HYDROCHLORICACID AND MISCALLANEOUS INORGANIC CHEMICALS

IRMAK ULUCAN
SEDEF USLU
ASIM KARAKUŞ
TUĞRA BALCI
AHMAD AYYASH

INORGANIC CHEMICALS

- Inorganic chemistry is the study of the synthesis and behavior of inorganic compounds.

- Inorganic chemicals are substances of mineral origin that do not contain carbon in their molecular structures.

- Many inorganic compounds are ionic compounds, consisting of cations and anions joined bu ionic bonding.

- Inorganic chemistry is a highly practical area of science.

- It has applications in every aspect of the chemical industry- including catalysis, materials science, pigments, surfactants, coatings, medicine, fuel, and agriculture.

- Manufacturing inorganic chemicals involves many diverse processes to produce a wide variety of end products, including various degrees of purity and concentrations for each one.

- Important classes of inorganic compounds include oxides, halides, carbonates and sulphates.

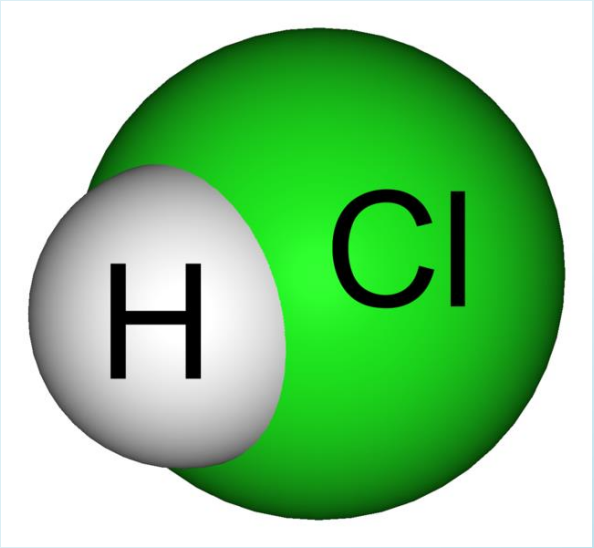
List of inorganic chemicals with widespread use in various industries

Acetic Acid	Barium Sulfite	Ferric Chloride	Manganese Iodide	Selenic Acid
Adipic Acid Solution	Bismuth Oxychloride	Ferric Fomate Ferric Nitrate	Manganese Lactate	Silicic Acid
Aluminum Bromate	Boric Acid	Ferric Oxalate	Manganese sulfate	Silicon Fluoride
Aluminum Bromide	Bromic Acid	Ferric Sulfate	Mercurous Nitrate	Silver Nitrate
Aluminum Chloride	Bromine Water	Ferric Sulfide	Nickel Bromide	Silver Perchlorate
Aluminum Fluoride	Cadmium Bromate	Ferric Thiocyanate	Nickel Chloride Nickel Formate	Silver Permanganate
Aluminum Hydroxide	Cadmium Bromide	Ferrous Chloride	Nickel Nitrate	Silver Thiosulfate
Aluminum Iodide	Calcium Bisulfite	Ferrous Chloroplatinate	Nickel Potassium Cyanide	Sodium Acetate
Aluminum Nitrate	Calcium Bromate	Ferrous ferricyanide	Nitric Acid	Sodium Bicarbonate
Aluminum Sodium Chloride	Calcium Bromide	Ferrous Fluoride	Palladium Chloride	Sodium Bisulfate
Aluminum Sulfate	Calcium Carbonate	Ferrous Formate	Platinic Acid	Sodium Bromide

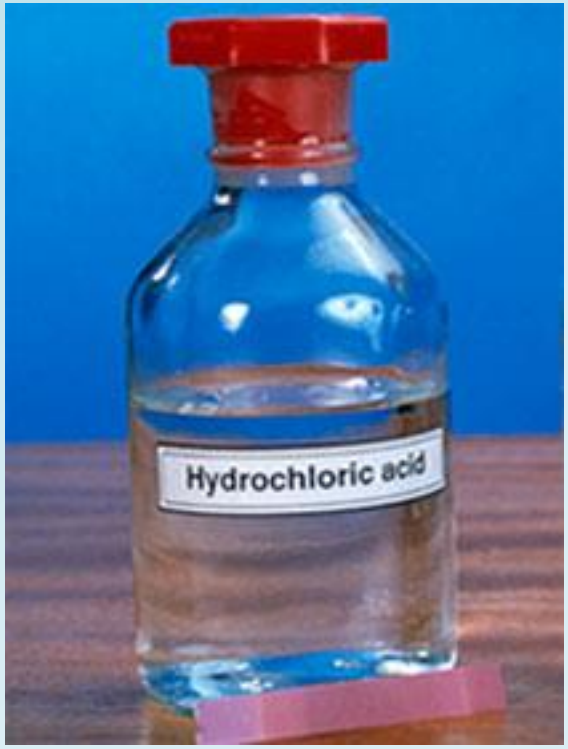
Ammonium Nitrate	Calcium Phosphate	Hydrochloric Acid	Potassium Chloride	Sodium Sulphate
Ammonium Oxalate	Calcium Sulfate	Hydrofluoric Acid	Potassium Cyanate	Sodium Sulfite
Ammonium Phosphate	Calcium Thiosulfate	Hydrogen Sulfide	Potassium Cyanide	Sodium Tetraborate
Ammonium Silicate	Carbon Disulfide	Hypochlorous Acid	Potassium Dichromate	Sodium Thiosulfate
Ammonium Sulfate	Carbonic Acid	Lauric Acid	Potassium Fluoride	Stannic Chloride
Ammonium Sulfide	Chloroacetic Acid	Lead Acetate	Potassium Hydrosulfide	Stearic Acid
Ammonium Trichloride	Chromic Acid	Lead Persulfate	Potassium Hydroxide	Sulfamic Acid
Barium Bromide	Chromic Sulfate	Lithium Acetate	Potassium Hypochlorite	Sulfuric Acid
Barium Carbonate	Chromous Chloride	Lithium Nitrate	Potassium Hypophosphite	Sulfurous Acid
Barium Chlorate	Chromous Iodide	Lithium Sulfide	Potassium Iodide	Tannic Acid
Barium Chloride	Citric Acid	Magnesium Acetate	Potassium Nitrate	Tantalum Fluoride
Barium Citrate	Copper Chloride	Magnesium Bromide	Potassium Phosphate	Tartaric Acid
Barium Dichromate	Copper Fluoride	Magnesium Carbonate	Potassium Phosphite	Titanium Chloride
Barium Hydroxide	Copper Nitrate	Magnesium Chloride	Potassium Silicate	Titanium Fluoride
Barium Iodate	Copper Sulfate	Magnesium Hydroxide	Potassium Sulfate	Titanium Nitrate
Barium Iodide	Cupric Bromate	Magnesium Nitrate	Potassium Sulfide	Titanium Tetrachloride
Barium Nitrate	Cupric Bromide	Magnesium Perchlorate	Potassium Sulfite	Zinc Chloride

HYDROCHLORIC ACID

- The chemical compound hydrochloric acid (or muriatic acid) is the aquaeos solution of hydrogen chloride gas. (Hydrogen chloride is very soluble in water.)



- It is a highly corrosive, strong acid with many industrial uses.



- Hydrogen chloride (HCl) is a monoprotic acid, which means it can ionize only once to give up one H^+ ion (a single proton). In aqueous hydrochloric acid, the H^+ joins a water molecule to form a hydronium ion, H_3O^+:

$$HCl + H_2O \rightarrow H_3O^+ + Cl^-$$

History of Hydrochloric Acid

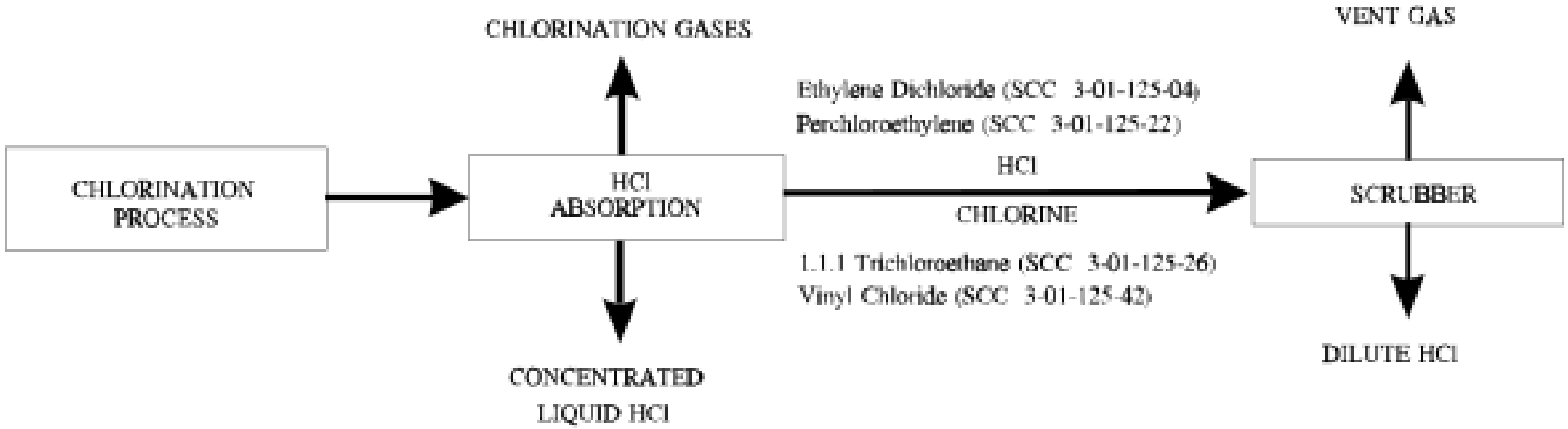
- Hydrogen chloride was discovered in the fifteenth century by Basilius Valentinius.
- Commercial production of hydrochloric acid began in England when legislation was passed prohibiting the indiscriminate discharge of HCl in to the atmosphere.
- As more uses of hydrochoric acid were discovered, plants were built solely for its production.

MANUFACTURE OF HYDROCHLORIC ACID

Organic sythesis:

- The largest volume production of hydrochloric acid is a by-product in the chlorination of both aromatic and aliphatic hydrocarbons.

$$R\text{-}H + Cl_2 \rightarrow R\text{-}Cl + HCl$$



HCl production from chlorination process.

The synthetic Process:

- This process generates hydrogen chloride by burning chlorine in hydrogen.

$$Cl_2 + H_2 \rightarrow 2\ HCl$$

- The purity of ensuing acid is depent upon the purity of the hydrogen and chlorine.

- This synthehic method produces the purest hydrogen chloride of all of the processes.

