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Stop Kicking the Can Down the Road

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In a hexavalent chromium plating solution, bubbles are generated through gas liberation due to the electrolysis reaction on parts being plated. The bubbles are composed of gases which are lighter than the solution and atmosphere around the tank. When the bubbles reach the surface, they pop and expel tiny droplets of hexavalent chromium solution into the air. In a hard chromium process, most of this mist is captured with a ventilation system equipped with a scrubber, and is then treated in a waste treatment system at a cost to the company. In decorative chromium processes, besides the remaining mist in functional chromium not collected in the ventilation system, the mist finds its way into work zones where the employees can be exposed, also depositing on the surfaces within the facility. This creates a hazardous workplace due to physical contact and inhalation of hexavalent chromium. The unintended consequences of this process cause an increased cost for employee health and safety.

To control this potential risk, the EPA has ruled that the surface tension should be less than 40 dynes/cm in the plating solution. The lower surface tension restricts the size of the bubbles that are created. When these smaller bubbles make it to the surface, their small size limits the amount of chromium solution that is expelled into the atmosphere around the tank. This means that there is less solution going into the ventilation equipment, less depositing around the facility, reduced exposure to the lungs of the employees and therefore less regulatory cost to the company. To accomplish this action, wetting agents are used in the plating solution. Some wetting agents also produce a light foam blanket, which physically blocks the mist from escaping from the tank. When the bubbles burst at the surface, the expelled droplets are captured by the foam. When these two modes of action are used simultaneously, the amount of mist which is produced from the plating tank is nearly eliminated.

Effective September 21st, 2016, the U.S. Environmental Protection Agency enacted a ban of a commonly used wetting agent used in formulations for the surface finishing industry. Perfluorooctanesulfonate (PFOS) was called "…persistent, bioaccumulative and toxic to mammalian species."

The properties which made PFOS persistent and bioaccumulative are the same properties which made it a very effective additive for plating hexavalent chromium. Small amounts of proprietary mixtures containing PFOS were added into hexavalent chromium plating solutions to lower emissions in compliance with new exposure limits for hexavalent chromium. The highly fluorinated molecule is extremely stable and able to remain intact and functional even while in the highly oxidizing and corrosive environment of a hexavalent plating tank.

When these regulations regarding the PFOS molecule were enacted, chemical manufacturers in the industry looked for other fluorinated molecules to solve the problems that the PFOS had previously resolved. These alternative molecules require more frequent additions because they are less stable than PFOS but still contain the potentially hazardous fluorinated backbone. The cliché, "Kicking the can down the road" comes to mind.

Recently, there has been some increased scrutiny on these fluorinated compounds. Michigan is leading the way with this attention. The MDEQ has increased the awareness around these chemicals and has released a list of 24 different CAS numbers for products including perfluorooctanesulfonic acid and its derivatives. Local municipalities are requiring all of their IPPs to submit test results that show levels of these chemicals (collectively called PFAS or per/poly fluorinated alkyl substances) at part per trillion concentrations. There are only a few laboratories which can do this analysis. Further, the methods are still being developed for detection at concentrations this low in wastewater which can vary due to matrix effects.

Once again, the call is out to the industry to develop technology which can limit these risks to platers who are using hexavalent chromium. There is at least one product on the market which can be added to accomplish these things but contains no fluorine atoms. It has been shown that surface tension holds below the established limits, while not causing any blistering or lack of adhesion in hard chromium baths. This product is biodegradable and compatible with most current systems allowing for easy slide conversions.