Reclaim Tank Effectiveness

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Reclaim tanks are among the most common means for drag-out recovery in the plating industry. Their effectiveness, which depends on a number of factors, can, under proper conditions, be quite high. Is there a simple way of quantitatively predicting how effective a reclaim tank can be and establishing work rules, providing for the achievement of the best possible results?

Consider a simple model (see Fig. 1), comprising a plating tank 1 with plating solution concentration C_p and a reclaim tank 2 with solution concentration C_r. The parts to be processed can enter the plating tank either directly after a clean rinse (case 1, broken lines) or, in a less common way, after an intermediate dip into the reclaim tank (case 2, solid lines). After plating, all the parts are rinsed in the reclaim tank (solid lines). Plating bath evaporation losses are replenished by the solution from the reclaim tank, which, in its turn, is being replenished by clean water (double lines)

Using the approach previously described [1] and denoting the specific evaporation loss rate by E (plating tank evaporation loss per unit surface area of plated parts) and specific drag-out rate by D, a material balance equation for the equilibrium conditions of the system can be written for the average reclaim tank concentration when it reaches a constant value:

Case 1: $D \times C_p = (E + D) \times C_r$ (1)

Case 2: $D \times C_p = (E + 2D) \times C_r$ (2)

It is easy to express from these equations the C_r/C_p ratio for both cases:

$$(C_r/C_p)_1 = \frac{1}{1 + E/D} \quad (3)$$

$$(C_r/C_p)_2 = \frac{1}{2 + E/D} \quad (4)$$

The recuperation factor R gives a quantitative measure of reclaim tank effectiveness. It is determined as the ratio of the amount of chemicals being returned to the plating tank with the makeup solution to the amount of same leaving the plating tank as drag-out. Using equations 1 to 4 the following expressions for R can be obtained:

$$R_1 = \frac{E/D}{E/D + 1} \quad (5)$$

$$R_2 = \frac{E/D + 1}{E/D + 2} \quad (6)$$

Now, it is possible to plot the C_r/C_p ratio and R for both cases against the parameter E/D which is the main factor determining reclaim tank effectiveness (see Fig. 2). Some unexpected conclusions can be drawn from these curves.

For most practical cases, the E/D ratio lies in the range of 0.1 to 100. On the one hand, for high values of E/D the recuperation rates for both the single dip and double dip cases are close to unity. It is obvious, therefore, that for E/D values higher than 10 to 15 the additional reclaim tank dip preceding the plating tank is unnecessary and impractical.

On the other hand, when the evaporation rates get smaller, the effectiveness of the single dip reclaim tank diminishes quickly, while the equilibrium concentration C_r rises steeply and almost reaches the plating tank concentration. In striking contrast to this, the double dip approach still works effectively and saves no less than 50% of drag-out chemicals at less than half the plating bath concentration C_r in the reclaim tank.

To get the best possible results from a reclaim tank it is very important to determine the E/D ratio and make an intelligent choice on the way the reclaim tank will be used (just after, or both before and after the plating operation). Alternatively, by determining the reclaim tank equilibrium concentration C_r for an existing plating facility and using the curves of Fig. 2, it is possible to establish the particular E/D ratio and to predict if work rescheduling could help to save more chemicals by the use of a double dip reclaim tank. While calculating the evaporation to drag-out rate ratio, E and D should be expressed in consistent units, as was shown in the previous paper.[1]

In conclusion, it should be stressed that reclaim tank chemistry should always be kept in mind. Sometimes it might have undesirable effects on the plating bath, which should be dealt with; but, in other cases, it can be helpful as with nickel plating when the reclaim tank not only saves chemicals, but enables the plater to use harder

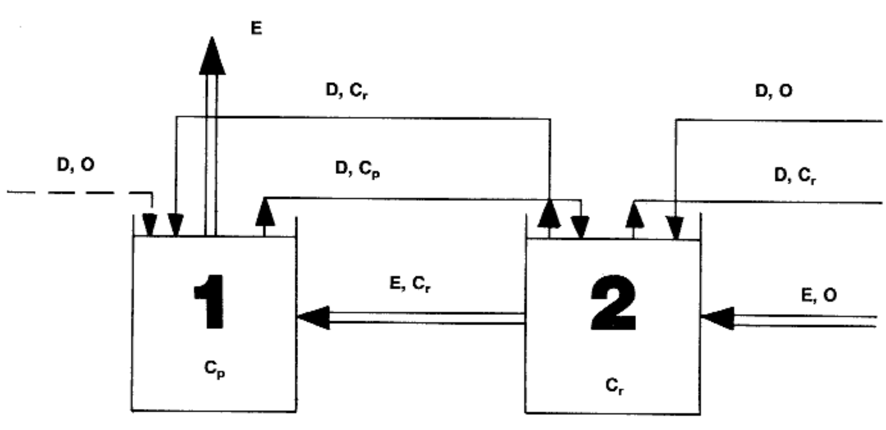

Fig. 1. Material flow schematic diagram.

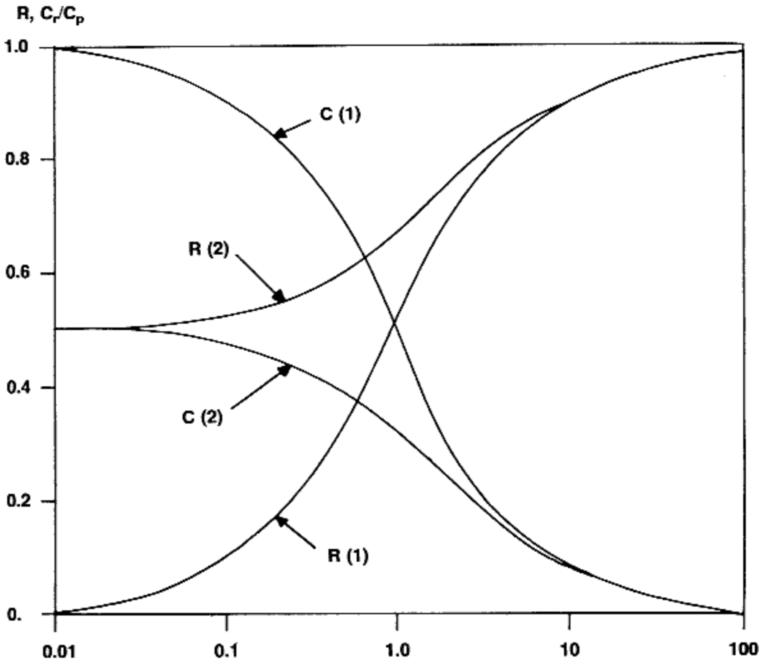

Fig. 2. Relationship between recuperation factors, relative reclaim tank concentrations and evaporation to drag-out rate ratios.

water for bath makeup. This is due to the fact that, by acting like a chemical filter, the reclaim tank settles out the calcium ions because of high sulfate concentration and part of the iron due to relatively high pH values. **MF**

Reference

1. B. Stein, Metal Finishing, 86, 27 (Jan. 1988).

Biography

Bob Stein is a 1974 chemical engineering graduate of the Moscow Institute of Fine Chemical Technology. He was formerly responsible for plating operations at an electrical appliances plant in Chernovtsy, USSR. As of press time, Stein and his family had left the USSR and were in Vienna, awaiting approval for Canadian visas.