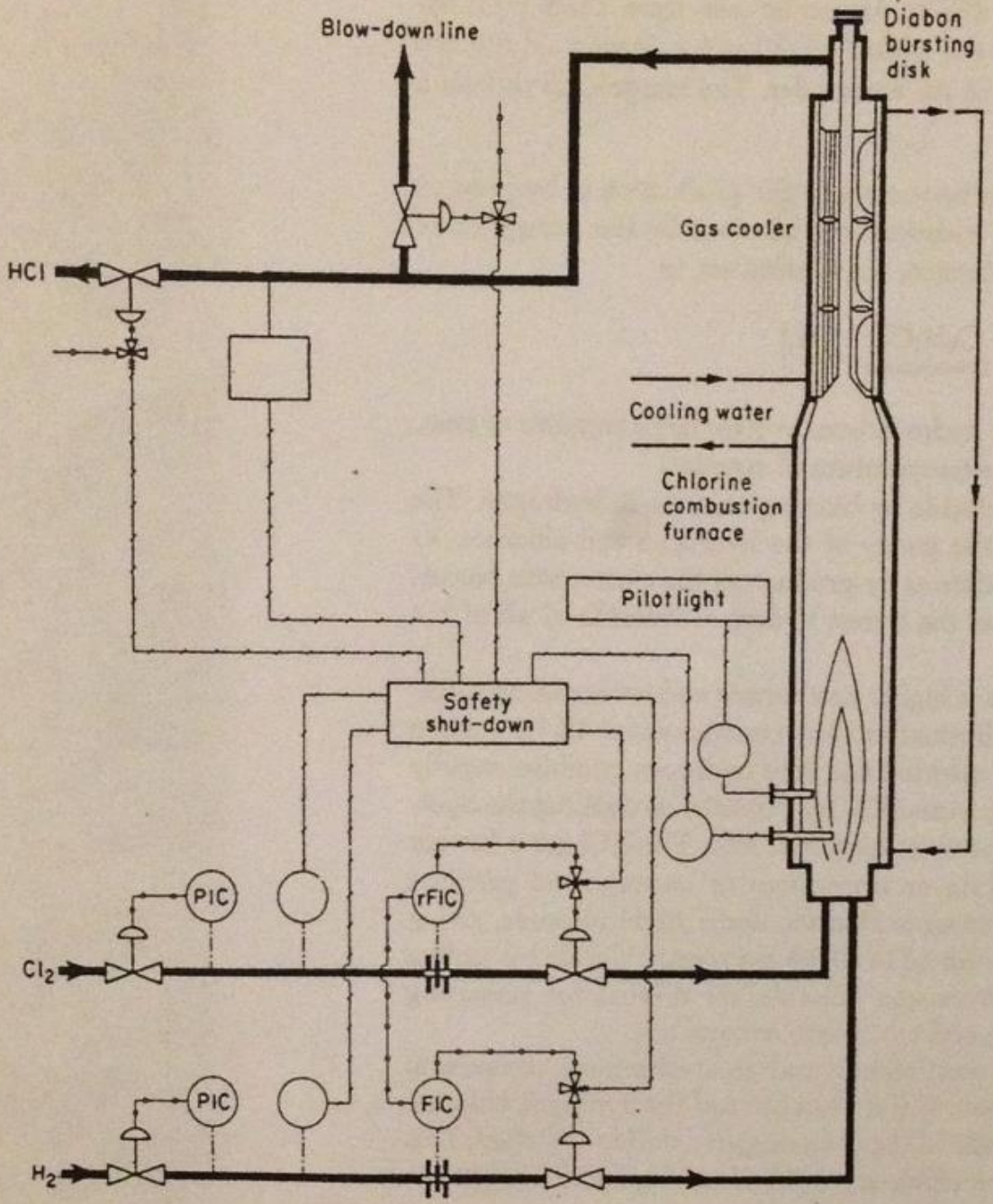


Fig. 20.1. Chlorine combustion furnace. *(SIGRI Elektrographit GMBH.)*

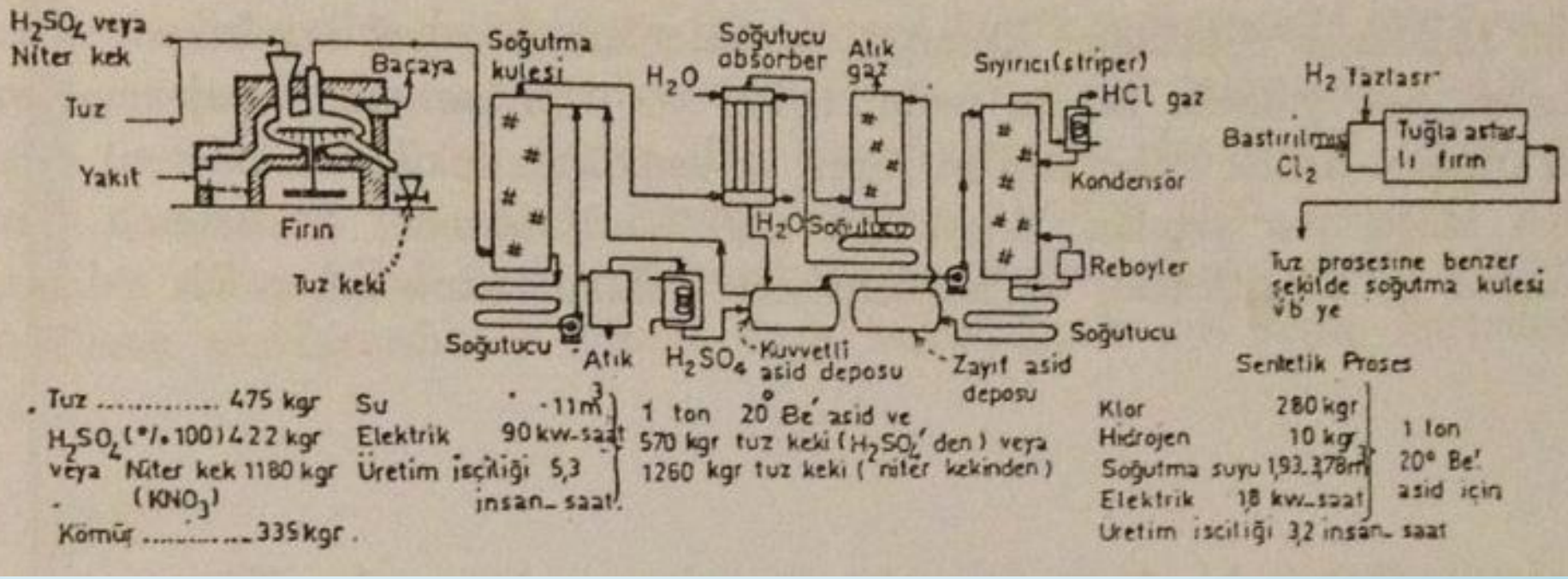
From Reacting Salt and Sulfuric Acid:

- Reaction of metallic chlorides, particularly sodium chloride (NaCl), with sulfuric acid (H_2SO_4) or a hydrogen sulfate:

$$NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$$

$$NaCl + NaHSO_4 \rightarrow Na_2SO_4 + HCl$$

$$2NaCl + H_2SO_4 \rightarrow Na_2SO_4 + 2HCl \qquad \text{(net reaction)}$$



Tuz ..... 475 kgr
H_2SO_4 (%100) 422 kgr
veya Niter kek 1180 kgr (KNO_3)
Kömür ..... 335 kgr

Su 11 m^3
Elektrik 90 kw-saat
Üretim işçiliği 5,3 insan-saat

1 ton 20° Be' asid ve 570 kgr tuz keki (H_2SO_4'den) veya 1260 kgr tuz keki (niter kekinden)

Sentetik Proses

Klor 280 kgr
Hidrojen 10 kgr
Soğutma suyu 193,378 m^3
Elektrik 18 kw-saat
Üretim işçiliği 3,2 insan-saat

1 ton 20° Be' asid için

From Hargreaves-type operations:

$$4NaCl + 2SO2 + O2 + 2H2O \rightarrow 2Na2SO4 + 4HCl$$

- This process is used only one big company which produces 60 000 tonnes HCl per year.

Organic Waste Incineration:

- Hydrochloric acid is made during incineration, at high temperatures, of chlorinated wastes as follows:

$$C_yH_{(2z+1)}Cl + (y+z/2)O_2 \rightarrow yCO_2 + zH_2O + HCl$$

USES OF HCL

Hydrochloric Acid uses are many and varied, both in industry and domestically where, as a strong, organic mineral acid, it is one of the most widely used.

The acid is also used in the production of organic compounds such as vinyl chloride and dichloroethane which are used in the manufacture of PVC, bisphenol A, used in the manufacture of polycarbonate, and many pharmaceutical products.

Technical-quality HCl at typically 18 percent concentration is the most commonly-used pickling agent for the pickling of carbon steel grades.

- $Fe_2O_3 + Fe + 6\ HCl \rightarrow 3\ FeCl_2 + 3\ H_2O$

The other applications of hydrochloric acid are:

- **Mining**
- **Food and Dairy Industry**
- **Water Treatment**
- **Chemical Raw Material**

PRODUCTION IN THE WORLD

Hydrochloric acid is produced in solutions up to 38 percent HCl (concentrated grade).

Major producers worldwide include Dow Chemical at 2 million metric tons annually (2 Mt/year), calculated as HCl gas, and FMC, Georgia Gulf Corporation, Tosoh Corporation, Akzo Nobel, and Tessenderlo at 0.5 to 1.5 Mt/year each. Total world production, for comparison purposes expressed as HCl, is estimated at 20 Mt/year, with 3 Mt/year from direct synthesis, and the rest as secondary product from organic and similar syntheses. By far, most of all hydrochloric acid is consumed captively by the producer. The open world market size is estimated at 5 Mt/year.

IODINE

- Non-metal
- Halogen
- Density: 4.93 g/cm^3

- Solid: bluish-black
  Vapor: purple

HISTORICAL DEVELOPMENT

Iodine was discovered by French chemist Bernard Courtois in 1811.

Gay-Lussac who suggested the name "*iode*", from the Greek word ιώδες (iodes) for violet (because of the color of iodine vapor).

RAW MATERIALS

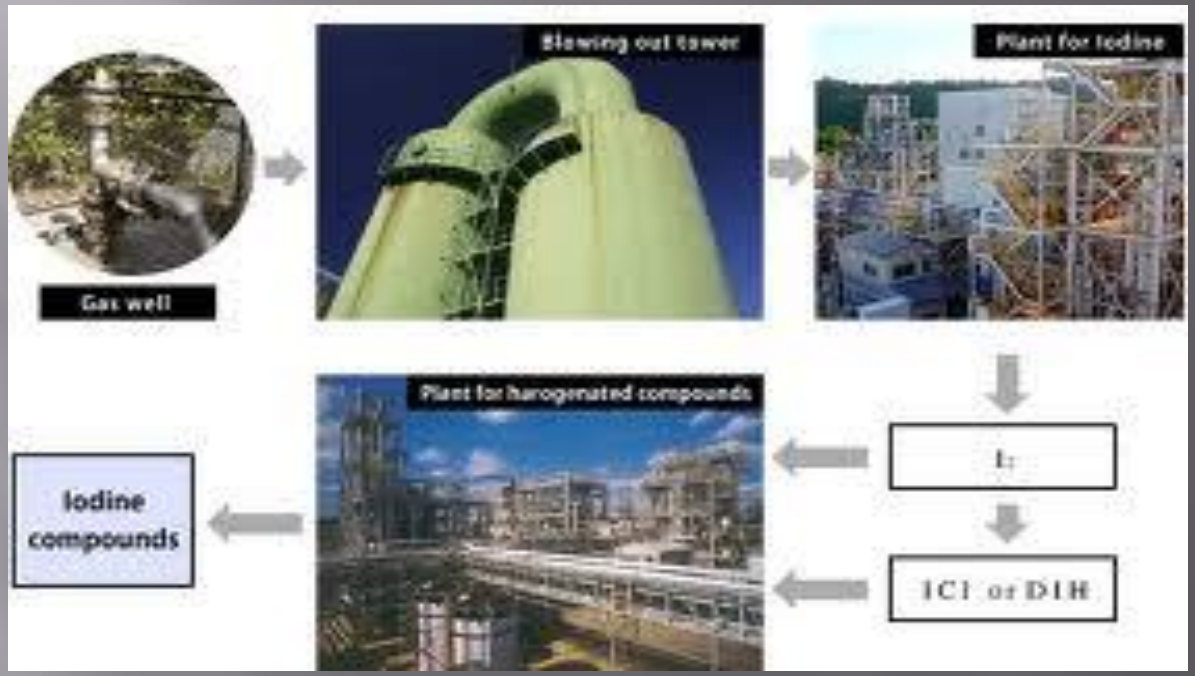
- Melting at 113.7 °C
- It forms compounds with many elements, but is less reactive than the other members of its group, the halogens.
- Has some metallic light reflectance.

