Many small to medium sized finishing shops would like to recycle more, but are inhibited by the costs that they think will be required to do so. Others are simply set in their ways, they want to stick with what they know works. The horror stories of others trying to implement waste minimization programs and winding up with pallet loads of rejects is enough to intimidate even the most intrepid recycler.

It doesn’t have to be that way. In fact, there are tried and true techniques for keeping the plating solution in the tank, so it never needs to be recovered in the first place. In addition, there are many things you can do without a lot of capital investment to bring the metal that does wind up in the rinse waters back as a valuable resource as opposed to metal hydroxide sludge.

A good place to begin is with the process that generates the regulated substance that has previously given rise to violations – or effluent numbers close enough to the limit to make you nervous. If you can cut the amount of that material down by 30 – 40%, those problems will likely vanish.

**Classical Waste Minimization**

The best kind of metal “recovery” is that which makes recovery unnecessary – keep it in the tank. These techniques are discussed at length in many places. We will briefly touch on a few of the most effective ones. Some solutions can be run at higher temperatures, like acid copper and Watts nickel solutions, without affecting plating quality. This decreases the viscosity of the plating solution, cutting drag out losses. It also creates room in the tank, because of evaporative losses, that can be filled with a spent static rinse.

Then, there are those old standbys – slower workpiece withdrawal, and longer drip time over the tank. These simple practices can cut drag-out by as much as 50%, if followed consistently. The key word here is consistently. It is very easy, especially when there is a lot of rush work coming through the shop, for platers to skimp on these steps in an effort to try and hustle the work out. They are trying to be conscientious workers; but when you think about it, the time saved is a very small fraction of the process cycle time. So educate, train, and provide management support, then reap the rewards – less money wasted hauling away metal hydroxide sludge, cleaner rinse waters and, more often than not, better product quality.

**Divide and Conquer**

There are two modern metal reclamation techniques that lie on opposite sides of the resource conservation coin – electrowinning and ion exchange. Electrowinning, or “plate out”, works best on concentrated solutions. Concentrated solutions also produce better, solid deposits; the kind of metal that can be sold as scrap. Ion exchange is best applied to dilute solutions. In a way, it is like a trash compactor. It converts a pound of waste metal into…a pound of waste metal. If you load that compactor with a trash barrel full of Styrofoam, you’ll convert it into something you could hold in your hand. If you load it with a barrel full of chunks of concrete, it won’t do much for you. Therefore, you must Divide and Conquer; split the wastewater stream in two.

1) Candidate for Electrowinning: A concentrated, metal rich liquid, geared to be plated out of.

2) Dilute rinses, ideal for ion exchange treatment. When the ion exchange resin needs to be regenerated, the spent regenerant is combined with (1). It’s that simple, in theory; now for the practice.

**Static and Spray Rinses**

These are the two ways that you can generate a low volume, concentrated waste stream, as described in (1). Either use a non-flowing “drag-out” tank, immediately following the plating bath, or use a low volume fresh water spray rinse.

If you do the latter, look out! The platers, especially when they’re in a hurry, may try to

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## Industry Event Calendar

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**INDUSTRY NEWS & NOTES**

**Forest City, NC** October 30, 2007: Paul Skelton has recently joined Carolina Process Control, LLC (CPC) as the new Vice President of Sales & Operations. CPC, based in Forest City, NC is a well-known supplier of metal finishing supplies and equipment for the plating and powder coating industry. Paul Skelton has relocated to North Carolina from Tulsa, OK with 20 years experience in the metal finishing industry. For more information please contact Carolina Process Control at (828) 245-1115 or email info@carolinaproductcontrol.com

**Indianapolis, IN** The National Association for Surface Finishing (NASF) is seeking papers for SUR/FIN 2008, June 16-18 at the Indiana Convention Center in Indianapolis, IN. Abstract submissions can address one or more of 50 topics, including alternative cleaning methods, automation of surface finishing processes, electropolishing, environmental issues, automotive surface finishing, lean manufacturing, organic finishing (powder coating), water and wastewater treatment, and more. Abstracts must be received with the appropriate documents by January 4, 2008, and final papers are due by April 15, 2008. For more information, including a complete list of topics, visit www.sur-fin.net.

