ELIMINATING WASTE DISCHARGE IN A REEL-TO-REEL ELECTROPLATING SHOP

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ABSTRACT

Orbel Corporation, a reel-to-reel electroplating facility, implemented several source reduction practices to reduce water usage. Wastewater remaining after source reduction was processed to reclaim metals and oils, and purified to produce water of the high quality needed for reuse in the reel-to-reel electroplating process. Similar systems have been successfully employed in the rack and barrel segments of the electroplating industry, however the reel-to-reel process requires a higher quality water supply. This project is intended to demonstrate both the technical and economic feasibility of eliminating wastewater discharge to the POTW through source reduction practices and waste rinse water treatment for process reuse.

INTRODUCTION

PROJECT DESCRIPTION

Orbel Corporation is an electroplating company specializing in plating strip foil and reel-to-reel piece parts. Clients include both commercial and military customers. A 45% reduction in hourly water use and the elimination of zinc from wastewater have been realized by Orbel Corporation in their reel-to-reel electroplating operation.

In the process of electroplating, the use of clean water is critical. The goal of this project was to implement a system to purify contaminated water from the plating process and return the water to the plating line. Metal, salts, and oils are removed from the water, and contaminants are addressed separately to render them easily recycled.

PROCEDURE

This project involves the logical management of the plating line process without the use of complex and expensive equipment. It was the result of ideas generated at Orbel's weekly production meeting. Several days were required to implement the suggested changes. System refinements were conducted over the following three to four weeks at which time satisfactory data were obtained. Two key methods were implemented to the process depending on the contaminant in the plating cell prior to rinsing.

1. Plating tank rinses were modified into three rinse stations, cutting water flow by 95 percent. This water flow is small enough to allow all rinse water to be circulated back into the plating tank.

2. Following the cleaner and acid tanks, water is counterflowed from the acid rinse to the cleaner rinse. This permits management of the water within the plating line.

Figures 1 compares the original and modified plating cells; Figure 2 compares the original and modified cleaning lines.

APPLICATION

The introduction of counterflow rinsing into the plating line has many advantages.

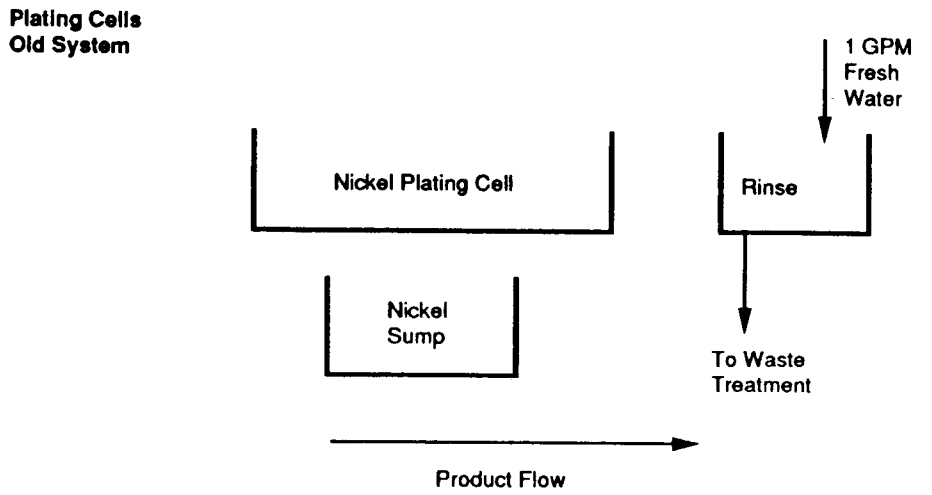
1. Caustic consumption was reduced by 7,000 pounds per year and eliminated acid for waste treatment.

2. With the reduction of water consumption, additional time is available to manage the wastewater.

3. Counterflow into the nickel plating tank has completely eliminated nickel from the waste stream.

Water is considered a renewable resource within the plant, and a number of materials may be recovered from the wastewater. Metal is recycled through a local metal smelter. Oils will be utilized as fuel at a licensed facility. Salt water is the only true waste product, and is sent to a deep well facility for treatment and disposal.

