

FURNACES

INTERNATIONAL

FURNACE TECHNOLOGY FOR THERMAL PROCESSING OF METALS, GLASS & MATERIALS



www.furnaces-international.com - MARCH 2023



FURNACES
INTERNATIONAL



6

30

30

Editor: Nadine Bloxsome
 nadinebloxsome@quartzltd.com
 Tel: +44 (0) 1737 855016

Editorial Assistant: Zahra Awan
 Tel: +44 (0) 1737 855038
 zahraawan@quartzltd.com

Production Editor: Annie Baker

Sales Manager/Advertisement
 production: Esme Horn
 esmethorn@quartzltd.com
 Tel: +44 (0) 1737 855036

Subscriptions:
 Jack Horwood
 subscriptions@quartzltd.com

Managing Director: Tony Crivnan

Published by: Quartz Business Media Ltd,
 Quartz House, 20 Clarendon Road,
 Redhill, Surrey RH1 1QX, UK.
 Tel: +44 (0)1737 855000.
 Email: furnaces@quartzltd.com
 www.furnaces-international.com

Furnaces International is published quarterly
 and distributed worldwide digitally



FRONT COVER:
 SMS Group



© Quartz Business Media Ltd. 2023

GLOBAL FURNACES

- 2 Global Furnaces News
- 6 Phoenix: From the flames... monitoring innovations
- 25 Event review: Glassman Europe 2023
 Making the Furnace of the Future
- 30 Ametek Global:
 How combining IMAGEPro Glass with NIR-B-2K thermal imaging and Lancom 4 can improve carbon footprint and reduce emissions

LIFE OF A FURNACE

- 34 Life of a Furnace News
- 36 Heat Treat Today:
 Radiant Tubes: Exploring your options
- 44 The rise and fall of a blast furnace

GREENER FURNACES

- 50 Greener Furnaces News
- 54 Decarbonising regenerative glass furnaces
- 64 Decarbonisation of secondary aluminium melting



Welcome to the March issue of Furnaces International.

As I'm writing this, the weather here in the UK can't seem to make up its mind as to whether it is officially spring yet, but with the clocks poised to go forward at the end of this month, longer days and lighter evenings are on the horizon again.

We are always a few steps ahead in publishing and looking towards the next few months, so the months can fly by, but it seems the furnaces industry is also not standing still at the moment.

After a lively Glassman Event was recently held in Istanbul, Turkey, this issue features a host of articles featuring the efforts going into decarbonising glass furnaces.

There is also a fascinating historical look at an iconic UK landmark, Redcar furnace, which after close to five decades of service, was demolished in late 2022.

I hope you enjoy this issue!

Nadine Bloxsome, Editor, Furnaces International,
 nadinebloxsome@quartzltd.com



© Quartz Business Media Ltd. 2023

FROM THE FLAMES ... MONITORING INNOVATION

Zahra Awan* Spoke with Dr Steve Offley** on the past, present and futures of the PhoenixTM company. With the introduction of new technology, the transition to Industry 4.0, for the furnaces industry, becomes one of many possibilities.

*Editorial Assistant

**Product Marketing Manager at PhoenixTM

1.Can you give a brief history of the PhoenixTM company - how was it founded and why?

PhoenixTM "Phoenix Temperature Measurement" was founded in 2010 by a small, experienced team of individuals who had previously worked together for a well-known temperature monitoring company which had been acquired by a large American corporation providing industrial handheld measurement systems. From humble beginnings PhoenixTM has grown over the last 13 years with its team being strengthened by other experienced personnel from the same original company including myself (over 20 years), extending market and technology knowledge further.

As you can see by the name chosen for the company the vision of PhoenixTM was to bring back new life to an important industrial technology. It seemed also fitting as the image of the phoenix rising from the flames/ashes is comparable to the PhoenixTM system emerging from the flames of a heat treat



PhoenixTM
Phoenix Temperature Measurement



furnace.

The company prides itself on a strong ethos to innovate and provide added value in terms of performance, and extended application suitability. We offer a value solution with informed market knowledge and quick efficient responsive service and support globally. Small enough to care, yet large enough to support the customer base. We strive to exceed customer expectations, offering that personal touch that makes a difference, often missing from larger corporate operations. As our tag line states.....where experience counts!

