

MEI benefits from switch to a new coating system

Minnesota Elevator, Inc. made several successful changes to their coating systems in 2009. A multi-stage conversion coating system and a powder coating system were added to improve product quality.

Since 1971, Minnesota Elevator, Inc. (MEI) in Mankato, Minnesota, has specialized in the manufacture, installation, modernization, and servicing of various types of elevators. Their equipment is found in nearly every US state as well as several foreign countries.

Process Overview

Prior to 2009, parts manufactured at MEI were manually cleaned with either a spray wand cleaner (iron phosphatizing process) or by hand; employees would wipe the parts with rags. Once cleaned, the parts were painted with an air-dried water-based primer and topcoat. Parts required up to 24 hours of dry time between coats. They were then assembled or shipped to customers.

Incentives for Change

Due to a variety of reasons, MEI was experiencing an unacceptable rate of defects. The defects were primarily caused by poor cleaning practices, which resulted in flash rusting and poor paint appearance. Additionally, the painting process often took several days as parts dried and the paint cured, which limited the facility's throughput and the drying process required a significant amount of floor space.

The Solution

MEI needed to address the issues being caused by the current cleaning and painting process. Therefore, the company worked with a variety of vendors to determine how to decrease the number of defects and increase the facility's throughput, while maintaining or reducing operating costs. Through the company's research, they decided to install a new powder coating line with a five-stage conversion coating line.

Conversion Coating Line Installation

MEI determined that improving the conversion coating line would not only improve the product cleaning process, but also product quality. Therefore, a new conversion coating line was installed. It consisted of five stages including an acid de-scaling stage, rinse, cleaner / phosphatizer,

rinse, and sealer. A reverse osmosis (RO) system was also added to provide cleaner water for chemical bath make-up and the rinse stages.

Stage	Iron Phosphatizing Line
1	Acid descale - heated to 130° F
2	Room temp RO rinse
3	Cleaner / phosphate - heated to 130° F
4	Room temp RO rinse
5	Non-chrome seal coat

Powder Coating Line Installation

The new powder coating line that was installed was designed by MEI with the help of coating, chemical, and equipment suppliers to ensure the system would fit the company's needs and within the space available in the plant. The new booth was installed in an area previously occupied by a second liquid painting line that was dismantled.

Currently, the new powder coating spray booth holds two painters who manually apply the powder coating. A power and free conveyor, also installed as part of this project, allows flexibility in the system to stage racks of parts and move them through the system when needed. The conveyor also has adjustable speeds to handle most of the parts that MEI paints.

Improving on the Solution

Once the new conversion coating and powder coating system was installed and functioning well, MEI began to look at ways to improve the overall system as well as their process. MEI determined that different chemicals could be used in their manufacturing process as well as the conversion coating system to lessen the toxicity of the system and the energy required to heat the baths.

Changes to Metal Cutting Gas

Part of MEI's manufacturing process includes laser cutting parts. It is important that these parts are cut accurately and are also cosmetically appealing. During the laser cutting process, MEI previously

used an oxygen assist gas for the carbon-steel cutting. However, oxygen has a number of challenges associated with its use including oxidizing the cut surface. Once the parts were cut, MEI had to remove the oxide scale from them prior to painting to eliminate potential paint defects.

As MEI undertook the installation of the new chemical conversion and powder coating line, they also investigated an alternative to the oxygen assist gas. The facility determined that nitrogen gas was a better option for the laser cutting process on certain parts and implemented the change in their process. This change increased the processing speed of the laser cutting and eliminated the oxide scale on the parts. Therefore, MEI was able to eliminate the strong acid in the first step of the conversion coating process. This step was replaced with an alkaline cleaner.

Changes to the Phosphatizing Step

After the conversion coating line was installed, MEI saw a noticeable difference in the number of defects. They determined that the new line, as well as the powder coating booth, was improving the throughput and quality of their products. Facility staff members then began investigating ways to reduce chemical and energy use within the conversion coating line.

MEI worked with their chemical supplier to evaluate alternatives to the iron phosphatizing chemical used in stage 3. The supplier suggested zirconium oxide (nano-ceramic) conversion coating, which is phosphate free, used at ambient temperatures, and does not require a seal rinse. MEI tested the alternative coating in combination with both paint lines, liquid and powder, and found that the new conversion coating met or exceeded performance requirements. MEI began using the alternative conversion coating, which allowed the facility to reduce the number of chemical stages from three to two and eliminated the energy previously required to heat the iron phosphate stage. Due to the rinse requirements before the conversion coating, MEI moved the chemical to stage 4 and added another RO rinse to stage 3.

Stage	Zirconium Oxide
1	Alkaline cleaner - heated to 130° F
2	Room temp RO rinse
3	Room temp RO rinse
4	Room temp Zirconium Oxide
5	Room temp RO rinse

Benefits

Since installing the new conversion coating and powder coating system, MEI has experienced improved product quality including better appearance and fewer paint defects. The company reports that customer reports of defects have virtually been eliminated

since the conversion coating and powder coating system came online. Increases in production throughput are another benefit MEI has realized through this project. In fact, the facility's coating line capacity has doubled as the parts come off the line ready to assemble after just one coat of paint, unlike the water-based paint line.

The company has also been able to free up approximately 900 square feet of floor space previously needed for drying parts. This has reduced congestion and opened up space for manufacturing processes, packaging, and shipping.

The installation of the new conversion coating and powder coating system also had some hidden benefits for employees. The new conveyor system that was installed as part of this project has improved employee safety because parts are not lifted and turned as often during the cleaning and painting process. Additionally, the powder coating system has resulted in a cleaner work environment as the transfer efficiency is higher than that of the liquid paint line and overspray in the powder booth is collected.

The facility has seen a reduction in thermal load since the installation. While the new system requires energy for drying and curing parts, the heated air make-up requirements have been reduced as the liquid spray paint booth is used for only about 25% of the parts in the facility. Therefore, the facility does not have to exhaust as much heated air during the winter months in the liquid painting area. Additionally, the switch to the non-phosphate, non-heated conversion coating has reduced the facility's annual thermal load by approximately 16,000 therms, resulting in savings of approximately \$10,000.

MEI is also using fewer chemicals in the conversion coating system. Since the switch to zirconium oxide conversion coating, the facility is only using two chemical baths, rather than three. The installation of the new conversion coating system will annually keep 400 gallons of phosphorus-containing chemicals out of the system and will eliminate 340 pounds of phosphorus in the wastewater stream.

Next Steps

To continue improving upon their painting system, MEI is in the process of evaluating new powder coatings, which will cure at lower temperatures and reduce the powder curing oven's energy use.

Additionally, MEI has found that the new conversion coating system results in more wastewater than the facility was discharging before the installation. Therefore, the facility has automatic shut-off valves on rinse stages which turn off the water if no parts are entering the system in an attempt to lower the wastewater discharge. MEI also continues to look at options to reuse RO reject water and to minimize the use of rinse water.



For More Information

MnTAP has a variety of technical assistance services available to help Minnesota businesses implement industry-tailored solutions that maximize resource efficiency, prevent pollution, increase energy efficiency, and reduce costs. Our information resources are available online at <mntap.umn.edu>. Please call MnTAP at 612.624.1300 or 800.247.0015 for personal assistance.