CASE HISTORY

Bombmaker hits the target with a one-step cleaner

To make a better bomb, a manufacturer switches materials and installs a finishing line that uses the combination of a one-step nonaqueous cleaner with powder coating.

How does an established company that takes the pains to open a new finishing plant in southern California end up relocating its fledgling operation to Greenville, Wis.? Convenience might sum it up. Compliance might be another explanation. Cost-effectiveness. Coating quality and ease might be another. Or maybe, all of these apply to Allied Mechanical's midwestern operation, Allied Mechanical Wisconsin.

The company supplies practice bombs to the government, which has been buying this bomb style since the Korean War. Specifications call for a 500-pound bomb. Practice bomb might be categorized as an oxymoron in some people's mind. But these practice bombs do serve a necessary function in training jet pilots. "People say 'practice bomb—what the heck do you want to do that for?'" said Jim Rice, manufacturing manager. "How many of those half-million dollar bombs that you hear of on the news do you think that they're going to go out and practice with? They're going on jets to train the pilots—not necessarily how to hit things with them but how to control the aircraft when you let go of one."

Allied Mechanical decided to adopt powder coating as its new finishing method. Powder coating seemed suitable to the climate of the southern California finishing environment as well as the conditions the practice bombs would be subjected to. The company's solvent coatings would be problematic in getting permits to apply it. "Up until this point, everybody's been using the solvent-based paints, which is very unfriendly environmentally," Rice said. "It needs a ton of permits. With powder coat-

The 500-pound bombs enter and exit the washer through flapped plastic shields that contain the cleaner within the unit. A series of nozzles spray the chemical, a propylene glycol-based compound, that cleans, phosphatizes, and seals without postrinses.

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Powder proved logistically sound for coating in southern California. However, cast-ductile iron bombs need to be formed in a foundry. The foundry Allied Mechanical would work with is in Wisconsin. Because this new plant was devoted to making practice bombs from cast-ductile iron, it became evident that locating the plant in Wisconsin would make more sense. "The driving force of locating here was close proximity to the foundry," Rice said. "We're 45 minutes away, so when you start figuring the shipping costs and all that, it's a no-brainer. So that's how we ended up in Wisconsin."

A year ago, the company transported the finishing line and installed it in its Greenville, Wis., plant. Because it complied with the most stringent regulations in the nation, getting approvals for the system at its new location proved easy.

Machining and loading 500-pound parts

The foundry produces a precision casting bomb that is aerodynamically complete and that meets a certain metallurgical standard. Allied Mechanical uses an automated machining line to machine the casting exterior, including the nose end and the aft end, and to place lug inserts into the middle of the bomb. The lug inserts enable the bomb to be attached to a jet wing. A large robot performs the whole machining process. "The bomb weighs 500 pounds," Rice said. "The fixturing we use to machine the bomb weighs 500 pounds so [that the robot is] wheeling 1,000 pounds around. It's kind of a big monster."

After machining the bomb, workers load the bombs onto the powder coating line with a series of overhead hoists that hang the bomb body onto the conveyor track. Allied Mechanical designed this overhead hoisting system to handle a 2,000-pound load.

"One of the driving forces was that this was going to be installed in southern California," said the company's manufacturing manager. "With this one-step pretreatment, no permits are needed and it's environmentally friendly."

Cleaning proves the catalyst for compliance and quality

Once on the conveyor, these practice bombs enter the cornerstone of the system, the washer. In the design phase, Allied considered many types of pretreatment, including iron phosphate. However, one rose above the others in terms of compliance issues while meeting the government specification. The surface preparation solution the company chose is a one-step pretreatment method. The chemical, a propylene glycol-based compound, cleans, phosphatizes, and seals metals without postrinses. The process works at ambient temperature and can be used in spray (low-pressure flowcoat), immersion, and batch coating systems. Process times range from 60 to 90 seconds. The cleaning solution has unlimited bath service life and never needs changing, demanding only chemical additions to compensate for drag out.

The finishing line powder coats the bombs with government-specified sky blue.

The process doesn't create effluent or solid waste or generate hazardous substances, such as hazardous air pollutants. "With this one-step pretreatment, no permits are needed, and it's environmentally friendly," Rice said.

The bombs enter and exit the washer through polypropylene flaps. These flapped entries help contain the chemical inside the washer. Inside, a series of nozzles sprays the cleaning solution onto the bombs. Before exiting, any residual chemical is blown off the parts. "We don't waste a drop of it," Rice said.

This portion of the system has proved to be low-maintenance. Besides turning the washer on, workers only change the filters and top-off the chemical levels as needed. Workers change the filters weekly. The cast-ductile iron dictates this frequency because it tends to be dusty and deposits more impurities into the wash system than other metal types. According to Rice, diligent filtration allows the company to effectively control surface preparation quality. "We're very pleased with what we're getting for [service] life out of it," Rice said.

In a straight cost comparison, the propylene glycol-based compound costs more than a conventional phosphate system. But when other processing factors are considered, the one-step pretreatment proved the more cost-effective method for Allied Mechanical Wisconsin. Unlike iron phosphate, this pretreatment method doesn't need waste treatment equipment and ancillary disposal costs. In addition, the one-step pretreatment needs no permits.

An infrared booster oven and convection oven combination cures the finish on these massive missiles.

Curing mass proves critical

After exiting the washer, the bombs traverse the conveyor line and then pass through a dry-off oven. Next, they pass through the powder coating booth that applies the government-specified sky-blue colored powder to the bombshells.

At the other end of the finishing line arose the great processing challenge. Where pretreatment proved a relatively straightforward proposition, curing these massive parts posed a processing riddle that Allied Mechanical had to wrestle with to achieve a proper finish. The cast-ductile iron bomb functions as a huge heat sink, which means it's difficult to bring up to metal temperature and then equally troublesome to cool for workers to unload the parts. A learning curve spanning 6 weeks of calculated trial and error ensued. Using an infrared booster oven followed by convection curing and forced cooling, Rice and his team experimented with combinations of temperatures and line speeds to concoct the perfect bomb-baking recipe. "It was phenomenal what we needed to do and the speeds we needed to work at in order to get the powder to cure," Rice said. "I kept doing it and doing it to find the best cure schedule. It was an in-depth process because I think everyone underestimated what it takes to heat up that amount of mass."

Blowing liquid coatings out of the water

The combination of the one-step cleaner and powder allowed Allied Mechanical not only to meet, but also to surpass, the government's specifications for this project. In addition to assembling a finishing line that was environmentally compliant, the company was able to produce a more durable finish with powder than with the liquid coatings previously used. "There are a certain number of salt-spray hours to meet and everything else," Rice said. "What [the government is] finding with this powder is that it holds up so much better. The powder coating is performing very well for them—far superior to solvent-based." **PC**

Allied Mechanical Wisconsin makes these practice bombs from cast-ductile iron. As a result they can be reused.

One-step nonaqueous pretreatment: ***Carpenter Chemicals, Alexandria, Va. 703/683-1570.*** *www.cc-lc.com*

Carpenter Chemicals LC

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