Heavy Metal Removal
(Extracted from the Diaion Manuals pages 214 to 215)

7. Treatments of Heavy metals waste waters

Waste waters excreted from plating factories are typical ones that contain heavy metals and they contain various kinds of metals; zinc, copper, chromium, nickel, cadmium, gold, silver or tin. Common plating process consists of preparation such as degreasing and/or acid picklings and of electroplating in plating baths. After electroplating, the plating liquid that stain plated materials is collected in a collecting vessel and the plated materials are then washed with much water. Waste waters excreted in this way hold the compound of nearly the same composition as in the plating baths could never be discharged as they are. Thus, they are treated with proper IERs as well as ones from other processes. Typical treatment processes are as follows:

Case-1) Heavy metals are only targeted:
Na-form SACERs are selected when other alkali or alkaline earth metals concentrations are low. Chelate resins are selected when such other metals concentrations are high.

Case-2) Alkali or alkaline earth metals concentrations are low and the waters should be recovered:
Two-bed and two-tower systems of SACERs with SBAERs or SACERs with WBAERs are recommended.

Case-3) Waste waters include free acids and their pH is low:
The procedures in case-1, or the ones in case-2 after the treatment with SBAERs to remove free mineral acids. If the pH value of raw water is higher than one, Na-form SACERs or chelate resins after neutralization can be selected. If the pH value of raw water is higher than 4, chelate resins without neutralization can be applied.

Case-4) Waste waters include both free acids and the metals that could form complex anions depending on the acid concentrations:
SBAERs of the same acid form are recommended.

The methods in case-2 are usually applied: a) remove all the metal cations with SACERs, b) remove all the anions with SBAERs, and c) reuse the treated water as rinse water. In these methods, the SBAERs not only adsorb all the cations and but also decompose unstable metal complex anions and then adsorb such metals as cations. The WBAERs, on the other hand, adsorb chromic acid, other stable metal complex anions and strong mineral acids, and the SBAERs adsorb weak acids such as CN^-, HCO_3^- and SiO_2. The treated waters can be reused as supply waters of 0.2 ~ 5 mS/m.

The IERs saturated with such cations or anions are regenerated with HCl and NaOH solutions and applied repeatedly. Though the waste waters from plating factories can be treated as already explained, the high concentration waste waters such as used plating liquids can be treated not with IERs but by other chemical treatments with the waste waters from the IERs regeneration step; oxidation, reduction, neutralization and coagulation. When some heavy metals exist in the treated water after coagulation, further treatment with chelate resins should be applied as explained in this chapter clause 8.

In cases where lead is in high-concentration, the lead adsorbed in IERs sometimes cannot be eliminated sufficiently due to the low solubility of lead chloride or lead sulfate. Ammonium acetate solutions are used as eluents, but it is necessary to treat ammonium acetate in the waste waters from regeneration. Though the solubility of lead nitrate is high, HNO_3 solutions are not recommended because it is difficult to treat waste water that contains NO_3^-. The regeneration of the IERs that adsorb lead is thought to be the combination of NaOH and HCl solutions as in Table VI-7-1[34]. Care must be taken of the precipitation of lead during the regeneration.

[Table VI-7-1] Regeneration of IERs that adsorb Pb[34]

No.	Regenerants	Conc. [%]	Regeneration level [g/L-R]	Pb adsorbed [mg]	Pb desorbed [mg]	Desorbed/ Adsorbed [%]	
1	NaOH	2	200	840	707.5	84.2	
2	NaOH	5	200	870	637	73.2	
3	HCl→	5	500	862	318	36.9	87.1
	NaOH	5	200		433	50.2	
4	HCl→	5	140	950	299	31.5	95.4
	NaOH	2	300		607	63.9	
5	HCl→	5	140	1027	272	26.5	96.6
	NaOH	5	300		720	70.1	