Executive Summary

The National Coil Coating Association (NCCA), founded in 1962, fosters the development of pollution prevention initiatives.

The accompanying document titled Opportunities for Pollution Prevention in the Coil Coating Industry is a comprehensive review of the coil coating process. The document is broken down into five (5) main sections. Section 1 focuses on the incoming steel coils and oil management as well as various water issues present in the wet section. Section 2 focuses on waste treatment technologies for both water and sludge. Section 3 focuses on the coating, curing and strip cooling process with issues ranging from recycled solvent to doctor blades usage. Section 4 focuses on operating practices commonly used in the industry to reduce the environmental impact of the process. Finally, Section 5 focuses on pollution prevention activities for VOC’s in the coating process.

This document was a collaborative effort on the behalf of members of the NCCA Government Relations Committee.

For more information regarding the NCCA or the coil coating industry, visit the www.coilcoating.org or call 216-241-7333.

Section 1

WET SECTION

Oil Elimination

Incoming raw materials in coil form may contain one or more types of oil and/or lubricants left on the metal as a result of coil rolling and processing such as with aluminum, or by design for corrosion protection as is the case with bare steel and galvanized products. These materials include slushing and rolling oils, in the case of plated products, vanishing oil, and lubricants such as wax and petrolatum.

Although these materials may be part of the coil processing at the mill or used for corrosion protection, complete elimination of their use may not be possible. However, it is possible, by working closely with your vendors, to limit the number or types of materials used, as well as the amount used in processing and protecting the particular coil coated in your facility. These individual specifications can easily be incorporated into overall specifications for the coil products.

The control of the amount of these materials, and the elimination of excessive quantities required will reduce the amount of contaminants introduced into the cleaning stages. This will extend the cleaning solution life and reduce waste solution disposal requirements and cleaner concentrate consumption.

Oil Reduction

Coil is normally received at the coil coaters with varying amounts and types of oils, often called Rust Preventative (RP) oils. These oils are intended to prevent substrate degradation (e.g. red rust, white rust, metal oxides, etc.). RP oils are most commonly applied to steel, coated steel, and sometimes aluminum. The amount and type of RP oil required to prevent substrate degradation depends on the same type of metal, the time, and the environmental exposure conditions present from the mill until coil coating. Usually, a minimum film thickness of RP oil is specified. The RP oil is usually applied at the mill through spray bars, then squeegee to remove the excess. Sometimes, squeegee rolls are not used.

Often, excessive oil is applied. This can occur for several reasons. Primarily, application systems at the mill are unable to provide a consistently thin layer of oil. Thus, levels are set to apply a ‘safe’ thickness to ensure adequate protection. Also, excessive oil may be applied because the specified minimum thickness is in excess of what is required to prevent degradation.

The amount of RP oil on the incoming strip can be reduced in several ways:

- Establish an oil film thickness range (min. and max.)
- Periodically check the thickness of oil on the strip.
- Re-evaluate the validity of the RP oil specification. A lower minimum film thickness may be acceptable.
- Improve application systems for the RP oil at the mill.
The benefits and savings of less oil on the surface of the incoming strip include:

1. Easier to clean strip  
   • Financial savings from reduced Free Alk. and/or lower bath temp.
2. Increased cleaner bath longevity – less dumps  
   • Financial savings from less cleaner chemical
3. Less sludge and/or oily waste  
   • Financial savings from less volume of sludge/oil for disposal
4. Reduced oil use at the mill  
   • Financial savings for the mill

**Oil Consistency – Amount and Type**

This is in reference to the same oil as described above in “Oil Reduction.” Just as the amount of oil can be excessive, the amount and type of oil can be inconsistent. In some cases, the variation is necessary based on varying stock. Often, it is avoidable.

Wide variations in amount and type of RP oil, usually require that cleaning processes be set for the worst case condition. Consequently, excessive cleaning occurs much of the time. Usually excessive cleaning is not detrimental, but in some cases, substrate damage can occur. Regardless, excessive cleaning is wasteful and costly.

Similar to remedial ideas cited in the previous section, the variation and type of RP oil on the incoming strip can be reduced in several ways:

- Establish an oil film thickness range min. and max.)
- Periodically check the thickness of oil on the strip.
- Re-evaluate the validity of the RP oil specification. A lower minimum film thickness may be acceptable. A narrower range may be achievable.
- Improve application systems for the RP oil at the mill.

The benefits and savings of greater consistency of the amount and type of oil on the surface of the incoming strip include:

1. Easier to clean the strip  
   • Financial savings from reduced Free Alk. and/or lower bath temp
2. Increased cleaner bath longevity – less dumps  
   • Financial savings from less cleaner chemical
3. Less sludge and/or oily waste  
   • Financial savings from less volume of sludge/oil for disposal
4. Reduce chance of poor cleaning caused by excessive oil.  
   • Financial savings from less re-work
5. Less frequent operational change to maintain cleaning.

**Paintable Passivation**

Passivation or a chemical treatment is a coating, usually applied at the mill, which is used to protect coated steels (hot dip or electrogalvanized) from corrosion. Passivated galvanized or Al-Zn alloy coated steels are used widely for unpainted applications. Passivated tin mill productions such as tin plate and tin-free steel are used for the manufacturer of containers, which are decorated with organic coatings without cleaning or pretreatment.
Passivated galvanized and more recently, Galvalume®, have been painted with different degrees of success for many years. They require processing through the wet section to remove oil, usually increasing the waste generated by chromium contamination of the cleaners. Since only some pretreatment processes can react with passivated surfaces, the pretreatment choices are limited. Although passivated galvanized can be prepainted, the product quality is frequently inferior in quality to the conventional processes of unpassivated galvanize.

A preferable type of passivation would be one which does not cause chrome contamination of cleaning stages, does not require brushing, reacts with all pertinent pretreatments, and produces conversion coating quality comparable to unpassivated galvanize.

The main advantage of this approach is reduced metal inventory, as there would be a need for passivated coil only. Also, if only passivated stock was produced, it would exhibit significantly improved corrosion protection in transit and storage while at the coil coating facility.

**Non-Chrome Passivation – Equivalent to Chrome Performance**

This is a new product idea not presently available.

Zinc coated or hot dipped galvanized (HDG) and Zinc/Aluminum coated steel is normally received at the coil coaters with a chrome passivated surface. This passivation is used to prevent the degradation of the metal surface by white rusting during transportation/storage. Although oil only HDG is readily available, corrosion resistance is inferior to passivation. Also, other coated steels, such as Galvalume, are now available in Chrome Treated form only.

Unpassivated HDG causes two problems:

1. Rejected metal due to white rusting/staining – especially when shipped during the winter months and in humid areas of the country.

2. Inventory problems become more challenging at the coated steel producer (most of the HDG produced is used in unpainted form and requires the protection of passivation).

If long-term non-chrome passivation was available for use at coated steel suppliers, there would be benefits to the coil coater. Some of these would include:

1. The cleaner bath would not become contaminated with chromium and the solid waste generated from the neutralization and treatment of the cleaner bath would not be contaminated with chrome (from passivation).

If the replacement passivation was also designed for easy removal with only alkaline spray cleaning, then the additional advantages would also include:

2. Eliminate the necessity of using brushes and the labor and material associated.
   - a. electrical power
   - b. replacement cost of the brushes
   - c. metallic fines disposal
   - d. water use
WET SECTION PROCESS

Physical Removal of Oil

This is generally accomplished by means of using non-woven rolls to squeegee the strip. This involves cylinder brushes mechanically removing oil and depositing the same into a collection sump for further processing.

Oils can also be removed with high velocity spray of hot water, which scrub the oils and residue off the strip. The residual is also processed further, where oils are usually split out.

The collected oil can then be recycled for use in non-critical applications, incinerated, or disposed.