- Elemental iodine is slightly soluble in water.
- Nonpolar solvents such as hexane and carbon tetrachloride provide a higher solubility.
- Since the atomic size of iodine is larger, its melting point is higher.
- Iodine is rare in the solar system and Earth's crust; however, iodide salts are often very soluble in water.

- Iodine occurs in slightly greater concentrations in seawater than in rocks, 0.05 vs. 0.04 ppm.

- Minerals containing iodine include caliche, found in Chile.

MANUFACTURING



Of the several places in which iodine occurs in nature, only two sources are useful commercially:

- CALICHE

The caliche contains sodium nitrate, which is the main product of the mining activities, and small amounts of sodium iodate and sodium iodide.

In the extraction of sodium nitrate, the sodium iodate and sodium iodide are extracted.

- BRINE

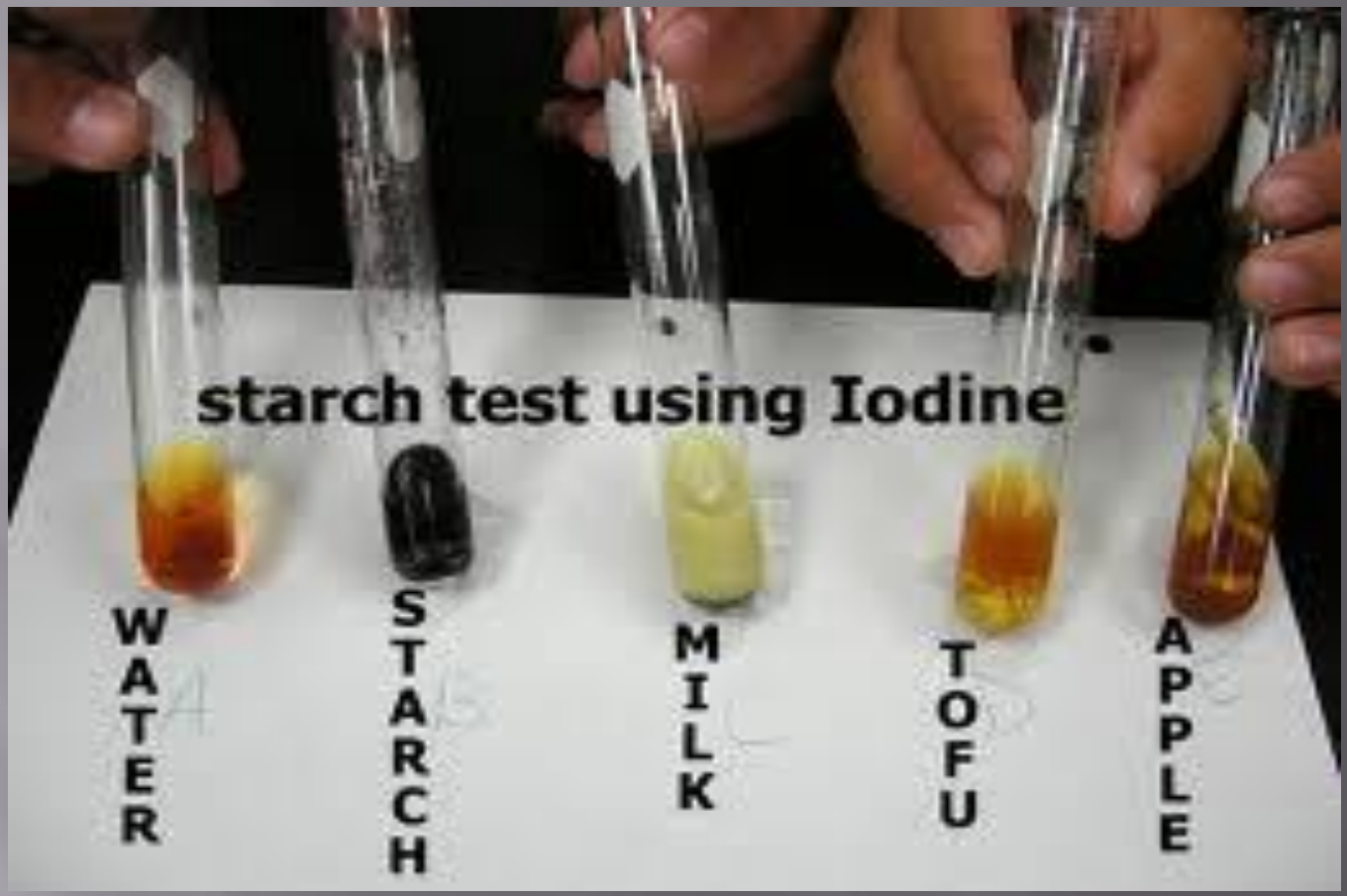
The brine is first purified and acidified using sulfuric acid, then the iodide present is oxidized to iodine with chlorine. An iodine solution is produced, but is dilute and must be concentrated.

There are also other methods of isolating this element in the laboratory, for example, the method used to isolate other halogens: oxidation of the iodide in hydrogen iodide (often made with an iodide and sulfuric acid) by manganese dioxide.

- $2\,HI + Cl_2 \rightarrow I_2 + 2\,HCl$

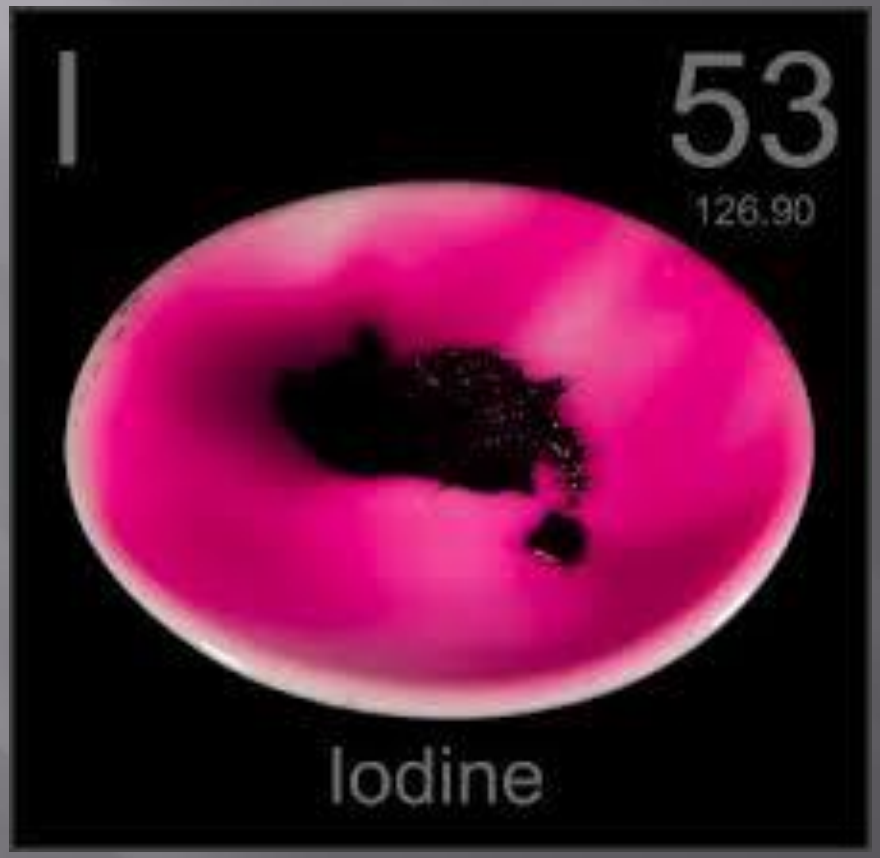
- $I_2 + 2\,H_2O + SO_2 \rightarrow 2\,HI + H_2SO_4$

- $2\,HI + Cl_2 \rightarrow I_2 + 2\,HCl$



Iodine is useful in analytical chemistry because of its reactions with alkenes, starch and oxidizing and reducing agents. The highly colored species involved in these reactions make it easy to detect the endpoints in many analytical determinations. Iodine is a common general stain used in thin-layer chromatography. Iodine forms an intense blue complex with the glucose polymers starch and glycogen.

USES



Industrial iodine could be used to produce raw materials of various chemical products.

- In dye industry
- In food industry

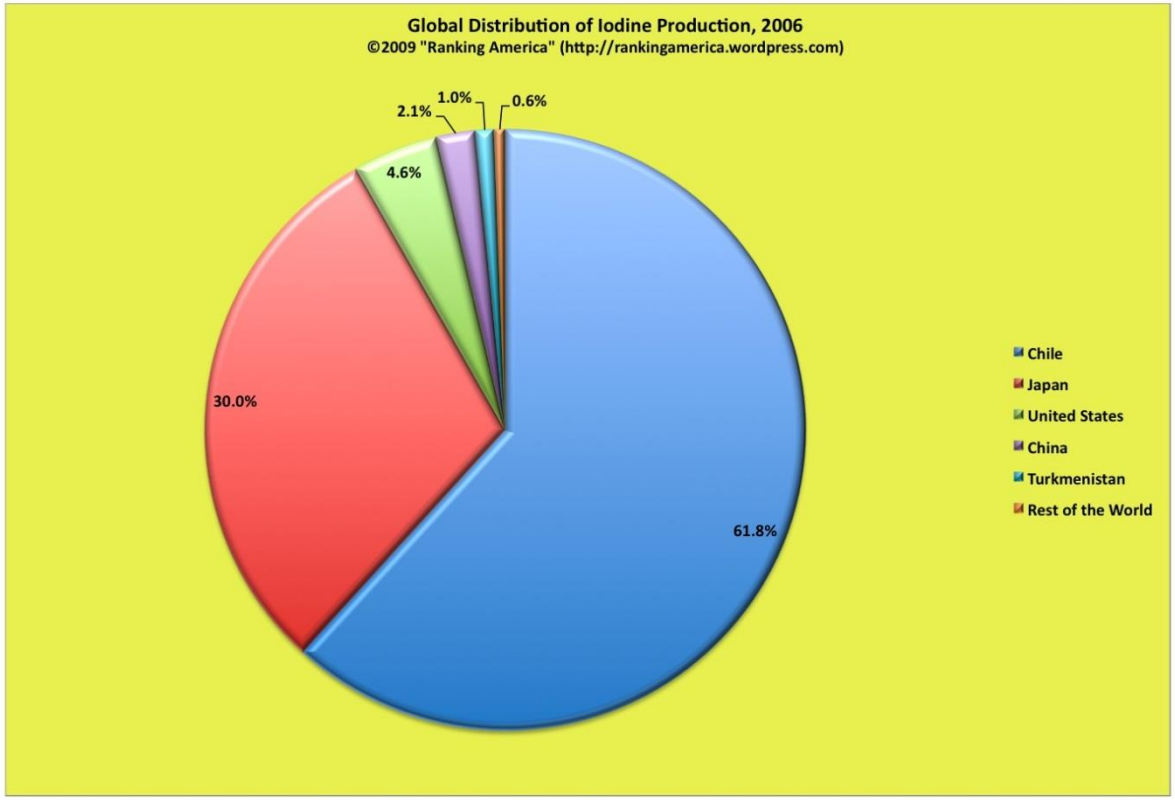
Other usage areas of iodine:

- Photography
- Weather Modification
- Optical Polarizing Film
- Radioactive Tracer
- Pesticides

ECONOMICS

Upon development of the iodine from oil well brines in the southwestern United States, the price of iodine was reduced to approximately 4.80 dolars per kilogram. Japan has recently become the world's largest iodine producer. In 1971 Japan produced more than three times the amount produced by Chile, and in 1980 over 50 percent of the world's total production. The United States produces less than 30 percent of the amount it uses. The price in 1981 was 15.90 dolars per kilogram. Five of the 18 iodine manufacturing plants in Japan have been built since 1970.

