



## Advice & Counsel

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### Fume Suppression

**Dear Advice & Counsel,**

My company performs hard chromium plating on large rolls. We are in an argument with our state EPA. They want us to add a fume suppressant to our plating solution as a "stop-gap" emission control measure, while we are waiting to complete the installation of air scrubbing equipment. We are unsure how these products work, and have heard stories about mist suppressants causing plating problems. Can you help us keep the EPA at bay?

**Signed,  
Holding the Fort**

Dear Holding,

I suppose you could point out to your state EPA representatives that the U.S. EPA did not consider fume suppressants as being viable controls for hard chromium plating when they proposed and finalized the regulations. On the other hand, because the regulations have been in place for some time now and you are asking for special dispensation (because, technically, you are out of compliance), you might want to try a foam blanket instead of a fume suppressant that reduces surface tension. Let's discuss how these products work.

#### Fume & Spray Suppressants

The best place to minimize airborne mist is at the surface of the solution, before it enters the ventilation system. Chromium plating generates hydrogen gas at the cathode and oxygen gas at the anode (Fig. 1). Additionally, there may be air agitation in the tank, adding air bubbles to the process. These gas bubbles rise to the surface of the plating solution, where they

break the surface of the solution, causing small droplets of mist to be expelled into the air. As illustrated in Fig. 2, the air bubble breaks the surface of a liquid, spreading the liquid apart.

Because for every action there is a reaction, the liquid responds to being pushed aside by pushing back. This "rebound" of the liquid surface can "sling-shot" a droplet of liquid into the air. That sling-shot droplet becomes the mist, which is regulated. The larger the gas bubble breaking the surface, the larger the sling-shot effect.

To eliminate the mist droplets, we can work at capturing the mist, or preventing it from forming in the first place. Foaming agents, fume scrubbers and mesh pad systems work by capturing the mist. Fume suppressants, which are based on surfactants, work at preventing the mist from forming in the first place.

Foaming fume suppressants create a foam by the physical disturbance of

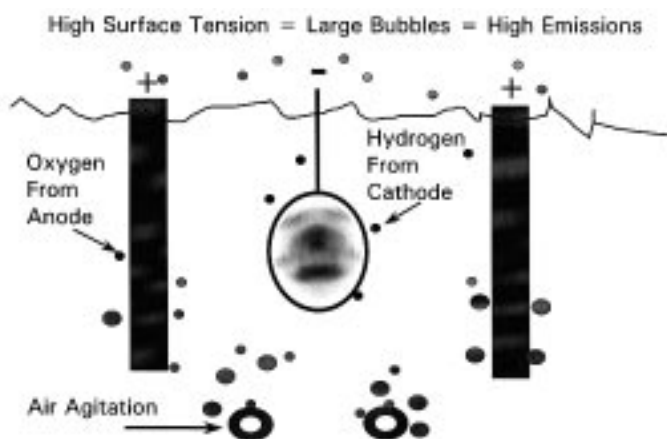


Fig. 1—Source of chromium emissions.

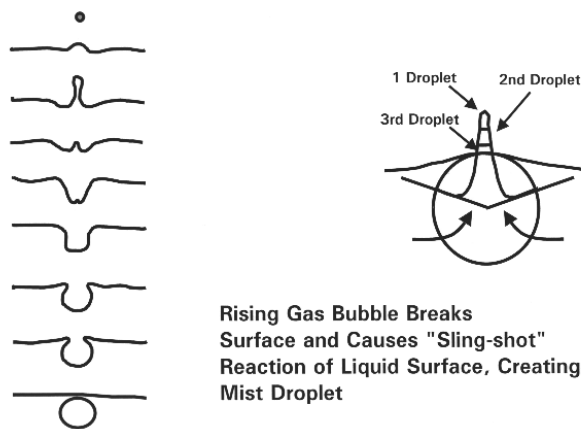


Fig. 2—Mist generation and control.

the bursting gas bubbles, creating foam cells with the foaming agent. The foam traps the mist within the cells, allowing it to eventually return to the plating solution. The foam is designed so that it will not alter the chemistry or physical properties of the chromium plating solution. Because it does not impact the surface tension, the chance of it causing pitting is very low. This type of fume suppressant,

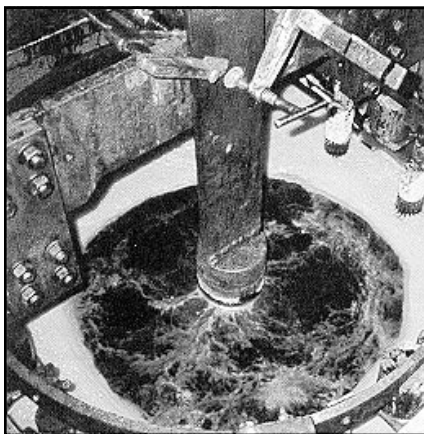


Fig. 3—Low-foaming fume suppressant.

however, is only effective when a dense foam 1–2-in. thick is maintained by visual control. If the foam blanket breaks, so does the control of the mist. The foam cells also trap hydrogen gas, and can yield a mighty loud explosion if set off with an electric spark from racks contacting tank bus.

Another problem arises if too much foaming agent is used. In this case, the foam tends to get so thick that large portions are either evacuated from the tank into the exhaust system, or overflow the tank, much like a beer in a too-small glass. Foam-type fume suppressants are not compatible with the kind that reduce surface tension.

The second kind of fume suppressant drastically reduces surface tension of the plating solution, from about 72 dynes/cm to between 30 and 40 dynes/cm, depending on the amount added and the chemistry of the product. When the surface tension is reduced this low, the gas bubbles are so small that there is not enough force pushing the water aside to create a mist droplet.

These types of fume suppressants produce a variety of foam, in addition to reducing surface tension, ranging from almost no foam (Fig. 3) to 1.5–2-in. of foam (Fig. 4). Because foam can reduce evaporation losses from the plating tank (and thereby reduces the ability of recycling rinsewater to the tank), the less foam these products produce, the more effective they are in reducing mist and maintaining pollution prevention.

Studies conducted by the Metal Finishers Foundation and confirmed by the Industrial Technology Institute (Ann Arbor, MI) have shown that the use of fume suppressants that lower



Fig. 4—Foam blanket-type fume suppressant.

surface tension can reduce mist emissions significantly, making compliance with EPA air emission regulations easier. In one study, the airborne chromium measured six in. (15 cm) above the solution **averaged 0.0027 mg/A-hr** with a standard deviation of 0.0032 mg/A-hr. *This represents an average reduction of greater than 99.9 percent compared to a control with no fume suppressant.*

Because fume suppressants that reduce surface tension reduce the size of gas bubbles, the tendency of gas bubbles to leave a surface is reduced, increasing the chance of pitting—especially when the surface has imperfections, such as metal tears and microscopic pits. Our experience with numerous hard chromium platers is that most do not experience a pitting problem, but some do. Almost all of those who experienced pitting problems with the use of fume suppressants that lower surface tension, were plating heavy deposits (over 0.001 in., 25 microns), and almost all were limited in the quality of surface finish they could apply before plating.

#### Operating Tips

1. Fume suppressants greatly reduce drag-out of plating solution, which may require an adjustment in schedules for addition of bath replenishment materials.

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