Tank Insulation

A common cause of additional energy consumption is the loss of heat in heated process tanks. This results in the use of extra gas and/or electric to maintain the desired solution temperature. By insulating the process tanks, booths and associated piping, it is possible to reduce the heat loss, thus reducing the energy demand on boilers, heating elements and alike.

Insulation of process tanks and booths can be done off line during tank repair and/or replacement, or it can be done in place. The latter may not be as effective as some surfaces may be inaccessible.

Typical types of insulation used for exterior work use include rolled or sheeted “bats” of fiberglass held in place with some form of bonding. Also used is a spray applied fiber and resin material, which adheres to the surfaces and hardens. Typical piping insulation comes in pre-formed lengths of pressed fiberglass with an exterior paper or plastic wrap, and they are held in place with straps. These are common for steam pipe installations.

Vertical Pumps (Tank Mounted)

A common cause of additional energy consumption is the loss of heat in process solutions caused by piping runs to and from remote process pumps. This results in the use of extra gas and/or electric to maintain the desired solution temperature. Even insulation may not be enough to convey energy.

A common method of reducing the amount of piping is the use of tank mounted vertical pumps. The motor of the pump is located on the top of the tank and is connected to the impeller and suction point at the bottom of the tank by a shaft. This eliminates the piping required to connect the suction side of a remote pump. The discharge of the vertical pump originates at the bottom of the tank. The piping passes through the heated solution to the application area thus limiting the amount of exposed pipe.

Also, since the pump is located in the bath, the use of vertical pumps also avoids waste associated with leaking pump components or fittings.

There are many types and varieties of vertical pumps with the full spectrum of capacities, horsepowers, and lengths available. They are a common item in many process pumping applications.
Side-Stream Coalescer for Cleaner Bath

Traditional alkaline cleaners are designed to emulsify oils as part of the cleaning process. Alkaline cleaner baths are periodically, or continuously, overflowed by adding fresh water and cleaner chemical. This is done primarily to purge the cleaner bath of emulsified oils, which inhibit cleaning effectiveness if allowed to accumulate. Cleaner tank overflow can approach 10% of bath volume per hour.

Recently, alkaline cleaners have been developed, which are designed to reject (vs. emulsify) oils. However, in a well-agitated spray stage tank, the turbulence may disperse the non-emulsified oil, so as to prevent separation.

The use of a side-stream coalescer can provide enough quiescence for an oil-rejecting cleaner to perform optimally. With oil-emulsifying cleaners, the coalescer will allow free (non-emulsified) oils to float within several minutes. A coalescer can also provide a waste treatment function (i.e., emulsion breaking, oil separation, and collection of oil).

A side-stream coalescer may be as simple as a tank or a more complicated series of baffles within a tank, the former requiring a larger volume. In either case, the principle is to provide a zone where liquid movement is slow and non-turbulent. This allows the oils to coalesce and float to the top of the coalescer.

The liquid circuit is as follows: the cleaner bath overflow drains (by gravity) to the coalescer inlet. The aqueous discharge from the coalescer is pumped back to the cleaner bath, while the floated oil is drained off. It should be noted that provisions should be made for the removal of metal fines from the unit as they will settle out.

The benefits and savings of a side-stream coalescer include:

1. Longer bath life - less frequent dumping
   • Cost savings from less cleaner chemical
2. Less sludge volume - free oil is a reduced portion of sludge
   • Cost savings from reduced sludge disposal costs
3. Reduce waste water flow to waste
   • Cost savings from less to treat/discharge in waste plant
4. Improve waste treatment in general; oil interferes with complete settling in the clarifier.

Easy Maintenance Nozzles and Risers

Spray nozzles are an essential component of the coil line wet section. They are used in the cleaning, rinsing, and conventional conversion coating spray stages.

Because of the pressure and flow volume involved, nozzles are usually designed with a small orifice. This small orifice is prone to pluggage. In the cleaner stage, this pluggage may be caused/aggravated by metal fines, sludge, excessively high temperature, and precipitated water salts. In the conversion coating stage, pluggage can be caused by drag-in, build-up of reaction products, and even the inherent nature of the process, e.g., build-up of zinc phosphate in a zinc phosphate process. Compared to the cleaning and conversion coating stages, pluggage of nozzles in the rinse stage is usually minor. As nozzles become plugged, spray coverage and uniformity are compromised. This can result in unacceptable quality, thus wasted or scrap strip.
Steps can be taken to reduce the severity of nozzle pluggage, such as filtration. However, some degree of maintenance will always be necessary. Maintenance may involve inspection, nozzle removal, cleaning and replacing. This represents labor costs and possible precious downtime.

Nozzles designed for easy maintenance are available. They reduce the amount of time required to remove and replace nozzles. Instead of threaded fittings associated with conventional nozzles, easy maintenance nozzles have spring clip retainers, which clamp the nozzle body onto the riser. The riser is not required to have threaded fittings either, but merely specified diameter holes. The nozzle is removed or installed by manipulating the spring clip. Cleaning is much the same as conventional nozzles. Also, special nozzles are available, which include specially designed internals to resist pluggage. Alternatively, quick change couplings on spray riser bars may be used to remove the entire spray riser.

**Double Squeegees**

The use of double squeegees has a simple important benefit: their use decreases drag out from stage to stage by approximately 30-50%. Therefore, their implementation can significantly reduce the amount of wastewater from the wet section that needs to be neutralized/treated. Another important use of the second pair of squeegee rolls is as a fail safe mechanism - a badly worn or cut single pair of squeegee rolls can empty a bath or rinse stage in just a couple of hours. The use of double squeegees has the following benefits:

1. Cleaner Stage: By reducing the drag out of cleaner into the following rinse stage, the stabilization rate of the rinse stage may be cut by as much as half. Since most cleaner baths are still stabilized at a constant rate, the potential cleaner savings is small. There are more potential savings with the introduction of longer life cleaners that are recycled through coalescers rather than continuously overflowed.

2. Rinse Stages: The drag out of rinse water can dilute, neutralize, or contaminate the subsequent pretreatment stage. This leads to poor finished product quality, increased pretreatment chemical usage, and risk of rejected product. The eventual load on waste treatment will also be increased, especially if a single set of rolls is cut of badly worn.

3. Pretreatment State: Presently, the amount of treatment chemical saved with reactive baths through the installation of double squeegees at the exit will be minimal. That is because most of the pretreatment consumption will result from vigorous reactions with the metal surface and/or through the build-up of reaction products and the resultant need for stabilization. However, cutting the amount of chemical dragging into the following rinse stage will allow for a substantial reduction in the amount of rinse water that must be overflowed to the waste stream.

Most coil coaters have double squeegees installed, after at least their cleaner and pretreatment stages. If you don’t, by installing them you can probably reduce your cleaner rinse and pretreatment rinse stage overflows by 30 to 50%.

**Self-Healing Squeegee**

This can be defined as a roll designed with synthetic material bonded together in a non-woven pattern, forming a sleeve that slides over a shaft.
The benefit of these rolls, as they relate to minimization, is their resistance to cuts and tears, and this leads to the concept of self-healing.

Because these rolls last longer than typical rubber and polyurethane rolls, they offer an attractive minimization effort. These rolls are also cost effective due to their life expectancy.

As for the operational effects, these rolls provide better ‘squeegee’ action, thus reducing drag out. Reductions in drag out prevent excessive material loss and reduced waste treatment needs, all contributing to waste minimization.

Another benefit of this roll is the appearance of the strip. Self-healing rolls are not prone to staining and, consequently, improve overall quality.