PRODUCTION IN THE WORLD



Data from British Geological Survey
http://www.bgs.ac.uk/mineralsuk/


Br
35
79.904
Bromine

*What is Bromine ?

- Bromos
- Stench
- Halojen

- 1826
- Antoine Balard who is a French chemist

- 1865
- Germany
- Stassfurt

*Sources of Bromine

65 ppm

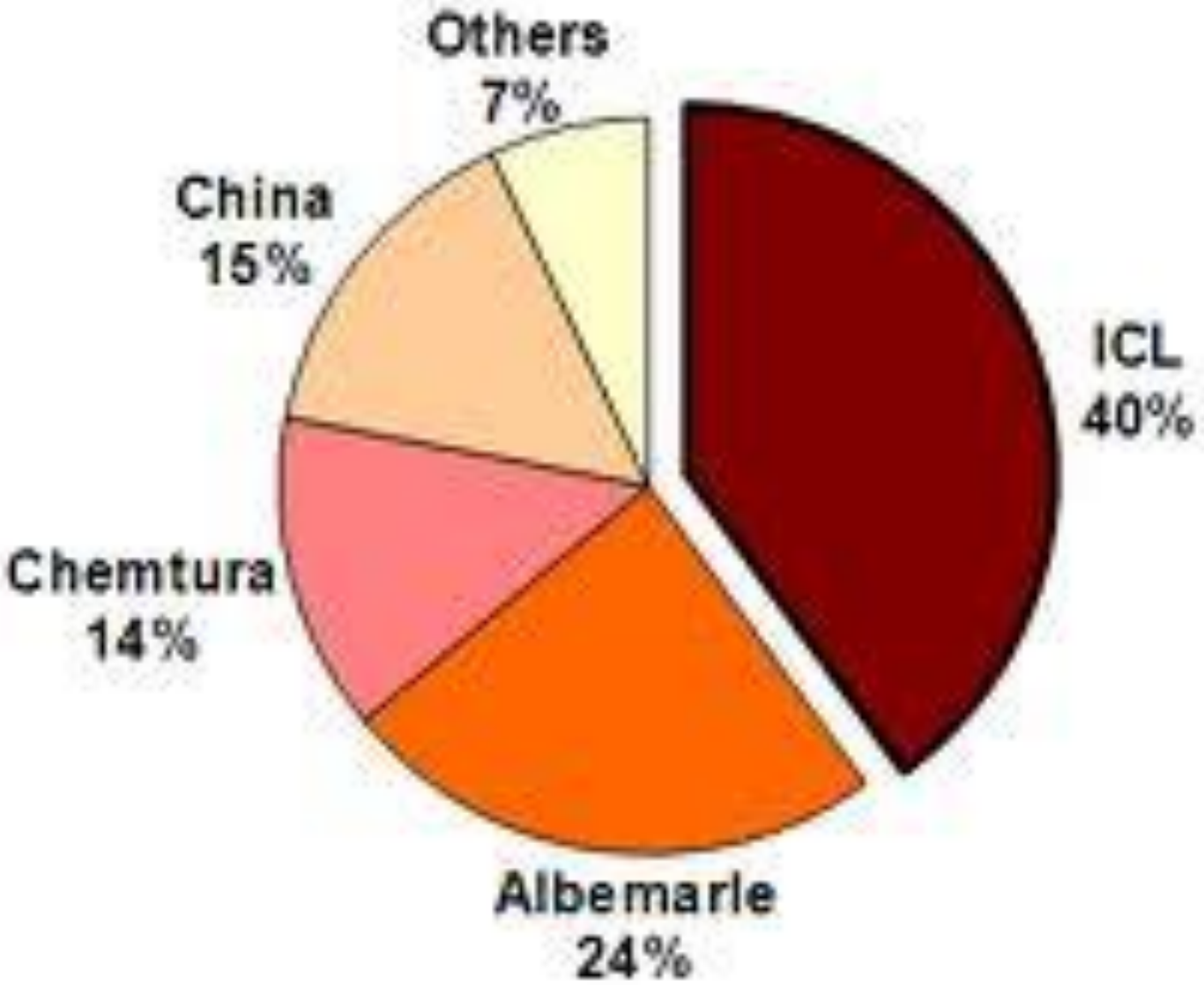
- Seawater
  100 trillion ton Bromine
- Dead Sea in Israel
  1 billion ton Bromine

1300 ppm

- Poland
- ABD

ABD	• Arkansas • Michigan
ISRAEL	• % 40 • Dead Sea
9 other countries	• Seawater

Dead Sea in ISRAEL



Industrial Companies that produce Bromine

EXTRACTION OF BROMINE FROM SEA WATER

1. Oxidation of Bromide ions to Bromine
2. Removal of Bromine Vapour
3. Hydrogen bromide production
4. Oxidation of Hydrobromic acid to Bromine

1. Oxidation of Bromide ions to Bromine

$$Br_{2(g)} + H_2O_{(l)} \rightarrow HBr_{(aq)} + HOBr_{(aq)}$$

$$Cl_{2(g)} + H_2O_{(l)} \rightarrow HCl_{(aq)} + HOCl_{(aq)}$$

*2. Removal of Bromine Vapour

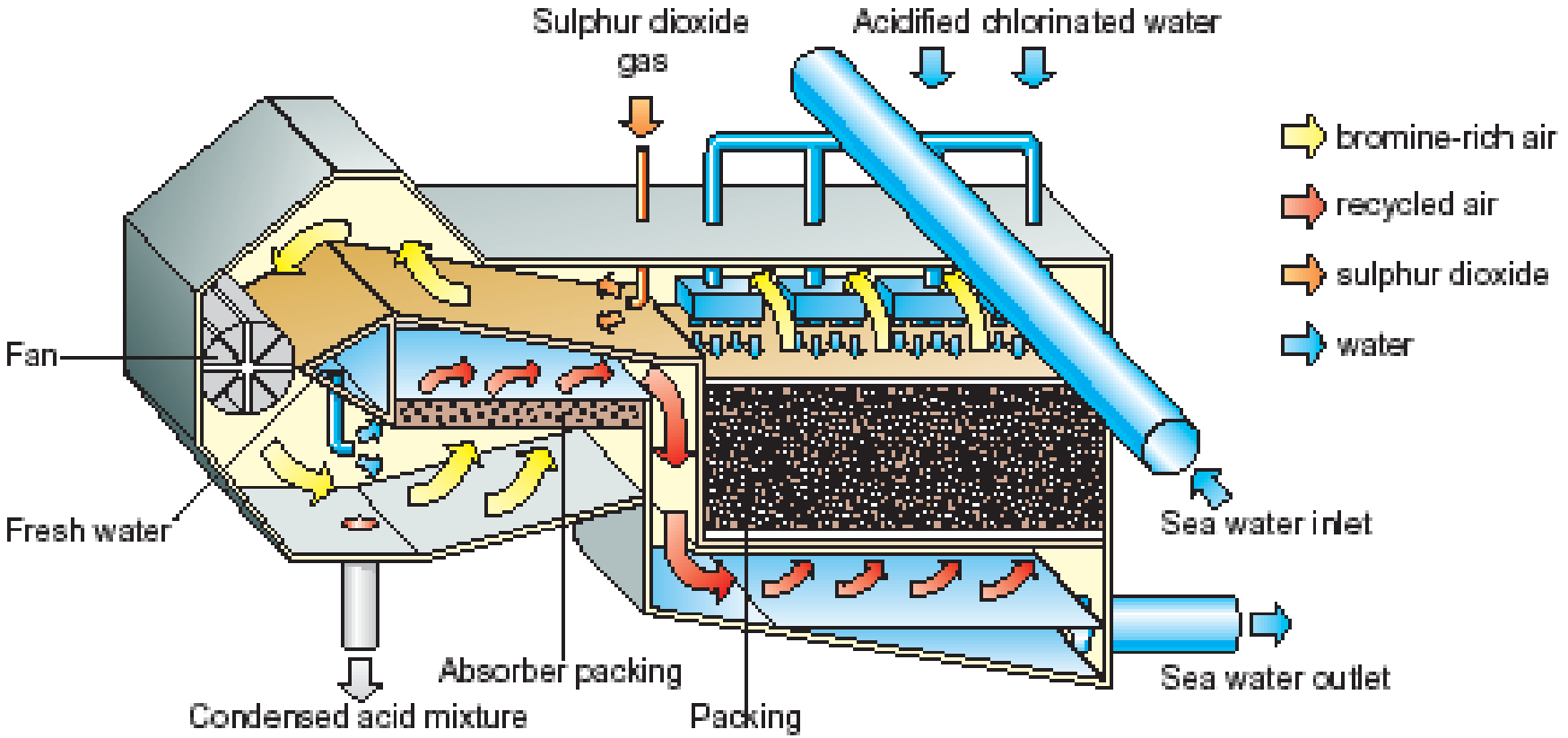
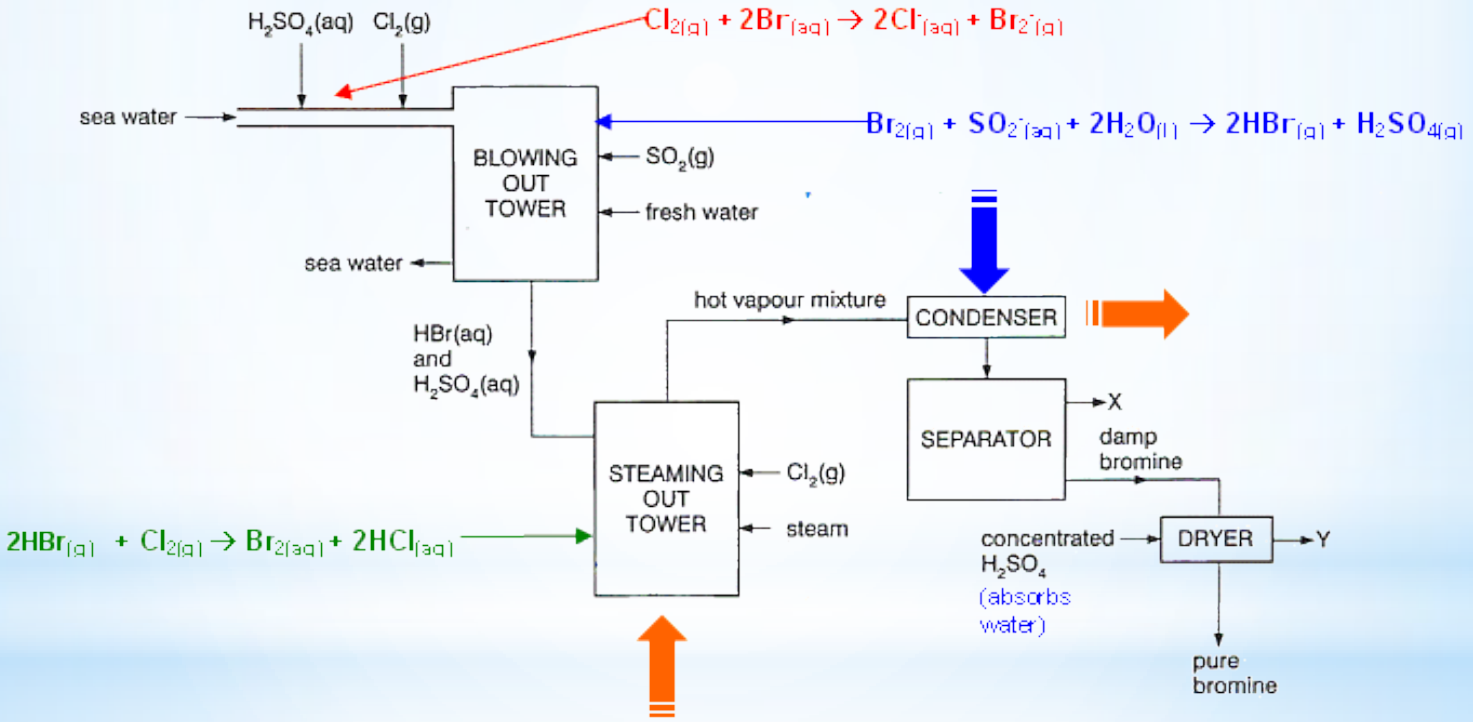


