



**POLYLLOY  
COATINGS**

# **KILN SHELL CORROSION COATINGS**



Surjit Gill

Edita Rojasova, PhD.

**Hayward, California, USA**

# Corrosion Problems Inside Cement Kilns

## Introduction

- Cement kilns face severe conditions: **high temperatures, chemical attack, and abrasive dust.**
- Corrosion affects both **refractory linings** and **metal components.**
- Understanding causes helps extend **kiln life** and **reduce maintenance costs.**

## Main Causes of Corrosion

- **Chemical Attack**  
Alkalis, chlorides, and sulfates form corrosive compounds.  
Deposit formation on cooler surfaces initiates corrosion.
- **Acid Dew Point Corrosion**  
Condensation of sulfuric and hydrochloric acids at low temperatures.  
Common in **preheater towers** and **ducting.**
- **Molten Phase Attack**  
Molten clinker or alkali salts attack refractory linings and anchors.
- **Mechanical & Thermal Stress**  
Abrasion + temperature cycling remove protective layers.

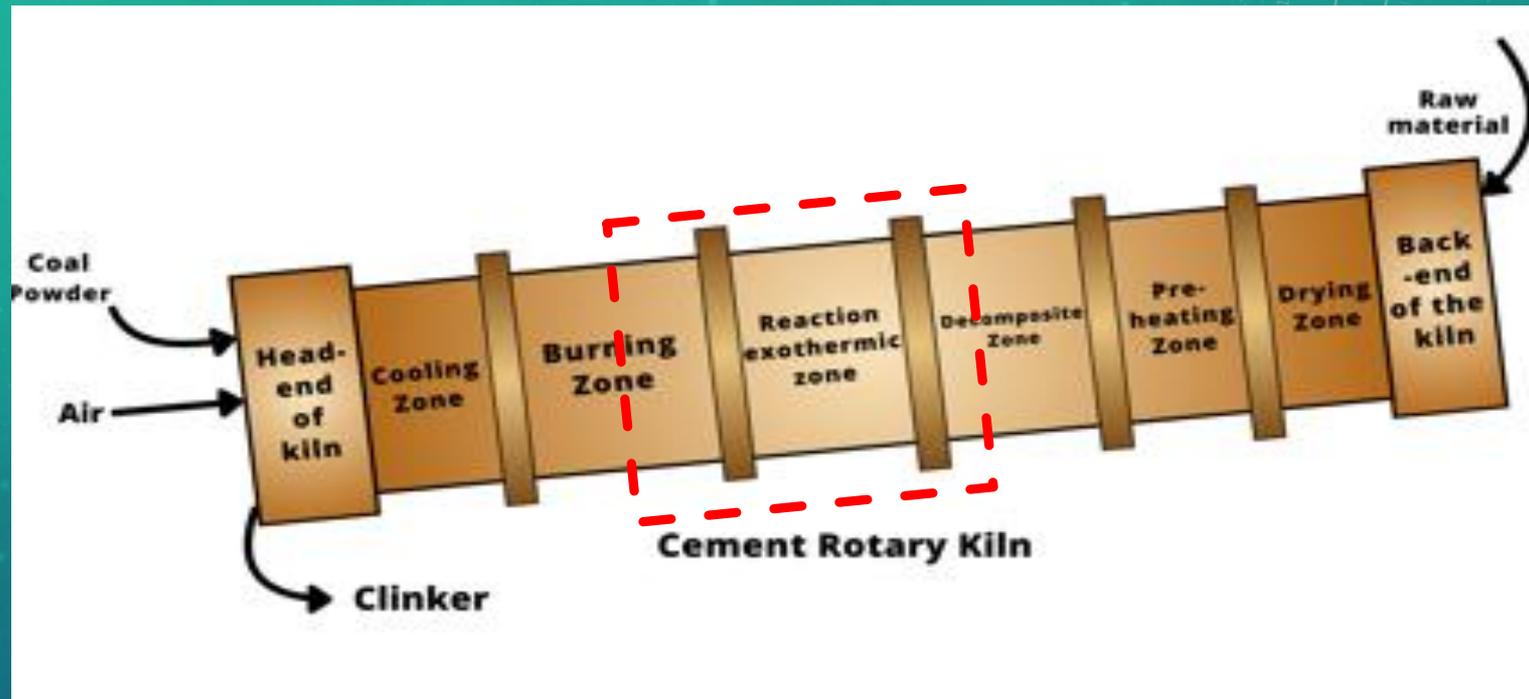
# Typical affected areas

- Kiln inlet & outlet zones
- Preheater cyclones & ducts
- Clinker cooler
- Burner pipe & nose ring
- Kiln shell behind refractory

