

POTENTIAL BENEFITS OF SUPERVISORY CONTROL SYSTEMS IN SINTERING FURNACES FOR PM

A test was conducted at Allegheny Powder Metallurgy (APM) to validate CompAS' value proposition. APM, a subsidiary of Hawk group, manufactures PM and MIM parts for automobiles, power-tools, lawn and garden, and home appliances. There are five divisions of Hawk group, which are located at different parts of US. APM is a mid-sized PM plant and is situated in Falls Creek, PA, a town very close to St. Marys, the PM capital of the world. There are several steps in the production of PM parts. The process starts with the metal powder, which is pressed into molds. Next, these molded parts are heat-treated/sintered in a sintering furnace. After traversing the length of the furnace they exit as a finished product. One of the greatest challenges in sintering is setting up furnace parameters. Before placing parts inside the furnace, operators must determine optimum furnace settings (e.g., zone temperatures, belt speed, process gas flow, etc.) to ensure proper heat treatment of the parts. This includes proper part de-lubing in the preheat zones followed by proper sintering in the high heat zone. The challenge; there is no simple way to determine "best" furnace settings to achieve good quality parts. In addition, there are several such furnaces to setup (nine in the case of APM). As a consequence, every part is processed with the same furnace setting irrespective of their size, shapes and property. This wastes resources, utilities and energy, reducing overall productivity.

Objectives

The underlying objective of the study was to quantify the potential benefits derived from use of LINEMOD software to (a) Increase furnace productivity, (b) Automate furnace operation & data collection, (c) Reduce pilot runs, and (d) Enable remote monitoring of furnaces.

Approach

The test at APM was conducted at one of the two furnaces where we have installed LINEMOD system. First, the biggest part (shown in Fig. 2) was run through the furnace to establish a base case and the data recorded using LINEMOD. This run enabled us to determine the critical process parameters, e.g. sintering time at temperature of 13 minutes and delube temperature of 1550 F (shown in Fig. 1).

Three other parts (Fig. 2) with varying sizes were selected. Previously, these parts were all run at the same belt speed regardless of the differences in their sizes. LINEMOD was first applied off-line, to generate optimum setpoints for each of these parts. The new setpoints were then used to process parts in real time and the parts tested for quality.

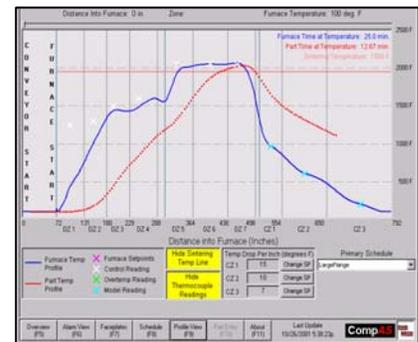


Fig. 1: LINEMOD PROFILE screen showing base case profiles for furnace (blue) and parts (red)



Fig. 2: Four different types of test parts.

Results

All the parts in the test (Fig. 2) were previously being processed at 6.0 in/min. With the setpoints generated by LINEMOD, APM was able to achieve a belt speed of 8.0 in/min for Parts 1 & 3, a 33.33% increase in belt speed. Part 2 was tested at 7.5 in/min and satisfactorily passed the quality tests demonstrating a 25% increase in belt speed. (Table 1.0 summarizes the results)

Part Name	Weight (g)	Existing Production speed	LINEMOD Prediction	Test Belt Speed	Measurement Test	Micro-Structure Test
Base Case	520.0	6.00 in/min	6.00 in/min	6.0 in/min	Passed	Passed
Part 1	20.87	6.00 in/min	8.15 in/min	8.0 in/min	Passed	Passed
Part 2	73.30	6.00 in/min	7.7 in/min	7.5 in/min	Passed	Passed
Part 3	10.94	6.00 in/min	8.2 in/min	8.0 in/min	Passed	Passed

Table 1.0. Test results

In order to translate the impact of increased belt speed into economic terms, a payback calculation was performed (Table 2.0). An increase in belt speed meant greater throughput and increased efficiency, a saving of upto \$76,000/year¹ on one furnace alone. Since the system can be used off-line to simulate the effect of alternate furnace setups, it helped APM to drastically cut down on pilot runs. In addition, LINEMOD system provided APM with the ability to automatically collect furnace and part data to create process reports. eProessView further extended LINEMOD's capabilities. Using Internet, the system can send data to any remote computer and an authorized user can view the furnace operations in real time. While this has allowed APM to easily share process data with its partners, it has also enabled remote troubleshooting of operations.

PAYBACK TABLE BASED ON SINTERING COSTS				
Belt Speed (in./min.)		% Efficiency Improvement	Cost Savings / yr.	Payback (months)
Original	New			
6.0	6.5	8.33%	\$19,192.00	7.2
6.0	7.0	16.67%	\$38,407.00	3.6
6.0	7.5	25.00%	\$57,600.00	2.4
6.0	8.0	33.33%	\$76,792.00	1.8

Table 2.0. Payback Calculation

¹ Calculation is based on a 33.33% increase in belt speed from 6.00-8.00 in/min, \$40/hr processing cost and 5760 work hours in a year.