**Brush Water Recycling**

Brushing the strip is used to enhance cleaning effectiveness and to help ‘activate’ the metal surface in preparation for a reactive conversion coating. Brushing is done with either bristle or non woven types which have abrasives embedded in the brush material. Metallic brushes and natural fiber brushes are sometimes used. Brushing produces a significant amount of friction and heat. Water must be continuously applied to the brush strip contact point to prevent excessive heat build-up and flush away the material removed by the brushes. This promotes uniform abrasion.

Brush water is usually once through. This means that plant water is supplied to the brushes, and the runoff goes directly to waste. Since the flow from a single brush stage can be substantial (5-40 GPM), this represents a significant cost for plant water and waste treatment.

Brush water can be recycled by collecting the runoff and pumping it back to the brushes in a continuous loop, much like a typical spray stage. A small amount of fresh make-up water (about 1-3 GPM) may be required. A large quantity of metal finishes is produced in the brushing process. To prevent these metal fines from building-up in the re-circulated water, a settling chamber, bag filtration or centrifuge is suggested as part of the loop. Care must be taken in the handling of the metal fines waste, as a combination of Fe and Al particles in an alkaline solution can cause gassing and in the extreme lead to metal fires. To minimize the potential for fires and gassing, the metal fines waste must be adjusted to a neutral pH prior to filtration.

The benefits and savings of brush water recycling include:

1. Reduced fresh water flow to brushed.
   - Cost savings from less plant water used
2. Reduced waste water flow to waste
   - Cost savings from reduced volume to treat/discharge in waste plant

**Physical Cleaning of Brushes**

The easiest way to save the materials and labor involved in cleaning or redressing brushes is to decrease the frequencies at which this maintenance is needed. There are a few basic rules of thumb for forestalling the need to dress these brushes off.

1. Keep the brushes wet enough to prevent them from burning/excessive wear.
2. The total flow rate for each set of brush rolls (top and bottom) should be 4-6 gallons per foot width of metal.

3. The water should be directed at the brush’s contact point with the metal both in front of and behind the brush. Therefore, each riser will deliver between 1-1.5 gallons per foot width of metal, two risers for each brush.

4. The water should be delivered with V-jet nozzles spaced such that the spray overlaps to the center of the other V-jets. This set up will act as a fail-safe in the event that one of the nozzles becomes clogged. If there were not overlapping sprays to cover each other, then a clogged riser would immediately result in that section of the brush building up with residue and wearing out.

5. The flow of water may be reused after filtration through a sand filter, filter bed or centrifuge. Usually, a 40 micron filter is more than adequate. Filters in the range of 20 to 30 microns may be used for micro finishing.

Redressing of the brushes can be done on a lathe with the use of either abrasive wheels or grinding belts. Non woven rolls can be dressed with a single point cutting tool. Most coil coating lines are able to save on labor/downtime because they have installed in-line lathe set-ups. These are integral units that incorporate screw type lathes, which can physically clean the brushes in line with the use of either clean and strip wheels or steel brushes.

**Immersion Cell**

Conversion coating processes often result in insoluble by-products, which can deposit in the spray nozzles and prevent effective spraying of process solutions. The plugged nozzles require maintenance, which can result in additional chemical waste.

The immersion (reaction) cell is the preferred equipment for the application of phosphating and other processes, which generate solid by-products.

**Smaller Pans (D-I-P Treatment)**

The use of smaller pans can apply to the application area of paint or dried-in-place pretreatments. Most pans have much greater capacity than necessary. Replacing large pans with those that are sized closer to the minimum necessary to provide good pickup of the coating or pretreatment solution would provide the following benefits:

1. Easier to clean the pans
2. Reduce waste of paint or chemical (especially paint)
3. Reduced usage of solvent or water during each cleanup
4. Reduced volume of hazardous waste generated, that is not reused, during each cleanup
Automation / Better Control

To achieve the required surface preparation prior to painting, the pretreatment section needs to be maintained within established limits. The process temperatures, chemical concentrations and levels of contamination need to be monitored and maintained by the addition of chemicals and water.

Automatic monitoring and process control can achieve the optimum conditions for surface preparation continuously with minimal chemical usage. This may not only reduce the operating costs, but also avoid excessive loads of additional chemical waste for the waste treatment plant. The use of waste treatment chemicals and the resulting solid waste can be significantly reduced by process automation.

Also, refer to “Better Automation…” in the ‘Waste Treatment Plant’ section.

On-Line Coating Weight Detection

The use of a continuous on-line coating weight monitor would provide instantaneous information on the acceptability of metal pretreatment and treatment application conditions. This provides several excellent opportunities for quality improvement, waste reduction and cost savings.

1. With continuous coating weight detection, there would be greatly reduced instances of under-treated metal. This would therefore lead to reduced frequency of rejected product, scrap, and field claims.

2. There would also be reduced instances of applying too much pretreatment, especially on those lines with a conservative claims preventive philosophy. “Too much pre-treat is better than too little”. Reducing instances of over treatment leads immediately to savings in chemical consumption. In the case of conventional, reactive pre-treatments, a chemical bath that isn’t applying more coating than necessary is also producing reaction by-products and sludge/scale at a reduced rate.

   a. Reduced rate of reaction product build-up means less bath stabilization or dumping is necessary. Therefore, less waste volume is generated.

   b. Reduced sludge/scale formation in the chemical bath means reduced labor required for cleanup of heat exchangers, risers, nozzles, screens, etc.

If the on-line coating weight monitor was also designed to control the reactive pre-treatment bath, the above advantages would be accentuated. Such a device could also more closely control applied dried-in-place coating weights (by adjusting applicator roll speeds, for example). This would allow for even tighter control of coating weights and reduction of chemical usage.

WET SECTION TREATMENT

High Pressure Pre-Clean Using Recycled Counter-Flow Water

With the variety of coils received by coil coating operations comes a wide variety of soils. Cleaner baths must often be adjusted to accommodate this variety. These adjustments result in a waste of cleaner product (overflow) or downtime, while chemical/process adjustments are being implemented.
The use of high pressure pre-cleaning can serve to minimize this problem. It is designed to remove ‘gross’ soils and provide a more consistent, less soiled substrate for the conventional cleaning stage. High pressure pre-cleaning is not intended to replace, but rather to augment conventional cleaning. Typical process conditions are 80-150 psig for 3-6 seconds at 150-170 degrees F. Water alone is normally used, or chemical cleaners are sometimes added.

The most efficient way to operate a pre-clean stage is to counter flow from the cleaner stage. This maximizes the utility of the cleaner chemical by making additional use of cleaner overflow, which is ordinarily sent to waste.

The benefits of high pressure pre-clean, with recycled counter flow make-up, include:

1. More consistent soil loading to the cleaner bath
   • Cost savings from improved process consistency
2. Longer cleaner bath life - less dumping
   • Cost savings from less cleaner chemical
3. Reduced need to vary cleaner bath chemistry
   • Cost savings from less downtime and less cleaner chemical

**Multi-Stage Cleaning/Rinsing**

Many existing coil lines operate a single cleaning and rinse stage. This arrangement is capable of providing acceptable cleaning/rinsing in most situations. Cleaner rinse baths must be overflowed. Overflowing is accomplished by fresh water make-up. Cleaner baths are overflowed to eliminate emulsified oils, and limit cleaner bath reaction products (e.g., aluminum). Cleaner rinse baths are overflowed to maintain purity, which prevents cross contamination.

The use of multiple stage cleaning and rinsing can provide equal or better cleaning/rinsing, while reducing the quantity of cleaner bath and rinse water overflow. The typical process sequence is two cleaner stages followed by two rinse stages in series. In some cases, triple stages of combinations are in use. In the double stage process, the overflow is counter-flowed from the second rinse to the first rinse and from the second cleaner to the first cleaner bath. Economy of operation and reduced waste generation results from this counter-flowing.