Figure 7 Inside a blowing-out tower.

*3. Hydrogen bromide production

$$Br_{2(g)} + SO_{2(g)} + 2H_2O_{(l)} \rightarrow 2HBr_{(g)} + H_2SO_{4(g)}$$



HEAT

COOL

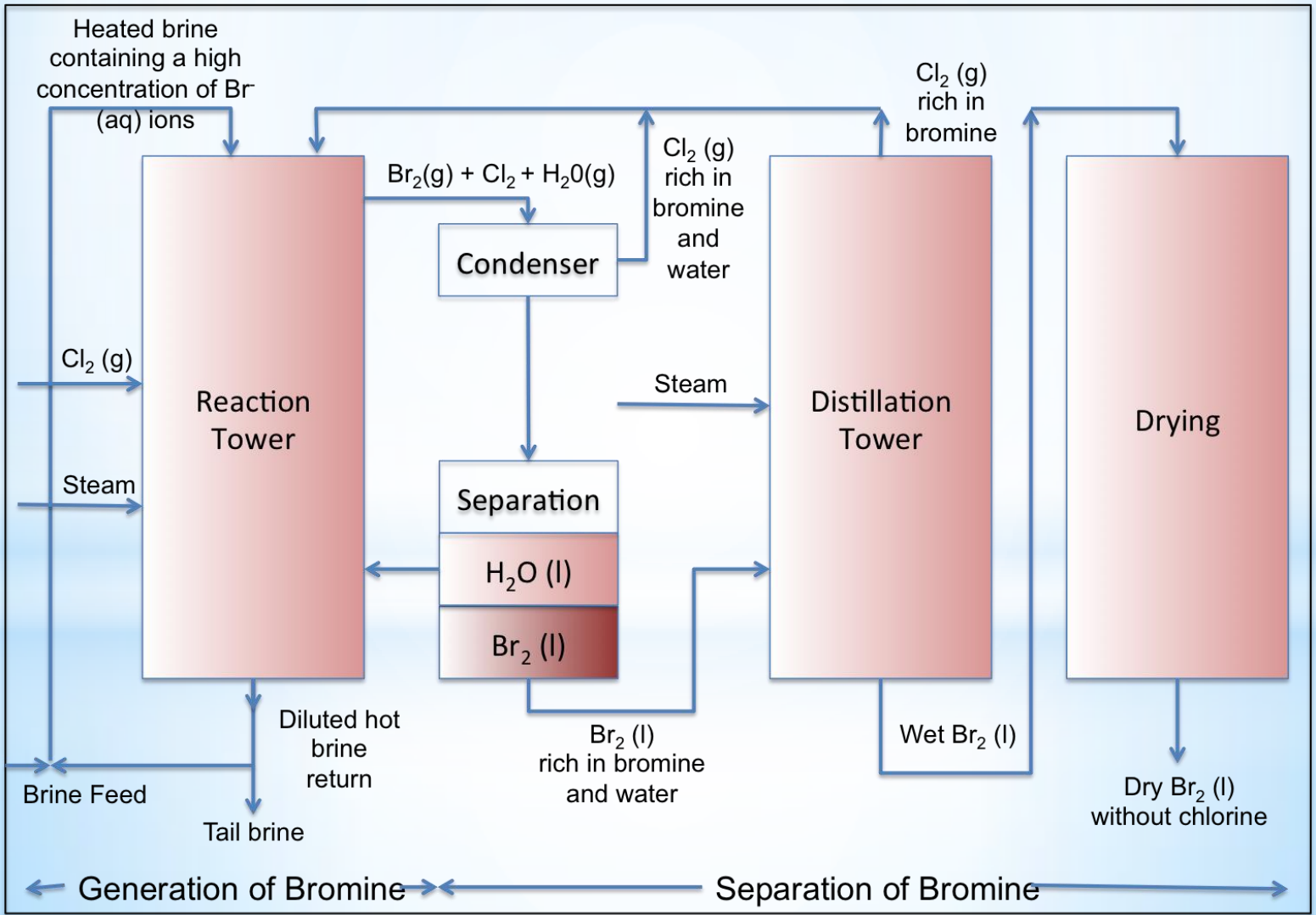
Oxidation of bromide ions to form bromine.

Production of hydrogen bromide.

Oxidation of hydrogen bromide to bromine.

* 4. Oxidation of Hydrobromic acid to Bromine

$$2HBr_{(g)} + Cl_{2(g)} \rightleftharpoons Br_{2(aq)} + 2HCl_{(aq)}$$



- Extraction is a continuous process.

- Bromine is transported in lead-lined steel Tanks.

*USES


bluehorizons
Bromine Tablets
Use for disinfection of pool and spa water

Water Purification

- One of the major uses of bromine is as a water purifier/disinfectant.

* the world's best known chemical test-strip manufactuer for pools and spas

$17.40

Blue Horizons Bromine Tablets 5kg (20gm tablets)

Price: £35.98

*Agriculture


PROFENOFOS 40% + CYPERMETHRIN
CORSA-808
1 Litre
CHLORPYRIPHOS 50%+CYPERMETHRIN 5% E.C.
Spine-505
INSECTICIDE
1 Litre
ETHION 40%+CYPERMETHERIN 5%
Innova
INSECTICIDE
SHRI RASAYAN

*Healthcare

- Drugs
- AIDS
- Cancer
- Alzheimer

*photography

A Brief Introduction to BORON COMPOUNDS

Economicly important sources of boron are ;

* Rasorite (kernite)
* Colemanite
* Tincal (borax ore)
* Boracite

*MANUFACTURE and SOURCES

Searles Lake in California

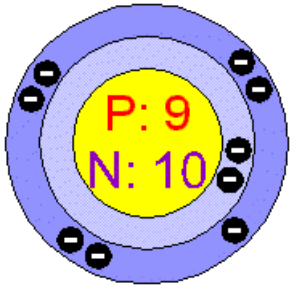

Bursa
Balıkesir
Kütahya
Eskişehir

*Uses of Borax

- Glass-pyrex
- Detergents
- Flame retardants
- Ceramics
- Drugs
- Aircraft fuel

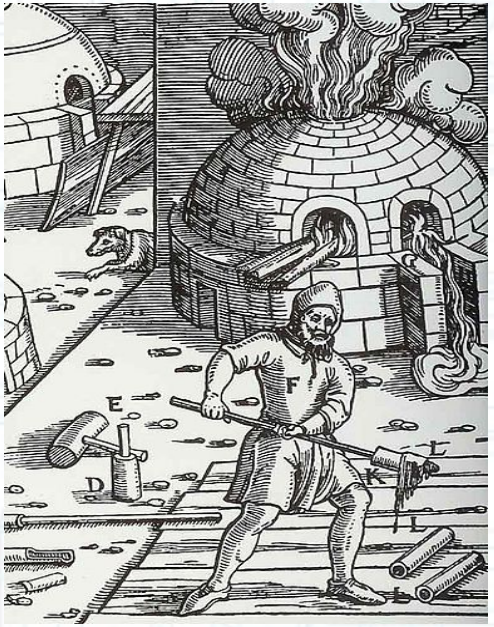
Flourochemicals

- The science of fluorochemistry begins with fluorine.
- Fluorine is the most abundant member of the halogen family and is one of the most reactive of all the elements.
- Ionic metal fluorides are the most common chemical forms of fluorine found in nature, such as fluorspar (CaF2).



History of Fluorine

- The word "fluorine" derives from the Latin stem of the main source mineral, fluorite, which was first mentioned in 1529 by Georgius Agricola, who described it as a flux—an additive that helps melt ores and slags during smelting.
- Elemental fluorine was not isolated until 1886, a reiativety late date, as chemical discoveries go.



Production of Fluorine Gas

- Fluorine gas is generated by electrolysis of KHF2 under varying conditions of temperature and electrolyte composition.
- CaF2+H2SO4 ->CaSO4 +2HF

Electrolytic synthesis

- Several thousand metric tons of elemental fluorine are produced annually by electrolysis of potassium bifluoride in hydrogen fluoride.

$$HF + KF \rightarrow KHF_2$$

- A mixture with the approximate composition KF•2HF melts at 70°C and is electrolyzed between 70°C and 130°C.

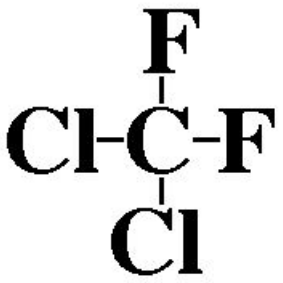
$$2\ HF_2^- \rightarrow H_2\uparrow + F_2\uparrow + 2\ F^-$$

Perfluorocarbon

Perfluorocarbons, sometimes referred to as fluorocarbons or PFC[1]s.

