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Outokumpu is a metals and technology company with production facilities around the world. The Outokumpu PoriCopper production plant in Pori, Finland, produces precisely specified copper and copper alloy products for a variety of industries and end-users. In 2002, two continuous furnaces were retrofitted with atmosphere control systems supplied by AGA. Mr. Timo Tuohimaa, Development Supervisor at Outokumpu PoriCopper, is responsible for quality assurance and development projects at the industrial tubes product line in Pori.

Bright annealing in a reducing atmosphere

Annealing is a heat treatment process, where metal parts are heated and cooled in order to give them the desired microstructure and mechanical properties. The time-temperature cycle and atmosphere composition are critical process parameters. Bright annealing is performed in a reducing atmosphere in order to avoid oxidation and produce a bright, clean surface. Usually a nitrogen or nitrogen/hydrogen atmosphere is used.

Dewpoint indicates oxidation

Dewpoint is a good indicator of how oxidizing or reducing the atmosphere with a fixed hydrogen concentration is. The lower the dewpoint in the furnace atmosphere, the more reducing the environment is, and the better the surface properties of the end product. Dewpoint measurement is a simple and reliable way to get an indication of atmosphere quality, with leaks in the furnace detectable through an increase in dewpoint.



Industrial copper tubes entering the annealing furnace.

Dewpoint monitoring in harsh environments Atmosphere Control System for Annealing Furnaces

Outokumpu PoriCopper is one of the world's largest manufacturers of copper and copper alloy products. The company has optimized the operation of two copper tube annealing furnaces with an atmosphere control system, designed and built by AGA. The Vaisala DRYCAP® Dewpoint Transmitter DMP248 is an integral part of the atmosphere control system, giving real-time information on the quality of the furnace atmosphere.

Atmosphere control system by AGA: Hydroflex®

AGA, a member of the Linde Gas Group, is a supplier and manufacturer of industrial and

specialty gases. New gas application installations and the retrofitting of existing installations are also part of AGA's operations.

AGA's Hydroflex® consists mainly of a flow train and a con-

trol cabinet. The PLC-PC equipped cabinet contains a sample system and gas analyzers. The flow train is equipped with proportional valves and flow transmitters. The furnace atmosphere from the hot and cooling ►



Outokumpu PoriCopper plant in Pori produces copper and copper alloy products.

producing a carbon monoxide shield gas by burning butane was replaced by AGA's Hydroflex[®] system with nitrogen/hydrogen flow. In the high heat zone, the

zones is sampled and analyzed.

The dewpoint of the hot zone is in closed loop with the nitrogen and hydrogen flow and air additions. For dewpoint measurement in this system, AGA has chosen the Vaisala DRYCAP[®] Dewpoint Transmitter DMP248. The cooling zone oxygen concentration is in closed loop with nitrogen flow to the cooling zone. If the furnace is equipped with vacuum vestibules, the control system also features a furnace pressure loop.

All together this gives stable furnace conditions. External disturbances such as furnace load variations and air leakages are

automatically compensated for, and at the same time the gas consumption is minimized. Other features include process visualization, recipe handling, historical data collection and alarms.

Copper tubes and coils with a bright finish

In the annealing furnaces at Outokumpu PoriCopper, copper tubes and coils are heated at approximately 600 °C and then cooled in a cooling section to ambient temperature. A protective atmosphere is maintained inside the furnace.

In 2002, an exogas generator

dewpoint and temperature values as well as information on flow rate and composition are gathered. A sampling system is used to cool down and filter the hot furnace gas before it reaches the sensor. The cooling section is controlled through oxygen and pressure measurement.

Together with AGA's application specialists, Timo Tuohimaa and his colleagues have developed "recipes" for the atmosphere compositions and conditions used when manufacturing different products. Both set point values and alarm levels for the measured quantities have been defined. For dewpoint, a

typical set point value is between -10 and -20 °C. If a rise in dewpoint is observed, the system feeds more shield gas into the furnace to prevent the oxidation of the copper parts.

Enhanced quality and cost savings

The automated control system has enhanced quality at Outokumpu. Development supervisor Timo Tuohimaa explains: "In the past, we didn't know about a problem in the furnace atmosphere before end products with a bad surface quality came out at the other end. These oxidized parts had to be scrapped and processed all over again. With an automated atmosphere control system we get on-line information about the atmosphere and can control it. The change for the better is evident at system startup. Before, it took hours to get a furnace that had been cooled to produce copper parts that fulfill our specifications. Now the system is up and running straight away. This obviously gives us more capacity. We also save money by not having to maintain the exogas generator anymore, and by being able to optimize gas consumption. We have been satisfied with the atmosphere control system overall, and the Vaisala dewpoint transmitter within it." ●



Development supervisor Timo Tuohimaa is responsible for quality assurance and development projects.



The Vaisala DRYCAP[®] Dewpoint Transmitter DMP248 monitors dewpoint in an annealing furnace.