



Technical Plating Saves Over \$45,000 by Reducing Water and Sewer Costs

Minnesota Technical Assistance Program ■ INTERN SUMMARY

Decreasing a SAC Fee

Company	Technical Plating Brooklyn Park, Minnesota
Results	Improved flow control on one plating line and effluent reuse reduced water demand by 2,625,000 gallons per year, saving \$7,100 a year plus \$44,100 in one-time SAC fees.

Technical Plating is a small metal finisher that specializes in applying tin, tin-lead and electroless nickel coatings on parts as a service to electronics, medical and general manufacturing industries. The plating processes generally involve degreasing, etching or otherwise activating the metal surface, electroplating, and rinsing between each step to remove any contaminants or chemicals remaining on part surfaces. Typically, the parts are plated to change the functional characteristics of the surface, such as improving corrosion resistance, solderability or conductivity.

Much of Technical Plating's work is small parts in large volumes. The company processes most parts in plating barrels, but it also does rack plating and reel-to-reel plating.

Incentives for Change

Between 1998 and 2001, water use at Technical Plating increased from 40,500 to 54,000 gallons per day (gpd). The local sewer authority, Metropolitan Council Environmental Services (MCES), proposed a one-time sewer access charge (SAC) of \$56,000 for this increased water use. SAC fees help defray future capital costs to accommodate and treat these higher flows. MCES gave Technical Plating one year to review practices and reduce flows.

Technical Plating requested a MnTAP intern to help reduce water use, hoping to lower or eliminate the SAC. The intern helped the company explore how to reuse treated effluent for some plating rinses and devised and evaluated an internal rinse system for barrel plating.

Effluent Reuse

Wastewater from rinses and from batch dumps of exhausted chemical baths was treated to remove metals and adjust pH to levels specified by MCES. Technical Plating speculated that this treated water was clean enough for reuse. The intern tested reuse of the effluent on the matte-tin and bright-tin lines because they can tolerate wider operating parameters. The effluent was cloudy and had a brown tint. Using only the treated effluent as rinse water, parts from the matte-tin trials met all specifications for adhesion, solderability and appearance. Parts in the bright-tin trials met adhesion and solderability specifications but had a cloudy appearance. Using a 50/50 effluent/fresh water rinse improved appearance to equal a 100 percent fresh water rinse.

Further work showed that filtering effluent to 0.5 micron would eliminate total suspended solids (TSS) but, as expected, did little to reduce total dissolved solids (TDS) levels measured by conductivity. By modeling concentrations under various reuse conditions, the intern investigated the affects of effluent reuse on the levels of sulfate, chloride and TDS that might build up over time. Simulations showed that contaminants would increase to about five times the concentration in city water. Because the maximum concentration would be reached quickly, adverse affects would show up without delay.

To reuse the effluent, Technical Plating installed a sand filter and two holding tanks. One tank was used to recirculate water through the sand filter for one to two hours, and the second tank held the

filtered effluent until it was needed on the line. Effluent was reused on one line with no measurable decrease in the quality of parts produced.

The system cost \$5,200 to install and costs \$800 a year to operate. It saved \$3,800 a year in fresh water purchase and sewer fees by eliminating 5,500 gpd [1,375,000 gallons per year (gpy)] of water use. The system also reduced one-time SAC fees by \$23,100.

Improving Rinse Efficiency

To start research on internal barrel rinsing, the intern wanted to determine water use baselines on the rinses in order to estimate the impact of reduction efforts. After measuring many of the rinses' flow rates, the intern saw that the flows varied between plating lines and different days on the same line—with some flows being three times higher than others. Part volumes and quality specifications did not explain this variability.

The intern noticed that for most of the company's two-stage, cascaded rinses, the conductivity of the second rinse dropped to the freshwater level very early in the cycle instead of gradually—indicating water overuse.

Ball valves. The variability was due in part to the use of ball valves to control flow. Although commonly used, ball valves do not regulate flow well and are best used as on/off controls. Operators set flow rates by adjusting the position of the ball valve handle, without measuring or seeing the actual flow. Water entered the rinse tanks near the bottom where the flow was not visible. Optimal flows had not been set for the rinse operations and operators lacked incentive to avoid overuse.

Flow meters. Technical Plating installed three flow meters on one line's rinses at a cost of \$450. After management gave instructions to limit flows, water use decreased by 5,000 gpd (1,250,000 gpy), saving \$4,100 in sewer and water costs and \$21,000 in one-time SAC fees.

Optimal flow rates. The intern investigated the method of Pinkerton and Graham¹ for calculating rinse flow rates based on dragout concentration and volume, the time between plating cycles and acceptable contaminant concentration in the rinse. The method appeared to be a good starting place for setting flow rates for rinses.

