Can you have your Cake and Eat it?

Pollution solutions to emission legislation that prove to be cost saving investments

In this article Robert Sawyer, from Serfilco International, suggests ways to enable the surface finishing industry to control exposure to nickel and other hazardous or toxic chemistry, whilst using the same equipment to reduce operating costs and improve quality.

Environmental Pressures

Increasingly legislators are proposing reclassification of acids and salts used in the surface treatment industries, this is particularly true in Europe and the US but is sure to become a global phenomenon. For example the UK's Health and Safety Executive has in recent years reclassified sulphuric acid mist, and throughout Europe nickel salts including nickel sulphamate, nickel sulphate and nickel chloride – all widely used in the plating industry – are being reclassified as chronically toxic and carcinogenic through inhalation. The primary risk reduction strategy in regard of inhalation is to reduce or eliminate the formation of fumes above tanks and recommendations are also in place to limit exposure to skin by minimising handling and using the appropriate protective equipment.

But whilst legislation will in time make these strategies essential and naturally improve the environment inside and outside our plating shops we should not view it in a singular light, instead we should look to the other benefits that such strategies and their associated solutions will bring with them to the plating environment, such as cost savings, process efficiency and improved product quality.

Fume Reductions

Initially we are looking at proposals for ways of enabling the Surface Finishing Industry to control exposure to Nickel Salts and other toxins; this follows on from the past reclassification of

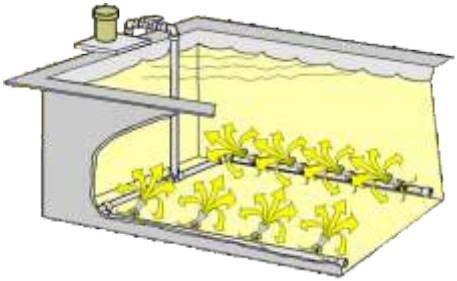
Sulphuric Acid Mist by the HSE in the UK. The Nickel Risk is being reclassified into the chronic toxicity classification. This may be implemented as soon as June 2008 in Europe, but certainly by next year. The primary risk reduction strategy is to reduce or eliminate inhalation of fumes emissions. The recommendation is to replace air agitation with Pump Flow Eductors – but why?

For many years air blowers or compressed air have been the primary mode of agitating process tanks in surface treatment. It was assumed air provided sufficient movement for a relatively low cost, especially when compared with cathode rod agitation; however over time it has become clear that air does have some inherent defects, most notable of which from a legislators point of view, is it's tendency to absorb chemistry from the process tank and put it into the environment in the form of a toxic mists.

These toxic mists are what we need to address from a legislation perspective, and by replacing current air agitation methods with correctly sized pumped flow eductor agitation systems it is possible to reduce above tank fumes by as much as 90% whilst maintaining or improving agitation levels – so you have your cake, what about eating it?

Process and Cost Benefits of Eductors

It is always assumed that the main benefit of replacing air agitation with eductor agitation is that of eliminating fumes, and whilst this is to some extent true, notably on hot process tanks, there are a number of other proven benefits to be found which can make the use of eductors a cost saving, process improving investment:

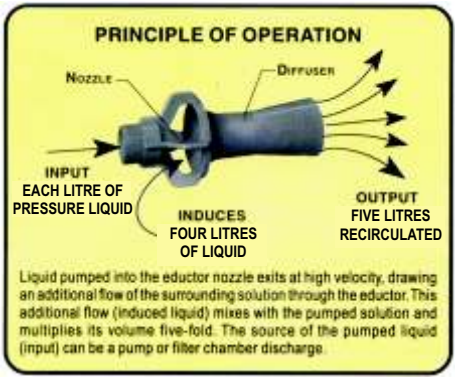


An array of eductors in a process tank

- By removing non-conductive air the solution conductivity rises and the same plating effect can be achieved for less amps, or faster plating at the same amps – So you can lower your energy

bills.

- By removing cooling or heating air the temperature of the process tank is maintained (+/- 0.5°C) and so expensive heaters and cooling aids are used less – saving energy.
- By removing air from the tank the conductivity around the work is more uniform, as a result the disparity between high and low current density areas is reduced. The typical need for extensive over-plating in high current density areas to reach minimum levels in low current density areas is thus no longer necessary – reducing metal usage, waste and ultimately operating costs.
- High levels of agitation focussed around the work-piece can either improve cleaning in the case of hot alkaline cleaners and degreasers, or reduce gas pitting in the case of plating tanks, thus reducing rejects and improving the finished parts quality.



- As eductor systems use pumps to circulate the fluid, mixing is inherent in the system's nature; the result of this is a homogenous solution where temperature, chemistry and additions are well mixed and present throughout. Typically chemical additions can be reduced and heating and cooling can be controlled more effectively – thus saving costs and providing controlled quality plating.