Figure 1. Plating Cells: Comparison of New and Old Systems



16 hours of operation per day

	Per Hour	Per Day	Per Week
Old System	60 G	960 G	4,800 G
New System	0	0	0

Yearly water savings 249,600 gallons

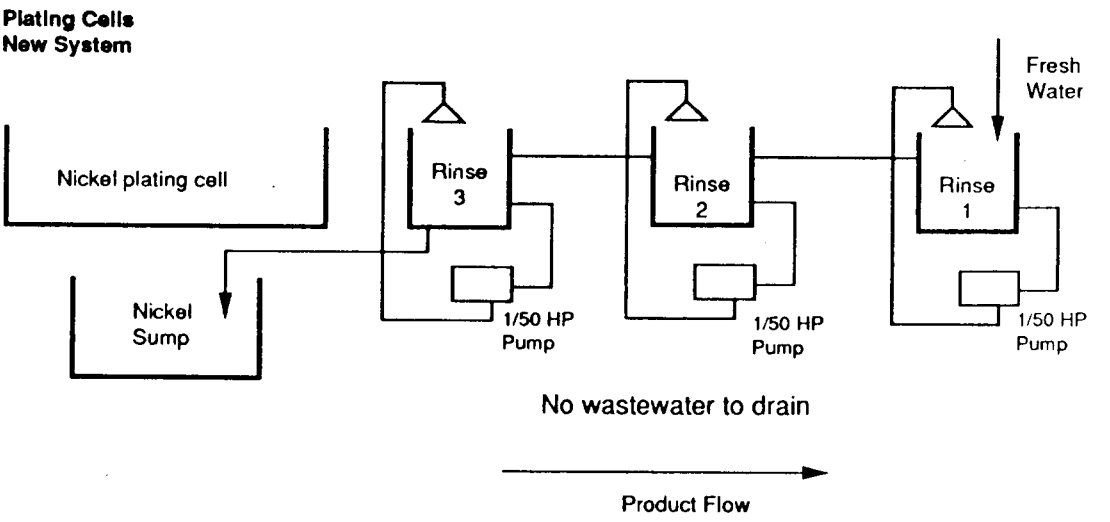
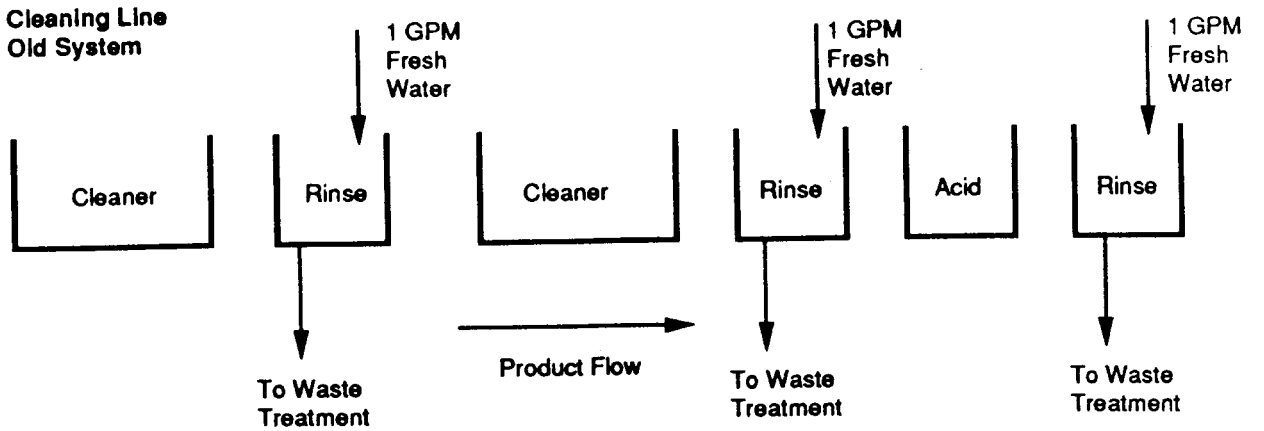
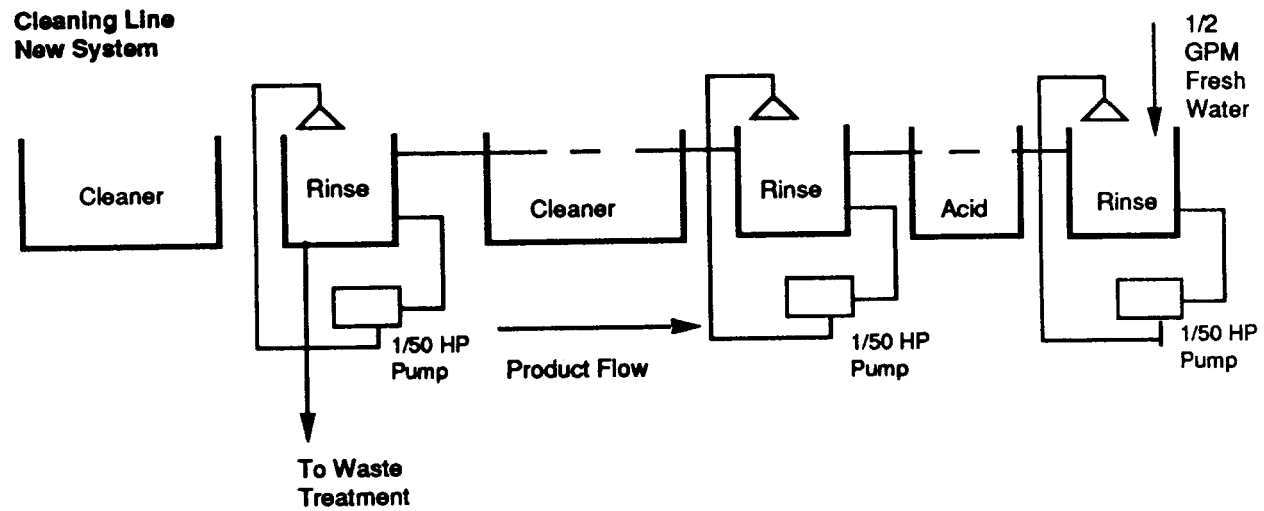