## Consequences of Corrosion

- Refractory loss and frequent shutdowns
- Shell deformation or cracking
- Increased fuel consumption
- Contamination of clinker
- Higher repair costs

# PROCESS ON SHELL CORROSION



High rate of corrosion in the Burning/Reaction Exothermic Zones/Decomposition Zones observed in 5 to 20 meters section of kiln

- Sulphates get recycled along with the feed material
- $\text{SO}_3$ ,  $\text{CO}_2$ ,  $\text{CO}$  and  $\text{Cl}$  concentration increases in the section over time
- Gases penetrate through the porous refractory lining toward the kiln shell

# CORROSION UNDER REFRACTORY



## Kiln Shell Corrosion Mechanisms

- **High-Temperature Oxidation:** Scaling of steel shell from iron oxidation at elevated temperature.
- **Moisture Rusting:** Condensation and humid air during shutdown cause rust formation.
- **Acidic Condensation:**  
 $\text{SO}_2 + \text{O}_2 \rightarrow \text{SO}_3 \rightarrow \text{H}_2\text{SO}_4 \rightarrow$  acid attack on shell surface.

# CORROSION MITIGATION & PREVENTION

- Use **corrosion-resistant refractories** (high-alumina, chrome-free)
- Maintain **temperature control** to prevent acid condensation
- **Gas cleaning** to lower sulfur and chloride levels
- Apply **protective coatings** to metallic parts
- **Regular inspections & monitoring**

## Kiln Corrosion Summary

- Corrosion is driven by **chemical, thermal, and mechanical factors**.
- Impacts **kiln reliability, maintenance cost, and production efficiency**.
- Preventive actions must combine **material selection, process control, and regular monitoring**.

# PROTECTIVE COATINGS FOR CEMENT KILN SHELL (UNDER REFRACTORY)

The **kiln shell** (typically carbon steel) is exposed to:

- **High temperatures** (200–400 °C at the shell surface)
- **Chemical vapors** (alkalis, chlorides, sulfur compounds)
- **Moisture ingress** when the kiln is offline
- **Oxygen exposure** through cracks in refractory

**Without protection, these factors cause oxidation, sulfidation, and corrosion pitting, leading to shell weakening, deformation, or costly downtime.**

**Protective coatings act as a barrier layer between the steel shell and the refractory system.**

# KEY REQUIREMENTS FOR COATINGS

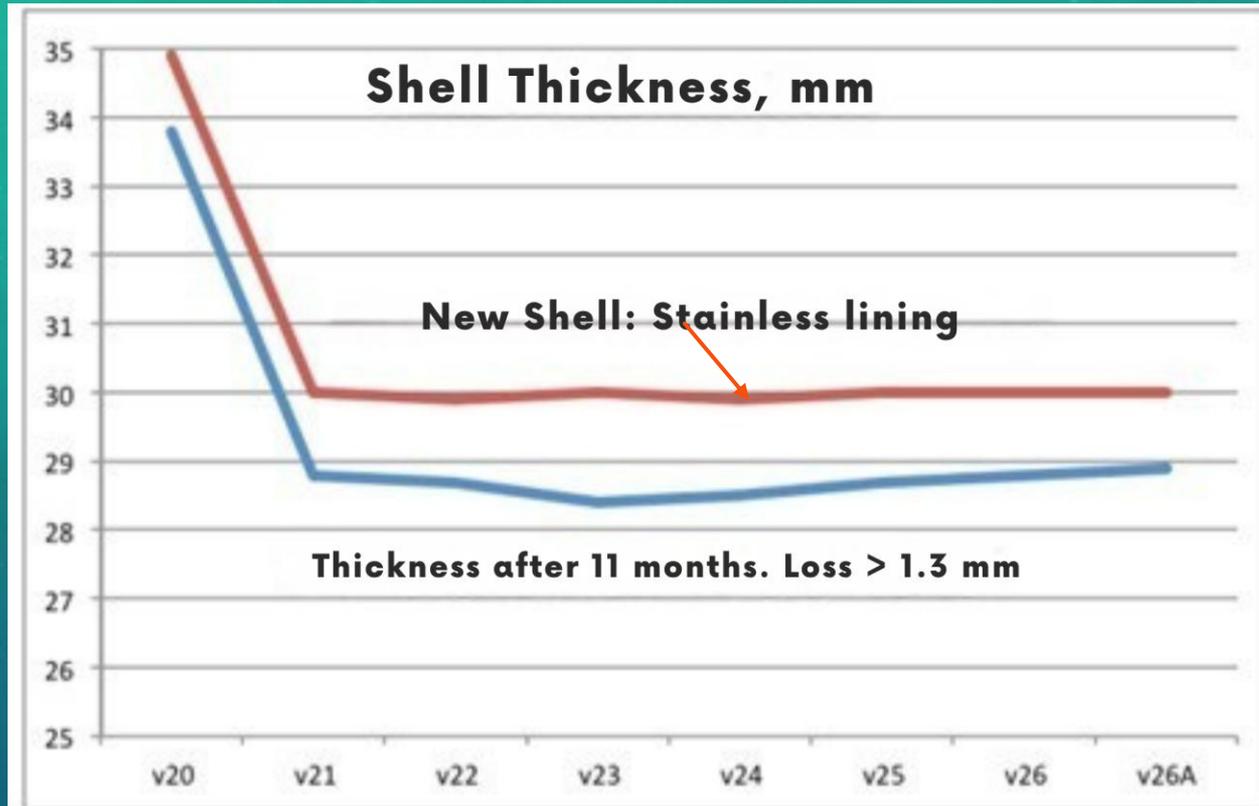
## A good protective coating under refractory should:

