

# MONITORING HEAT TREATMENT PROCESSES FROM INSIDE THE PRODUCT

Facing the challenge of satisfying tighter heat treatment specifications Vallourec turn to Datapaq to develop a unique monitoring solution.

Vallourec, based in Northern France, are among the world's top suppliers of drawn alloy steel tube. Supplying to the oil and automobile industry means that they have many different but exacting heat treatment requirements, which involve continuously adjusting the furnace settings to match the temperature profile specification for each batch of tubes.

In the first stage of the tube manufacture - re-heating the billets, piercing, rolling, and calibration - the temperature profiles are changed less frequently. But in the final stages, when the tube is taken from stock and heat treated to meet the customers' requirements, the set temperatures and speed of the normalising furnace have to be set precisely to ensure that the final properties of the material are exactly as required.

To make their scheduling as efficient as possible, Vallourec have developed a mathematical model that allows them to calculate, from the finished product specification, the zone set temperatures and dwell times for both the austenitising and normalising furnaces. To verify this programme and refine the calculations they needed to measure the actual product temperature as the tubes moved through the furnace.

Starting with the normalising furnace, efforts were made to attach a

thermocouple to the tube as it was being heat treated. However, there were two problems; first, only one thermocouple could be used due to the difficulty of guiding it through the furnace; second, the normalising process consisted of two separate walking beam furnaces which made it impossible to measure the entire process in one operation.

At this stage Vallourec approached Datapaq - who specialise in monitoring product temperature in continuous processes. Datapaq proposed a unique solution, based on their Furnace Tracker product range, which involved designing a data logging system to fit inside a tube and monitor temperature from inside the product as it was being heat treated. This solution had various advantages:

- Temperatures could be monitored along the length of the tube at fixed points showing an accurate profile across the furnace width;
- The data logger would travel with the tube so that both furnaces in the normalising operation could be monitored together;
- The thermocouples could be re-used and only short lengths needed to be purchased;
- The system was highly accurate when compared to the inaccuracies of a long thermocouple trailing through the furnace.

To keep the logger at a safe working temperature during the process, which peaked at 700°C, it was housed inside a thermal barrier which had

been specially designed to fit inside a 200mm diameter tube. The software, supplied as part of the system, not only gave Vallourec the ability to visually examine the heat treatment process in great detail, but also allowed them to export the temperature data directly into their mathematical model so that theoretical predictions could be verified by actual results.

This information verified the accuracy of Vallourec's furnace control programme and ensured that customer specifications and overall quality requirements were fulfilled.

After the success of these trials the Datapaq Furnace Tracker system was installed at Vallourec's automobile tube plant and a further system was developed to fit inside a 150mm diameter tube at the Aulnoye plant. Trials are also underway to measure rates of cooling during the water quench in the austenitising process; this uses a specially developed data logger which can sample temperatures at a very fast rate as the tube cools.



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