Cleaning the hard to clean

Process Matters in Solving Critical Parts Cleaning Issues

Even though they didn't get the order, Hubbard-Hall's cleaning team used its process knowledge expertise to solve a $1M issue for a defense manufacturer

In Brief

Hubbard-Hall's cleaning team resolved a $1 million inventory issue for a defense manufacturer by addressing process issues, not just cleaning chemistry. Despite not winning the product sale, their expertise led to the acceptance of 400 tubes, demonstrating a commitment to customer satisfaction and building confidence for future collaboration.

Stewart Holloway didn't get the sale he was looking for when he walked out of the prospective customer's plant, but that didn't matter to him.

"We helped them solve a potential quality issue they were facing, and that is all that matters," says Holloway, a Senior Account Manager at Hubbard-Hall, where he works with manufacturers and finishers to solve their manufacturing process problems, improve quality and first-time yields.

Holloway and several other members of the Hubbard-Hall team had spent months working with a manufacturer of military components to solve an issue that was causing customer concern of more than $1 million in inventory of aluminum tubes used in weaponry.

The problem was process-oriented — and not necessarily a cleaning chemistry matter — and with Hubbard-Hall's help, the defense contractor accepted the parts in question resulting in the release of the high-value inventory of parts of the manufacturer, who decided for the moment to stay with their current chemistry supplier.

Having the Customer's Best Interest at Heart

"We would very much have liked to partner with them on their chemistry," says Holloway, an Air Force veteran who flew Lockheed Martin's C-130 Hercules cargo planes and knew intimately about

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the weapons that were being made, cleaned, and coated. “But that day will come soon enough. For now, they know that we have their best interest at heart.”

Hubbard-Hall was called in 2020 by the company, a deep-drawn manufacturer and stamper, where 95% of the parts are aluminum with some mild steel. The facility has internal powder coating and liquid paint operations, and they outsource tin plating.

The company extrudes aluminum tubes as part of two individual missile systems: an armor piercing air to surface missile, and a multiple launch surface-to-surface guided rocket system. The tubes are 8 inches in diameter and up to 48 inches long and are extruded using a draw lube that is extremely thick and applied heavily with a paint roller.

The tubes are washed after each draw; 8 tubes are washed at a time in a SS basket with tubes positioned vertically. After two draws, tubes are sent out for heat treat at 970°F for three hours in an atmospheric oven before being returned to the manufacturer for additional forming steps and trimming. The final treatment is chem-film per MIL DTL 5541, which is performed at an outside applicator.

400 Tubes on hold at a Value of $1,000,000

The defense contractor was alarmed by a stain that appears after heat treating and remains through chem-film. This caused the tubes to be held at the manufacturer, pending an investigation into the root cause and potential remedy.

“This contract represents 40% of the manufacturer’s revenue,” says Mike Valenti, Director of Cleaning Technology and Product Development at Hubbard-Hall, who worked with Holloway on the account. “They had not supplied the defense contractor with a good tube in over three months when we got there.”

The manufacturer originally wanted Hubbard-Hall’s help in solving the stain issue in the cleaning stage, thinking it was an issue related to how the tubes were cleaned in an ultrasonic cleaning process they were using.

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The manufacturer asked Hubbard-Hall to meet two objectives:

1. Establish a cleaning process that cleans the tubes adequately, so the staining is eliminated.
2. Develop etch process that will remove staining on the 400 parts that have been through heat treat and held at the manufacturer in order to release $1,000,000 in parts.

When Holloway and Valenti inspected and evaluated the entire manufacturing process, they discovered several items that were a concern for them that they felt could be leading to the staining issue.

“Mike and I discovered several process issues that are contributing to their quality issues,” Holloway says. “There was also a single rinse that is 100% closed-loop, and water is fed to the rinse tank from a side tank when needed for drag-out replenishment. This water goes through a 3-step filtration process with a basket for large particles, a cartridge filtration, and a pool filter filled with pea gravel. There was biological growth present throughout the rinse system.”

Witnessing Process Concerns

Both Holloway and Valenti saw during the first production run that the tubes were not cleaned adequately when they tested using Hubbard-Hall’s Aquaease SLA 2300, an acidic soak and ultrasonic cleaner that can be used for the removal of a variety of soils and oxides from aluminum, stainless steel, Monel, and other high nickel alloys.

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"It was ugly with visible lube remaining on the top of the tube," Valenti says. "We noticed that when they set the cage of tubes down into the tank, the operator raised the cage up off the bottom. We asked why he did this, and he said the equipment manufacturer suggested this to keep the cage off the bottom of the tank to avoid excess wear on the tank bottom."

The Hubbard-Hall team discussed alternative fixturing of the parts and tried several different ways before determining that the original fixturing method was best for this application. Holloway and Valenti had them put the load back in, but this time directed the operator to put it all the way down. This proved to show a dramatic improvement in removing the lube, but a staining pattern was already present where the excessive lube contacted the tube.

