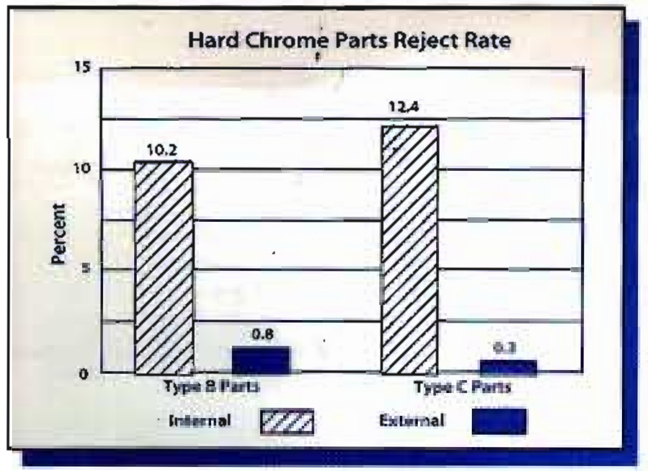

Figure 5: Decreased Reject Rates

ing system, and found that the reject rate for the internal cooling system was reduced by over 90 percent. The reject rate for Type B parts decreased from 10.2 percent with the internal cooling system to 0.8 percent with the external cooling system. The contrast was most evident for Type C parts, as the reject rate decreased from 12.4 percent to 0.3 percent with an external cooling system (see Figure 5).

Microplate also found that the external cooling system significantly reduced waste associated with the electroplating process. Microplate calculates that production of sludge containing chrome generated during stripping decreased over 90 percent because of the installation of the external cooling system. Microplate also tracked the labor associated with replating rejects and found that the decrease in reject rates immediately reduced labor costs associated with rejects (that is, the labor costs for troubleshooting, stripping, reracking, and replating) and by about $300 per month when combined with other savings (see Figure 6).

Costs Category Due to Rejects	Monthly Savings
Raw Materials	$ 5
Sludge Disposal	$ 40
Labor (14hrs @ $18/hr)	$252
Total	$297

Figure 6: Savings Due to Pollution Prevention

Long-term cost savings will result from Microplate's use of the external cooling system. Although Microplate estimates that the installation cost for an internal cooling system is less than that for an external cooling system, the company is most impressed with the increase in production capacity (at least 25 percent) resulting from its use of the external cooling system. Previously, Microplate had to limit the load (amperage) into the electroplating system because of the cooling system's limitations. With the installation of the external cooling system, cooling capacity and solution mixing are no longer limiting factors. Without these restrictions, Microplate is able to load the tanks with more parts and increase the amperage applied to the plating solution. Additional sources of increased productivity associated with the external cooling system include improved mixing, simplified racking, and diminished setup time.

Calculating Costs

Guidance for Calculating Costs for Raw Materials and Waste Disposal from Rejects

- 0.59 ounce of chromium per square foot of chrome plating per 0.001 inch of thickness
- average cost of chromic acid is $3/pound
- 3-5 pounds of sludge generated for each 1 pound of chrome plating stripped
- cost of sludge disposal is $300/ton
- fume-suppressing foam is $50/gallon

• External cooling	$8-$15/gallon of plating solution cooled
• Internal cooling	$6-$10/gallon of plating solution cooled

Figure 7: Comparing Capital Costs for Cooling

OTHER APPLICATIONS OF THE EXTERNAL COOLING SYSTEM

The external cooling system is potentially applicable to other electroplating processes, with different heat exchange materials being used:

- Decorative chrome electroplaters could use a heat exchanger made of niobium (columbium).
- Acid copper electroplaters could use a heat exchanger made of titanium or stainless steel.
- Cadmium cyanide platers could use a heat exchanger made of steel.

ADDITIONAL SOURCES OF INFORMATION

For more information about the Merit Partnership, external cooling systems, or chrome emission regulations, you can contact any of the following individuals:

Laura Bloch (EPA Region 9)	(415) 744-2279
John Siemak (CMTC)	(310) 263-3097
Dan Cunningham (MFASC)	(818) 445-3303
Steve Peterman (Microplate)	(310) 478-0837
Ali Ghasemi (South California Air Quality Management Division)	(909) 396-2451

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INNOVATIVE COOLING SYSTEMS FOR HARD CHROME ELECTROPLATING

INCREASED PRODUCTIVITY AND REGULATORY COMPLIANCE

The Merit Partnership is a joint venture between U.S. Environmental Protection Agency (EPA) Region 9, state and local regulatory agencies, private sector industries, and community representatives. This partnership was created to promote pollution prevention (P2), identify P2 technology needs, and accelerate P2 technology transfer within various industries in southern California. One of these industries is metal finishing, which is represented in the Merit Partnership by the Metal Finishing Association of Southern California (MFASC). Together, MFASC, EPA Region 9, and the California Manufacturing Technology Center (CMTC) established the Merit Partnership P2 Project for Metal Finishers. This project involves implementing P2 techniques and technologies at metal finishing facilities in southern California and documenting results. The project is funded by the Environmental Technology Initiative and EPA Region 9.

This fact sheet provides a summary of chrome emission regulations, information on external cooling systems for hard chrome electroplaters, and the benefits of implementing such systems, including reduced waste, decreased labor and material costs, and increased plating capacity. It also summarizes the results of an external cooling system case study conducted at a hard chrome electroplating facility in southern California.

THE DEVELOPMENT OF HARD CHROME AIR EMISSION REGULATIONS

Regulation of bath temperature and mixing of the plating solution are essential for successful hard chrome electroplating. The hard chrome electroplating process involves long plating times and intense heat generation. Failure to both dissipate the heat and maintain a uniform solution temperature impairs plating quality. In the past, hard chrome electroplaters maintained optimum plating temperatures (typically within 2 °F of the target temperature of 135 °F) by directing air bubbles upward through the plating solution. Turbulence created by the bubbles both mixed the plating solution and transferred heat from the solution to the air by evaporative cooling. Air bubblers were an easy and efficient means of maximizing production because they addressed the most problematic aspects of hard chrome electroplating: heat dissipation and solution mixing. As the bubbles reached the plating solution's surface and burst, air emissions containing chromium were created.

EPA introduced the National Emission Standards for Hazardous Air Pollutants (NESHAP), which became effective in January 1995, to regulate industrial air emissions. One part of NESHAP mandates that all hard chrome electroplating facilities meet several requirements established to minimize chrome emissions in plating operations involving chrome. Hard chrome electroplaters have been able to meet these requirements by discontinuing the use of air bubblers and implementing fume suppressant systems made up of plastic balls or foam that float on the surface of the plating solution.

COOLING HARD CHROME ELECTROPLATING SOLUTIONS

To maintain plating solutions that are well mixed and at the correct temperatures without the use of air bubblers, most facilities have opted to install cooling coils on the interior walls of their plating tanks. Figure 1 shows an internal cooling system of this type. However, internal cooling systems have drawbacks. For example, slower plating rates, increased downtime, and higher reject rates have been experienced after installing such systems. Parts are considered rejects by the electroplater if, after plating, they do not meet specifications because of discoloration, poor adhesion, roughness, lack of hardness, or high porosity.

Figure 1: An Internal Cooling System

The rise in reject rates causes more waste generation (see Figure 2) and increases operation and maintenance (O&M) activities and repair costs. These increases hit hard at electroplaters' bottom lines.

CMTC

MFASC

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