SECO/WARWICK

INVENTION MEETS RELIABILITY

VORTEX

System for aluminum coils annealing

VORTEX

Vortex Jet Airflow Coil Annealing Furnaces using High Convection

INDUSTRIES

- Automotive
- Building
- Packaging

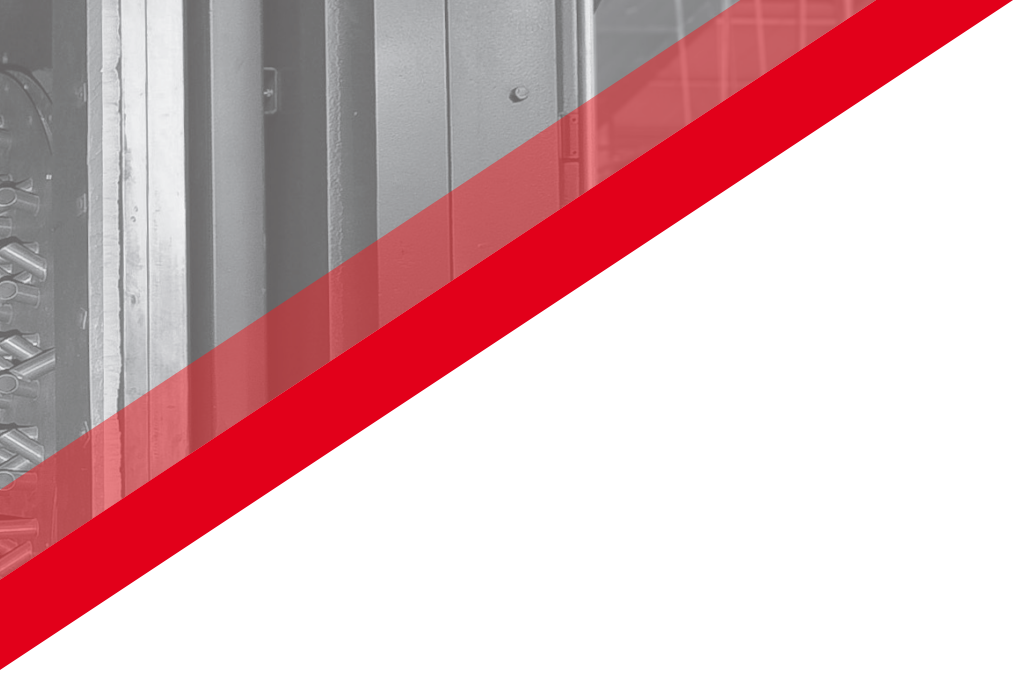
PROCESSES

- Annealing and homogenizing

SECO/WARWICK provides custom engineered aluminum coil and foil annealing furnaces with capacities ranging from single coil modular furnaces to multi-zone furnaces with tight zone control.

Using patented Vortex jet airflow technology, SECO/WARWICK's Vortex aluminum coils annealing system, combined with Bypass Cooler and SeCoil control and simulation software, provides coils producers the ability to significantly reduce the overall cycle time of their furnaces, resulting in energy savings, increased productivity, and improved surface quality.

The key to the system is an increased heat transfer coefficient achieved by high speed air impinging on both sides of the coil. The intent is to transfer heat through the coil's edges as opposed to only through the outside layer of the coil.



FEATURES

The challenge in coil annealing is to optimize the process by shortening the cycle time to the greatest extent possible, while maintaining the desired metallurgical properties over the entire load.

Vortex Jet Heating System

The effective thermal conductivity in a strip coil is much lower in the radial direction than in the axial direction, therefore, the most effective way of heating the coil is through the edges of the coil layers. The difference between the thermal conductivity for the two directions is caused by the heat-insulating effect of the gas and milling of oil layers in the coil between the coil layers.

The Vortex AirFlow Jet Heating System incorporates arrays of round-nozzle jets, pointing at multiple angles, which generate a spiral vortex motion of air that results in high heat transfer without producing hot spots in the coil. The high-volume flow of this nozzle system in conjunction with a unique semi-axial or centrifugal fan design allows the coil to be heated more uniformly by a larger mass of atmosphere. Analysis of infrared pictures shows that a more uniform surface temperature can be achieved by using the new Vortex AirFflow Jet Heating System. The coil surface temperature uniformity profiles present an overview of temperature uniformity for the entire heat up cycle.