- Withstand **high temperatures** (up to 500 °C or more)
- Resist **alkali, sulfur, and chloride attack**
- Maintain **adhesion** under thermal cycling
- Have **low permeability** to moisture and gases
- Be **compatible** with refractory mortar or anchors

## COATING BENEFITS

- Easier refractory removal during maintenance (coating prevents bonding).
- Extends shell life and reduces risk of corrosion beneath refractory.
- Minimizes downtime and long-term repair costs.

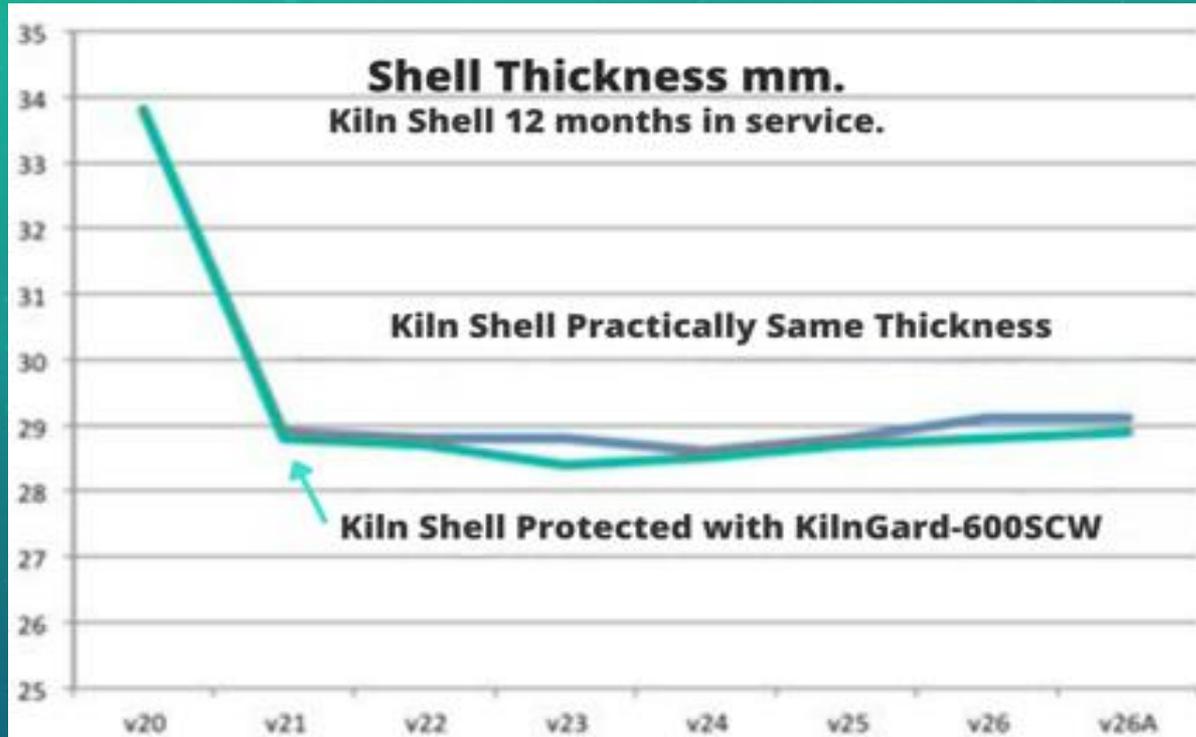
# LOSS OF KILN SHELL THICKNESS DUE CORROSION



## Observed Shell Thickness Loss

- Sacrificial stainless-steel lining installed for protection.
- **1.3 mm loss** in shell thickness observed within **11 months**.
- For a new kiln shell (15–30 mm thick), this equals about **30–40% loss over 7 years**, if unprotected.