Haloalkanes

CFC's:

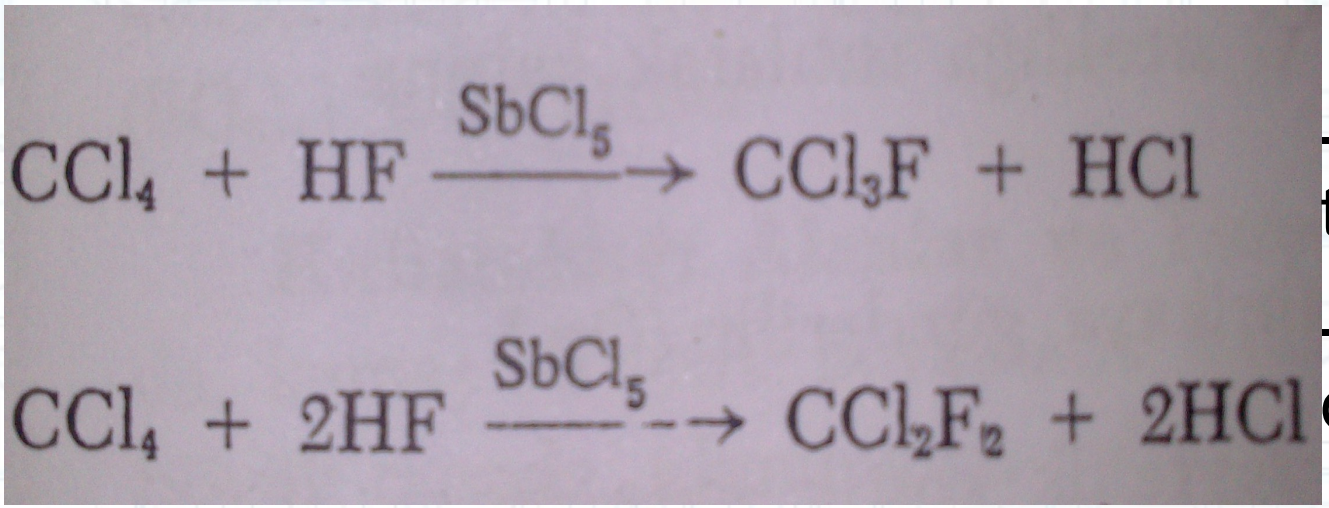


Freon-12

dichlorodifluoromethane

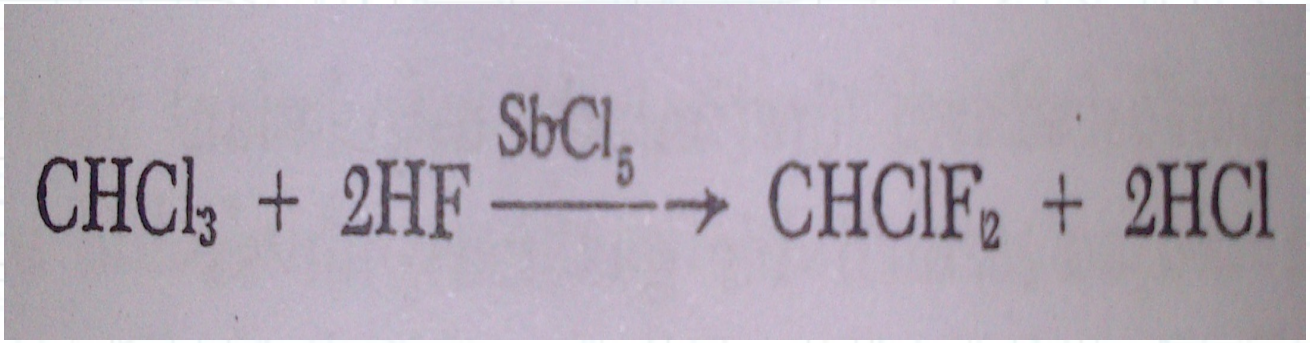
Production of PFC

FREON(11,12,22)

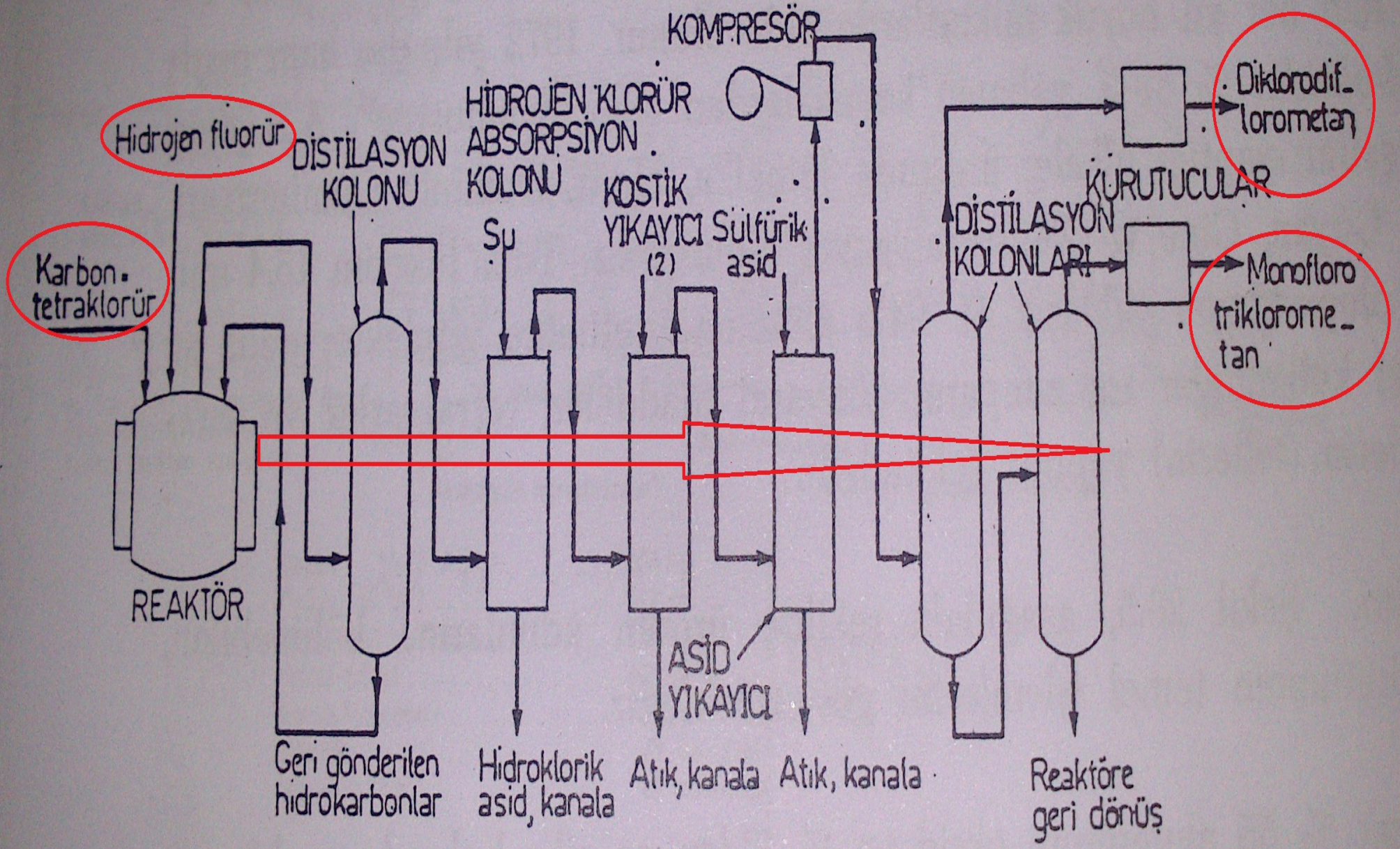


-Monofluoro trichloromethane

-Difluoro dichloromethane



-Chlorodifluoromethane



* Fabrika, ham madde olarak kloroform kullanacak olursa, difluoromonoklorometan üretir.

Şekil 20.4 Fluorokarbon üretimi. [Chem. Eng. (N.Y.), 72(2), 93 (1965).]

Industry and Applications

- The global market for fluorochemicals was about US$16 billion per year as of 2006.
- The industry was predicted to reach 2.6 million metric tons per year by 2015.
- The largest market is the United States.
- Western Europe is the second largest.
- China in particular has experienced significant growth as a fluorochemical market and is becoming a producer of them as well.
- Fluorite mining (the main source of fluorine) was estimated in 2003 to be a $550 million industry, extracting 4.5 million tons per year.

Fluorochemicals Applications

Pharmaceuticals - Fluorinated compounds have shown efficacy as antibacterials, antifungals, antibiotics, anesthetics, protease inhibitors and anticancer agents, among many other applications.

Agricultural Chemicals - Fluorinated compounds are used as fungicides, herbicides and insecticides and often show more potency than their non-fluorinated analogues. The increased potency allows lower application rates.

Advanced Photoresists - In the quest for finer features in semiconductor lithography, photoresist polymers incorporating fluorine and/or fluorinated substituents exhibit the best combination of optical transparency at shorter wavelengths, etch resistance and solubility.

Liquid Crystals - For use in display devices, the addition of fluorine has been found to change viscosity, miscibility, electrical properties, steric characteristics and other qualities that are important to these devices.

Fluorinated Surfactants - Utilized as emulsifying and dispersing agents, while related compounds are used as repellant finishes or soil-release finishes for textiles, these compounds rely on the ability of fluorine to alter surface-energy properties.

Dyes - The addition of fluorine or fluorinated substituents, such as the CF3 group, has been found to improve the fixation yield, lightfastness and chemical resistance of dyes.

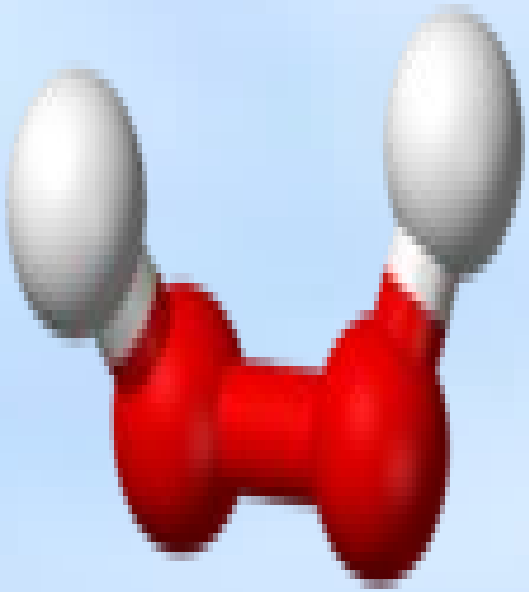
Fluoroplastics and Fluoroelastomers - Used as coatings, vessel liners, films, wiring insulation, gaskets, seals, lab equipment and hoses because of their chemical and thermal stability.

Ion-Exchange Membranes - Fluoropolymer membranes are used for enhanced chemical and thermal stability in harsh environments.

