Refractory and Insulation Applications in Continuous Strip Annealing Furnaces: CCEWOOL® Lining Product Configurations and Custom Solutions



Continuous annealing furnaces in the steel industry are primarily used for the heat treatment of cold-rolled steel strips. Through controlled heating, soaking, and cooling, these furnaces improve the microstructure, hardness, and ductility of steel to meet subsequent forming and processing requirements. Continuous annealing furnaces are also widely used in continuous hot-dip galvanizing lines, where steel strips undergo the necessary heating and annealing processes before entering the zinc bath.

Depending on production line layouts and process requirements, continuous annealing furnaces may feature vertical or horizontal configurations, incorporating direct-fired heating, radiant tube heating, soaking, and various cooling systems. Furnace zone arrangements vary between production lines, and each area operates under different temperature, furnace atmosphere, and gas flow conditions.

For example, in certain continuous hot-dip galvanizing lines, a Direct-Fired Furnace (DFF) can heat steel strips to approximately 680–750°C, while radiant tube heating can bring the steel strip annealing temperature to approximately 900–920°C. Some radiant tubes are designed for temperatures up to 1200°C. These values represent specific process and equipment designs rather than fixed operating temperatures for all production lines.

CCEWOOL® provides ceramic fiber modules, ceramic fiber blankets, ceramic fiber boards, and complementary refractory materials according to the operating conditions of different furnace zones. By combining suitable hot-face working linings, backup insulation layers, and localized sealing structures, CCEWOOL® supports material selection and custom fabrication for continuous annealing furnace applications.

Zibo Double Egret Thermal Insulation Co.,Ltd
Add: No.105 Liuquan Road, Zibo City, Shandong, China
Tel: +86-533-7986860
Email: info@ccewool.com
ccewool@ceceramicfiber.com
Website: www.ceceramicfiber.com

1. Selecting Insulation Material Grades Based on Actual Temperatures and Furnace Atmospheres



Material selection for continuous annealing furnaces must begin with the actual operating temperature at the installation location rather than relying solely on the steel strip temperature or furnace chamber temperature. The refractory working lining, overall lining thickness, and structural configuration all influence the actual temperature experienced by backup insulation materials.

CCEWOOL® ceramic fiber modules are available in classification temperature grades of 1260°C, 1400°C, and 1430°C. Ceramic fiber blankets and boards are also offered in different temperature grades, densities, and thicknesses. Specific products should be selected according to their recommended operating temperatures, permanent linear shrinkage characteristics, and installation conditions.

In direct-fired heating zones, particular attention should be given to localized high temperatures, flame impingement, and flue gas erosion. Radiant tube heating and soaking zones require consideration of protective atmospheres, such as nitrogen or nitrogen-hydrogen mixtures, as well as whether fiber materials are directly exposed to furnace gas flow. Fiber insulation installed close to steel strips should also be evaluated for shot content, potential fiber particle shedding, and necessary surface protection.

2. Configuring Refractory and Insulation Materials for Different Furnace Zones Based on Flame, Gas Flow, and Mechanical Conditions



Lining structures cannot be identical throughout a continuous annealing furnace. Based on actual temperatures, gas flow conditions, and installation requirements, CCEWOOL® combines ceramic fiber modules, blankets, and boards with CCEFIRE® refractory products, allowing each material to perform its intended refractory or insulation function.

Direct-Fired Heating & Preheating Zone

Areas around burners, furnace roofs, and hot gas passages are exposed to relatively high localized thermal loads, requiring both refractory protection and resistance to gas erosion.

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Hot-Face Working Lining: Suitable CCEFIRE® high-alumina refractory bricks or refractory castables.

Backup Insulation: CCEWOOL® ceramic fiber blankets and ceramic fiber boards.

Applicable Areas: Furnace walls, roofs, and protected areas surrounding burner openings.

For furnace walls and roofs where gas flow conditions permit fiber hot-face linings, CCEWOOL® ceramic fiber modules can also be installed with ceramic fiber blankets behind them, forming a combined modular hot-face and backup insulation structure.

Non-Oxidizing Furnace (NOF) Zone

Some continuous hot-dip galvanizing lines incorporate non-oxidizing heating and atmosphere-control configurations, such as NOF systems. Their specific structures depend on production line design, and not all installations use the same combination of furnace zones.

CCEWOOL® ceramic fiber blankets or boards can be used as backup insulation for protected furnace walls and roofs. Where modular fiber linings are suitable, ceramic fiber modules may be combined with backup blankets. Around burner openings, thermocouple ports, and equipment connections, custom-fabricated ceramic fiber boards can be incorporated into protected local insulation structures.

Radiant Tube Heating & Soaking Zone



Radiant tubes transfer heat indirectly to steel strips through thermal radiation, bringing the strips to their target annealing temperatures. These zones typically operate under protective atmospheres such as nitrogen or nitrogen-hydrogen mixtures, requiring both effective thermal insulation and appropriate fiber protection.

Primary Insulation Layer: CCEWOOL® ceramic fiber modules.
Backup Insulation Layer: CCEWOOL® ceramic fiber blankets.
Custom-Fabricated Components: CCEWOOL® ceramic fiber boards.