Compared to a single cleaner/rinse scenario, the total overflow from the multi-stage (2/2) process can be reduced by 30 to 50%, while maintaining the same cleaning effectiveness and rinse water purity. Also, less cleaner chemical may be required by operating two or more cleaner baths at a lower concentration than just one.

The benefits of multi-stage cleaning/rinsing include:

1. Reduced waste generation from less cleaner/rinse overflow
   • Cost savings from less to treat/discharge in waste plan
2. Flexibility of operation to tune washer to substrate
   • Cost savings from maximum efficiency of wet section
3. Reduced cleaner concentration in second stage
   • Cost savings from less cleaner chemical
No-Rinse Pretreatment

One of the most effective ways to minimize waste is to treat metal with a no-rinse dried-in-place (DIP) pretreatment. There are two important reasons why the sheer volume of waste water normally produced with conventional spray or immersion pretreatments is greatly reduced or eliminated:

1. The rinse stages normally required with conventional pretreatments are eliminated; therefore, the waste water from the stabilization required keeping these rinses clean, or within contaminant limitations, are eliminated.

2. Essentially, 100% of the no-rinse pretreatment solution, which contacts the metal, is carried out on the metal surface; therefore, build-up of reaction by-products and the necessity for pretreatment bath stabilization is also essentially eliminated.

3. Usually reduces the amount of hazardous waste generated.

When a coil coating line is able to convert to a no-rinse process, a significant reduction in the volume of waste water and sludge generated from the wet section is common. Besides greatly reduced waste volume, other important benefits are inherent through the use of no-rinse pretreatments. These include:

1. Savings in floor space

2. Reduced maintenance
   a. Less equipment to clean and maintain
   b. Less automatic control equipment

3. Reduce labor
   a. Fewer wet section stages to control and monitor
   b. The pretreatment solution doesn’t require continuing adjustments after make-up.

4. Reduced pretreatment variation/better pretreatment consistency
   a. The no-rinse pretreatment is far less vulnerable to pretreatment solution changes.

An important trade-off in the use of a no-rinse pretreatment: this treatment method is not as forgiving as conventional baths for marginally cleaned metal. The coating uniformity provided by no-rinse is dependent on the coater quality and its maintenance. It is important to note that conversions to no-rinse processes are a growing trend with coil coating lines successfully using these chemicals.

Multi-Metal No-Rinse

The use of no-rinse pretreatments is a proven, effective method for simplifying the wet section area of coil coating lines, while greatly reducing waste water and sludge volume. But, many lines aren’t dedicated to just one substrate and, therefore, may have need for more than one no-rinse pretreatment. In these cases, it would be desirable to further simplify the pretreatment process, since changing from one no-rinse chemical to another usually involves clean-up of the pretreatment solution application equipment, and initial adjustment of the second chemical to ensure proper coating ranges.
A single no-rinse pretreatment chemical effective on two or more substrates will result in:

1. Reduced labor (to complete clean-up and switch-over operations)

2. Further reductions in the generation of waste water production (from clean-up water)

3. A possible reduction in downtime (in those cases where paint change-overs aren’t the limiting factors to production).

**Non-Chrome Pretreatments**

Since chromium is one of the metals covered by coil coating effluent discharge limits, its elimination from the pretreatment section could substantially simplify compliance with EPA effluent discharge limits. In the steel segment, many conventional pretreatment processes only use chromium in the final rinse step. Chromium-free processes are available for the processing of aluminum. Several large aluminum coaters have converted to the chrome-free processes. Several coil coaters have participated in line trials of new chromium-free processes.

Unfortunately, chromate products, such as passivated Galvalume® and HDG, are also processed on coil coating lines. Two factors are important in the processing of the passivated substrates:

1. Their processing introduces chromium into the wet section

2. The only suitable pretreatments for passivated substrates are chromate based.

**Non-Chrome Final Rinse**

For coil coaters not processing Galvalume® or passivated substrates, many conventional pretreatments without chromium are available. The replacement of the conventional chromate final rinse with a chromium-free final rinse offers an attractive alternative, which can eliminate chromium from the pretreatment section entirely. Several chrome-free rinses are available on the market, but their use is rather limited. Although they can, in many instances, provide a high standard of performance over a variety of substrates and paint systems, they don’t always match the performance of the chrome final rinse.
Section 2

WASTE TREATMENT

Process

Zinc Removal Before Waste Treatment

Since the proper operation of an abrasive brush unit of scrubber requires a large amount of cooling/flushing water, this unit can be best served by re-circulation. This reduces the amount of water sent to waste treatment and also allows for a closed loop filtering system to remove zinc and aluminum-zinc particles. Filtering can be accomplished with a paper bed or vacuum unit similar to those used for filtering coolant on machine tools.

Since the metallic waste is concentrated and contains one or two primary constituents, it may be of greater value to a metal reclaimers.

Separate Chrome and Non-Chrome Wastewater Streams

The purpose for segregating the chrome and non-chrome wastewater streams is to reduce the amount of hazardous waste generated. Chrome and non-chrome conversion coatings are usually applied to aluminum substrates. All waste water generated from the conversion coating of aluminum is considered to be hazardous. The sludges generated from that waste are listed F019 hazardous waste. Any waste mixed with the conversion coating waste is considered to be hazardous. By segregating those streams, the amount of hazardous waste generated can be minimized. However, nearly redundant waste treatment systems may be required.

Heat Applied for Oil Splitting

Most oil in water emulsions can be broken by the application of heat. A gravity separator fitted with steam operated coils or electric immersion heaters will break out emulsified oil at approximately 190 to 200 degrees Fahrenheit. A 15 to 20 minute residence time is also required. As with the “Free Oil” separator, an under-flow and overflow weir is required.

Dissolved or Induced Air Flotation

Dissolved or induced air flotation equipment is used in many industries to separate oil from water. Air is injected into the waste stream to create tiny bubbles. As the bubbles rise to the surface, oil particles attach themselves and improved oil flotation is achieved. This type of system will hasten oil removal from the wastewater for an improved discharge effluent. However, no significant increase in the oil recovered should be expected.

This process cannot be used as a side stream of a cleaning stage to remove oil because organic polymers are generally required to aid flotation. The organic polymers will interfere with cleaning.

Chrome Reduction Automation

Both batch and continuous processes for reducing hexavalent to trivalent chrome can benefit from the use of ORP control. Oxidation Reduction Potential controllers can measure the solution potential and add reducing agents to keep the process at a given set point value. These instruments are similar to pH meters and the sensing element contains a measuring and reference probe.
Automatic control of chrome reduction requires accurate pH control, as low pH conditions will cause a false ORP reading and excessive amounts of reducing chemical will be used.

**Sludge Dryer**

The purpose of a sludge dryer is to reduce the moisture in the sludge by evaporation through the application of hot air, without combusting the solid materials. Each manufacturer of sludge drying equipment has their own system design. Typical coil coater waste sludge containing 60-80% moisture can be reduced to 10-30% moisture by a sludge dryer. A large amount of ancillary equipment is generally required to operate a sludge dryer; i.e., cyclones, scrubber, air blowers, etc.

**Sludge Reclamation**

Sludge reclamation is an option for sludges containing significant amounts of chrome and aluminum. Sludge reclamation is not a true means for minimizing hazardous waste, but it does represent an opportunity for minimizing the liability of the hazardous waste. Sludge from chrome conversion coated aluminum waste streams is considered an F019 hazardous waste. The resultant sludge from this process can be sent to a sludge reclamation firm. The sludge must be transported under a hazardous waste manifest. The sludge reclamation firm will recover the chrome and aluminum from the sludge and create a usable product. This is considered a recycling operation, hence the hazardous waste is consumed and the original generator’s liability ended.