2. What is the technical principle of Thru-process temperature monitoring solutions offered by PhoenixTM and how do they benefit over traditional methodology?

In any thermal processing there is a need to monitor the temperature of the product being processed in the furnace. The product temperature is often critical to important metallurgical transitions to give material specific properties essential for its intended use.

Traditional temperature monitoring methods don't always give the desired information.

Furnace control Thermocouples provide only a snapshot of the furnace temperature at a specific location but not the product temperature. IR sensors or cameras are generally fixed point also, need line of sight, and only offer approximate average



Data Logger

surface temperature measurement. Trailing thermocouples can give product temperature measurement continuously through a furnace but use is difficult, if not impossible, and unsafe in many applications. The method is not feasible if the heat treat process is modular and generally impossible during production flow.

Thru-process temperature profiling is a simple concept but gives you product temperature information through the complete furnace with efficiency and safety. The data logger measuring product and or environment temperature is sent through the entire furnace process measuring temperature continuously during the journey. The data logger is protected from the potentially harmful process conditions (Heat, Gases, Pressure, Water Quench, Oil Quench) with a process specific thermal barrier design. The shape, form, material and protection technology is matched to the specific application challenges.

At the end of the process a temperature profile is obtained which is basically a thermal fingerprint of what temperature



Help the planet
with existing
technology

- Reduce
CO₂ with:
- Boost
 - More boost
 - Electric
forehearth
 - Superboost
 - Hybrid
furnaces

Flexible future
furnaces from
Glass Service and FIC

www.fic-uk.com
+44 (0) 1736 366 962



The World's **Number One**
in Furnace Technology

FIC (UK) Limited
Long Rock Industrial Estate, Penzance,
Cornwall TR20 6HX, United Kingdom

changes the product experienced during its processing. Such information allows full understanding of the process performance to guarantee quality, allow control and optimisation of the process and provide evidence to satisfy accreditation demands such as AMS2750 and CQI-9.

In the current global energy crisis optimisation of any thermal process is critical to manage energy usage costs and carbon emissions. The Phoenix™ system provides an accurate profile of the product temperature, allowing confident optimisation of the furnace program (Set-points and Line speed) to make a signifi-



Oil Quench



Slab

cant impact on the running costs of the production line without risk of compromising product quality. Consider the cost saving potential of reducing the furnace set-point by 10-20 °C over an entire annual production cycle.

3. Where is the Phoenix™ solution applied and what specific benefits does it bring to specific industries?

The Phoenix™ system is beneficial in any manufacturing process where the temperature of the process is critical to final properties of the product being processed. The scope and reach of the system is vast, crossing industry boundaries including heat treatment of primary raw metals and finished products, coating of products with thermally cured paint or powder coatings, kiln firing of ceramics and building products even processing of ready



Go efficiency. Go Boldly™

Emerson's combustion technology provides superior quality and flow performance, enabling you to meet the highest standards of safety and energy efficiency in your industrial burner application.

Learn more at [Emerson.com/Combustion](https://www.emerson.com/Combustion)



to eat foods "cooking".

The principle is the same but the solution may look very different in size design and complexity.

An excellent example of how thru-process monitoring can help optimise the operation of a process is that of the demanding reheat processing of Steel Slabs prior to rolling.

Steel Slab Reheat System

The Phoenix™ 'thru-process' temperature profiling system has been designed specifically to allow comprehensive monitoring of the slab/ billet, through the entire furnace pre-heat and soak processes to validate mathematical models used to control the furnace programs.



Optic



TUS

The TS07 system allows temperature monitoring both along the slab length and at different core depths within the slab. The water filled phased evaporation thermal barrier provides protection at up to 1300°C, is mounted in a cut-out within the slab allowing heavy duty MI thermocouples to be run along the slab to where measurement is required.

By applying accurate profile data to mathematical models, targeted roughing mill exit temperatures can be set to obtain a desired furnace drop out temperature throughout the product thickness. Accurate control of such variables allows a successful rolling operation with minimal scale build up maximising mill yields, saving significant energy and maximising production throughput. By accurate optimisation and reduction of the furnace operating temperature, the furnace life can be extended. At the same time under temperature products can be prevented, further protecting down-stream processing machinery.

