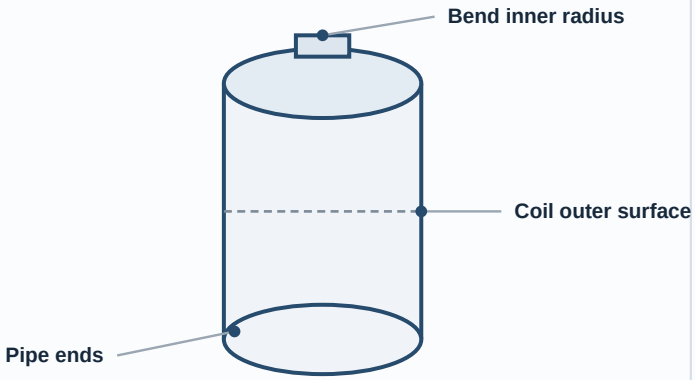
UNDERSTAND THE SURFACE BEFORE DESIGNING THE COATING.

Coil / Heat Exchanger (Enamelled Pipe) — Hot tank water on one side and pressurised heat-transfer fluid on the other; continuous thermal cycling and the need for heat conduction. Before designing the right coating, we evaluate the material chemistry, the geometry and the service conditions together.

PART DIAGRAM — COIL / HEAT EXCHANGER (ENAMELLED PIPE)



COATING CROSS-SECTION



Five questions define a coating system

1 MATERIAL
Enamelling-grade steel coil pipe; a helically bent, thin-walled, small-diameter geometry. It transfers heat between the boiler/solar collector fluid and the tank water.

2 SURFACE
Oil, drawing residues and oxide on the outer pipe surface must be removed; a uniform, active surface along the coil.

3 GEOMETRY
Tight helical bends and a small pipe diameter; in dip enamelling, risk of runs/pooling at the bend inner radius and touching/bridging between adjacent turns.

4 SERVICE CONDITIONS
Hot tank water on one side and pressurised heat-transfer fluid on the other; continuous thermal cycling and the need for heat conduction

5 PRODUCTION TARGET
Medium-high volume; a thin, uniform enamel coat along the coil that does not impair heat conduction.

CONCLUSION: For the Coil / Heat Exchanger, the goal is not just a good-looking finish; it is a pore-free enamel surface, uniform along the coil, that preserves heat conduction and withstands acid and thermal cycling.

FROM SURFACE TO PROCESS ENGINEERING FLOW

The Coil / Heat Exchanger cannot be coated like just any part. A sound process needs measurement, pretreatment, the right coating selection, application and verification to work together.

01 **ANALYSIS** Substrate + surface
02 **PRETREATMENT** Cleaning + surface
03 **ENAMEL** Slip + density
04 **APPLICATION** Dipping / spraying
05 **FIRING** Drying + furnace
06 **VERIFICATION** Test + record

A. Surface Characterisation

The condition of the substrate surface (cleanliness, roughness, oxide/scale and any weld zones) is determined. The right process starts with the right definition of the surface.

MEASURABLE INPUTS
Surface cleanliness • roughness • weld marks

B. Pretreatment Design

Degreasing, oxide removal and rinsing; a dip-based pretreatment that reaches the whole surface of the coil geometry.

CORE TARGET
Clean, active, uniform, repeatable surface

C. Enamel System Selection

An acid- and thermal-cycling-resistant wet (slip) enamel that gives a thin coat without reducing heat transfer much is selected; CTE matching targets resistance to cracking/spalling.

DECISION CRITERIA
Durability • appearance • service life • cost

D. Application Engineering

Wet (slip) enamel is applied by dipping/spraying; dip-and-drain geometry, rotation and drain time are set to prevent runs at bend inner radii and bridging between adjacent turns.

