Cost savings with oven temperature profiling

By understanding and controlling your thermal cure process, you can improve operating efficiency and maximize your company’s profitability. This article discusses how oven temperature profilers helped two companies improve their finishing output. It includes graphs and charts on how this was done, and discusses four key areas in your curing system where oven temperature profiling can help cut costs.

The majority of today’s oven temperature profiling systems (see example Figure 1) are used to simply check that the coated product reaches and maintains the specified temperature for the correct time (dwell time), ensuring the coating is thermally cured. This is an essential step to improving operating profit by simply reducing the risk of rejects or the need for costly rework. Not getting the cure schedule right could significantly increase the true costs to your company and affect your whole operation: labor, energy, coatings, and lost business (Figure 2). Guaranteeing cure quality is the mere tip of the iceberg in terms of how profiling can help you achieve the full potential of your coating operation.

Oven control: Cost-saving potential
To be able to control your oven, you first need to understand the way it works. A temperature profiling system is an ideal tool for maximizing the efficiency of your process and for getting the most out of your cure oven. Many oven temperature profiling systems can be used for such purposes. For example, systems are available for measuring up to six product or air temperatures inside an oven, providing protection for up to 2 hours at 400°F (200°C). This type of system is ideal for standard
paint and powder coating applications. These units have been designed for ease of use and are rugged, reliable, and affordable.

Rousseau Metals uses such a system in its operations. Said Yves St-Amant, production engineer: “On my powder line that was installed a year ago, I found that the curing wasn’t constant along the oven and I had cold spots. For that entire year, I had to raise the oven temperature 15°F to get a good curing.” When the company first used an oven profiling system, it discovered the temperature variation (Figure 3a), he said. To correct the situation, the company installed walls in the oven to prevent cold air from coming in and cooling the parts at these specific spots (Figure 3b). Following are some ways you, too, can realize gains from oven profiling.

**Match process conditions.** In many coating operations, maximum productivity levels are limited by the rate at which the cure process is performed. Optimizing the oven line speed accurately can significantly affect the throughput of product, and hence its operating profit. After analyzing the oven profile data, it’s possible that optimal line speeds can be determined for each batch of product, ensuring the oven works at maximum capacity for each job. Increasing the line speed by 10 percent doesn’t seem like much, but over the period of a year can have a significant effect on productivity without any significant increase in operating costs because the energy and labor costs would remain unchanged.

St-Amant explained it this way: “Right now I am looking to replace all the ducts in the oven as I am not able to get enough airflow where I need it. Once replaced, I will use the [oven profiling] system to ensure we still have good curing and stable curve along the oven. At that time, I will be able to lower the oven temperature by 10°F and raise the line speed on some products to achieve better productivity.”

**Monitor process variations.** Monitoring your process regularly (Figure 4) allows you to identify how your oven performs. Using such information is possible to then identify any gradual drifts in process variations, which left unchecked may eventually create cure problems. Rousseau Metals built a standard rack (Figure 5) with different plate thicknesses for the oven profiling system with three probes at the top and three at the bottom, said St-Amant. There is one air probe at the top and bottom, one probe on 12-gauge steel on the top and bottom, and finally one probe on 24-gauge steel on the top and bottom. “This way, I am able to compare two trends, knowing that the probes were exactly placed in the same condition,” he said.
Before cure quality is affected, it may be possible to make necessary process adjustments or possibly repair or replace the faulty component causing the problem. Brian Plawecki from Tawas Powder Coating uses the same oven profiling system as Rousseau Metals. The company had one part that was on the low end of the cure window. “We made process adjustments to center the cure in the cure window of the material specified,” he said. “[In doing so], we have not had to re-cure the material.”

Such action is made at the company’s convenience so that it can be planned on a weekend or service period without any compromise to the production schedule.

**Minimize downtime.** When problems occur, identify them immediately. Use the profile data to identify the possible cause of the problem, and allow corrective action. Remember, every minute your oven is non-operational, your operating profit is affected.

**Balance the oven.** Use an oven profiling system to balance the heating conditions over the entire oven (vertical height or across mesh belt). Place the maximum load in the oven, and optimize throughput. Even today, it’s not uncommon to find powder coating lines operating with the rack only partially loaded. Cure lines with product excluded from the top of the rack to avoid overcure or from the bottom to avoid undercure will benefit significantly from any level of temperature balancing. Often, in convection ovens such imbalance can be corrected by adjusting or servicing air inlet baffles, resulting in a changed airflow through the oven. By using the temperature profiling system, it’s possible to monitor the air temperature over the entire height and length of the oven, which is essential in a temperature balancing operation. Increasing the rack load immediately increases productivity. For example, by increasing the load from eight to 10 aluminum extrusions, productivity increases by 20 percent. Successful balancing operations may even allow the setpoint temperature to be reduced, allowing additional fuel savings.

**Energy savings: The financial justification**

In a powder coating plant, the operating cost of the cure oven is significant in the total operating cost. Making small percentage changes in the operating efficiency of the cure process can make a significant contribution to the overall operating profitability. “A lower temperature in the oven means energy savings and that is what I used to calculate the return on investment to replace the air ducts in my oven,” St-Amant said. “Our savings [are] estimated at $2,500 a year for propane only.”

**Promote your company’s quality procedures.** In a competitive market, providing your product or your company’s services with that added extra can make the difference between winning and losing business. With coating functionality and prices being very similar, an excellent means of adding value to the service you offer is to provide validated evidence of the coating cure quality in the form of a profile graph (Figure 6).

“We were asked by a customer not to cure their product above a certain temperature,”
said Plawecki of Tawas Powder Coating. The company was able to use its temperature profiling system to determine the maximum temperature and make process changes to ensure proper cure of their product. "Without it, we would have been guessing at the metal temperature and complete cure time," he said. "The system worked flawlessly and the graphs generated won us the business." Such information can make all the difference and gives your customers confidence in the product.

**Conclusion**

Regular use of temperature profiling equipment can not only guarantee the quality of coated products, but also significantly enhance the efficiency and operating profitability of the cure process. Oven profile systems can help you get the best out of your oven and maximize your business potential.

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**Editor’s note**

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