Advice & Counsel

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P2 Technology for Barrel Plating

Dear Advice & Counsel,
I recently took over a jobshop electroplating facility from my Dad, who is now semi-retired. We do a lot of barrel plating, and I've received a lot of on-the-job training, but there are a few questions on barrel plating that I periodically wonder about. For example:

The barrels we use are quite old, and I see ads all the time about newer designs or newer ways to do bulk part plating. They claim to be more efficient and produce less drag-out. Without buying each one, is there any way to tell if a barrel will actually reduce the loading to our wastewater treatment system?

Signed,
Spin Dangler

Dear Mr. Dangler,

Because you are located in Illinois, I took your question to Tim Lindsey, Manager, Pollution Prevention Programs, Waste Management & Research Center (WMRC), located in Springfield. Lindsey and his office have developed a program called ADOP^{2}T (Accelerated Diffusion of Pollution Prevention Technologies).

ADOP^{2}T uses stakeholders from various agencies, municipalities, trade associations, companies, and vendors to identify promising P2 practices, promote awareness, conduct brief demonstrations and extended pilot trials of the practices and technologies in industrial settings.

The ADOP^{2}T program was initiated in Chicago's metal finishing sector in 1999 in an effort to help companies meet the requirements of the U.S. Environmental Protection Agency's (EPA) Strategic Goals Program (SGP).

Over the past few years, pilot trials of innovative P2 practices have been conducted at multiple facilities in your state, with technical and monetary support from the "stakeholders." The stakeholders are shops such as yours, which agree to be the site of a pilot study, conducted by organizations, such as the Chicago Metal Finishers Institute, The Metropolitan Water Reclamation District of Greater Chicago, Commonwealth Edison, USEPA Region V, USEPA DFE, Illinois EPA and the Illinois Department of Natural Resources. The total annual budget for projects was $385,000 last year alone.

The ADOP^{2}T model has been successfully field tested in Chicago's metal finishing sector since Spring 1999. A stakeholders group was formed consisting of representatives from the Chicago Metal Finishers' Institute, WMRC, consultants, local publicly owned treatment works (POTW), and 10 top metal finishers. Since that time, dozens of technology demonstrations have been performed for multiple metal finishing firms. Pilot trials of innovative technologies have included: conductivity controls, ultrafiltration, diffusion dialysis, reverse osmosis, vacuum evaporation and the project that provided an answer to your question: alternative barrel designs.

The ADOP^{2}T model has provided many benefits to Chicago-area metal finishers, including reduced waste, improved compliance, reduced costs, improved quality, improved safety and improved competitiveness. The local POTW has benefitted from having less industrial waste to treat and manage. Citizens in the Chicago area have been exposed to less industrial waste and water pollution, and the environment has benefitted from less pollution.

Many states, including Minnesota, Iowa, Wisconsin, Michigan, Indiana, Kentucky, Massachusetts, Pennsylvania, and North Carolina, are in the process of developing and implementing their own ADOP^{2}T programs. Additionally, it is anticipated that the ADOP^{2}T program can be implemented in multiple industrial sectors. Therefore, widespread use of the ADOP^{2}T model could conceivably benefit citizens and the environment throughout the U.S. Further, it is likely that widespread implementation of the ADOP^{2}T model in the U.S. will lead to implementation of this model in other countries as well.

The project conducted at your (Mr. Dangler's) facility was designed to determine if some of the newer barrel designs would reduce drag-out rate, therefore reducing pollution loading and waste generation. The following is an executive summary from the report on this project. The full report has been submitted to AESF as a paper to be presented at AESF Week next January in Orlando.

Executive Summary: Barrel Design vs. Drag-out

Metal finishing operations typically process large numbers of small parts, such as rivets and fasteners in perforated cylindrical barrels for operations such as electroplating, electropolishing, phosphating, black oxiding, and several other coating operations. Because this type of processing produces large volumes of entrapped liquid (called drag-out), it is a major source of waste, as the drag-out typically is waste treated yielding F-006 hazardous waste in many cases. Further, the drag-out chemical must be rinsed during the processing steps, and the volume rate of rinsewater is directly related to drag-out rate. As an example, for an ideal single rinse, the rinsewater flow necessary to achieve a specific purity of rinse is determined by the equation: $F = D (Ct/Cr)$, where F is the rinse flow rate, D is the drag-out rate and Ct/Cr is the rinse ratio (concentration of contaminant in the process tank divided by the concentration of the same contaminant in the rinse tank).

Therefore, reduction of drag-out from barrel processing operations prevents pollution in several ways:

1. Reduces water consumption
2. Reduces hazardous waste generation
3. Reduces operating costs by saving chemicals purchased

The Illinois Waste Management Resources Center agreed, through their ADOP²T program, to fund a study that would produce a benchmark test that can be conducted to compare drag-out rates of plating barrels. We used this test to compare a small sample of barrel designs, in order to illustrate the efficacy of the test and provide the metal finishing industry with guidance that can be used to reduce drag-out rates, making it easier to achieve their goals under SGI. The information can also be used by equipment manufacturers* to improve the designs of their plating barrels, so that lower levels of drag-out rates can result in lower levels of pollution on a nationwide basis.

The study was limited to two size ranges of plating barrels, small and large.

Small Barrels

For small barrels (6 in. x 12 in.), testing showed that a reduction in drag-out rate, as high as 48 percent, can be achieved by replacing commonly used existing barrels constructed of solid walls and drilled holes, with newer designs that incorporate meshed material into the walls of the barrel. The results obtained were:

Summary of Drag-out Rates—Small Barrels

Lowest drag-out rate	142.2 mL, 23.7 mL/lb
Highest drag-out rate	270.8 mL, 45.1 mL/lb
Average of 4 barrels	200.35 mL, 33.375 mL/lb

While the above data are for small barrels, we would expect similar reductions using mesh-type designs, if the barrels were larger (such as those reported below).

Large Barrels

For large barrels (16 in. x 34 in.), testing showed that a reduction as high as 44 percednt can be obtained. The barrels yielding the best results included one design that utilizes portable, oblique rotating baskets, as opposed to the commonly used plastic walls perforated with drilled holes. The other well-performing design utilized slots instead of drilled holes, and this design yielded the best overall results for large barrels. Test data generated showed:

Summary of Drag-out Rates—Large Barrels

Lowest drag-out rate	1670 mL, 11.18 mL/lb
Highest drag-out rate	2986 mL, 19.9 mL/lb
Average of 4 barrels	2079 mL, 13.9 mL/lb

The average drag-out rates reported above for the size of barrels tested can be used as a “benchmark” by metal finishers in evaluating their own equipment (test procedure is provided in the full report). Barrels that drag out less than the average can be considered to be pollution prevention “friendly.”

In conclusion, this study:

1. Developed a procedure for “benchmarking” barrels used in various metal finishing operations. This procedure is relatively easy to conduct and can be conducted by any metal finisher at reasonable effort and cost.
2. Demonstrated that there is a significant difference in drag-out rate

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