**Philadelphia, PA** Rohm and Haas Company earlier this week announced it is seeking price increases for most of its chemical products, effective Nov. 1, 2007. Increases will range from 5%-15%. According to Pierre Brondeau, executive vice president in charge of Specialty Materials, the costs of key raw materials—such as propylene, ethylene, methanol, as well as other raw materials like tin—have remained persistently high. Brondeau has directed each business segment in each geographic region to pursue the appropriate price increase with their customers, based on the escalation of raw materials and delivered costs for the products.

**Washington, DC** On Oct. 9, 2007, the U.S. Environmental Protection Agency (EPA) issued a final rule imposing restrictions under Section 5 of the Toxics Substances Control Act (TSCA) on the manufacture, import and use of 183 perfluoroalkyl sulfonate (PFAS) chemical compounds. 72 Fed. Reg. 57222. These PFAS compounds are used as fume suppressants for controlling emissions from several metal finishing operations such as chrome plating. EPA’s exclusion for the use of PFAS compounds in metal finishing operations is consistent with similar actions taken by the European Union and Canada. These agencies have indicated that they will reconsider the exclusion in another five to 10 years based on the availability of effective alternative fume suppressants that do not contain PFAS compounds. For more information on this announcement, please visit the NASF website at www.nasf.org.

**Tempe, AZ** The Department of Defense (DOD) and the surface finishing industry will continue its cooperative technology information exchange on metal finishing applications at a conference to be held Feb. 26–28 at the Fiesta Resort and Conference Center in Tempe, Ariz. The conference is the next step in the evolution of workshops and discussions on surface finishing, repair and maintenance issues related to new military aircraft. Please visit the NASF website at www.nasf.org for more info.

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It is the properties of electroless nickel that are responsible for the rapid expansion of its use as a functional metallic alloy deposit in recent years.

**Corrosion Resistance**
One of the most common reasons for selection of electroless nickel coatings in functional applications is its excellent corrosion resistance. In the very corrosive conditions encountered in drilling oil wells and pumping out the oil, for example, electroless nickel has shown its ability to withstand the combination of corrosive chemicals and abrasion.

**Density**
An electroless nickel deposit containing 3 pct phosphorus has a density of 8.52 g/cm³. An electroless nickel deposit with 7.5 pct phosphorus content has reported density of 7.92 g/cm³. These values are lower than those of pure metallurgical nickel (8.91 g/cm³).

The lower density of electroless nickel is caused by the presence of phosphorus as an alloying constituent. The most common range of phosphorus present in commercially applied deposits is generally 3 to 12 pct. Analysis has also shown minor levels of other elements present. These elements affect density and include hydrogen (0.0016%); nitrogen (0.0005%); oxygen (0.0023%); and carbon (0.04%).

**Coefficient of Thermal Expansion**
The coefficient of thermal expansion of a deposit containing 8 to 9 pct phosphorus is 13 to 14.5 x 10⁻⁶/°C.

**Heat of Conductivity**
The heat of conductivity for an electroless nickel deposit containing 8 to 9 pct phosphorus is 0.105 to 0.0135 cal/cm²/sec/°C.

**Melting Temperature**
The melting temperatures of electroless nickel deposits vary widely, depending upon the amount of phosphorus alloyed in the deposit. A generally accepted melting point is about 1616°F (880°C) for deposits from processes with approximately 7 to 9 pct phosphorus.

**Magnetism**
Electroless nickel deposits containing greater than 8 pct phosphorus are considered to be essentially nonmagnetic as plated. The coercivity of 8.6 pct and 7.0 pct phosphorus content deposits has been reported at 1.4 oersteds and 2.0 oersteds respectively. A 3.5 pct phosphorus content deposit produces a magnetic coating of 30 oersteds. When the phosphorus content is increased to 10 pct, the deposit is nonmagnetic.

Most deposits which contain above 9 pct phosphorus will become slightly magnetic when heat treated above 518 to 536°F (260 to 280°C); however, some will show lower remnant magnetism. It is at this temperature that the solid solutions of phosphorus in nickel which occur in the as-plated deposit begin to form both nonmagnetic nickel phosphide (Ni₃P) and magnetic nickel.

**Electrical Resistivity**
The electrical resistivity of pure metallurgical nickel has a value of 6.05 microohm-cm. Electroless nickel deposits containing 6 to 7 pct phosphorus have values (as plated) which range from 52 to 68 microohm-cm. A deposit with 2.2 pct phosphorus has electrical resistivity of 30 microohm-cm, while a deposit with 13 pct phosphorus has a significantly higher resistivity-110 microohm-cm.

