Expertise to improve heat treatment process efficiency

Eurotherm®

Variable reactance transformer (VRT) power supply replacement solution

Upgrading VRT power supplies to an EPower advanced digital power control solution improved the reliability and efficiency of vacuum furnaces in an AMS 2750 certified heat treatment facility, helping to reduce maintenance and energy costs.

eurotherm.com/heattreat

Life Is On | Schneider Electric

Our customer is part of a group recognized as an innovator in a wide range of heat treatment processes. Their valued heat treatment expertise meets the needs of forges, gear manufacturers, and toolmakers.

The Customer

Established in the 1970s, the company specializes in the treatment of large parts in vacuum and controlled gas heat treatment processes.

Through development work in the aeronautics sector, the business has established high levels of expertise and know-how which have enabled the business to achieve international Nadcap accreditation.

Challenges

Previously, the customer used variable reactance transformer (VRT) technology for most of their furnace power supplies. VRT devices incorporate saturated magnetic cores with an isolation transformer. These analog power supplies performed well during initial heating of the furnace. However, they had a few drawbacks that were impacting reliability and quality.

- At control outputs below 100% the VRTs caused high harmonic distortion on the power supply and poor power factor. Due to the resulting heat losses in the system, water cooling was required.
- The cooling water needed to be treated to prevent corrosion, mineral build-up and cooling system blockage.
- Water pipes were sometimes clogging, causing maintenance issues, and dielectric insulation in the pipes was at risk of breaking down, causing safety concerns.
- Deadband regions caused by the VRT resulted in unstable control of the furnace heaters. Therefore, the control loop strategy was more difficult to setup and adjust, becoming less robust over time.
- The analog VRTs caused difficulties in the control of the furnace heaters. The required stability and accuracy could not be achieved causing process repeatability issues.
- At outputs below 100%, the VRTs were suffering power leakage and a significant decline in energy efficiency.
- Poor power factor meant energy was being wasted in the system, leading to unnecessary extra cost.

Goal

Improve vacuum furnace power supply reliability. Increase process repeatability, performance and energy efficiency.

Story

Heater power was controlled by three VRTs. Over time, VRT cooling pipes were clogging, increasing maintenance time and cost. Unstable temperature control was affecting production quality and process efficiency.

Solution

Three zone digital power control cabinet with transformers based on the Eurotherm by Schneider Electric™ EPower™ advanced silicon controlled rectifier (SCR/thyristor) controller, with Predictive Load Management feature and corrective setpoint balancing coefficients to homogenize the furnace temperature.

Results

- Improved power factor (better than 0.9) across 1 - 100% of power output range
- Decreased maintenance time and cost, and reduced the risk of harm from deteriorating electrical equipment
- Improved process repeatability
- Increased Nadcap furnace class
- Optimized energy efficiency and reduced peak demand charges
- 11% energy savings
- Two year return on investment

A high efficiency cost effective solution

Eurotherm provided a turnkey power system solution based on EPower advanced SCR controller with air cooled transformers. This system has now been in operation for over 10 years.

Reduced CapEx and OpEx

Improved power factor achieved by the EPower controller meant costly unreliable water cooling was no longer needed. Therefore the Eurotherm power cabinet solution cost less than the VRT solution and enhanced system robustness.

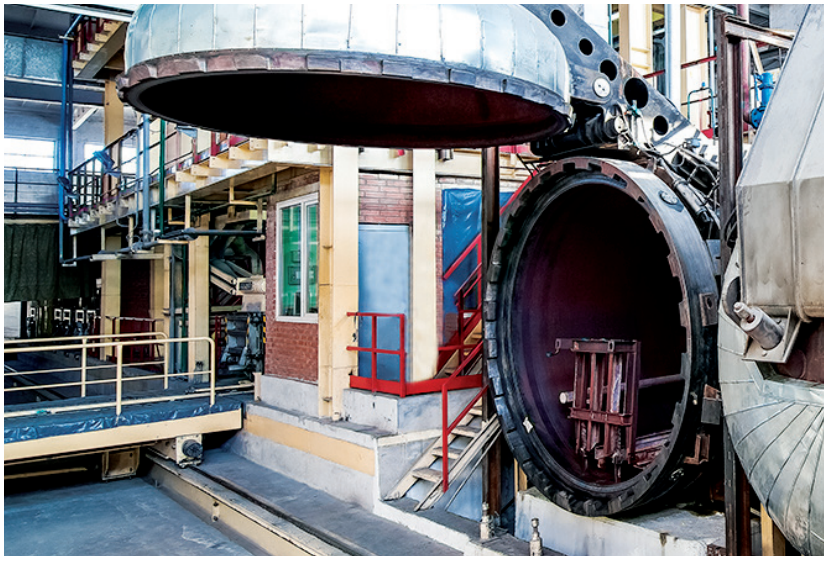
Since its installation, no unplanned maintenance issues have been reported.

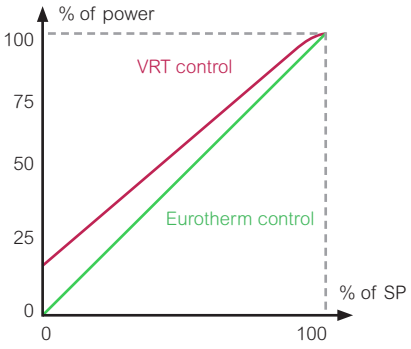
Better measurement accuracy and control precision improved temperature linearity, process repeatability and Nadcap class uniformity.

Thanks to EPower hybrid control, no filters or power factor correction systems were needed to meet the power factor limits set by the energy supplier.

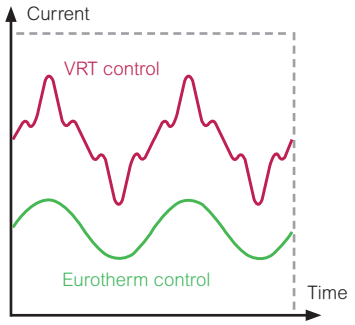
The power factor was greatly increased due to less harmonic content, and peak power demands were reduced by EPower Predictive Load Management strategy, resulting in electricity cost savings of 11%.

In this case, based on local energy costs, the EPower solution achieved a two year return on investment.





Eurotherm digital SCR power control helps to provide linear control across the entire output % range, whereas the VRTs cause unstable control at low setpoints.



VRTs waste energy by drawing more power from the supply than is required by the heater due to harmonic generation at most setpoint levels.

Industry 4.0 ready technology

The EPower advanced SCR controller is EcoStruxure-ready and has been carefully designed to provide optimum efficiency in industrial electrical heating systems. EcoStruxure™ is Schneider Electric's IoT-enabled system architecture and platform.

- Digital, high accuracy power control
- Corrective coefficient in EPower controller rebalances temperature inside the furnace
- Predictive Load Management (PLM) smooths the energy consumption to avoid peak power demand

Discover
EPower controller

Discover
Heat Treatment

Contact us

Life Is On | Schneider Electric

Eurotherm USA

44621 Guilford Drive, Suite 100
20147 Ashburn, VA
USA

Phone: +1-703-724-7300

www.eurotherm.com

Published April 2021

Document Number HA033499USA Issue 2 SE part Number 998-21215702-GMA-UK