4. What are the major innovations introduced by PhoenixTM in Temperature profiling?

The following section describes innovations to improve the monitoring of very different heat treating applications.

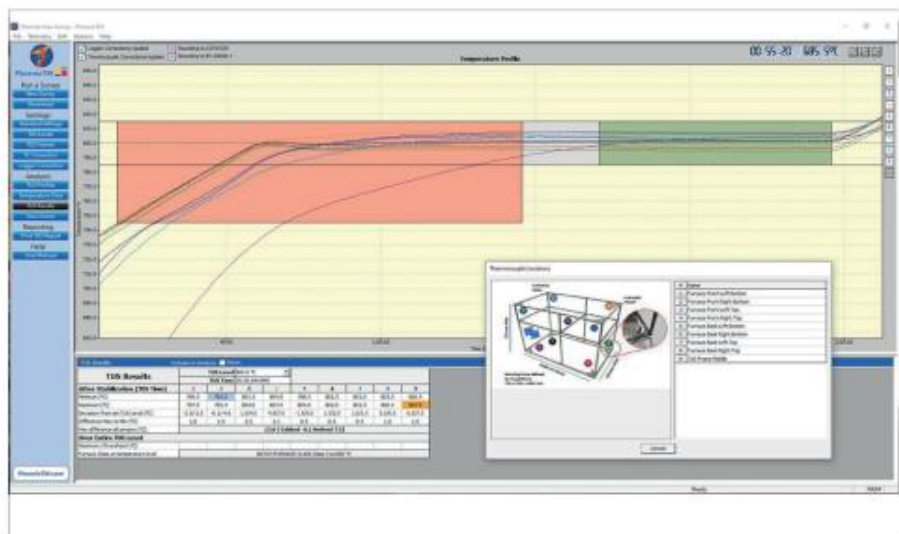
Oil Quench system

PhoenixTM are proud to have developed the first system, to not only allow monitoring of steel in a sealed gas carburizing furnace, but also allow safe monitoring of the critical integral oil quench and transfer through the final wash. The fully sealed thermal barrier is protected by an outer skin of sacrificial insulation blocks contained within a robust structural frame. Historically the monitoring system would need to bypass the oil quench completely which often created a physical and safety challenge retrieving the monitoring unit from the furnace exit where access may be very limited. Allowing passage through the oil quench allows monitoring of the product quench rate which is critical to not only the metallurgical phase transitions within the steel but identifying potential for part distortion / warpage and quench cracking.

Contamination free Controlled Atmosphere Brazing system

In Controlled Atmosphere Brazing, control of the product temperature is critical to achieve selective melting of the filler alloy 580°C -620°C to allow it to flow and fill the joints between the parent metal substrate without risk of melting the substrate itself.

Critical to the process is surface preparation and removal of any oxide layer with the use of a cleaning flux. The flux used is aggressive and can generate HF gas which is damaging to traditional glass cloth used in the construction of thermal barriers.



TUS SW

To eliminate the damage to barriers, extend operational life expectancy, and minimise process contamination outgassing of air ($O_2(g)$) or moisture, PhoenixTM developed a unique TSQ8 thermal barrier specifically for the demands of Controlled Atmosphere Brazing.

The barrier design significantly reduces the amount of insulation cloth that is exposed to the aggressive flux. To eliminate outgassing contamination of the furnace environment prior to supply, the insulation block is preheated in a high vacuum and back flushed with nitrogen ($N_2(g)$) to drive out any air trapped in the porous insulation structure. For processes where any air outgassing is a significant contamination risk, it is possible, with specific barrier configurations, for customers to purge the small barrier cavity of any remaining air with a supply of low-pressure Nitrogen ($N_2(g)$).

Intrinsic safety ATEX system

With an ever increasing drive to improve health and safety on the processing floor, many areas are now classified as having an explosion risk, with a designated ATEX zone grading. In such areas instrumentation should be certified as ATEX approved to allow safe operation. To extend monitoring in such areas PhoenixTM complemented its data logger range with the PTM1500 Epsilon-x temperature data logger offering a unique intrinsically safe 10/20 channel profiling system. The PTM1500 data logger is certified against the ATEX European and cMETus USA standards as Group II category for safe operation in gaseous and dust environments (ATEX Zone 2 and 22 respectively).

