Layers of Soil - Layers of Problems

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Sifting through the layers of confusion to keep production running.

In the present industrial environment, internal quality systems and external customer demands require metal forming companies to wash virtually every component they stamp, cut, hydro-form, turn, shear or otherwise make in their facility.

This wash process is essential for each manufacturer and his customer to produce a quality product. This fact was proven by an independent automotive study conducted in the early 1990s. This study attempted to determine the cause for transmission failure. One reason for failure was the amount of soil in a faulty transmission. What was surprising however, was that analysis of this soil found most of the failure causing soil was not the result of driving. Rather, nearly 80% of all the soil found in the failed transmissions was introduced during the original manufacturing of the engine.

Originally, part cleaning was effectively done using solvents. However, degreasing operations such as those that used ozone depleting substances like 1,1,1-Trichloroethane and chlorinated fluorocarbons like CFC-113 and HCFC-141b , have been made illegal. Now washing must be done with some combination of water and a chemical compound blended soap, usually with a pH level that is alkaline in nature.

Time, temperature, mechanical action, chemical blend, part orientation and other variables all work in conjunction with each other to take a dirty part, process it and release a cleaned part to the next step in the manufacturing process.

Problems soon arise in the washing process, however, simply because the washer is accomplishing its goal. Dirty parts are coming in and clean parts are going out. While this happens, the entire load of soil that has been removed from the part is left in the washer bath. Each part traveling through the production cycle leaves all of the previous manufacturing by-products in the wash fluid.

As this process continues, the ratio of clean wash fluid to soil continues to decrease. Without continuous in-process treatment, the bath becomes saturated and the process is forced to wash parts with dirty water. This uncontrolled situation places the entire burden of the washing process on merely two variables: heat of the water and mechanical action. These two variables alone are not able to achieve the results the process achieves at the beginning of the washing cycle. An example that may drive this point home is the old story of the large family who all take their bath on Saturday night. The first child comes out sparking clean, while child number 8 steps out of the same wash tub not so clean. Consequently, the more parts that are washed, the worse the result becomes for every part.

Two alternatives exist to rectify this situation. The wash water can be dumped and the system recharged completely, or systems can be put into service to remove the various layers of soil acquired during production.

To dump and recharge the entire bath is the simplest, yet the most expensive solution. The continuous washing results rely on individual machine operators taking ownership of the washing process and also taking the initiative to subjectively determine when the parts are not being cleaned to the expected specification. When they arbitrarily decide an unacceptable level of contamination remains on each part after they have traveled through the washer, the entire production line is shut down.

After production is halted, the plant maintenance crew must follow these next steps to, thoroughly clean the washer and recharge it.

First, a pre-determined amount of washer cleaner and de-scaler is added to the present bath. Next the nozzles and filters are removed from the washer and the water is heated to its highest sustainable level. This mixed solution is then pumped through the system for a period of 4 – 8 hours depending on the build up of scale and sludge in the tank. After this heated run is complete, the entire mixture is pumped out of the washer and either transported to holding tanks for disposal or transferred to the individual plant's water treatment system.

Consider this, a heavy metal stamping company in Windsor Ontario is performing the above tasks every other day. The bath is 580 gallons. The cost of the overtime labor to perform the task, the chemistry necessary to recharge the system and the disposal of the old waste water adds up to $1,500.00 every time. That is a cost of over $5,000.00 weekly.

Even if that extravagant cost were not enough, the commodity that cannot be recaptured using this dump and re-charge equation is time. Each shut down of the line puts the plant farther behind its production goal. In today's vibrant economy and just-in-time manufacturing environment, lost production time is a company killer. The other problems with performing this work is finding someone willing to literally dive into the messy sludge and clean it out. Consequently, this work is normally not performed when it first becomes necessary. Therefore, part quality suffers and subsequent production processes suffer as well. The worst part of this scenario is the problems never level off, they continue to get worse.

The other, more proactive, option is to treat the soil as it is being washed off of the part. This treatment should begin when the parts first begin traveling through the washer and continue for the duration of the process. The challenge is to find the best treatment system for each level of soil as it sits in the agitated bath tank.

When metal is formed there are a myriad of by-products that are created and need to be removed from the system in order to maintain the part cleanliness level that is expected. These by–products, how they can be classified and subsequently removed from the fluid, can be separated based on how they float, or sink, or remain suspended in a glass jar.

Heavy particles and chips drop to the bottom after the agitation of the bath ceases and they have a chance to settle out. What also drops to the bottom are heavy drawing lubricants that are made of a chlorinated paraffin substance. This wax based lubricant is heavier than water. Therefore, it will drop soon after mechanical agitation created by the pump stops or the bath becomes heavily laden with the wax and chemical solution mixture.

Synthetic metal working fluids and oils that are held in suspension by surfactant cleaning packages, remain emulsified and neither float nor sink. Instead, they remain in the bath and gradually saturate the cleaning solution.

Mechanically, emulsified oils stay emulsified until the mechanical action that causes the agitation is removed and then, being lighter than water, separate by floating to the surface of the tank naturally.