Figure 2. Cleaning Lines: Comparison of New and Old Systems





	16 hours of operation per day		
	Per Hour	Per Day	Per Week
Old System	180 G	2,880 G	14,400 G
New System	30 G	480 G	2,400 G

Similar process changes may be easily implemented in metal finishing operations. In addition, this basic "rethinking" of process management towards pollution prevention is applicable to almost any industry. Such process changes may often be implemented at low cost to the company and require no major technology changes.

RESULTS AND DISCUSSION

PERFORMANCE RESULTS

Simple test parameters were applied to determine the success of the process changes. Nickel, copper, and zinc levels, and water consumption were measured as shown in Tables 1 and 2.

Table 1: Water Test Summary

	Nickel (ppm)	Copper (ppm)	Zinc (ppm)
NJ NPDES Standard*	2.38	2.07	1.48
September 1990	.05	.38	.13
September 1991	.05	.63	.032
October 1990	.21	.43	.10
October 1991	.05	.40	.013
November 1990	.74	1.10	.25
November 1991	.10	.21	.19

*New Jersey National Pollutant Discharge Elimination System: Electroplating Effluent Guidelines, Pretreatment Standard for Existing Sources Greater Than 10,000 Gallons Per Day

Table 2. Water Consumption

	Daily (gal.)	Hourly (gal.)	Yearly (gal.)
Sept.-Nov. 1990	8,281 running 16 hours	517	2,070,250
Sept.-Nov. 1991	6,821 running 24 hours	284	1,705,250

Water consumption was measured via the plant water meter. All water in the plant is controlled by one switch. Since the plant operates the same number of hours each day, water consumption is consistent as daily water flow is started and stopped by one switch at approximately the same times. Figures shown represent a 45 percent reduction in hourly plant consumption of water.

Upon implementation of the changes within the plating line, spotting and oxidation of the work pieces were noted. When the volume of water was reduced in the tanks, chemical concentrations increased. Agitation of the water in the final rinse cells evenly distributed the chemicals throughout the tank without the need for additional fresh water. Also, agitation dispersed and settled the layer of "scum" on the top of the tank.

The materials which are being separated from the wastewater do have potential value. However, due to the complex nature of waste regulations and the small amounts of materials generated, no income has been realized as yet from the reclaimed materials. Table 3 compares costs for the old and new systems.

Cost/Benefit Analysis

Table 3. Cost Comparison of the Old and New Systems

	System ($)	New System ($)
Compliance Testing	1,820.00	1,820.00
Water Purchases	4,037.00	1,816.65
Sewer	4,900.00	2,205.00
Electricity	16,800.00	16,800.00
Labor	7,488.00	6,500.00
Treatment Chemicals	5,000.00	2,000.00
Maintenance/Repairs	9,300.00	10,500.00
ANNUAL TOTAL	49,345.00	41,641.65

The old system used city water delivered under pressure. The new system, which recirculates water, must have its own pumps. The increased maintenance costs in the new system are attributed to the repair cost of these pumps.

CONCLUSION

POLLUTION PREVENTION ASSESSMENT

While an ideal goal of zero discharge to the sewer system was not realized, many positive changes were implemented within the plating line. These process changes will be further refined; however, present modifications can be easily implemented in other plating and metal finishing operations.

A major challenge to this project is the management of dissolved solids in the water which can hinder water reuse. Short term solutions include the use of sand and carbon filters to allow additional water cycles within the line prior to discharge. While these filters generate solid waste that requires disposal, Orbel is investigating the regeneration and reuse of the filters.