So whilst the last 2 or 3 years environmental concerns have loomed large on the agenda, and with the implementation of IPPC Legislation especially, the focus has been on the fume control benefits of airless agitation. However it is clear that emissions control is only a small part of what is on offer – the real benefits to the surface treatment industry are in the cost savings and short payback time of this "Best-Available-Technique".

The success of the use of such systems in the US, Europe and Far East led to them becoming an accepted, respected and increasingly mature technology. If you speak to the right supplier they will have such confidence in their systems, their sizing and installation criteria and their experience in the use of eductors that they now confidently promote their systems with a "performance guarantee" – ensuring that you can investigate and trial these systems safe in the knowledge that they will work.

Manual Handling

Whilst one facet of pollution and Health and Safety is fumes, the other is chemical spills and manual handling leading to operator contact, expensive clean ups, increased workload on effluent treatment plants and increased waste. The application of correctly sized, state of the art pumps and filters can lessen the impact of manual handling, reduce the risk of spillage and minimise waste – and as with eductors these products do not need to cost you anything in the long term.

Filtration

For many years "plate and paper" type filtration systems have been the most typical in use in the plating environment. However, the questions now arising over manual handling mean that the typically short cycle times between the changing of discs create more manual handling and chemical exposure than necessary. This short cycle time is a result of low surface area within a disc system, so to increase surface area a larger system is needed, or a different type of filter. This is where cartridge filters come into play – in a cartridge system of the same footprint size of a disc system you can find up to 10 times the surface area, meaning that the filter will have a much longer time between change-out and reduce the operator exposure to toxic chemicals.

But of course cartridge filters are perceived as a more expensive method of filtration (as cartridges are typically more expensive than papers), but experience shows us otherwise and if we examine the lifetime costs of filters we can see that in fact a properly sized

cartridge system is far cheaper to run:

- Change-outs are less frequent with cartridges as a result the time spent changing filters is less, so non-productive man-hours can be reduced
- Each change of a filter system leads to a loss of chemistry (1-15L depending on the size of the system), by reducing change-outs we reduce the loss of valuable chemistry
- Cartridge systems maintain their flow rates for longer (when compared size for size with a disc system), as a result the tank is kept cleaner and rejects are reduced.
- So it is clear that again – it is possible to reduce the impact of manual handling in a cost effective manner.

Carbon Purification

As a final stage let us look at the use of carbon purification – the dirtiest of the manually handled processes because of the nature of carbon powder and the problems of slurry tank mixing, and because it is so dirty perhaps the least commonly carried out?

Typically, when using discs and a slurry tank the powder gets everywhere, pre-blocks the filters and requires a complete disc change-out. This means that it is dirty, time consuming and expensive to carry out such procedures – not to mention the extensive operator exposure. The downsides to such treatment methods mean that many platers carry out carbon treatment to remove organics as little as possible or only when they are experiencing problems. And when they are experiencing problems it is just too late. So what methods are there available that are operator / manual handling friendly yet low cost and efficient?

Most plating shops using cartridge filters will have tried or used carbon cartridges, and whilst these are cleaner and easier than discs they are a quite expensive option. As a result plating managers will install one cartridge in a chamber with normal particulate filters.This means that the carbon has a high flow rate so is not used

efficiently and also acts as a particulate filter, thus reducing its efficiency and total use of the carbon.

A by-pass filter arrangement

The most efficient and low-operator contact method of carbon purification is to use a bypass chamber, with a re-usable carbon canister filled with granular activated carbon. This method involves the installation of a small chamber on the clean side of the filter, the solution flows to this chamber via a bypass line where a small percentage of the flow can continuously flow through the carbon, or be easily opened and closed to allow batch treatments. The beauty of this method is that it is 100% controllable, easily changed-out and reduces operator contact to an absolute minimum.

Conclusions

Due to time and space constraints this article has concentrated on only three aspects of plating shop equipment, but in each case it is clear that whilst agitation, filtration and carbon purification are necessary to reduce environmental impact and manual handling, if selected and installed correctly they can actually have a very positive effect on a plants process efficiency, waste minimisation, energy budget and overall costs. In fact in this instance it appears that "You Can Have Your Cake and Eat It!"

Robert Sawyer is the European Business Development Manager for Serfilco International and has recently become responsible for their business in South Africa. Serfilco are a manufacturer of pumps, filtration and agitation equipment and have recently become associate international members of SAMFA. Robert has a great deal of experience in the UK and European plating environment and has installed all of the technologies talked about above in plating shops across Europe. Robert will be in South Africa in May / June and will be available to speak about such technologies and the potential cost savings on offer.