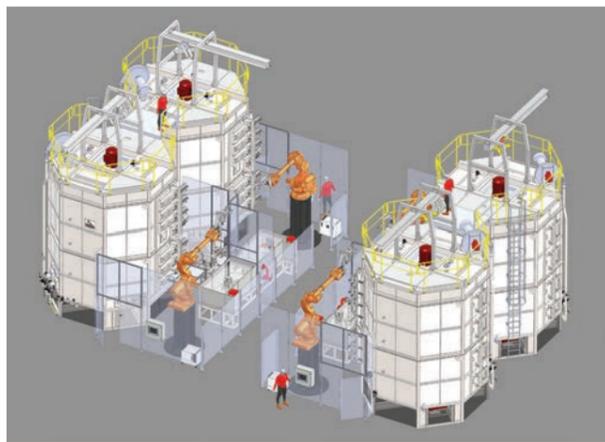


Innovation in the heat treatment of aluminium automotive components and monitoring challenges

By Dieter Conrads (BSN Thermprozesstechnik GmbH) and Carola Konitzer (PhoenixTM GmbH)

In the automotive industry, the trend towards lightweight construction continues and, with the increasing development of high-strength aluminum alloys, it is constantly finding new application areas. In engine technology, these materials have replaced steel in many places. The heat treatment equipment required for this purpose must meet the high standards of automotive production. Not only does low cycle times and high process reliability play a role here, but last but not least, the ever-increasing demands on quality assurance and their seamless traceability must be integrated into ongoing processes.

BSN Thermprozesstechnik based in Simmerath has broken new ground in the heat treatment of engine blocks, cylinder heads and similar components made of aluminum with the innovative concept of multi-level rotary hearth furnaces for solution annealing, quenching and subsequent artificial aging.



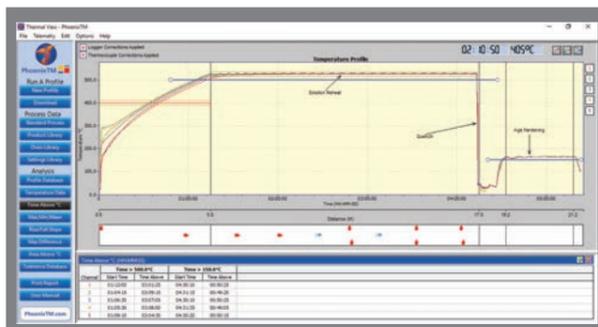
Sketch of a rotary Furnace plant with quench bath

These rotary hearth furnaces allow, in contrast to other furnace concepts, the required reproducible individual treatment of the components. Due to the central robot loading and unloading and the associated elimination of charging racks, (the grippers place the component directly on the respective receiving places in the oven), the costly return transport of these transport aids is eliminated and efficiency increases. Due to the special air flow a uniform and fast heating of all parts is provided. This means that all components can be heated with exactly the same parameters without mutual interference.

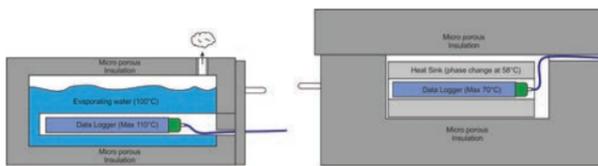
Despite the success of the furnace technology, a problem arises. How can you measure the product temperature in such a rotary furnace in a meaningful way and comply with process standards? The furnace itself, like all industrial furnaces, is equipped with temperature sensors for regulation. But these sensors do not give any indication of what really happens internally or on the surface of the product. Previously, the actual product temperatures were measured using trailing thermocouples that had to be routed



Prepared Aluminium part fitted with the PhoenixTM profile system



ThermalView Plus Software displaying the full process profile trace



Sketch of the PhoenixTM heat protection principles

through the furnace. Naturally, this is not possible with this special oven design because the thermocouples would wind up. Conventional measuring systems require too much space to provide the required thermal performance.

PhoenixTM, manufacturer of temperature profiling systems, has tackled this particular problem. In close cooperation with BSN, systems have been developed that can be integrated into the process without any loss of time. The PhoenixTM systems work according to the "hot box" principle. A data logger, protected by a thermal barrier, is driven through the furnace and collects data at up to 20 measuring points. Thermocouples, which are attached to or inserted into the product, record the actual product temperatures and store them in the datalogger. The evaluation software ThermalView Survey or Plus generates a complete report and gives you an idea of the respective temperatures at a glance.

The difficulty arises from the conflict between limited space and demanding heat protection performance. It must also be ensured that the heat protection container is adapted to the component in such a way that the robot can still grasp it automatically.

Thus, the production is not disturbed and the measurements can be performed reproducibly at any time without loss of production time and capacity. The collected data reflects accurate and meaningful values. Such profile data provides validation to the end customer that the product meets target quality standards.

The PhoenixTM heat protection containers work using one of two principles:

1. Water-cooled containers - In these containers the data logger is protected in a waterproof housing. The heat protection performance is achieved by evaporating water. The size of the tank must be adapted to the respective process duration.
2. Heatsink Technology - Here is the heat protection provided by the insulating material and a heat sink surrounding the data logger. The heat sink is filled with a special salt that absorbs the heat and liquefies at temperatures of 58°C.

The water-cooled containers are the means of choice here, as they are ideal for these applications due to their more compact design.

In several concepts, rotary hearth furnaces were implemented for solution annealing, water quenching or air quenching and subsequent artificial aging. Engine blocks were milled out so that the heat protection container found sufficient space inside and also the thermal load capacity for the relatively long process was not exceeded. The system with the data logger in the container does not protrude beyond the external dimensions of the component. The gripper takes the prepared block (the thermocouples were placed in advance in the relevant places) and puts it, without interrupting production in the oven chamber. The furnace run with temperatures around 550 °C and a process time of several hours is recorded, the block is removed and left in the quench bath. In the water, the container fills up again preparing it for the next hot aging furnace. Thus, longer process times are no problem and the automatic assembly makes it very easy for the user to measure regularly and reproducibly according to quality specifications and standards. But not only the process reliability and quality of the products plays a big role. Equally important are the efficiency of the furnace and the optimization of the operating costs. All this is directly related to the correct setting of the ovens. The aim of every furnace measurement is to bring the energy and the quality of the products into balance, so that both are in an optimal relationship. This is exactly what the PhoenixTM temperature measurement systems and industrial ovens from BSN stand for.

BSN and PhoenixTM are exhibiting at the upcoming Aluminum trade fair from 09.-11.10.2018 in Düsseldorf. Visit us.

BSN

•• bsn-therm.de •• Booth E61

PhoenixTM

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Component and PhoenixTM system being loaded into furnace by gripper