"We looked at the SDS for the draw lube and determined that it contains an amine that Mike believes was causing an attack on the surface if allowed to remain in contact with the tube," Holloway says. "We suggested they hand-wipe the head of the tube after each draw to remove excessive lube and move from draw to wash as quickly as possible to minimize the lube exposure to the surface of the tube."

Changes in the Cleaning Process

The Hubbard-Hall team also noticed that it appeared that the ultrasonic energy might not be hitting all the surfaces of the tubes. They lowered the cage to the bottom of the cleaning tank and observed a noticeable improvement in removing the lube. Valenti also had them increase the energy of the transducers.

"The cage is allowed to dwell over the cleaner tank for an excessive amount of time, which allows the cleaner to 'dry down' on several areas of the tube," Valenti says. "They do this to minimize drag-out, and we explained why this is not recommended and detrimental to the process. The subsequent loads were processed with minimal dwell time over the cleaner tank."

> "The result showed that Hubbard-Hall's Aquaease SLA 2300 outperformed the existing cleaning chemistry when the proper adjustments were made to the process."

The cage was also being rinsed in a single flowing rinse tank with 100% recycled water, but the filtration process did not remove organic matter such as a surfactant. Hubbard-Hall suggested that incorporating carbon in the filtration system would help remove organics, which would result in a better-quality rinse and mitigate biological growth.

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Holloway says they also noticed that the manufacturer was using hot water from a garden hose to spray rinse the tubes after they exited the rinse tank, and Valenti explained the detrimental effects on the tubes due to accelerated oxidation from this practice.

“This practice was stopped,” Holloway says. “A water break was immediately observed when the hot water spray contacted the tubes. They now use cold water and have eliminated the water break condition. They have another tank available to incorporate a second rinse. We strongly recommended that they incorporate this tank into the rinsing scheme and make it counterflow.”

An Important Tool to Validate Any Surface for Cleanliness

Valenti says an important asset that Hubbard-Hall has begun using to show cleaning improvements is BTG Labs’ Surface Analyst, a tool used to validate any surface for cleanliness and guarantee reliable adhesion. The result showed that Hubbard-Hall’s Aquaease SLA 2300 outperformed the existing cleaning chemistry when the proper adjustments were made to the process.

> “Mike was able to determine with high confidence that the lube being used in the ironing process was the root cause of staining/etching of the tubes. The manufacturer diluted the lube by 20% to 25% with water for the ironing process to minimize staining/etch effect caused by the lube.”

“The new BTG Labs Surface Analyst tool was an asset in determining the effectiveness of our process versus the incumbents’ ultrasonic alkaline cleaner,” Valenti says. “I discussed with their president our ability to generate data that could be used to quantitatively substantiate the improvement realized in using our process. He said he would like to include some of this data in a report that will go to the defense contractor.”

The tubes are allowed to air dry (no mechanical drying). You can see residue left behind as the water evaporates and the surface becomes dryer. The ability to dry the tubes quicker would likely be an improvement, but IMO they need to also address the cleanliness of the rinse water.

The manufacturer sent 39 tubes to be heat treated to determine the effectiveness of Hubbard-Hall’s Aquaease SLA 2300 versus the existing cleaner. The results came back as expected.

“In the end, the Aquaease SLA 2300 is a better cleaner for this application,” Holloway says. “It gives a better surface finish, deoxidizes the parts, and is more free rinsing. Any significant residues — whether cleaner, lube, or both — are the cause of the burned-in defects during heat treatment. It also eliminates any high alkalinity remaining on the surface, which contributes to the surface etching pattern during heat treat.”

400 Tubes Accepted after Data from Hubbard-Hall

Without the needed process improvements, however, changing the chemistry alone was not going to eliminate the long-term pain for the manufacturer. Eventually, they did make many of the process changes suggested by the Hubbard-Hall team, and the result was noticeable. In fact, almost all of the 400+ tubes that were on hold by the defense contractor were eventually accepted after data from the Hubbard-Hall tests showed that the stains would not be detrimental to adhesion during the finishing and coating process.

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In addition, the closed-loop rinsing was also revisited as a likely contributor to staining issues. The swimming pool filter was removed and cleaned and will be packed with carbon before being returned to service, which Holloway says should help to remove organic material from the rinse water and improve rinsing.

While the Hubbard-Hall Aquaease SLA 2300 was removed from the tank pending additional investigation and approval for use by the defense contractor, Holloway and Valenti feel that the chemistry will result in a much better output by the manufacturer and a further reduction in rejects or issues.

Not being able to write the order for Aquaease SLA 2300 was a bit disheartening for Holloway because he knows it is a superior product, but he takes satisfaction in the fact that Hubbard-Hall was able to solve several process issues with the manufacturer and have built the confidence that is needed to forge a strong relationship down the road.

"Hubbard-Hall is known all over the manufacturing and finishing industry for its superior chemistry," Holloway says. "But we also know a lot about process systems and what is happening — or should happen — to parts long before they get to the cleaning tanks. We proved that, and we are ready to help them again if needed."