These profiles demonstrate that a better surface uniformity is achieved using the vortex nozzle system thanks to this Because of this, the load surface is “washed” by the atmosphere and not locally overheated. The Vortex system allows for faster load heating as a result of better heat transfer coefficient up to 150 W/m2 K in relation to approx. 110 W/m2 K for the standard straight nozzle system.

The heat transfer coefficient calculation, based on the above data, is 1.25 for the Vortex nozzle system in relation to 1.65 for the standard straight nozzle system. For aluminum alloys of lower thermal conductivity, this parameter is expected to be even higher.

Bypass Coolers

The SECO/WARWICK proprietary bypass cooler design for annealing furnaces provides cooling under a protective atmosphere.

Cooling is very important in this application for both metallurgical and handling considerations. The coolers use an internal bypass arrangement which limits the temperature of the atmosphere going through the heat exchangers to 175°C.

This prevents baking of the volatized rolling oil on the fins of the heat exchanger. The coolers are designed to provide in-depth plunge, programmed, or auxiliary cooling and are available in standard or custom sizes. The coolers can be rear, or side mounted according to space availability. Additionally, users can also add a Bypass Cooler to an existing annealing

furnace. SECO/WARWICK has large numbers of these coolers in operation in coil and foil annealing applications. The newest bypass cooler design eliminates the need of any foundation pit.

SeCoil process control and simulation software

SeCoil is a simulator for heating a coil in a Vortex furnace, based on a mathematical model that has been derived from well-known laws of physics using well-known mathematical principles (in brief: phenomenological modeling). The SeCoil simulator can be supplemented by a meta-model that uses artificial intelligence methods (behavioral modeling). The advantage of the phenomenological model is its great universality, since it is based on the known laws of physics.

The developed mathematical model takes into account the variability of numerous parameters, such as temperature and outlet velocity of the heating medium, type of alloy, sheet thickness, and roll dimensions.

The use of modern numerical calculation techniques allows for the current identification of the temperature field in the cross-section of the heated coil. With the SeCoil simulator you can simulate the heating curve of any point located in the longitudinal section of the coil (virtual thermocouple).

The SeCoil simulator provides us with knowledge about the thermal state of the coil at any time during the process. It may, therefore, be used in many ways, including for forecasting heating curves for different types of coil and process conditions (furnace temperature, mixer efficiency) and for continuous control of the annealing process without the need to use batch thermocouples (controller).

The meta-model was created using artificial intelligence methods (behavioral modeling), and can be an alternative or a supplement to a simulator based on phenomenological modeling. In contrast to the phenomenological model, the behavioral model applies only to the tested system and within the assumed limits of operating conditions. However, its accuracy for the analyzed range of data may be greater than in the case of the phenomenological model.

BENEFITS

- High-Efficiency Process: Process efficiency can be improved up to 30% comparing to traditional annealing systems – without local overheating.
- High Quality Process: Improved uniformity of material properties as well as Minimized local cracking and staining of milling oil.
- Lower Cost Operation: Uses less electricity for gas circulation.
- Flexible System Design: Various coils diameters, widths, sheet thicknesses.

SECO/WARWICK
Invention Meets Reliability

SECO/WARWICK is the 1st Choice Supplier
of Solutions for Heat Treatment and Metallurgy.

We create innovative products that provide our customers with reliable, safe and environmentally friendly solutions for heat treatment and metallurgy and ensure the economic efficiency of their businesses. Expertise includes end-to-end solutions in 5 categories: vacuum heat treatment, atmosphere, and aluminum thermal processing, controlled atmosphere brazing of aluminum heat exchangers and vacuum metallurgy.

SECO/WARWICK Group, with 7 companies located on 3 continents, has customers in nearly 70 countries with more than 5000 deployed solutions. The company provides standard or customized state-of-the-art heat processing and metallurgy equipment and technologies to leading companies in the following industries: automotive, aerospace, electronics, tooling, medical, recycling, energy including nuclear, wind, oil, gas, solar and production of steel, titanium, and aluminum.

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