Heat treating electroless nickel reduces its electrical resistivity. Heat treatment up to 320°F (150°C) produces changes in the deposit primarily attributed to hydrogen. Beginning in the range of 500-536°F (260-280°C), heat treating produces a further decrease in electrical resistivity. This change is attributed to the precipitation of nickel phosphide (Ni₃P) in the coating. An electroless nickel deposit with 7 pct phosphorus, heat treated to 140°F (60°C) was reportedly reduced from 72 to 20 microohm-cm.

**Solderability/Weldability**
Electroless nickel-phosphorus alloys are easily soldered with a highly active acid flux. Soldering without a flux or with mildly active fluxes can be more difficult if the parts are allowed to oxidize by extended exposure to the atmosphere. The heat processing of electroless nickel plated parts can make soldering very difficult unless a highly active acid flux is used.

Welding of electroless nickel deposits is not commonly done. There is a tendency of phosphorus to migrate to grain boundaries during cooling of the weld. This results in “hot cracks” or disintegration of the weld.

**Adhesion**
Excellent adhesion of electroless nickel deposits can be achieved on a wide range of substrates, including steel, aluminum, copper, and copper alloys. Typical bond strengths reported for electroless nickel on iron and copper alloys range from 50 to 64 kpsi (345 to 441 M Pa). The bond strength on light metals, such as aluminum, tends to be lower, in the range of 15 to 35 kpsi (103 to 241 M Pa) for most alloys.

**Thickness**
Electroless nickel can be deposited to produce a wide range of coating thicknesses, with the uniformity and minimum variation from point to point. This uniformity can be maintained in plating both large and small parts and on components which are fairly complex, with recessed areas. Electroplating of such parts, on the other hand, would produce thickness variation and possible voids in the plating when coating holes and inside diameters. The range of thicknesses for electroless nickel in commercial applications is 0.1 mil to 5 mils, although deposits as thick as 40 mils have been reported. Normally thickness is built at the rate of 0.3 to 0.8 mils/hr.

**Brightness**
The brightness and reflectivity of electroless nickel vary significantly, depending on the specific formulation. The reflectivity is also affected by the surface finish of the substrate. Thus a very bright electroless deposit may appear dull if the substrate is rough. The appearance of electroless nickel is similar to that of electrodeposited nickel, but slightly more yellow.

This information was used with permission from the MFSA – Metal Finishing Suppliers’ Association.
get the parts completely rinsed with a thorough spray rinsing. That’s not its purpose! The idea is to use a low volume of sprayed water to remove something like 50% of the surface contamination on the parts. The rest of the job of rinsing is left to conventional flowing rinses. So, once again: educate, train, and back up the waste minimization plan with management support.

Putting the spray rinse on some kind of timed cycle prevents this consideration from even becoming an issue to begin with.

It is not difficult to engineer a simple spray rinse system. If you have sufficient head pressure from your city water supply, a simple row of spray nozzles regulated by a valve and installed in an empty rinse tank may be all you need. However, a booster pump is usually required to generate the pressure required to get the fine spray needed here. I’ve seen both centrifugal and diaphragm pumps used in this application. Talk to your equipment vendor to see which works best for you.

If the option you prefer is a static rinse, the engineering is even simpler. Just take the first rinse out of the flowing rinse cascade, and re-pipe the fresh water feed to the second rinse. One potential problem may arise, mainly for nickel and nickel chrome platers, when using a static rinse—passivation. This can be prevented by transferring the work quickly. In some cases, adding a bit of acid to the static rinse may help prevent passivation. It’s a matter of what works for you.

Ion Exchange Resins
They come in two varieties. Both can be of use in capturing metal ions out of rinse waters. Cationic resins grab up positive ions out of contaminated rinses, and kick out hydrogen or sodium ions. This makes them a good option for collecting metal out of rinses following acid copper or nickel plating solutions. Anionic resins grab up negative ions, and replace them with hydroxide ions. This makes them good for collecting metal that is in solution as a negative ion, such as zinc as zincate in an alkaline bath, or tin as stannate from an alkaline tin process. It can also be applied to cyanide rinses, but that requires extra safety measures to be taken that are beyond the scope of this article.