**Water Reuse**

Water reuse from the wastewater treatment system benefits the operation in two ways: water conservation and higher concentration limits for the regulated metals. Usually, wastewater can be used in any process where metal concentration in the area of 1-2 ppm will not be harmful. (Care must be taken not to reuse any water while there is a waste treatment process upset.) Even low levels of chrome can cause a problem with some treatment chemicals.

Before reusing water, the total dissolved solids should be checked. High total dissolved solids should be avoided, as they will promote fouling. Total suspended solids can be filtered out while pumping the effluent to the holding tank or process.

**Better Automation and Alarms**

The widespread use of digital controllers and chart recorders has greatly improved the operation and data collection of the waste treatment process. The new controllers are more versatile in that they allow for multiple types of inputs and outputs. A few can also be set up as dual reagent controller adding either acid or base, as required. Most newer chart recorders can be fitted with an alarm option, which allows either high or low alarm for each channel to be selected. Being microprocessor controlled, the set points can be set from a keyboard rather than by adjusting limit switches, as required with older units.

Also, refer to ‘AUTOMATION’ in the ‘Wet Section’.
WASTE TREATMENT

Treatment

Ion Exchange Systems

Removal of dissolved salts (Ca/Mg/Fe/Zn, etc.) from the effluent wastewater treatment plant may be required before reusing the water within the coil coating process. Ion exchange systems are systems that exchange ions in the effluent water with ions bound to the exchange sites, and hold them until released by a regeneration solution. Generally, filtration is required to remove colloidal particles and oil prior to ion exchange units to prevent fouling.

Evaporation

Evaporation is a separation process, which can substantially reduce the wastewater discharge from the plant. Rinse waters or wastewater can be boiled off under reduced pressure to concentrate the chemicals for a smaller waste stream. The condensed steam is recycled for use in the plant. The evaporators require a significant capital investment, which makes this approach mainly attractive in areas with limited water availability or very tight volume discharge restrictions.

Membrane Systems

Membrane processes can be used in place of ion exchange prior to reuse of the effluent water. Membrane processes include ultra-filtration, reverse osmosis, electro-dialysis, and electro-dialysis reversal. Although these processes, with the exception of ultra-filtration, remove ions, additional non-ionized organics and particulates are also efficiently removed.

Ultra-filtration membrane porosity is too large for ion rejection and is, therefore used to remove contaminants, such as oil, grease, and suspended solids. Except for ultra-filtration, some sort of pretreatment (filtration) to remove colloidal particles, oils, and grease is required ahead of membrane systems.

Reciprocation Flow Ion Exchange (RFIE)

The ion exchange process is well established in industrial operation for water purification. The reciprocating flow ion exchange was especially developed by ECO-TEC Ltd. for purifying large volume flows economically. It is used in many electroplating operations for chemical recovery, acid purification, and water de-ionization. The unit can effectively prevent the contaminant buildup in rinsing and pickling applications.

Polymers – Oil Split De-watering

The oil recovered from oil coalescers on cleaner stages and from oil splitting processes in the wastewater treatment plant are generally oil-in-water emulsions. To reduce the amount of water which is “wasted”, polymers can be used in batch type operations to break the emulsion. This will result in higher-grade oil, which may or may not be of benefit. The water and sediment, which is removed, will be sent to the waste treatment plant.
Cleaner Which Easily Splits Oil

The primary function of any cleaning process is to remove ship-out and rust-protective oils from the surface of the strip. As these oils build up in the cleaner, the cleaning process becomes less effective. The oils are present in the cleaner stage in an emulsified form. If this emulsion is destabilized, and the oils are separated to the surface, they can be removed by mechanical means, such as skimming or overflow, to prolong the life of the cleaner.

The stability of oil/water emulsions can be affected by many factors: mixing, temperature, component, concentrations, etc. With a proper selection of the cleaner components and the control of mechanical factors, the oils can be more effectively separated to the cleaner surface. Unfortunately, some oils are self-emulsifying, which makes the oil splitting process more complex.

Dolomitic Lime

The two most common materials used for neutralization are lime and caustic soda. Caustic soda minimizes the amount of sludge generated due to its soluble salts, while lime is easier to de-water. Lime can be purchased in two varieties depending on location, high calcium, and dolomitic. High calcium lime is 98% calcium, while dolomitic lime contains about 55% calcium and 40% magnesium.

The presence of magnesium in the dolomitic lime has a tendency to stabilize the neutralization reaction. (Magnesium hydroxide buffers out at a pH of 9). High calcium line also has undissolved particles.

Substitution of Caustic for Lime to Reduce Sludge

Lime is generally used to precipitate metals in the wastewater from the coil coating process. The substitution of caustic in place of lime can be used to generate a smaller sludge volume. This will result in less sludge that needs to be land filled. It should be noted that the use of caustic is much more expensive than lime. However, the availability of caustic soda in liquid form will significantly reduce the handling problems associated with powdered lime. Finally, using caustic may require a co-precipitant to ensure adequate solids settling as caustic forms soluble salts. The resulting filter cake from caustic neutralizers may also fail the Toxicity Character Leeching Procedure (TCLP) Chrome Test, which is why lime is normally used.
Section 3

COATING, CURING, QUENCHING

Coating

Control of Paint Samples and Orders

It is important to gain control of the incoming paint samples and orders. This is where excess paint waste begins. Accuracy in the paint ordering process can reduce excess paint inventory and paint waste. As one approaches an operation based on the “just in time” principle, to succeed involve accurate requests from the end customer, timely forecasting and information from the coil coater, and responsiveness from the paint vendor. Communication and commitment between all parties is essential. A learning curve in such a program will take place; however, the dividends are worth the effort. This program will reduce paint inventories, eliminate safety stock and control the amount of paint waste.

Modify or Eliminate Pre-ship Program

Modification or elimination of the current pre-ship programs can minimize waste. A certification program agreed upon between the coil coater and paint vendor can eliminate wet pre-ships and save the coil coater lengthy test duplications. This program starts by both parties agreeing to a desired number of tests and required parameters. The paint vendor will perform the tests and quality checks and assure that each batch of paint meets the required parameters. The certification results and dry panels are forwarded to the coil coater for inspection. The coil coater forwards line run data and future adjustments back to the paint vendor after each batch of paint has been run on the line. Communication between coil coater and paint vendor is the key for certification programs to succeed. Confidence levels will grow as the program progresses. Negative factors associated with wet pre-ships can be eliminated. If a certification program is not desired, then recycling of wet pre-ships can be done through on-site backer generation, supplier disposal, or incorporation into the particular process batch that the pre-ship represents.

Paint Additive Control

Paint additives should be controlled and not allowed to remain at the coil coating line. Paint vendors should remove the excess additive from the coil coater after the intended purpose of the additive is achieved. Many times, inactive additive can lead to waste propagation through mishandling and contamination.

Use of Obsolete Paints

Obsolete paint is something that will always exist, but can be minimized through the above mentioned processes. Programs between coil coaters and plant vendors can be set up to use obsolete paint waste to manufacture generic backers and some brands of roof deck coatings.

Evaporation of Waste Solvents

Faced with a mountain of regulations, paperwork and liability, companies today can ease their burden by finding alternative disposal methods for waste solvent and waste paint, hence reducing their liability risk.
Once a solvent is used, it is classified as hazardous, per requirements of the Federal Resource Conservation and Recovery Act (RCRA) regulations. Solvents covered by this legislation have been banned from landfill disposal since the creation of the first land-ban rule in 1986.

Waste solvent must be either incinerated or recycled. Usually it is more economical to recover waste solvents than to dispose of waste solvent in a fuel-blending program. Based on the quantity of waste generated, an on-site solvent recovery program could be considered the most economical means of treatment/waste minimization. Manpower to run the system and cost of new solvent can be determining factors in the decision making process.