HYDROGEN PERXOIDE

INTRODUCTION

- **Hydrogen peroxide (H_2O_2) is the simplest peroxide**
- **Hydrogen peroxide is a clear liquid, slightly more viscous than water.**



HISTORY

- **Hydrogen peroxide was first manufactured in 1818 by Louis Jacques Thenard by reacting barium peroxide with nitric acid. An improved version of this process used hydrochloric acid, followed by sulfuric acid to precipitate the barium sulfate byproduct. Thenard's process was used from the end of the 19th century until the middle of the 20th century.**

MANUFACTURING PROCESSES

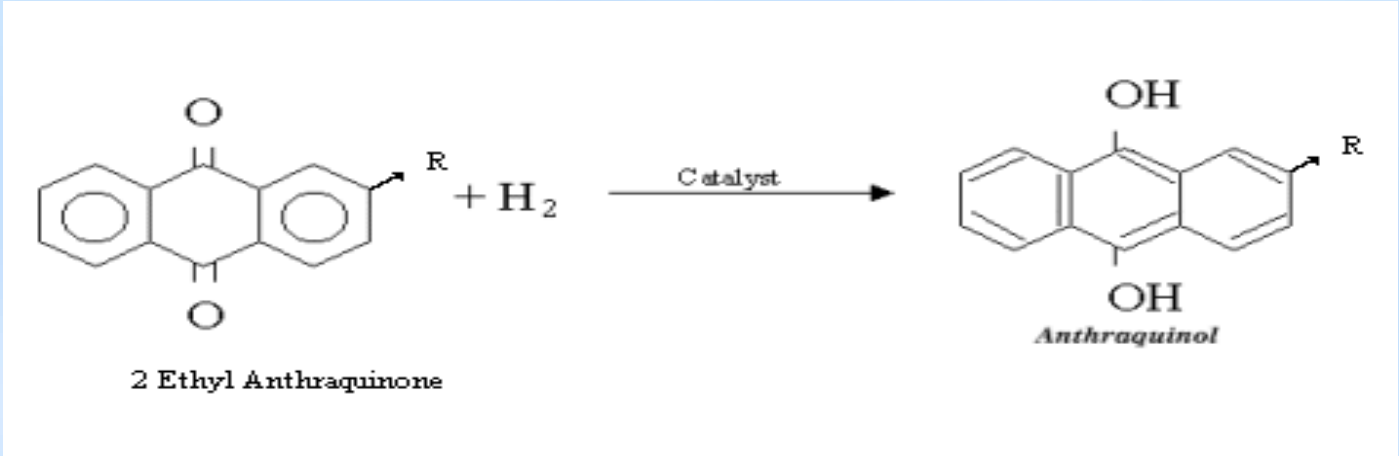
- Wet Chemical Process
- Electrochemical Process
- Autoxidation Process

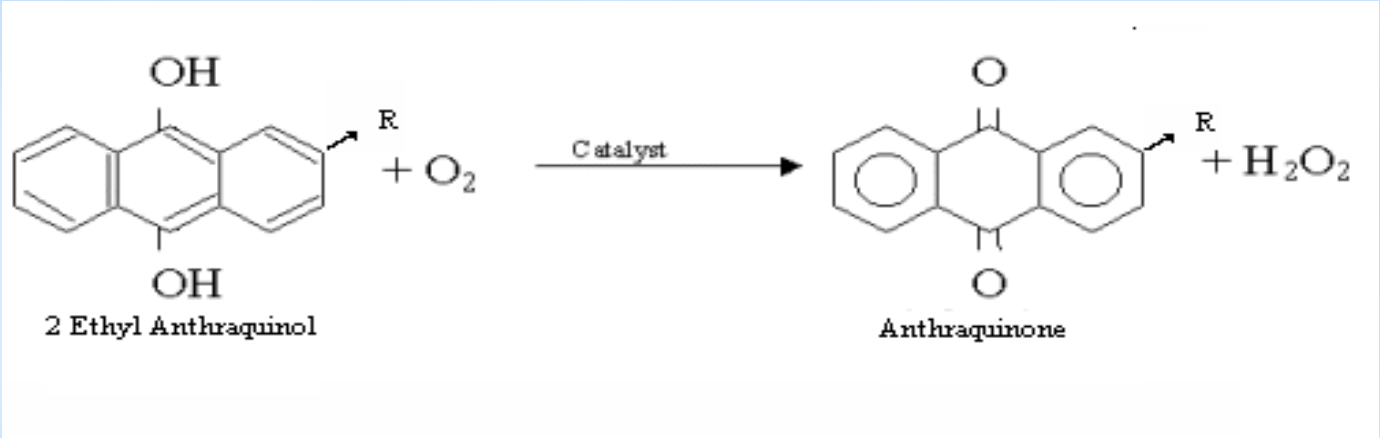
AUTOXIDATION PROCESS

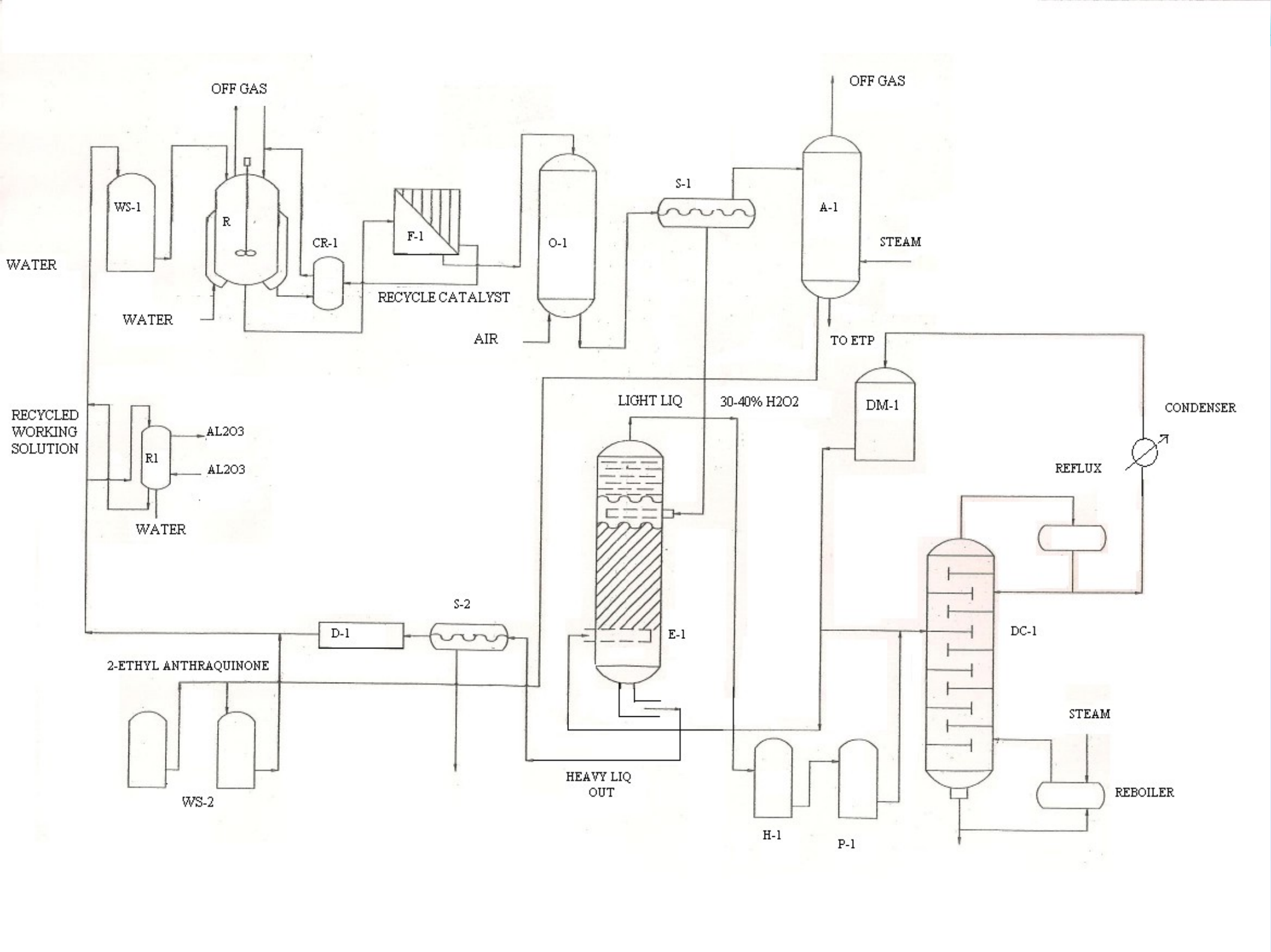
- Hydrogen peroxide is manufactured almost exclusively by the autoxidation (AO) process. The process is based on a reduction of anthraquinone, followed by oxidation resulting in the formation of H2O2.
- Hydrogen peroxide is separated from water with extraction and is concentrated to produce grades at standard commercial strengths of 35 - 65%.

Reactions Of Autoxidation Process

- Hydrogenation



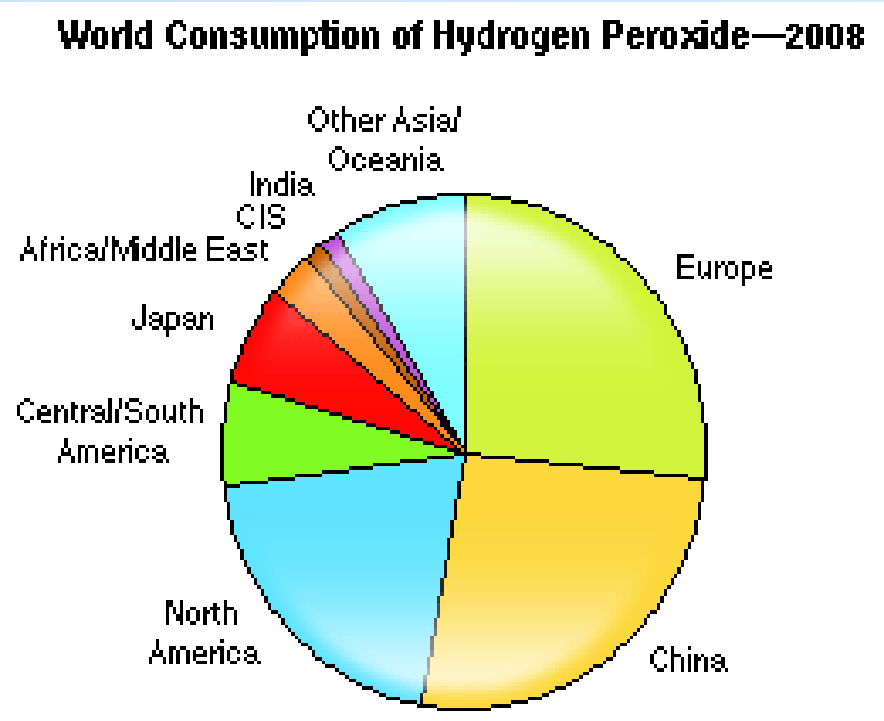



OFF GAS
OFF GAS
WS-1
R
CR-1
F-1
O-1
S-1
A-1
STEAM
WATER
WATER
RECYCLE CATALYST
AIR
TO ETP
LIGHT LIQ
30-40% H2O2
DM-1
CONDENSER
RECYCLED WORKING SOLUTION
R1
AL2O3
AL2O3
WATER
REFLUX
S-2
D-1
E-1
DC-1
2-ETHYL ANTHRAQUINONE
STEAM
WS-2
HEAVY LIQ OUT
REBOILER
H-1
P-1

USES

- Pulp and paper
- Mining
- Textile bleaching
- Controlling fungus on fish and eggs
- Waste water treatment
- Healing wounds
- Explosive

MARKET SURVEY



IMPORT AND EXPORT

IMPORT		EXPORT	
COUNTRY	QUANTITY (Kg)	COUNTRY	QUANTITY (Kg)
China	5 155 989	Untd. Arab Emts.	1 167 115
Indonesia	2 268 897	Bangladesh	1 156 390
Rep. Of Korea	1 121 118	Maldives	400 000
Turkey	887 374	Sri Lanka	259 830
Taiwan	600 277	Kenya	105 000

- Alumina
- Aluminum Chloride
- Copper Salts
- Strontium Salts
- Lithium Salts

Ahmed AYYASH
21000715
GROUP 2

ALUMINA

- Aluminas are the most abundant mineral of the earth crust.

- Pure aluminas are used for pottery, ceramics, refractories, catalyst supports.

