CATERPILLAR, PENNSYLVANIA RECOVERS HARD CHROME

Bob Jeanmenne, Caterpillar, Inc.
Stephen Perrone, Agualogic, Inc.

In the summer of 1991, Caterpillar Inc. of York, PA made a commitment to purchase a new automated hard chrome plating machine to replace the existing hard chrome operation. The new line would use a high speed proprietary hard chrome plating process. The new chemistry was felt to be superior to the old baths, however, the new process was considerably more expensive to use. Caterpillar contracted with Agualogic to design and build a chrome recovery system. The system would allow the conversion of the old line to the new chemistry and close the loop at the source. POLLUTION PREVENTION. The system had to be capable of being moved to the new line when it was installed.

The existing plating operation was observed in operation and the baths, drag-out and rinse tanks were sampled. A general plan was developed based upon the analytical data generated in Agualogic's laboratory. It became apparent that we had to address the drag-out tank, rinses and the automatic washdown of the scrubber hoods. The analytical results indicated that the sources to be recovered contained contaminants of iron, copper, and trivalent chromium. The tests further indicated that-the hexavalent chrome content, although exceptionally high by rinse standards was still low by plating standards.

OBJECTIVE:

The objective became clear. We had multiple tasks that needed to be accomplished if we were going to recover the chrome.

1. The three sources had to be collected and equalized.
2. The trivalent chrome, tramp iron and copper had to be removed prior to recovery.
3. The "cleaned" and recovered chrome had to be concentrated before being returned to the chrome plating tank.
4. The water recovered from the evaporator is to be reused.

PROCESS:

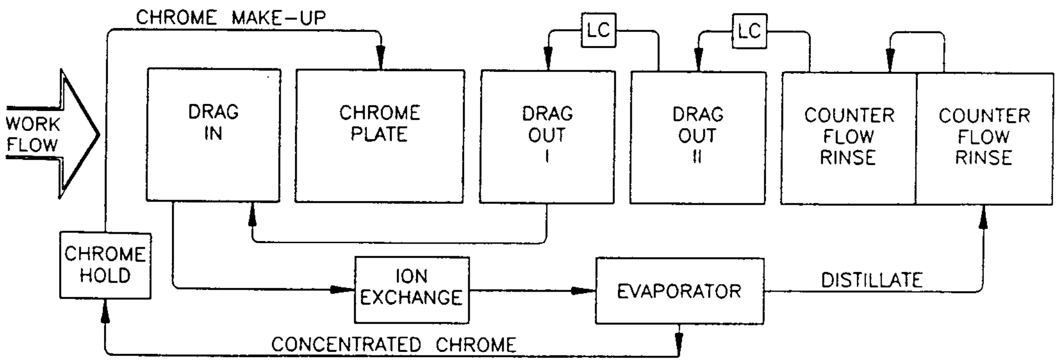
The plating process has a drag-in tank, plating and drag-out tanks, and rinse stations. As the parts pass through the plating cycle, chrome is carried to the drag-out tank. In this case we have two drag-out tanks which are counterflowed to each other.

The rinsewater is used as make-up for the drag-out tanks. The drag-out is then removed at the rate of 30-60 gallons per hour. The chrome-bearing waste water is collected in a holding tank and combined with the automatic washdown of the scrubber. The solution is then passed through a dual trained, cation-only ion-exchange system. The resins remove the contaminants and the dilute, "cleaned" chrome is collected and held for transfer on demand to the evaporator.

The ion-exchange module is designed as a dual-train system with an on-line train containing tandem cylinders and a similar backup train which goes on-line when the first system needs regeneration. The system alternates between the two trains for continuous operation on a 24-hour basis.

A vacuum evaporator was selected to concentrate the "cleaned" chrome. The evaporator is made primarily of glass, and its fairly open construction allows ease of monitoring, cleaning, and maintenance. The unit requires steam as its heat source. The evaporator receives approximately 30 l-gallon batches automatically from the cleaned chrome holding vessel.

FLOW DIAGRAM A:



The chrome is then concentrated to 35-37 oz. per gallon. The concentrated chrome is held in a vessel and an automatic feed system transfers the solution to the plating tanks on demand.

The distillate from the evaporator is returned to the last rinse tank in the plating process and counterflowed through the entire chrome plating process and the auto-scrubber and hood wash-down.

The entire system is controlled with a central PLC located on the modularized ion-exchange package. The feeds, level controls and transfers to and from the evaporator all function from this single source. Flow Diagram A illustrates the basic process.

PRODUCTS OF THE PROCESS:

1. Chromic acid solution (35-37 oz. per gallon) which is pumped to four chrome plating tanks on . demand.
2. Distilled water which is pumped back to the rinse tank on demand.
3. Sulfuric acid (20%) used in the regeneration process of the ion-exchange system (approximately 50 gallons per month).

BENEFITS OF THE PROJECT:

The old method of chrome treatment required the use of SO_2 as the reducing agent. The volume of chrome to be treated was substantial and the SO_2 was purchased in l-ton cylinders.

The new system virtually recovers all of the chrome and discharges no wastewater from the process plating line. The recovery system has been in operation since April, 1992 and has achieved dramatic results.

The system returns in excess of 200 gallons per week of concentrated chrome to the plating tanks. This equates to a recovered solution at 36 oz. per gallon (271 g/l) . The actual savings in chrome is 450 lbs. of chromic acid each week. With the current cost of HEEF-25 at $3.44 per pound, the weekly savings amounts to $1,548 and the annual savings is $77,000!

The existing system requires 3 gpm of rinsewater discharged to the treatment system. With the new system couterflowing all of the water back through the rinses and drag-out tanks, the water is captured and fed through the evaporator with the distillate being used for make-up. The old methods required more than l,000,000 gallons of water annually and with the current cost of water placed at $9.57 per 1,000 gallons, the annual savings is $10,300

CONCLUSION: The success of the project is further emphasized by the approval of a grant from the State of Pennsylvania after installation and verification of the performance of the system. The grant, which provides partial reimbursement for hazardous waste recycling equipment, awarded Caterpillar a check for $46,112.22 in July of 1992.