5. What other areas of process monitoring is PhoenixTM looking to offer?

Optical profiling "Optic System"

Optical profiling is a new complementary technique to that of 'thru-process' temperature profiling. The new technology developed by PhoenixTM allows for the first-time process engineers to view the inner workings of the furnace under normal production conditions. Travelling through the furnace, with the products being processed, the Optic system gives a product's eye view of the entire heat treatment journey. Employing similar thermal protection technology 'thermal barrier' used in temperature profiling, in place of the temperature data logger a compact video camera and Torch (flashlight) are used to record a video of what a product would see travelling through the furnace. The principle is just like your car's dash cam, the only difference being that your journey is being performed in a furnace at up to 600 °C. The resulting video "Optical Furnace Profile" shows process engi-



RF

neers so much about how their process is operating without any need to stop, cool and dismantle the furnace. This allows safe routine furnace inspection without any of the problems of costly lost production. The technique allows identification of the true root cause of furnace problems not only effecting the thermal processing of the product but also general furnace operation.

6. What future challenges do you see in temperature monitoring of Industrial heat treating market and how are you addressing them?

Industry is increasingly driven by pressures to comply with quality standards, to which they need accreditation to industry standards such as CQI-9 and AMS2750. Such standards and TUS monitoring requirements are constantly being updated with a need for customers to adapt their monitoring surveying SOPs,

reporting protocols and deliverables.

PhoenixTM works diligently to keep abreast of legislative changes and adapt the system solutions to match the exact requirements of pyrometry standards so that heat treaters can maintain accreditation without extensive inhouse complimentary processing and reporting. As a dynamic team we have the flexibility to address customer requirements whether it be a customised thermal barrier design to match processing criteria or addition of new software features to address new specific analysis or reporting demands.

As a testimony to this fact the following is a direct quote from Safran Landing Systems' site in Mirabel, Quebec, using the PhoenixTM Thermal View Survey software.

"We can definitely say that by using the PhoenixTM Survey software to produce our TUS has improved the process. Before, we had to debug our VBA code a couple of time per year, not counting the headaches when an up-revision of the AMS2750 occurred. We now have the peace of mind that our TUS are backed by a software from a company which has the right level of expertise and that we will be supported in the future. Also, the ease of use of the software helps a lot."

We at PhoenixTM are constantly working with customers to specifically adapt the operating software Thermal View particularly Thermal View Survey to comply fully to the demands of the pyrometry standards and allow accurate, quick, efficient and traceable TUS reporting both from a monitoring hardware and data review, calculation and reporting perspective.

In industry automation and a move to real time monitoring and control of processes is becoming a major desire. Although thru-process monitoring is a transient point in time operation,

significant steps have been made to enhance the efficiency and value of the technique. One such innovation is that of

RF Telemetry, allowing live monitoring of product temperature during the processing run. Not continuous monitoring but the next step to possible 24/7 product temperature collection. Phoenix TM has a flexible two way system allowing live data transfer from the data logger in the furnace to a monitoring PC, also allowing communication and control of the data logger live in-process.

Portable RF receivers known as repeaters can be positioned/moved to where they need to be to act as a virtual data chain transferring the RF signal from the data logger back to the monitoring PC with master RF receiver called the Coordinator. No external power supply is needed or cumbersome communication cable between receivers. The receivers can be located exactly where they need to be allowing transfer of temperature data over hundreds of meters. Such operation allows you to identify process problems when they happen allowing possible immediate corrective action, reducing risk of waste and excessive process downtime. ■

In memory of David Plester one of the original founders of PhoenixTM.



ABOUT THE AUTHOR:

Dr Steve Offley aka "Dr O" is Product Marketing Manager at PhoenixTM

Joined April 2018

25 years experience in the industrial temperature profiling market

Company Website: www.phoenixtm.com

WE ARE USING ALL OUR ENERGY DESIGNING YOUR FURNACE, SO YOU DON'T WASTE YOURS!



INNOVATION AS STANDARD

TECO[®]

www.teco.com

TOLEDO ENGINEERING / TECOGLAS / ZEDTEC / KTG ENGINEERING / KTG SYSTEMS / EAE TECH