# KILN SHELL PROTECTED WITH HIGH-TEMPERATURE NANO-CERAMIC COATING



## Kiln Shell Protection – Nano-Ceramic Coating (KilnGard-600 SCW)

- High-temperature nano-ceramic coating applied on inner shell surface.
- 0.5 mm (20 mils) layer sprayed on sandblasted steel, air-dried, and heat-cured during refractory curing.

**Result:** After 12 months in service, *no shell thickness loss observed.*

# WHAT IS KILNGARD®-600SCW ?

- **Nano-Ceramic Coating Technology – Kiln Shell Protection**
- Densely cross-linked **inorganic/metal matrix** for durability.
- Withstands temperatures up to **600°C (1112°F)**.
- Applied **under refractory** on the inner kiln shell.
- **Water-based, non-toxic**, and easy to apply.
- Forms a **passive protective layer** through chemical bonding with steel.
- **Excellent abrasion resistance** – unaffected by refractory contact during rotation.

# KILNGARD®-600SCW APPLICATION PROJECT



New kiln section



Replacing the kiln section



Surface Preparation



Application of KilnGard-600SCW

# EXAMPLES OF KILNGARD-600SCW PROJECTS

- AMBUJA CEMENTS Kiln Shell Section, **India**
- HOLCIM Davao, New Kiln Section, **Philippines**
- CEMENT AUSTRALIA New Cement Kiln Section, **Australia**
- CEMEX Tamuin, CEMEX Monterrey, CEMEX Mérida, CEMEX Torreón, CEMEX Huichapan, Projects in cement kilns, **Mexico**
- D.G. KHAN CEMENT, Lahore, Kiln shell protection, **Pakistan**
- HOLCIM, Barroso, Kiln Shell Protection, **Brazil**
- Cementos de Norte CENOSA, Cement Kiln Shell, **Honduras**
- Christy Refractories, St. Louis MO, Thermal Oxidizer Stack USA
- CEMEX Rudniki, Cement Kiln, **Poland**
- YTL Perak-Hanjoong Simen, Kiln protection. **Malaysia**
- Monomeros CV, Barranquilla. New kiln section. **Colombia**
- Navi Doha, Kiln Protection. **Qatar**
- Holcim Indonesia. Kiln protection. **Indonesia**
- Cemex Spain. Kiln Protection. **Spain**

# Polyloy Coatings Inc.-Company profile

- **High-Performance coating-technology**
  - **Product Line acquired from 3L&T, Inc.**
  - **Polymer-inorganic– alloy matrix and covalent linkage to the substrate**
  - **R&D and Manufacturing in California**
  - **Go-to-Market Strategy: Global Partners and Technical Support**
- **3 Categories with 9 core breakthrough solutions:**
    - **High Temperature (225 to 455°C) flue gas acid corrosion resistance**
    - **Very high temperature (>600°C) and abrasion resistant**
    - **Coatings for aggressive chemicals resistance**
  - **20+ years proven performance >1200 applications globally**
    - **Cement and lime plants**
    - **Power generation plants. Hazardous Waste Incineration**
    - **Metal smelters**
    - **Battery recycle, glass, carbon black..**

# Global Partner Network



Company	Region/Country
PA Technologies	France/EU/Canada/Africa
ProSol Industrial Resources Corp	Philippines
Vertex Industries	Spain/Portugal
Densit do Brasil	Brazil
ADVA Solutions	Mexico/LATAM
EpiMax Technologies	Australia/NZ
ETEC EL Raise	Egypt/UAE
Penta Engineering	USA
Christy Industrial Services & Refractories	USA
PT. Suprabakti Mandiri	Indonesia
Redecam	USA
Ferroser	Turkey
LV International	Thailand

# CONCLUSIONS

- **KilnGard™-600SCW** provides reliable protection against **corrosion, oxidation, and chemical attack.**
- A **preventive, cost-effective strategy** for sustainable kiln operation.
- Prevents **under-refractory corrosion and shell thinning.**
- **Extends kiln shell life** and reduces unplanned shutdowns.
- **Eases refractory removal** during future maintenance.
- Helps maintain **structural integrity and alignment** of the shell.
- Reduces **long-term maintenance and replacement costs.**