Internal Rinse Barrels

Standard barrel plating requires significantly larger volumes of rinse water than other types of plating because of the difficulty of getting rinse water inside the barrel.

The intern designed and developed a system for internal rinsing. The final design modified an existing barrel by installing large hubs on each end of the barrel cylinder. The hubs remain stationary as the barrel rotates. The new hubs had a diameter large enough to accommodate holes for dangles bringing an electrical charge to the parts in the barrel, and also for a permanently mounted pipe along the central axis of the barrel. The pipe had holes drilled to spray water on the parts evenly down the length of the barrel, and a quick connect fitting outside the barrel to help move the barrel between plating tanks.

Tests were done comparing internal barrel rinsing to two-tank, counterflow rinsing. The internal rinse barrels each require 30 seconds more rinse time than the counterflow immersion rinses. Substituting internal rinse barrels in place of the rinse tanks on one line should reduce water consumption by 1,400 gpd (350,000 gpy) and save about \$3,800 year. Operating the line would require three modified barrels, costing \$300 each. Because the rinse steps are not the production bottleneck, line capacity and labor costs would not be affected.

Expanding the use of internal rinse barrels to four additional lines would require modifying 12 more barrels at a cost of \$1,200. They should reduce water use by 21,700 gpd (5,400,000 gpy) and save a total of \$22,300 a year.

Counterflow internal rinsing. The intern also simulated counterflow rinsing in the internal rinse barrel and found this could reduce water consumption by another 60 percent. This could save an additional \$3,500 if implemented on the five barrel plating lines.

Patents. Patents cover some types of internal barrel rinsing. While they appear to cover counterflow internal rinsing, it is less clear if they cover internal rinsing with single pass, fresh water. The intern looked at the economics of purchasing commercial internal rinsing equipment and found paybacks of five to 10 years at Technical Plating while retrofitted barrels using single pass water could payback in one to four months.

Overall Results

With the help of a MnTAP intern, Technical Plating reduced water demand by 2,625,000 gpy, saving \$7,100 a year plus \$44,100 in one-time SAC fees.

Technical Plating had started working on maximizing its water use to minimize its SAC fee. But with the assistance of a MnTAP intern, the company was able to accelerate its development and testing. MnTAP was able to offer Technical Plating a staff person dedicated to its water conservation problem.

Results

	Effluent Reuse	Improved flow control
Reduced water use (gpy)	1,375,000	1,250,000
Savings per year	\$3,000	\$4,100
SAC savings	\$23,100	\$21,000
Cost	\$5,200	\$450
First year savings	\$20,900	\$24,650
Total first year savings	\$45,550	

Application to Other Facilities

MCES starts its SAC review one year prior to any new assessments. This gives companies the opportunity to reduce water use/discharge in lieu of new SAC fees. If your company receives notice of an impending SAC increase, the earlier you start working on water conservation the more likely you are to find opportunities to cut water use and lower the SAC fee.

Deciding to reuse treated plating effluent for plating rinses is a case-by-case situation. Facilities should consider rinse reuse for processes that are resilient or have less stringent water quality needs. Reuse opportunities may be better if clean wastewater, like high-purity rinses or noncontact cooling water, can be segregated from other wastewater streams.

To begin improving rinse efficiency, a first step is knowing the flow rates of specific operations and the variability of these flows. In many situations controlling flows may be beneficial. Areas for reducing water use include:

- processes where the water use volume is unknown
- processes where flow is not visible and offers no feedback to the operator
- flows controlled by ball valves, especially if flows are not visible
- flows that are clean, either visibly or measurably (e.g., low conductivity)
- cooling flows that are still cool when going to drain

Internal rinse barrels have the potential to reduce rinse consumption wherever large volumes of small parts are cleaned. Carried to the concept's maximum extent, a single internal rinse barrel would be used with a single tank. During set cycles, process chemicals would be delivered from reservoirs to the barrel and chemical would be reclaimed from the tank after each step. This would reduce floor space and labor by bringing chemicals to the finishing barrel rather than bringing the barrel to the tanks.

More Information

MnTAP has a variety of technical assistance services available to help Minnesota businesses implement industry-tailored solutions that maximize resource efficiency, prevent pollution and reduce costs. Our information resources are available online at mntap.umn.edu. Or, call MnTAP at 612/624-1300 or 800/247-0015 from greater Minnesota for personal assistance or more information about MnTAP's Intern Program.

References

1. *Electroplating Engineering Handbook, Third Edition.*
Van Nostrand Reinhold Company, New York, 1971.

This project was conducted in 2002 by MnTAP intern, Eric Tsai a chemical engineering junior at the University of Minnesota.