The standard operations of treatment with IERs are as follows: some parts of bath liquors are a) drained from pickling baths, b) treated with H-form SACERs, e.g. DIAION® PK228, and c) returned to baths. IERs that adsorbed iron are used repeatedly after regeneration with HCl solutions. As regard to the grades of SACERs, gel-type SK110 or porous-type PK228 is suitable for this purpose since the physical strength is required. The exchange capacity, the amount of iron adsorbed by IERs, depends on the concentrations of phosphoric acid and iron in the solution. The equilibrium amount of the adsorbed iron is shown in Fig.VII-7-1. [53]

Inhibitors are usually used to prevent excessive dissolution of steel surfaces in the phosphoric acid pickling method. Please note that some inhibitors may possibly contaminate SACERs and decrease their effectiveness to adsorb iron.

Another application of phosphoric acid purification is the one in the surface treatment of aluminium materials. Illustrated in Fig.VII-7-2 is the removal of aluminium from spent phosphoric acid discharged in the aluminium foil manufacturing process for electrolytic capacitors with SACER, PK220. [54]

7. Purification of other Inorganic acids

The phosphoric acid pickling method is an efficient method to remove the scales on steel surfaces. However, its effectiveness decreases as iron dissolved from steel accumulates in the phosphoric acid solution. Thus, such phosphoric acid solutions should be treated with H-form SACERs at proper intervals to remove dissolved iron and to keep their effectiveness for long periods only with regular supply of phosphoric acid.
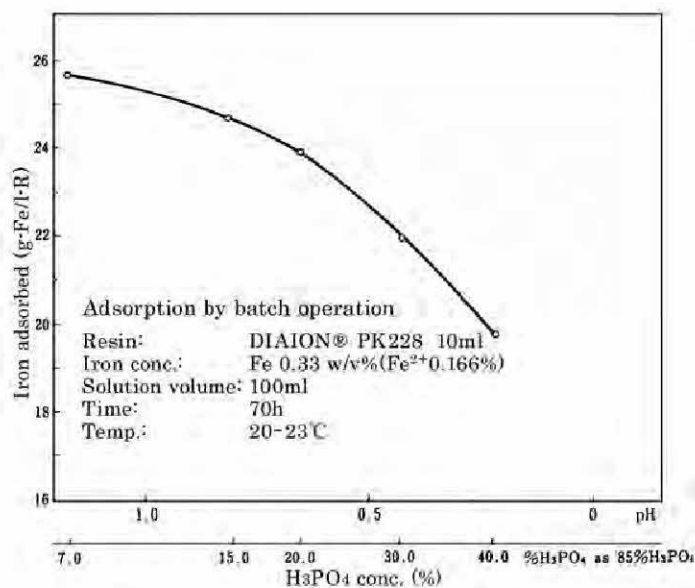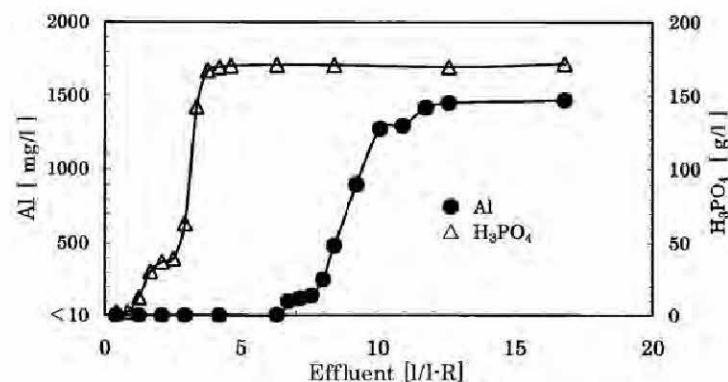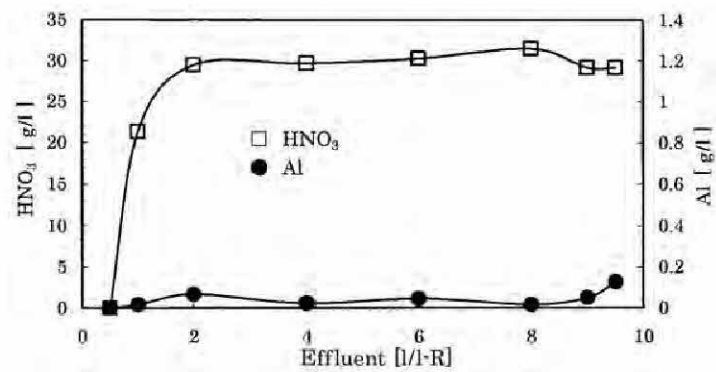

[Fig.VII-7-1] Amount of Iron adsorbed vs. Phosphoric acid conc. [53]

[Fig.VII-7-2] Removal of Al in Phosphoric acid solution

IER: PK220

Raw solution: H_3PO_4 = 46.4 g/L(~ 1.7L/L·R), 172.3g/L(1.71L/L·R ~)

Al = 2.2g/L(~ 1.7L/L·R), 1.56g/L(1.71L/L·R ~)

Flow rate: SV4

[Fig.VII-7-3] Removal of Al in Nitric acid solution
IER: PK228
Raw solution: HNO_3 = 30.5 g/L, Al = 1.33 g/L
Flow rate: SV1.13

SACERs are applied to remove metal ions from acid solutions of comparatively low concentration, in addition to phosphoric acid. Chelate resins cannot be used since these acid solutions are out of the suitable pH range of chelate resins. The correlations between HCl concentration and distribution coefficients, Kd, of various metal ions are tabulated at the end of this book. Fig.VII-7-3 shows an example of aluminium removal from nitric acid that was used in aluminium etching processes. [56]