For furnace walls and roofs suitable for fiber hot-face linings, ceramic fiber modules can be combined with backup blankets. Where heat-resistant metal protective panels are incorporated into the lining design, ceramic fiber blankets can be installed behind the panels to reduce direct fiber exposure to the furnace atmosphere.

The potential release of fiber particles must also be considered in areas close to steel strips. CCEWOOL® HPS 2300 ceramic fiber blankets have a specified shot content of ≤15%, providing a reference parameter for material selection. Where fibers may be directly exposed, suitable heat-resistant protective panels and fastening arrangements should be incorporated to minimize fiber exposure.

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Slow & Rapid Cooling Zone

After soaking, steel strips are cooled through controlled cooling processes, which may involve circulating protective gases, slow cooling, or high-velocity gas jets. Rapid cooling zones experience relatively high gas velocities, requiring insulation systems to maintain continuity, secure attachment, and adequate surface protection.

For furnace walls and roofs equipped with internal protective panels, CCEWOOL® ceramic fiber blankets can be installed in flat layers with staggered joints. Ceramic fiber boards can be used where fixed thicknesses and defined component profiles are required. If fiber layers are directly exposed to high-velocity gas flow, suitable heat-resistant metal panels or other protective structures should be installed to reduce direct gas erosion of the fibers.

Furnace Doors, Floors & Joints



Furnace doors, inspection openings, expansion joints, and connections between furnace zones are subject to thermal expansion, mechanical movement, and localized heat leakage.

CCEWOOL® ceramic fiber blankets and boards can be used for suitable furnace door backup insulation and inspection-opening insulation. Ceramic fiber ropes, tapes, and papers can provide localized filling and supplementary sealing for door joints, expansion gaps, and equipment interfaces.

Furnace floors, roller assemblies, and equipment support areas require particular attention to mechanical loads and abrasion resistance. CCEFIRE® insulating firebricks can be used in insulation layers or backup positions where their specific product properties meet the application requirements. Areas directly exposed to mechanical loads should instead use suitable refractory bricks, castables, and properly designed support structures. Lightweight insulation materials must not be used as substitutes for load-bearing working linings.

3. Custom Fabrication Based on Equipment Drawings to Meet Lining Installation and Interface Requirements

Burner openings, thermocouple ports, radiant tube penetrations, and furnace door structures in continuous annealing furnaces have different dimensional and geometric requirements. In addition to standard insulation products, CCEWOOL® supports module configuration selection, board fabrication, and customized sealing products according to customer engineering drawings.

Ceramic Fiber Modules: CCEWOOL® offers S-Fold, U-Fold, L-Shape, and Stack configurations for different furnace wall, roof, and corner installations. Center anchoring, side anchoring, and other suitable fastening arrangements can be selected to match module configurations with the furnace lining design.

Ceramic Fiber Blankets: Manufactured using a double-sided internal needling process, CCEWOOL® ceramic fiber blankets feature good structural integrity through mechanical fiber interlocking. They support cutting to specified lengths, slitting, and custom-width production, making them suitable for backup insulation installation and subsequent fabrication.

Ceramic Fiber Boards: CCEWOOL® ceramic fiber boards support cutting to size, drilling, grooving, chamfering, and CNC machining of custom shapes. Based on customer drawings, boards can be fabricated into insulation components for protected areas around burners, thermocouple openings, and equipment interfaces, helping align finished dimensions with installation requirements.

Complementary Sealing Products: CCEWOOL® ceramic fiber paper undergoes a nine-stage shot removal process to reduce shot content and supports cutting, die-cutting, and multilayer lamination. Ceramic fiber ropes and tapes are available in specifications suited to different joint dimensions and operating conditions for localized filling and supplementary sealing. However, these fiber products cannot replace welded furnace structures, metallic seals, or the overall gas-tight sealing system.

CCEWOOL® calcium silicate boards may also be considered for rigid backup insulation where operating temperatures and mechanical conditions are suitable. For areas requiring brick-based insulation structures, CCEFIRE® insulating firebricks can be incorporated according to the lining design.

CCEWOOL® Refractory and Insulation Solutions for Continuous Annealing Furnaces



Refractory and insulation solutions for continuous annealing furnaces must account for actual operating temperatures, furnace atmospheres, flame and gas flow conditions, and installation structures. Hot-face working linings, backup insulation layers, and localized sealing materials should be selected according to the requirements of each furnace area so that every product performs its intended function.

CCEWOOL® supplies ceramic fiber modules, ceramic fiber blankets, ceramic fiber boards, calcium silicate boards, and complementary sealing products, together with CCEFIRE® insulating firebricks, offering a range of refractory and insulation material options for continuous annealing furnaces and continuous hot-dip galvanizing lines.

For new furnace linings, maintenance projects, and insulation upgrades, customers can provide furnace zone details, actual operating temperatures, furnace atmosphere conditions, lining configurations, and engineering drawings. CCEWOOL® can assist in selecting suitable product grades, thicknesses, densities, module configurations, and anchoring methods, while providing corresponding custom fabrication and supply support.

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From large-area insulation for furnace walls and roofs to protected backup insulation around radiant tubes and localized sealing at furnace doors, equipment interfaces, and expansion joints, CCEWOOL® combines multiple insulation products with drawing-based fabrication to help customers translate furnace lining designs into defined material specifications and installation components, supporting new installations, maintenance, and insulation upgrades in the steel industry.

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