Companies that choose fuel-blending (incineration) or off-site solvent recovery are required to institute a waste management program for storage of waste up to 90 days if the plant is a large quantity generator (1000 kg/mo). Weekly inspections, storage and record-keeping requirements, manifest of the waste streams and the increased potential for spills does not stop once the waste is handed over to a treatment and disposal firm. Department of Transportation regulations apply to waste tracking during transportation and liability for potential spills during transit.

A way to reduce one’s liability is to recover waste solvent on-site. With on-site recovery, you can recover up to 90% of reusable solvent, reduce the need to purchase replacement solvents and slash the cost of transportation and disposal fees. To keep distilled residue in liquid form, a more reasonable recovery rate of 75% for distilled waste solvent and 30% (+) for solvents distilled from waste paints will keep the residue pumpable for disposal. This is more cost effective than disposing of a hard cake (as some systems produce).

A facility using today’s state of the art “solvent recovery units” (see diagram) should consider the convenience and safety of on-site recycling. Solvent is poured, pumped, or auto-filled into the tank, from a drum or solvent bath. As waste is processed, the tank is refilled without having to open the tank lid. The unit turns on and the solvent is heated. As vapors form, they pass through a vapor line into a water-cooled condenser. Vapors are condensed into a clean, clear (95 to 99 percent pure) distillate. From the condenser, the liquid auto-flows into an approved container, either tank or drum (see diagram). When all solvent has been processed, the unit automatically turns off per a preset timer and the unit is allowed to cool. Because the residue is liquid, cleanup is made easy through a clean-out port located at waist height.

In-house solvent distillation equipment is available with processing rates from 3 gallons/shift up to 170 gallons/shift. Distillation equipment is explosion proof, vented and conforms to OSHA/NEMA specifications.

It is important to remember that the advantages of solvent recovery are numerous:

a. Waste minimization is achieved, and it is encouraged by USEPA.

b. Company environmental liability is reduced.

c. Cost for replacement solvents are slashed.

d. Record-keeping and waste management requirements are minimized.

e. Significant reductions in the cost of processing hazardous waste are achieved.

f. A movement toward pollution reduction reflects responsible concern, shows concern for the company which improves community relations, and becomes part of the plant’s culture.
Federal regulations are compounding annually. Through solvent recovery and other waste reduction methods at the source or at the disposal end, positive benefits will be reaped to ease future regulatory pains.

Efficient Use of Wash Up Solvent

Use a five-gallon bucket with solvent (reclaim) and Kim Towels. Use solvent-soaked towels to clean off rolls, plastic scrapers to scrape as much paint out of the paint pan as you can, and return it to the drum. Use more solvent-soaked towels to wipe out paint pan.

Use a wash tank with lids, separated in the center - one side will be clean solvent; the other will be dirty solvent. Take parts from coater pans (pipes, elbows, paint pumps, mixers, etc.). Place them in the dirty solvent to remove heavy paint from the parts. Then finish-rinse them in the clean solvent side and wipe off with a towel. Once the clean side starts to get dirty, dump the dirty side and clean it out. Replace with clean solvent. Now, use the formerly clean side for dirty parts and the newly cleaned side for finishing parts. By having a separated tank, you will use less solvent for cleaning coater parts.

Spot mop the coater room floor only. By spot mopping, you hold the fumes down in the room, use less solvent, and still keep floors clean.

Paper Towels for Coater Clean-Up

The one-time use of paper Kim-Towels at the coater causes waste. Reuse the towels by using several for the initial cleaning of the coater parts. Use several more for the finishing of the cleanup. Save the finishing towels used on the prior cleanup and use them for initial cleaning. Then again, use several more towels for finish cleanup. This not only saves on the amount of towels used, but the amount of hazardous waste generated.

Doctor Blade (Scraper Bar)

If gauge and paint type allow, do not paint drum roll (backup roll, etc.).

When painting of the drum roll can’t be avoided, make sure that the doctor blade is clean and used effectively to scrape the drum while painting. By placing a clean bucket under the drain of the doctor blade, all paint from the drum roll can be caught in the bucket and placed back into the drum for reuse on the order.

All paint scraped off the drum roll will increase in viscosity. After placement into the drums of paint, make sure the viscosity is checked and adjusted to the desired value.

Optional backers or roof deck coatings can be generated at the doctor blade. The paint from the doctor blade is caught in a bucket and placed in an empty paint drum. Once the drum is filled, the paint can be reduced to an application viscosity and used for coating roof deck. This is also a good use of obsolete paint and scrap paint from the coater area. The scrap paints can be captured, mixed together, and used on orders in which the backside of the strip won’t be visible. This will help reduce the inventory of old paint without paying to have it hauled away and burned.
Recycle Waste Solvent

Waste Solvent:

A.) External Outside Recycling

1. Contacting Outside Vendor
2. Fuel Blending
3. Buy Back of Reclaimed Solvent

The first step one might take in finding an outside vendor would be to look in either the Thomas Registry or the Industrial Yellow Pages or simply to go to your front door and let in one of the sales reps. The company you choose should deal in waste disposal. The second step would be to obtain a sample of waste solvent. This will be needed for three reasons: 1) Identification of waste, 2) Classification of waste, 3) Determination of treatment method.

After the sample has been analyzed, the rep will get back to you with pricing and various uses of the waste.

Recycled Solvent:

This is done through a distillation process. The recovered solvent is returned with varying yields depending upon the coating used. The recovered solvent is now called lacquer thinner (to be used for cleanup of equipment, for example). You will find, however, that after several uses, the thinner will need to be fortified. This material can be purchased at a lesser cost than virgin solvent.

Fuel Blending:

This is done by using waste solvent as fuel extender and blending it with other types of fuels. The by-product is used as an energy source. Your sales rep can explain this in full detail and direct you to someone who deals in this. Both liquid and solid waste can be incinerated.

Curing

Overall Strategies for reducing VOCs

As environmental regulations become more demanding, efforts must be made to reduce VOC emissions from coater areas and oven/oxidizer exhaust systems. Early State and local regulations focused on the destruction efficiency of after burners, which in most cases were added on to existing oven exhaust systems. The standard for the day was operating the combustion chamber at 1400º Fahrenheit. Retention times ranged from ? to ½ of a second, exceeding the 90% destruction efficiency required by law. The oven exhaust system was the main thrust of the regulations; fugitive coater emissions were not addressed.
Many coating lines built during the 1960’s did not have coater enclosures. When installed, it was usually due to a requirement of the local fire code regarding the handling of flammable liquids. These rooms were designed as fire cut-off rooms and did not address fugitive emissions from the openings. Coater exhaust systems were necessary to provide dilution, ventilation, worker health and comfort. VOC’s from these sources were considered fugitive and not regulated.

As the air pollution control regulations evolved, fugitive emissions were addressed and the overall control efficiency (OCE) concept was created. The OCE is the combination of the capture efficiency and destruction efficiency of the entire coater/oven system. Recently the proposed Maximum Achievable Control Technology (MACT) standard includes 98% OCE as the compliance standard. In order to meet this standard, careful consideration must be given to the airflow into and out of the coater room and oven/oxidizer system.

Present day oxidizers are more than capable of obtaining 99% destruction efficiency. This leaves only 1% of the applied VOC to be released as a fugitive emission. The coater exhaust, which was once discharged to the atmosphere, must now be controlled either directly or via the oven. Since most ovens use combustion air for its burners and fresh air to minimize solvent vapor concentrations, taking this air from the coater area provides air to the oven, which will eventually pass through the oxidizer. Maintaining a separate low level safety ventilation system independent of the oven provides for vapor removal when the oven is down. This system can be designed to keep the emission rate to below the 1% level during operating conditions.

