

## TEMPERATURE PROFILING: UNDERSTANDING THE BASICS

When employing heat treatment as part of your manufacturing operation, the critical information you need is the temperature of the product as it is taken through the heating process. Achieving the correct temperature – and for the correct time – can significantly affect the quality of the product, whether it be the correct cure on a painted car body or the physical properties of a heat-treated aerospace part.

### What is Temperature Profiling?

Temperature profiling is the term used to describe the process of recording and interpreting the temperatures of products and/or air through a heat-treating process. Temperature data is measured continuously using thermocouples connected directly to the product(s) at different locations as it travels through the oven or furnace. The measured temperature readings are stored in a data logger, which moves along with the product and is protected from the hostile environment of the process by a thermally insulated box referred to as a thermal barrier (Fig. 1). Either during the process “telemetry” or post-process, the profile data is retrieved from the data logger and transferred to a computer software package where it can be reviewed, analyzed and reported.



*Fig. 1 The thermal barrier protects the data logger as it moves through the oven or furnace.*

Temperature data collected from the profiling operation provides a graph/profile showing what temperatures the product or oven experienced during the entire heating procedure. Such information creates a thermal fingerprint of the product and process, which is critical to the understanding of the heating operation. In its simplest form, this information tells you how hot your product became and for how long, and what temperatures it reached and at what point. Process engineers know what the perfect profile for their product should be; variations from the ideal indicate a potential problem or unacceptable quality. By analyzing the profile, they are able to verify products are of the highest quality, increase throughput, and solve production problems.

## **Which alternatives don't work?**

Control thermocouples can tell you how your oven is working, but do not provide the complete picture and do not allow direct product temperature measurement. This is critical, as the heating rate is governed by the makeup of the product (i.e., construction, material, size, etc.). Direct product temperature measurement is possible using trailing thermocouples, but this approach can be unsafe and difficult when the oven/furnace is long and full of product.

IR sensors are an alternative approach in some situations, but only offer a snapshot of the temperature at a specific point on the product and in the process. As such, the IR sensor point measurement does not provide the entire process profile.

## **Why should I profile my process?**

Your oven, furnace or kiln is the heart of your business. The quality and reliability of your finished product depends upon its performance. You know a lot about every other manufacturing step in your operation, but do you really understand what's going on inside your conveyORIZED oven or furnace? If production is going well, great! But can you make it better? Can you take immediate corrective action when it's not going well? Do you have information to prevent problems? Wouldn't you like to?

Routine temperature profiling delivers reliable data to optimize your process, prove process control, and make corrections when required. Today, however, compliance and traceability are key issues. A product report proving compliance to manufacturing specifications may not yet be a requirement, but will likely be a major selling point for your product.

You don't question why your doctor takes your pulse and blood pressure, do you? It's the same thing with your production line. A product report proving compliance to manufacturing specifications is like getting a clean bill of health from your doctor.

## **What are the benefits of profiling?**

### *Control product quality*

A growing scrap pile or increased customer returns means only one thing: something has gone wrong in your manufacturing operation. If you know precisely what is happening to your products during production, you can easily reduce rejects, rework, scrap and returns. Prevention is not as exciting as solving a problem once it has occurred, but it's a lot more profitable. Makes sense, doesn't it?

### *Rapidly setup new processes*

Routine monitoring of your process establishes a database of profile information, which will help you develop new processes accurately and efficiently. You'll know exactly what temperature settings and line speeds will result in the best quality product.

### *Identify problems before they affect quality*

Statistical Process Control (SPC) functions identify potential problems, allowing you to schedule preventative maintenance at your convenience.

### *Find faults quickly*

When a problem occurs because of improper heating, you'll quickly spot the cause and location. Then, you can analyze profile information to determine the necessary corrective action, and run follow-up profiles to prove the changes were successful.

### *Increase productivity*

Analysis of temperature profiles will also show how and where you can optimize operations. By rebalancing the time at temperature and heat ratios, you may be able to increase line speed and product throughput. And by knowing exactly what is happening to your product in your process, you'll be able to minimize time spent on test runs and process setups – allowing a greater number of profitable production runs.

### *Prove process control (QS/ISO9000)*

A single-page standard report is only one way our Tracker Systems prove process control – all the data files are fully traceable as well. Each file includes the operator name, product type and data logger serial number in addition to temperature information to prove that your process is being performed in a controlled and repeatable manner every day.

### *Minimize fuel costs*

Rising fuel costs can significantly impact your operating budget. The simple fact is that lower costs mean higher profits. Every Tracker System gives you the information you need to make the best possible product with the highest efficiency (i.e., less heat equals less fuel). And reduced fuel consumption has a positive environmental impact!

## Conclusion

Understanding what is happening to your product as it travels through an oven or furnace is the first step to controlling and optimizing that heat treatment process. Temperature profiling is a critical tool used by thousands to help obtain that understanding. Contact Datapaq to determine what Temperature profiling solution is best for you and how it can help you maximize the potential of your thermal manufacturing process.

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### Worldwide Service

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