Manufacturing Procedures

- **Bauxite Used for Alumina Production.**

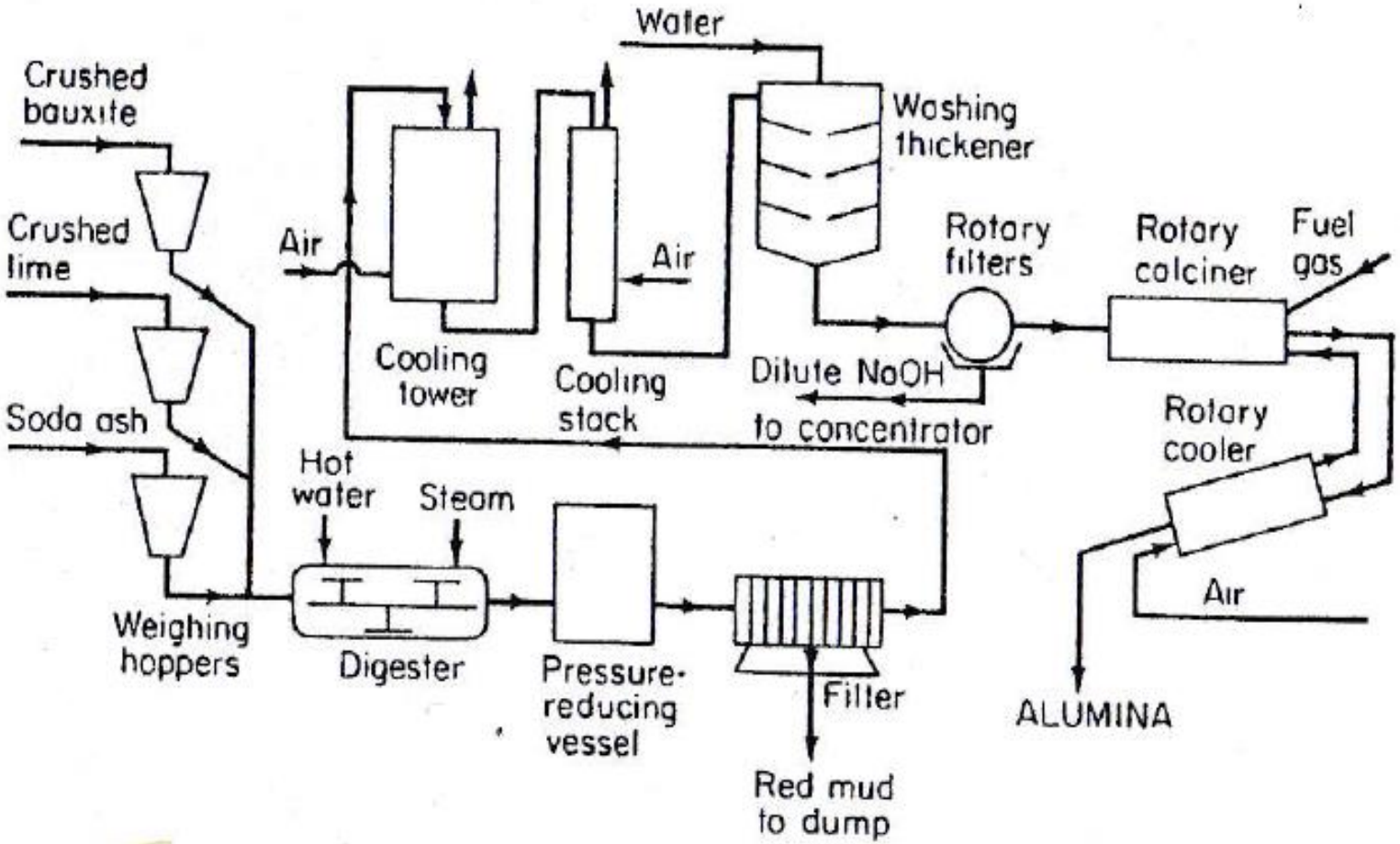
Estimated Bauxite Production (Thousand Metric Tons)	
Country	2010
Australia	68,414
China	44,000
Brazil	28,100
India	18,000
Guinea	17,400
Jamaica	8,540
Russia	5,475
Kazakhstan	5,310
Suriname	4,000
Greece	2,500

The values above are estimated bauxite production for 2010. Data from the USGS Mineral Commodity Summary.

Year	Production	Unit of Measure	% Change
2003	364.305999755859	Thousand metric tons	NA
2004	365.835998535156	Thousand metric tons	0.42 %
2005	475.348999023438	Thousand metric tons	29.94 %
2006	771.226989746094	Thousand metric tons	62.24 %
2007	343.563995361328	Thousand metric tons	-55.45 %
2008	350	Thousand metric tons	1.87 %
2009	330	Thousand metric tons	-5.71 %

bauxite production in Turkey

Source: United States Geological Survey (USGS) Minerals Resources Program


Water
Crushed bauxite
Crushed lime
Soda ash
Air
Air
Cooling tower
Cooling stack
Washing thickener
Rotary filters
Rotary calciner
Fuel gas
Dilute NaOH
to concentrator
Rotary cooler
Air
Hot water
Steam
Weighing hoppers
Digester
Pressure-reducing vessel
Filter
Red mud to dump
ALUMINA

Year	Production	Unit of Measure	% Change
2003	162	Thousand metric tons	NA
2004	170	Thousand metric tons	4.94 %
2005	113	Thousand metric tons	-33.53 %
2006	150	Thousand metric tons	32.74 %
2007	160	Thousand metric tons	6.67 %

Alumina production in Turkey

Source: United States Geological Survey (USGS) Minerals Resources Program

Aluminium chloride

In 1825 was first prepared by oersted .

Who passed chlorine over a mixture of alumina and carbon and condensed the vapor so Aluminum chloride formed .

Molecular formula	$AlCl_3$
Molar mass	133.34 g/mol (anhydrous) 241.43 g/mol (hexahydrate)
Appearance	white or pale yellow solid, hygroscopic
Density	2.48 g/cm^3 (anhydrous) 1.3 g/cm^3 (hexahydrate)
Melting point	192.4 °C *(anhydrous) 100 °C (hexahydrate)
Boiling point	120 °C (hexahydrate)

Uses of aluminum chloride

- **In Chemical Reactions :** its role as a catalyst in Friedel-Crafts reactions. Because of its strong Lewis acid properties
- **Petrochemical and Detergent Manufacturing:** Since aluminum chloride is also used for the isomerization and reforming of hydrocarbons, and helps in the polymerization of hydrocarbons with lighter molecular weight, the compound is commonly used in the petrochemical sector.
- **Organic Chemical Production :** It is used to insert aldehyde groups in aromatic system rings.
- **Hydrated Aluminum Chloride**

Manufacturing Procedures

- Anhydrous aluminum chloride is manufactured primarily by the reaction of chlorine vapor on molten aluminum.
- Chlorine is fed in below the surface of the aluminum, and the product sublimes and is collected by condensing.
- These air-cooled condensers are thin-walled, vertical steel cylinders with conical bottoms.
- Aluminum chloride crystals form on the condenser walls and are periodically removed, crushed, screened, and packaged in steel containers .

Copper salts

- Copper sulfate is the most important compound of copper, commonly known as blue vitriol.

- It's prepared by the action of sulfuric acid on cupric oxide or sulfide ores.

Uses of copper

- Copper sulfate is added to water reservoirs occasionally to kill algae.
- It's employed in electroplating and finds minor applications as a mordant, germicide, and agent in engraving.
- Certain copper compounds are added to antifouling paints used on ship bottoms.

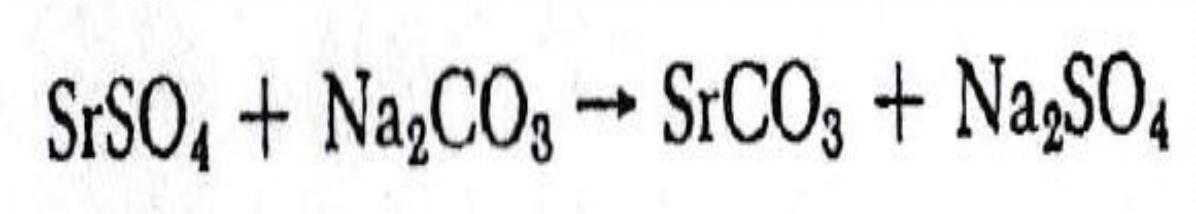
STRONTIUM SALTS

Adair Crawford and William Cruikshank were the first to detect strontium, in 1790, so named because it was found near Strontian, in Argyll.

Molecular formula	$SrCO_3$
Molar mass	147.63 g/mol
Appearance	White or grey powder hygroscopic
Odor	Odorless
Density	3.74 g/cm^3
Melting point	1494 °C (decomp.)
Solubility in water	0.0011 g/100 mL (18 °C) 0.065 g/100 mL (100 °C)
Refractive index (n_D)	1.518

Preparation of strontium salts

- Strontium is finely ground and converted to the carbonate by boiling with 10% sodium carbonate solution, giving almost a quantitative yield :



Uses of strontium salts

- red-flame pyrotechnic compositions, such as truck signal flares and railroad “fusees”, tracer bullets, military signal flares, and ceramic permanent magnets

- It is widely used as an x-ray screening agent in television picture-tube face plate glass and has no commercial alternative.

LITHIUM SALTS

- The use of lithium salts to treat mania was first proposed by the Australian psychiatrist John Cade in 1949, after he discovered the effect of first lithium urate, and then other lithium salts, on animals.

Preparation of Lithium salts

- Since spodumene is by far the most important ore, the manufacture of lithium carbonate from it is presented. Spodumene are (beneficiated to 3 to 5% Li2O) is converted from alpha form to the beta form by heating to over 1000 C. The alpha form is not attacked by hot H2SO4. The beta form is treated as follows:

$$\text{excess } Li_2O \cdot Al_2O_3 \cdot 4SiO_2 + H_2SO_4 \xrightarrow[\text{rotary kiln}]{250°\text{–}300°C} H_2O \cdot Al_2O_3 \cdot 4SiO_2 + Li_2SO_4$$

- The water-soluble lithium sulfate is leached out and reacted with sodium carbonate to yield lithium carbonate. Various salts are derived from the carbonate as follows:

$$Li_2CO_3 + Ca(OH)_2 + 2H_2O \rightarrow CaCO_3 + 2LiOH \cdot H_2O \xrightarrow{\Delta} 2LiOH$$

$$Li_2CO_3 + 2HCl \rightarrow H_2O + CO_2 + 2LiCl(soln) \xrightarrow{\Delta} 2LiCl(anyhd)$$

$$2LiCl(anhyd) \xrightarrow{\text{electrolysis}} 2Li + Cl_2\uparrow \xrightarrow{H_2} 2LiH \xrightarrow{2NH_3} 2LiNH_2 + 2H_2\uparrow$$

Uses of Lithium salts

- Lithium carbonate uses as a drug to treat manic depression.
- Lithium hydroxide is a component of the electrolyte in alkaline storage batteries and is employed in the removal of carbon dioxide in submarines and space capsules.
- Lithium bromide brine is used for air conditioning and dehumidification.
- Lithium chloride is in demand for low-temperature batteries and for aluminum brazing .
- Other lithium-compound uses include catalysts, glass manufacture, and of course nuclear energy.

THANK YOU FOR YOUR LISTENING