If you have the capital to invest, there are automated systems that will completely deionize spent rinse water, allowing you to reuse it. However, if you don’t have that money to invest, you can still make use of ion exchange. An ion exchange bed can be as simple as an open top, plastic 55 gal. drum, with a plastic riser pipe that comes up through the center. At the bottom, a simple grid of piping can evenly distribute the flow. As long as the flow rate is not too high, spent rinse water may be passed through this resin bed without the resin being lost. In a slightly more elaborate set-up, a disc of plastic sheet, perforated with ½ inch holes and covered on the bottom with an appropriate screening material, can be used to keep the resin in the bed under higher flow rate conditions.

The treated water can be removed from the drum by install-
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ing a circular gutter around the rim and allowing the drum to overflow into it. It can then be piped to a lift station. Another method is to let the whole drum just sit in the lift station, and allow the water to flow out into the lift station through a series of notches cut into the rim.

Will this gadget make the water legal for discharge? Probably not. That is not its purpose. It is solely a resource recovery device. Depending on how you run it, and how often you recharge it, it can scavenge anywhere from 20 – 60% of the metal in that rinse water up for reuse, rather than allowing it to be wasted as a metal hydroxide sludge. This is pollution prevention.

When the resin is fully loaded, it must be regenerated. This is accomplished with 10% sulfuric acid, for a cationic resin, or 10% sodium hydroxide, for an anionic one. The proper solution is passed through the resin bed, just as the rinse is. Then, the metal-rich regenerant, as mentioned above, goes right to the “plate-out” unit, along with the static or spray rinse. At this point, your resin bed is ready to be used again.

Now, what resin should you use? For cationic applications, Rohm and Haas’s Amberlite IR120 is a good, all purpose work horse. For anionic applications, Amberlite IRA458 is a good bet. All of the manufacturers of resins should have rough equivalents to these products. Talk to your vendor.

**ELECTROWINNING**

Also known as electrolytic metal recovery, or “plate-out”, this is the process that gets you back to the metal. It’s just plating—what you do for a living; but the object is a little different. It is solely to produce a solid deposit that can be sold as scrap, or even reused, as is in your shop. It need not be attractive, or a viable engineering material.

First of all – where to do it? The simplest place is right in the static rinse tank. This has the advantage of requiring no additional equipment installation, though there are disadvantages as well, even if you elected to use a spray rinse instead. A more effective recovery cell is housed in a separate tank, with the metal bearing liquid recirculated through it from a holding tank. The anode to cathode distance may be made small in a dedicated “plate-out” tank. If you try to do this in a working static rinse, there won’t be any place for the parts to go. In addition, the recirculation contributes extra turbulent agitation — always your friend in efficient metal deposition.

As with ion exchange, such units may be purchased off the shelf. Also, as with ion exchange, some are highly automated, very easy to use (and very pricey). If you don’t have those resources to dedicate, here are some pointers on how to construct your own system.

The heart of any such unit is the **anode**. In standard electroplating, frequently the metal being plated is the anode. However, in the case of a metal recovery unit, this would defeat the whole purpose of the operation. An inert material must be used. There are three that I’ll cover:

1. Plain, mild steel. This can be used to good effect in an alkaline electrolyte, such as would come from a cyanide zinc, cyanide cadmium, or cyanide silver process. It has the important advantage of being cheap and easy to work with. It is not suit-
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Sintering Electroless Nickel Deposits

Let us examine what happens to electroless nickel phosphorus when it is heated under certain conditions. Heating to 250-400°C, nickel phosphorus deposits harden considerably reaching a maximum at about 385°C, depending on the phosphorus content. Oxidation takes place and the deposit changes in volume, composition and structure. Nickel-phosphorus intermetallic compound forms. Oxidation of both nickel and phosphorus occurs. Above 600°C, migration of phosphorus to the surface and formation of phosphorus oxide has been observed. Above 800°C decomposition and evaporation of phosphorus from the coating occurs. “A kinetic study at 800 – 1000°C showed that a Ni-P deposit oxidizes about 100 times faster than pure nickel. The addition of even a small amount of boron to the deposit decreased the amount of oxidation. Phosphorus in the Ni-P coating is the cause of the poor oxidation resistance of the alloy and the much purer Ni-B coatings may be expected to have a much improved resistance to oxidation.” (2)

