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(a) It's mercury cell. The salt and water (Brine) into electrolysis cell, then the oxidation in the anode $2Cl^- \rightleftharpoons Cl_2 + 2e^-$, the chlorine gas been produced. The cathode only allow Na^+ to go through and dissolve in amalgam, $2Na/Hg + 2H_2O \longrightarrow 2NaOH + H_2 + 2Hg$, the NaOH is produced in the water chamber, it produce high purity of NaOH and release H_2 gas, the Hg can be reused. It's safety that Cl_2 and H_2 are sperated. But this cell contain mercury which is toxic to damage the enviroment and cause lung cancer. And the NaOH must crystalise.

(b) • molten sodium chloride only contain two ions : Na^+. Cl^-

oxidation reaction : $2Cl^- \longrightarrow Cl_2 + 2e^-$

reduction reaction : $Na^+ + e^- \longrightarrow Na(s)$ overall : $Na^+ + Cl^- \rightarrow NaCl$

• aqueous sodium chloride contain three pieces : Na^+. Cl^-. H_2O

The oxidation reaction is always $2Cl^- \rightarrow Cl_2 + 2e^-$, as Na^+ required large energy, therefore the reaction not been occur, then the reduction is $2H_2O + 2e^- \rightarrow H_2 + OH^-$

overall reaction : $NaCl + H_2O \longrightarrow H_2 + NaOH + Cl_2$

Therefore the product of electrolysis aqueous sodium is H_2. Cl_2. and OH^-

(c) (ii) $2SO_2 + O_2 \overset{V_2O_5}{\rightleftharpoons} 2SO_3$

when at time A . $n(SO_3) = 0.4mol$, $n(SO_2) = 0.5\,mol$

$\because c = \frac{n}{V}$

$\therefore C_{(SO_3)} = \frac{0.4\,mol}{10\,L} = 0.04\,M$

$C_{(SO_2)} = \frac{0.5mol}{10\,L} = 0.05\,M$

$C_{(O_2)} = \frac{0.4mol}{10L} = 0.04M$

$\therefore K_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]} = \frac{0.04^2}{0.05^2 \times 0.04} = 16$

(iii) when at time B. the moles of SO_3 and SO_2 stay constant $2SO_2 + O_2 \overset{V_2O_5}{\rightleftharpoons} 2SO_3$, when the moles of SO_3 and SO_2 is the same as time A. The new equilibrium position is formed.

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(d) (i) ~~sp~~ soaponification

reactant A : NaOH

(ii) Hydrolysis then neutralise. Firsty add the water to coconut oil then add NaOH to form the soap, after making soap, "salting out" to produce ~~soap~~ soap. During the soponification, do not touch and straight use the soap.

(e) • Solvay process is to produe Na_2CO_3 which the main use is glass, to remove the Ca^{2+}. Mg^{2+} in hard water and make chemical

• During the solvay process, CO_2 (ammonia) is produce but it can be reused again

• ~~Purify the~~ $CaCO_3 + H_2O \longrightarrow CaO + CO_2 + H_2O$

$CO_2 + NH_4^+ + OH^- + NaCl \longrightarrow NaHCO_3 + NH_4Cl$

$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$

$CaO + H_2O \longrightarrow Ca(OH)_2$

~~$NaHCO_3 + Ca(OH)_2 \rightarrow$~~ $2NH_4Cl + Ca(OH)_2 \rightarrow CaCl_2 + 2NH_3 + H_2O$

∴ The overall reaction is $CaCO_3 + 2NaCl \longrightarrow CaCl_2 + Na_2CO_3$

• The $CaCl_2$ is major waste, although it can be transfer to water and reused in solvay process, but the amount of $CaCl_2$ is still too large and recenly no technology to use the $CaCl_2$, and cool the $CaCl_2$ before transfer to sea water

• As solvay process produce large amount of heat. therefore the thermol pollution

• Noice is also the pollution

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