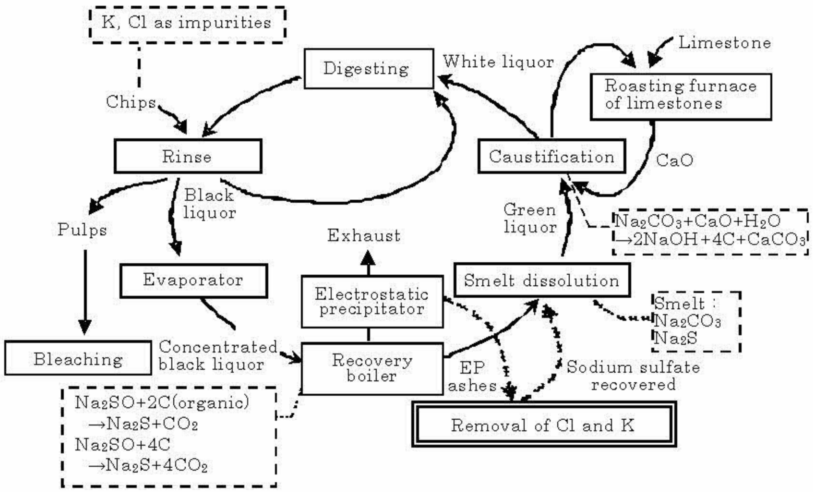
Potassium, Chloride Removal from Sodium Sulfate

(Extracted from the Diaion Manuals pages 233 to 236)

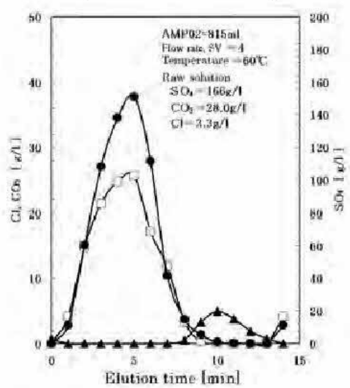
3. Removal of Chlorides and Potassium from Sodium Sulfate [47] [48]

The recovery process of sodium and sulfur has been recently developed, in which chlorides and potassium are eliminated from the ashes scavenged by EP, Electrostatic Precipitator, of the boilers to collect reagents for digesting sulfate pulps.



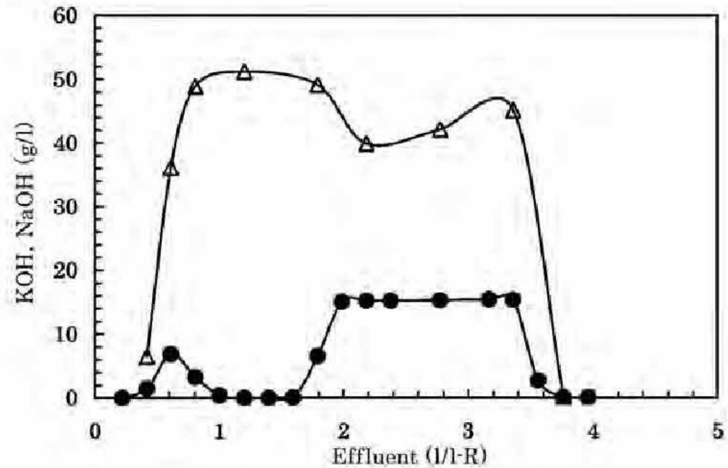
[Fig.VII-3-1] Recycling Process of Reagents for digesting sulphate pulps

In the sulfate pulp manufacturing process, digestion chemicals the main components of which are sodium hydroxide and sodium sulfide, the white liquor in Fig.VII-3-1, are used. The white liquor dissolves impurities in timbers, e.g. lignin, and turns into the black liquor, and sodium hydroxide and sodium sulfide in the black liquor changed into inert sodium sulfate and sodium carbonates. Such inert sodium sulfate is reduced into sodium sulfide by incineration with organics of timers as fuel in the boilers, and sodium carbonate returned into sodium hydroxide by the reaction with quicklime at the caustification step. Accumulated potassium and chlorides brought with timbers cause corrosion of boiler materials, and thus should be discarded as EP ashes at proper intervals.