Heating nickel phosphorus in air or moist hydrogen to a temperature of 400-850°C for 10-15 minutes results in removal of phosphorus from the surface of the deposit, making it much easier to solder, braze, wire bond or die-bond. Ohmic contacts are made to thick film layers on ceramic semiconductors by plating electroless nickel and heat treating gold, silver or platinum. Thick-film conductors are much more electrically resistant than expected from calculated values. Plating and then heat treating electroless nickel on these films enables the fabrication of stable, low-contact-resistance metal layers. (3) Nickel-boron deposits do not need the thermal excursion for die or wire bonding. However, if for certain brazing applications or exposure in laser devices, boron must be removed. This is accomplished by heating the nickel boron deposit in a moist hydrogen atmosphere to 950°C for 30+ minutes and evacuating. Boron hydride gas is formed and is removed by this process. It is interesting to note that moist hydrogen atmosphere is reducing for nickel but oxidizing for phosphorus. Phosphorus is oxidized by the oxygen supplied by some dissociation of water, and vaporized from the surface, leaving a few angstroms of pure active nickel. (3)

Soldering to Electroless Nickel Deposits

Soldering is usually defined as joining metals at low temperatures (usually below 800 degrees F, 426°C) by fusing a low melting alloy. The interaction between nickel and solder is important in determining reliability. Nickel-tin compounds form when using tin-lead solder. Ni3Sn, Ni3Sn2 and Ni3Sn4 have been detected at the interface. (4) Films on the surface of the electroless nickel deposits such as soils, phosphorus compounds, and oxides of nickel can interfere with soldering. Non wetting or dewetting results from foreign substances on the surface to be soldered. In the absence of these films good wetting of the surfaces by the solder results in a reliable joint.

Contact angle measurements and miniscograph instruments are commonly used to measure the wetting ability of solder to the substrate materials. It is reported that solder contact angle varies with phosphorus content. The higher the phosphorus content, the higher the contact angle, meaning poor solderability, for non annealed deposits. Tests were done in vacuum to avoid atmospheric interference. Higher contact angle means less wetting. However, when deposits were heated to temperatures in excess of 340-410 degrees C, prior to soldering, solder contact angles improved. This was true for both 95Pb/3Sn and 63Sn/37Pb solders. Annealing time to low contact angle was from 120 seconds minimum to reach equilibrium to about 600 seconds.

Check out installment three of this series in the January issue of Southern Metal Finishing.
able for use in an acid electrolyte, however. The iron would dissolve, contaminating the liquid and the recovered metal.

2. Graphite anodes are used in some such applications. They are relatively inexpensive, and easy to cut and shape. Graphite has the disadvantage of being apt to fragment and erode in service, limiting the useful life of the electrode and contaminating the electrolyte. This is especially true when it is used in service under high current densities, or in aggressive liquids.

3. The best (and most expensive) alternative is a dimensionally stable anode, or DSA. Some of these are platinum clad titanium; others are titanium coated with a specially applied mixed metal oxide. These are sturdy, and stand up to service better than the two materials discussed above. There are many vendors of this type of inert anode: discuss your application with them.

Next is the cathode. Generally, mild steel sheets are used. When the deposit of the target metal gets thick enough, it can frequently be peeled off. Certain metals that will not dissolve too quickly, such as copper or nickel, may benefit from a dip in some acid to help lift the deposit off the cathode substrate.

Here’s another idea if you’ve got some plating barrels around that aren’t being used. Make one of those the cathode! Load the barrel with scraps of anode material — little stubs of nickel crowns left over from the last time you cleaned out the anode baskets; scraps of copper from the machining department, perhaps. Put it in the electrolyte and plate away. The eventual result will be good sized pieces of metal, which may be shipped to a recycler, or even used in house, as is.

Almost any rectifier that you use in plating parts can be used to provide the current to drive one of these units. In fact, it’s a less demanding service — ripple, undesirable in many plating processes, is a good thing when plating out of less concentrated electrolytes. In a pinch, you could wire up one of your production rectifiers such that, during idle periods, it’s driving your plate-out unit instead of plating parts. Unlike production plating, metal recovery needs little attention. With proper containment and safeguards against electrical faults, it’s not hard to set something up that will run unattended.

One important safety note — these units must run with proper ventilation. Because there is no metal to dissolve, the anode reaction becomes one that results in gas evolution. When those gas bubbles break the surface of the electrolyte, they will create a mist that may be harmful. Also, sometimes the gas will have significant amounts of chlorine in it, which is hazardous in itself.