All of these layers need to be removed, however the sophistication of the methods of removal vary in their effectiveness and their maintainability from layer to layer.

Chips and fines are normally removed via some type of indexing paper, cartridge or bag filtration system. This can be done prior to the water stream entering the pump, or after the water stream leaves the pump and enters the manifold. The challenge in removing these chips, fines and slivers lie in choosing the correct micron size of filtration media to safely remove the particulate for the next process. This must be accomplished without investing so much into a system that we bypass the filtration payback or create a system that is effective in theory, but inoperable in practice.

Size a filtration system based on what is acceptable for the next step in your manufacturing process. If the next step can live with particulate 50 microns in size or smaller on the part after the wash, then the system should remove chips down to that size. The smaller the size needed to be removed, the more sophisticated the system and the more maintenance is required to assure it remains in operation. The larger the micron size filtered means the smaller particles are allowed to remain in the tank and possible cause problems of their own.

Particle filtration can use a step down, in-series configuration or a by- passable parallel arrangement or a combination of the two systems. The in-series method passes the water through a larger micron filter, then sends it through a filter with smaller microns and so on until the stream is filtered to the level necessary. This lengthens the duration the process can last by only filtering a specific size particle with each step. Therefore, each filter media step only holds a percentage of the total being filtered out of the stream.

The by-passable plumbing allows the operator to shut the flow off to a set of filters and send it through a completely different set of similar filters when the first set become plugged. This allows continuous operation by sending the water through the clean filter available with the turn of a valve. Dirty filters can be removed and replaced with clean filters at regularly scheduled intervals, rather than needing to shut the process down in the middle of a product run.

The combined approach allows filters to run longer by filtering only specific sizes, but also transfer water stream routes to allow for continuous operation. The drawback to this arrangement is it requires a great deal of floor space to accommodate all of this filtration.

The next layer of soil that can be addressed for removal is the mechanically emulsified oil in the tank. If this soil is taken out of the turbulation of the wash tank it will float to the surface. The challenge here is forcing the oil to float to the top and then processing it in a timely fashion so it can be returned to be used in the washing process.

This layer is the most noticeable and will cause the most problems for a number of reasons. First, if left untreated, this layer of oil will smell and, in extreme cases, create a breeding ground for bugs that feed off of the thick layer of stale oil. This layer, if allowed to build, will eventually fall out due to accumulated mass. When this happens, it creates the same problems as Chlorinated Paraffin and chips. It will coat heating coils, pump inlet screens and solution level controls and cause each of these to fail prematurely.

It will also carry over into subsequent stages including those that are non-fluid. When this occurs it creates a buildup on the blower manifolds or air knives. This is done due to the water being displaced with forced air. This air displaces the water and it is blown around the interior of the cabinet. As this blown water touches the steel manifolds, air knives and even conveying systems it evaporates. This leaves a residue made of accumulated soil and chemistry. In many cases this can build to the point where the interior of a washer's blow off cabinet resembles the interior of the Kentucky caverns because the build up is so pronounced.

The good news is, this is the layer where there has been the most advancement made in effective in-process treatment. These advancements have been made in both separation devices and the cleaning chemical's ability to reject oil when it is introduced into the solution. Manufacturers who effectively remove this layer of soil do so because they understand the origin of this layer and realize the profit potential it creates when it is removed effectively.

The manufacturer who knows his process realizes he will eventually have to deal with all by-products created in that process. Therefore, a business decision needs to be made as to what metal working fluid will be used to help form each part. Synthetic lubes, in general, improve tool life, but cannot be separated for easy removal once they are washed off of the part. Non-synthetic lubes are not as effective in protecting the metal working tools, but they can be separated using the correct cleaning chemical blend. Once they are separated, they are removed with different levels of success.

Depending on each manufacturer's cost-payback ratio, a decision must be made to use devices as inexpensive and archaic as an old style belt skimmer and squeeze blade; or as advanced a technology for separation as the Suparator thin film oil removal system. With a system like the Suparator, that aggressively uses flow and a patented weir device to force oil water separation, the possibilities exist to create additional revenue streams from the sale of used and recaptured oil because the oil and water can now be separated so thoroughly. This option can be explored in each individual application.

The middle layer of soil is the most difficult to address. This soil can be the result of such things as cleaners that chemically hold oil in suspension or the use of synthetic lubricants prior to washing. These synthetics often have, in their composition, soaps that will mix with the soaps in the wash cleaner to foam uncontrollably due to the chemical reaction between the two.

There is technology developed to remove this emulsified oil, but it presents its own set of restrictions. Since membrane systems and diffusion separation technology are challenged to remove chemically emulsified oils, their success or failure is determined by their ability to process a consistent stream of fluid. When that stream is altered in any way, it is quite possible the separation technology must be altered as well to accommodate the new stream. For those who can work within the parameters of this technology however, the results can be fantastic in terms of extended bath life.

Each layer of soil contributes to the deterioration of the washer and the reduced effectiveness of the washing process. It is up to each individual manufacturer to determine which method of in-process water treatment needs to be employed to allow that process to operate in the most profitable manner.