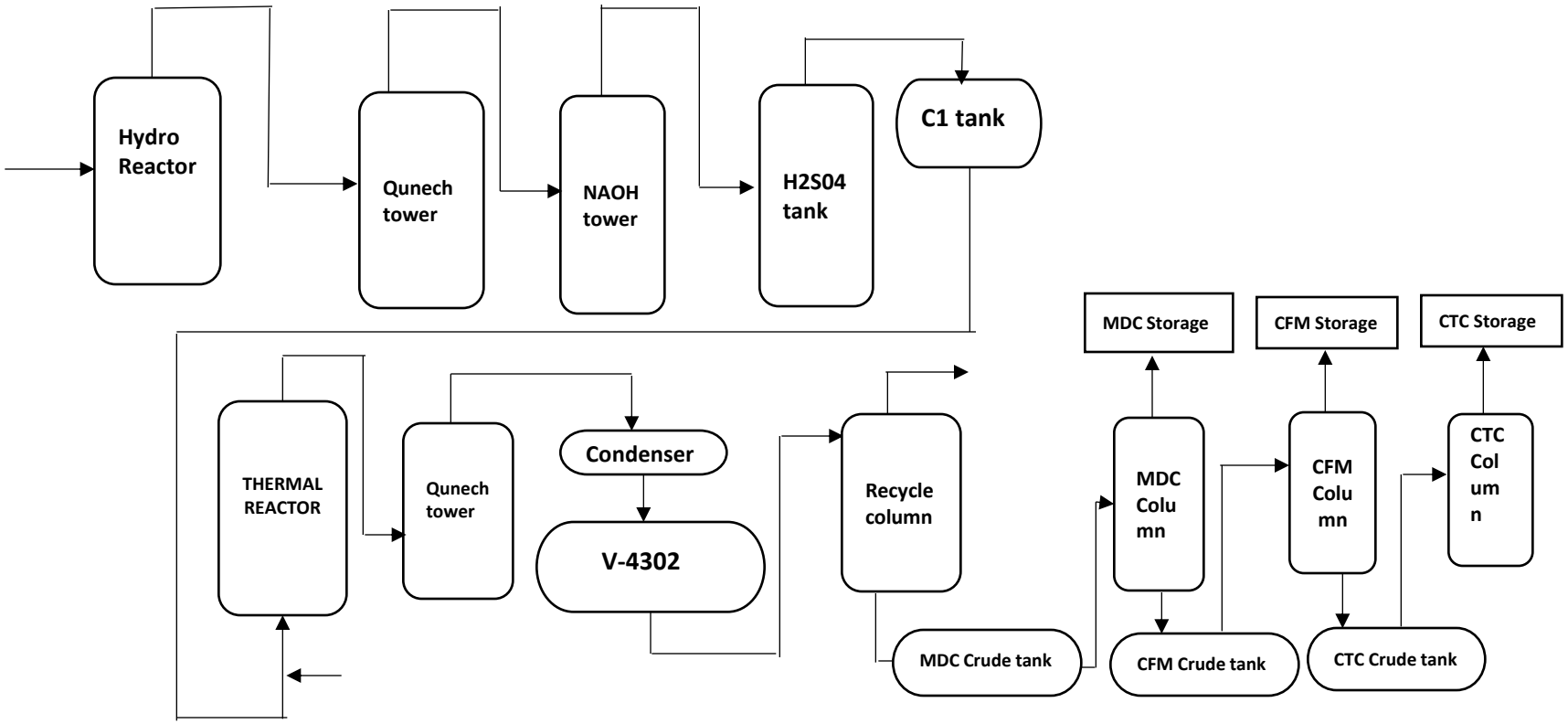
$CHCl_3 + 2Cl_2 = CCl_4 + HCl$

Raw Materials –Methanol, Chlorine,

Specific consumption of Chlorine 0.98 MT /MT of CMS. & ***consumption of Methanol 0.37 MT /MT of CMS.***

Ref: Operation Manual -JOC

CHLORORMETHANES PROCESS FLOW DIAGRAM



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Thank you for hearing patiently