The oven/oxidizer systems now in use in this industry cover a wide variety of scenarios to minimize airflow and recover wasted heat. Historic NFPA regulations required that 10,000 standard cubic feet of air per minute (SCFM) of ventilation air be provided for each gallon of solvent released in the oven. Installing a variable speed drive on the oven exhaust fan and controlling its speed by means of a lower explosive limit (LEL) monitoring system will minimize the quantity of air that must be heated to 1400ºF. New NFPA regulations now require 12,000 SCFM per gallon of solvent released. This increase in airflow can only be combated with higher thermal efficiencies in the oven/oxidizer system. Throughout the years, efforts have been made to match ventilation rates with solvent inputs, with minimum regard to thermal efficiencies, and maximize thermal efficiencies with minimum regard to ventilation rates. It should be noted that the later provides greater opportunity for higher flow rates from the coater room enclosure.

Pollution prevention efforts regarding VOCs can come from material substitution, using water base or high solids coatings, and minimizing flue gas emissions by maximizing thermal efficiencies and minimizing the volume of air sent to the control device. In some areas “low nox” burners are required to reduce nitrous oxide emissions. Energy conservation can be accomplished by having a workable system in place to minimize the quantity of air being sent to the control device. Changes in the air management of coater rooms to meet the proposed MACT standard will require a careful engineering review by the equipment supplier. Operators can do their part by accurately accessing solvent loading for various jobs. They must also acknowledge that in some cases, lowering the line speed on “high solvent rate” jobs might be necessary to keep the oven ventilation rate to a reasonable level.
Section 4

OPERATING PRACTICES

Operator Training

An extremely important factor in reducing or minimizing waste is wet section operator involvement. Effective operators are those who know more about the wet section than just knowing how to do titrations. A well trained operator will also know how the wet section changes the characteristics of a metal’s surface and how important each stage, bath chemical parameter, pump, riser, squeegee roll, etc. is to not only the quality of his company’s product, but also the overall cost of the process. If the operator better understands the interactions of each stage and each chemical he controls, he is also likely to have a greater concern whenever any of these factors are running outside the norm. Some of the things he should know:

1. WHY a titration is important. What is its significance and how can it affect performance. Why more isn’t necessarily better. This can have a great impact not only on product quality, but also on reduced generation of wastewater. For example, an operator who pumps up a pretreatment stage well above the required concentration to eliminate it as a continuing concern while it “coasts” back down may feel differently about this practice. If he understands that reaction products will build up so fast he will eventually have to fix it when QC complains, stabilize it more frequently, and have a tougher time during maintenance, because of all the extra scale/sludge produced as a result.

2. HOW a normal pretreatment should look and what are the most likely causes of an abnormal appearance. In other words, he should be trained in troubleshooting. Quickly making educated guesses as to a problem’s cause, rather than using shotgun approaches, can minimize a significant amount of waste each year. Think of the baths dumped and product time lost because of wild goose chases in the past.

3. WHEN to look for mechanical problems rather than technical problems. For example, poor cleaning even at a bath concentration twice normal, probably isn’t going to be solved by pumping in more cleaner concentrate. Now is the time to look for clogged risers or plugged nozzles. Another example may be a pretreatment bath that needs twice the replenishment rate than it used to, and the coating weights are still low. Now is the time to look for worn squeegee rolls or faulty level control.

4. WHERE to find all the necessary information and equipment in order to carry out his duties. It is one thing to teach a person how to do a good job; it’s another to give him the necessary tools. Convenient, well-lighted areas for titrations, review of information, access to control equipment and lab supplies will help him do a better job. An operator forced to cover a few shifts where he couldn’t do the job right because of a lack of equipment or titrating chemical will almost surely learn that it must not be that important anyway. Teaching an operator to do his job safely is most important. Easy access to safety and emergency equipment is crucial.

Production Scheduling

Effective production scheduling can have a significant impact on waste minimization efforts. This can be accomplished by “locking in” the production schedule far enough in advance to allow time for planned raw materials acquisition. Also keep “rush jobs” to a minimum. Arrange for “just in time” deliveries of small quantities of raw materials with vendors whenever possible.
Firm extended production forecasts allow for planned raw material deliveries and lot quantities, which limit the time and amount of material on the production floor. This in turn reduced the possibility of wasted materials due to container damage or material contamination.

Carefully planned production schedules allow for the purchase of enough raw materials to complete the run without large inventories of “left over” materials later to be obsolete or surpass their shelf life resulting in additional waste disposal.

Schedule production runs which require like materials such as pretreatment types, and/or coating types and colors. Extended runs of those materials will reduce the generation and disposal of waste materials from “washouts” and process solution changeovers.

**Rinse Chemical Drums Into Bath**

In general, the majorities of process solution chemicals are received as concentrates and are diluted on-line for use. This allows for the use of small quantities of process chemical to maintain large quantities of working solution. Therefore, any quantity of concentrate left in the drum or container is important when it comes to chemical consumption.

Most drum or container pumps or decanting devices don’t get all the material from the bottom of the container. This becomes wasted valuable chemical. In addition, chemical residues may pose a hazard, and in large enough quantities may become a regulated waste.

An easy method to ensure chemical containers are completely empty is to upend them into the process tank, draining the remaining material, and then rinsing the container with the diluent used in the solution (usually water). Small quantities of diluent can also be pumped or drained through pumps, hoses, and decanting devices into the process tank, thus recovering the material left in them.

**Bottom Outlets on Totes**

When dealing with raw material containers, it is preferred, when possible, to use large containers such as drums in place of pails or totes in place of drums. The typical totes used for paints and/or chemicals, varies from 200 to 350 gallon capacity. They can simplify handling large quantities of material. However, as with drums and other smaller containers, they can retain a heel when empty.

It is not feasible to upend a tote into a process tank or taint tray to ensure it is fully drained, but in most cases* a tote with a bottom drain and sloping bottom can be specified. This will assist in getting as much material as possible out of the tote. Tilting the tote in the direction of the drain with a forklift or other lifting device will aid draining as well.

*State and Federal regulations may prohibit bottom drains on totes of some materials. To prevent accidental spills, insure fitting is leak tested on a hose and chain connection.

**Boil Out Rinses Into Next Batch**

Periodically, some process tanks are cleaned by boiling (agitating) a cleaning solution in the tank. This is followed by water rinsing to prepare for the process.

Using the rinse water as a basis for building a new process batch would aid in the reduction of wastes. Additionally, aside from reducing costs and materials, a reduction in disposal and/or treatment would be realized.
Inventory Control/S.P.C.

The use of statistical process control (S.P.C.) methods can aid in the minimization of inventories, or more precisely, inventory losses. Monitoring the variability of raw material weights may show deviations or losses associated with a particular product or cause. Therefore, identifying the non-conformances may allow tighter controls.

S.P.C. is also used to control application techniques to prevent waste. An example would be paint application. Application below specification/above specification may cause additional and unnecessary inventory.

Container Preference of Bulk > Totes > Drums

Many supplies received by coil coaters are provided in a variety of containers, including bulk, totes, drums, bags, etc. With respect to liquids, if the volumes warrant and the storage space is available, bulk provides the least waste. Totes are the preferred second, while drums produce the most waste. Bulk and bottom drain totes eliminate product waste, where drums don’t. The cleaning operation, wastewater from cleaning, and drum disposal/recycling charges are eliminated with bulk and totes. With some totes, cleaning may be required. However, the supplier usually shoulders the burden of tote cleaning. Bulk also eliminates the need for warehouse space. Drums are usually least preferred, particularly non-returnable drums. Liability increases with non-returnable drums.