[Fig.VII-3-2] Chloride removing tower with AMP02 from EP ashes solution

● SO_4 □ CO_3 ▲ Cl



[Fig.VII-3-3] Removal of potassium from EP ashes solution

Resin: UBK530

Raw solution: Na = 47 g/L, K = 15.0 g/L

Flow rate: SV 2.9

Temperature: 50°C

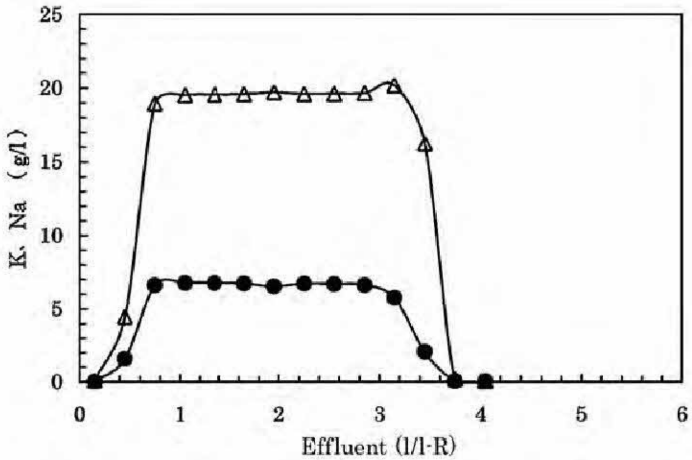
● K △ Na

Sulfates, carbonates and chlorides can be separated by the ion retardation method with amphoteric IER, DIAION® AMP02, as the same way as DSR01 already explained at the preceding clause.

The EP ashes collected from the electrostatic precipitator of the boiler is dissolved nearly at the saturated concentration of 60 °C and filtrated. The filtrate is then fed into chloride removing tower at 0.3L/L-R, and separated chromatographically with water as eluents. The sulfate and carbonate fractions are then treated in potassium removal tower filled in with SACERs DIAION® UBK530 (Na). Potassium ions are exchanged by sodium ions.

$$R\text{-}Na + K^+ \rightarrow R\text{-}K + Na^+$$

UBK530 saturated with potassium is regenerated with NaOH solutions, and the waste waters from regeneration are utilized as NaOH and KOH solutions in the bleaching process of pulps. Thus, the discharged water is only the chloride fraction in chloride removing tower.



[Fig.VII-3-4] Regeneration of K removal tower of EP ashes solution
Resin: UBK530
Regenerant level with NaOH = 120g/L-R (concentration is 4%)
Flow rate: SV 3, Temperature; 50 °C
● K △ Na

Figures VII-3-3 and VII-3-4 illustrate examples of removal of potassium from EP ashes solution and its regeneration respectively. In the regeneration, the potassium ion fraction in the liquid phase is calculated to be 0.17 from the concentrations of potassium and sodium at the steady state: K is 6.8 g/L (0.174 mol/L) and Na is 19.7 g/L (0.856 mol/L). This is equal to the concentration at the equilibrium when the selective coefficient is 1.81. The coefficient becomes high in dense regions, since the calculated value, K^{K}_{Na}, is 1.46 based on the relevant values; K^{Na}_{Li} = 1.98, K^{K}_{Li} = 2.90 in Table I-3-2 at Chapter I clause 3.

The potassium ion fraction is calculated to be 0.17 similarly from the potassium and sodium concentrations at the steady state after the potassium break in Fig.VII-3-3; K is 26 g/L (0.39 mol/L) and Na is 43 g/L (1.87 mol/L). These values can be analyzed by the ion-exchange equilibrium theory.