It’s Up To You
I hope these ideas help you get started; but a lot is left up to you. You must decide which process to start with, and how exactly to implement these recovery techniques. As you’ve seen, it is not necessary to invest a huge sum of money to begin your own recycling program, no matter what the size of your operation is. Simply some equipment you may already have lying around, some patience and planning, some experimentation… and, of course, plenty of American ingenuity!

This article was submitted by David Wichern, Chief Technical Officer of Dedalus Environmental. You can visit their website at: www.dedalusenviro.com
It seems that everything is being swept into the infinite arena of cyber space these days. Years ago, our forms of communication expanded to include the modern marvel of electronic mail. Today, the ability to have video board meetings with clients overseas has made it more cost efficient to simply conduct business from the comfort of your own office.

The ability to be two places at once is something humans have longed to have (and has been the brunt of many sarcastic rebuttals – “I can’t be in two places at once, you know”) since the dawn of our existence. As we begin to develop new technologies that make this increasingly possible, it is interesting to watch as innovations come out of the woodwork. Take CyberCoating 2007, for example. This 3-D, virtual, online trade show was held in Cyber Space (Can’t you see that becoming a new location? Somewhere on par with those two-letter, postal code, state abbreviations we had to remember in middle school – IL, CA, OH, AZ…CS?) from October 15th to October 26th, 2007, and is a first for the coating industry.

Among the listed benefits (and they are numerous), the facilitators of the event, the Powder Coating Institute (PCI), tout that all of the elements of a physical trade show are encompassed in their virtual conference. This includes custom exhibits running the gamut of standard trade-show sizes, the ability to display and ‘hand out’ literature and brochures, and, most importantly, conversing with other attendees. There are even some surprising advantages to attending a cyber tradeshow. Take, for instance, the feature that allows companies with 40’x40’ exhibits to set up a virtual, working model of one of their machines, allowing attendees to view the machine as a whole or in cutaway modes. There is also the added benefit of being able to attend any technical session on demand; so you can press play, sit back and relax with a nice hot cup of coffee and a fresh donut while you learn about heat sensitive substrate coating.

Along with the practical features, the software includes some pretty quirky features, too. Not only can you walk and run around the exhibit hall (which is pretty massive, featuring a large domed foyer and an information kiosk for new arrivals) you can also fly from one exhibit to another. You might even catch a group of people hanging out in the rafters having a conversation.

Many people had a difficult time even starting conversations, however, as a lot of time was spent (I have to admit, even I was lost at times) trying to figure out how to move, speak, and interact within a virtual world. The conference planners must have taken this into consideration—the expo was open for 12 days straight, giving even the most computer illiterate among us a fighting chance to partake in the anticipated event.

So far, the cyber expo seems like a fantastic idea. It offers most of the benefits of attending a physical conference, but without the added costs of hotel rooms, travel, meals, exhibit shipping and assembly, and more associated with a conventional tradeshow. Let’s now look at some of the ‘cons’ to exhibiting at a cyber expo.

I recently caught up with Griffe Youngleson, Director of Technology for the full service web design company, Zurv, to get a more in-depth opinion from someone who, in essence, works in cyber space. Griffe had the opportunity to attend CyberCoating 2007 last month, and shared with me his perspective of the show. “Many companies who would consider exhibiting at a virtual trade-show are the same ones that already have some sort of internet presence. In a way, by purchasing a virtual booth they are paying to replicate something they have already paid top dollar to build – their website. All of the information found at their booth can be found, perhaps more extensively, at the company’s home page. It is much quicker and easier to type in a URL than it is to say, register for a conference and download and install the proper plug-ins before a user can even see the exhibitor. In my opinion, a company’s money would be much better spent by enhancing their current web presence. For example, they could get just as many new clients by optimizing their results in a search engine, and they could even have interactive product demos built directly into the site itself. This would be a permanent investment, as opposed to a 12 day investment”.

Another issue he pointed out is that “though many people may attend the conference, it is unlikely that many sales and transactions will ensue. People like to know what they are going to invest their money into. Looking at a 3-D model of a powder coating gun is not the same as picking one up and testing it out for your self. Cyber interaction will never rival tangible interaction, though it is valuable in many areas”.

Obviously, the value of exhibiting or even attending a virtual conference is determined on a case by case basis. Overall, however, I think that as long as the virtual does not completely replace the ‘tangible’, companies and individuals may benefit in the long run by incorporating a bit of both into their yearly tradeshow repertoire.

To learn more about Cyber-Coating 2007 and future shows, visit: www.cyberoatingshow.com
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