Below is a comparison of bulk totes and drums for liquids:

<table>
<thead>
<tr>
<th></th>
<th>Costs</th>
<th>Risks</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>BULK</td>
<td>TOTES</td>
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<td>Container disposal</td>
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<td>0</td>
</tr>
<tr>
<td>Heel Waste</td>
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<tr>
<td>Container cleaning</td>
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<tr>
<td>Space for empty cont.</td>
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<tr>
<td>Warehouse space</td>
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<tr>
<td>Production floor space</td>
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<td>M</td>
</tr>
<tr>
<td>Operator attention</td>
<td>L</td>
<td>M</td>
</tr>
</tbody>
</table>

**Risks**
- Risk of product run-out: L M H
- Liability for waste cont.: 0 0 H
- Accidental excessive addition: M M L
- Product contamination: H M L

**Key**
- 0 = none (best)
- L = low
- M = moderate
- H = high (worst)

Returnable Drums

Drums which can be reused or recycled for chemicals as part of the scrap metal recycle program are recommended as good waste minimization options.
Inventory Control/Raw Materials (Order Quantities)

Controlling the amount of inventory needed for manufacturing purposes is necessary to be efficient and productive. Additionally, the effects of excess inventories on waste minimization can include storing products beyond their shelf life. In some cases, large or excessive inventories may be held to the point of obsolescence, whereby there is no longer a need or demand for the inventory. Disposal or return of the product may then be warranted. Steel inventories are also affected as the quality of the steel may deteriorate (rust, etc.) if held too long. Therefore, inventories for all materials should be minimized whenever possible.
## Section 5

### APPENDIX

Illustration one

<table>
<thead>
<tr>
<th>. . . INTO PROCESS</th>
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<tbody>
<tr>
<td>CLNR CLEANER</td>
<td>ADD ACCELERATOR/OR OTHER ADDITIVE</td>
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<tr>
<td>CT CHEMICAL TREATMENT</td>
<td>BW BATCH WASTE</td>
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<td>DF DEFOAMER</td>
<td>CF COUNTER FLOW</td>
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<td>FW FRESH WATER</td>
<td>CR COATER ROLL</td>
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<td>H HEATING</td>
<td>CW CHEMICAL WASTE</td>
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<td>HL HEATER LEAKS</td>
<td>DO LEAKS / SPILLS</td>
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<td>OF OVERFLOW</td>
<td>E &amp; M EVAPORATION &amp; MIST</td>
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<tr>
<td>PT PRETREATMENT</td>
<td>L LEAK (e.g. TANK)</td>
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<tr>
<td>RG ROLL GRINDINGS</td>
<td>L / S LEAK / SPILLS</td>
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<tr>
<td>SURF SURFACTANT</td>
<td>MTD EMPTY DRUM</td>
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<td>RW RINSE WASTE</td>
<td>S SLUDGE</td>
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<td>S SLUDGE</td>
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<td>WT WASTE TREATMENT</td>
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**OTHER ABBREVIATIONS**

DC = DUST COLLECTION  
FMW = FILTER MEDIA WASTE  
SQG = SQUEEGEE

### KEY

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<td>SLUDGE &amp; BATCH WASTE</td>
</tr>
<tr>
<td>FO</td>
<td>FINISH OVEN</td>
<td>SCR</td>
<td>SCRAP</td>
</tr>
<tr>
<td>HL</td>
<td>HEAT LOSS</td>
<td>SP</td>
<td>SPILLS</td>
</tr>
<tr>
<td>IL</td>
<td>INVENTORY LOSS</td>
<td>SW</td>
<td>SOLID WASTE</td>
</tr>
<tr>
<td>L</td>
<td>LEAKS</td>
<td>VOC</td>
<td>VOLATILE ORGANIC</td>
</tr>
<tr>
<td>MTD</td>
<td>EMPTY DRUM</td>
<td>VOC DIST</td>
<td>INCINERATION</td>
</tr>
<tr>
<td>NG</td>
<td>NATURAL GAS</td>
<td>VS</td>
<td>VIRGIN SOLVENT</td>
</tr>
<tr>
<td>O</td>
<td>OVEN</td>
<td>VOC</td>
<td>VOLATILE ORGANIC</td>
</tr>
<tr>
<td>OF</td>
<td>OVER FLOW</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Illustration two
Illustration three
Illustration four
Illustration five
Illustration six
Illustration seven
Illustration eight
Illustration nine
Illustration ten

![Diagram of Solution Tank Heating]

- Boiler Steam
- Amines
- Natural Gas
- Electricity
- Steam Coils
- Direct Fire
- Electric
- To Boiler
- HL
- L
- Plant Air (Heat Loss)
Illustration eleven
Illustration twelve
Illustration thirteen
Illustration fourteen
Illustration sixteen
Illustration seventeen

<table>
<thead>
<tr>
<th>CONTAMINATES &amp; CONDITION OF INCOMING COIL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ALUMINUM</strong></td>
</tr>
<tr>
<td>- Rolling oil</td>
</tr>
<tr>
<td>- Fines</td>
</tr>
<tr>
<td>- Lubricants (petrolatum, wax, etc)</td>
</tr>
<tr>
<td>- Oil contaminants</td>
</tr>
<tr>
<td>- Other met. constituents</td>
</tr>
<tr>
<td><strong>COLD ROLLED STEEL</strong></td>
</tr>
<tr>
<td>- Slushing oil</td>
</tr>
<tr>
<td>- Rolling oil</td>
</tr>
<tr>
<td>- Rust</td>
</tr>
<tr>
<td>- Scale</td>
</tr>
<tr>
<td>- Edge sealer</td>
</tr>
<tr>
<td>- Carbon smut</td>
</tr>
<tr>
<td>- Oil Contaminants</td>
</tr>
<tr>
<td><strong>HOT DIPPED GALVANIZED STEEL</strong></td>
</tr>
<tr>
<td>- Slushing oil</td>
</tr>
<tr>
<td>- Chrome passivation (Hex)</td>
</tr>
<tr>
<td>- Vanishing oil</td>
</tr>
<tr>
<td>- White rust</td>
</tr>
<tr>
<td>- Zinc</td>
</tr>
<tr>
<td>- Darkened spangle</td>
</tr>
<tr>
<td>- Other met. constituents (lead, antimony, Al, nickel)</td>
</tr>
<tr>
<td><strong>Zn/Al HOT DIP STEEL</strong></td>
</tr>
<tr>
<td>- Chrome passivation (Hex)</td>
</tr>
<tr>
<td>- Slushing oil</td>
</tr>
<tr>
<td>- Vanishing oil</td>
</tr>
<tr>
<td>- White rust</td>
</tr>
<tr>
<td>- Zn, Al</td>
</tr>
<tr>
<td>- Other met. constituents (Si, Al, nickel)</td>
</tr>
<tr>
<td><strong>ELECTROGALVANIZED STEEL</strong></td>
</tr>
<tr>
<td>- Slushing oil</td>
</tr>
<tr>
<td>- Vanishing oil</td>
</tr>
<tr>
<td>- Chrome passivation (Hex)</td>
</tr>
<tr>
<td>- White rust</td>
</tr>
<tr>
<td>- Zinc</td>
</tr>
<tr>
<td>- Other met. constituents (lead, nickel)</td>
</tr>
<tr>
<td><strong>PHYSICAL CONDITION OF COILS</strong></td>
</tr>
<tr>
<td>- Edge damage</td>
</tr>
<tr>
<td>- Shipping/package/handling</td>
</tr>
<tr>
<td>- Head/tail damage</td>
</tr>
<tr>
<td><strong>NONNAGE</strong></td>
</tr>
<tr>
<td>- Paper, poly, metal wrap</td>
</tr>
<tr>
<td>- Skids, banding, fillings, etc.</td>
</tr>
<tr>
<td>- Cores (fiber)</td>
</tr>
</tbody>
</table>