GEOMETRY EFFECT
Coil outer surface • Bend inner radius • Pipe ends

Managing the process with data, not by eye

µm
COAT THICKNESS
Enamel coat uniformity

g/cm³
SLIP DENSITY
Coat weight and coverage

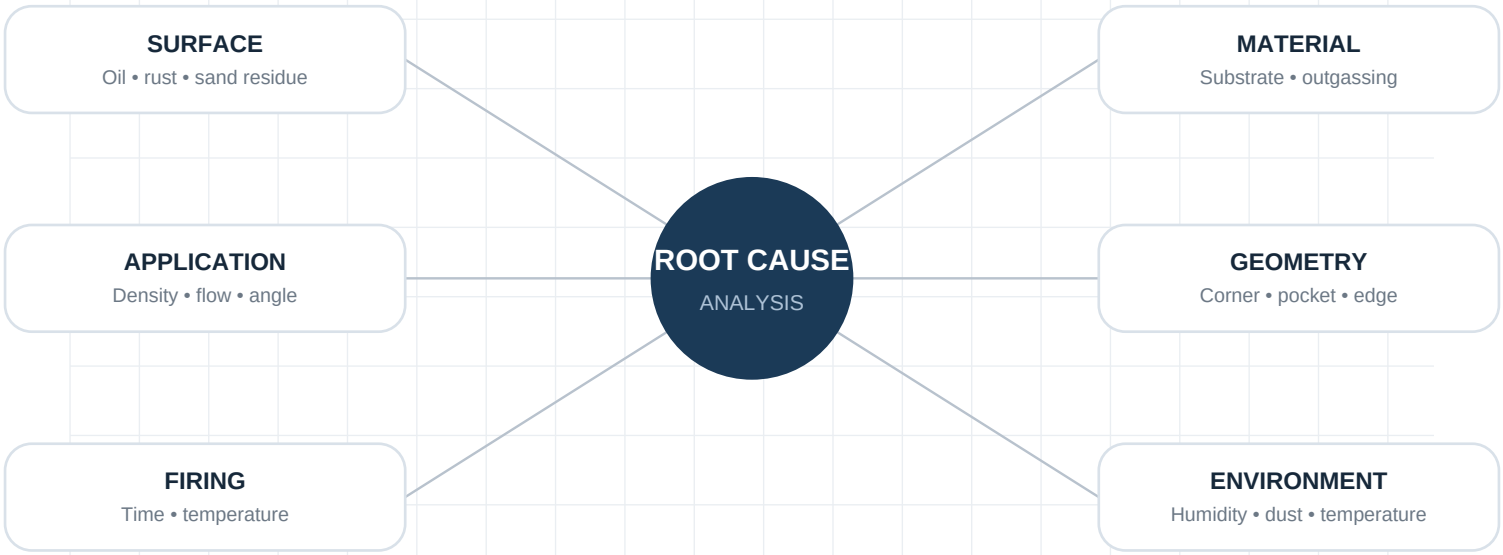
°C
FIRING TEMPERATURE
Actual firing condition

%RH
AMBIENT HUMIDITY
Drying and surface quality

ENGINEERING PRINCIPLE In the Coil / Heat Exchanger process, we define a process window rather than a single parameter. The aim is to reproduce the same surface quality across different shifts and part conditions.

A SURFACE DEFECT IS A SYMPTOM, NOT THE ROOT CAUSE

Enamel defects rarely come from a single setting. The same symptom may stem from surface preparation, the substrate, slip density, coat thickness or firing.



Common defects and diagnostic approach

POOR ADHESION

The enamel detaches from the substrate or chips on impact.

CHECK: surface / ground coat / firing

FISH-SCALING

Scale-shaped enamel spalling appears after firing.

CHECK: substrate / hydrogen / firing

PINHOLE / BLISTER

Pinholes or blisters form on the surface.

CHECK: gas / thickness / firing

RUNS & BUILD-UP

Thick build-up forms at edges and lower areas.

CHECK: density / draining / angle

CRACKING

Hairline cracks in thick coats or on rapid cooling.

CHECK: thickness / firing / cooling

UNCOVERED AREA

Thin or bare areas in corners and pockets.

CHECK: geometry / dipping angle

DIAGNOSTIC PROTOCOL

1 Define the symptom → **2** Measure the data → **3** Isolate the cause → **4** Test one variable → **5** Standardise

A GOOD SURFACE PROCESS must be measurable • repeatable • traceable • optimisable. This approach is the basis of part-specific application guides for parts such as the Coil / Heat Exchanger.

THE RIGHT EQUIPMENT, AT THE RIGHT SCALE.

For the Coil / Heat Exchanger, production volume drives the equipment choice. At low and medium volume, manual systems give flexibility; in series production, a conveyorised line repeats the same process on every part.

LOW / MEDIUM VOLUME

Manual application



Manual Booth with Turntable

Wet enamel with a manual gun in a dry-filter booth.



Box Enamel Furnace

Firing in batch production.

SERIES PRODUCTION

Automatic line



Conveyorised Line-Type Booth

Automatic wet enamel application on an overhead conveyor.



U-Type Furnace

Firing on a continuous line.



STRONG3000 wet enamel line

PROJECT SUPPORT Share your line, your part and your production target, and we will define the equipment selection and the booth, oven and conveyor layout together. strong3000.com · info@strong3000.com · WhatsApp +90 537 353 54 19