

KERONE Engineering Solutions Limited

Kerone Research & Development Centre (KRDC) | Since 1976

INDUSTRIAL CASE STUDY

Industrial Oven Installations & Process Optimization

Continuous Curing Oven Retrofit & Thermal Process Optimization
Designed, Engineered & Validated by KERONE Engineering Solutions Limited

3.5 m/min LINE SPEED Post-Optimization	200°C PROCESS TEMP. Zoned Control	20 min DWELL TIME Cure Window
---	--	--

32% ENERGY REDUCTION kWh + LPG Combined	0.9% REJECT RATE Down From 6.8%	~1.8 Yrs PAYBACK PERIOD On Retrofit CAPEX
--	--	--

PROJECT REFERENCE DETAIL	
Client Organisation	Suryaa Auto Components Pvt. Ltd. — Tier-1 automotive component manufacturer
KERONE Reference	KRDC/ICS/OvenOpt/2025-02 Based on KRDC Audit Report 63/KRDC/AUD/09
Technology	Continuous Conveyorized Curing Oven — Recirculating Hot Air, Zoned PID Control
Process Application	Powder-coat curing of automotive brackets, chassis mounts & sheet-metal parts
Product Outcome	OEM-spec cured finish — 100% cross-hatch adhesion, uniform gloss, zero under-cure
Plant Location	Client facility, Chakan, Pune, Maharashtra — Retrofit of existing coating line
Document Date	July 2026 Validated on KRDC Trial Data — April 2026

Automotive Components | Industrial Ovens | Powder Coating | Thermal Process Optimization | Energy Efficiency | Manufacturing Quality

Executive Summary

Suryaa Auto Components Pvt. Ltd., a Tier-1 supplier of powder-coated brackets and chassis components to leading Indian passenger-vehicle OEMs, was facing rising rejection rates and escalating energy costs on its existing conveyorized curing oven. The oven, originally commissioned over a decade earlier, exhibited poor temperature uniformity across its width and length, forcing operators to over-cure the product to guarantee minimum bake at the coolest zone — inflating fuel consumption and slowing line speed.

KERONE Engineering Solutions Limited was engaged to conduct a comprehensive thermal audit of the existing installation, re-engineer the recirculation and burner systems, and optimize the process envelope for a target line speed of 3.5 metres per minute without compromising cure quality.

Following a structured KRDC thermal-profiling exercise using traversable thermocouple arrays and datalogging across the existing and modified oven configurations, KERONE re-zoned the burner and airflow layout, upgraded the insulation package, and implemented closed-loop PID control per zone. The optimized oven — operating at 200 degrees Celsius supply air temperature with a 20-minute effective dwell time — reduced the temperature spread across the working chamber from $\pm 18^{\circ}\text{C}$ to $\pm 3^{\circ}\text{C}$, cut combined energy consumption by 32%, and reduced coating rejects from 6.8% to 0.9%.

CHALLENGE	KERONE SOLUTION	OUTCOME ACHIEVED
Non-uniform cure ($\pm 18^{\circ}\text{C}$ spread), 6.8% reject rate, high LPG/electricity use, line speed capped at 2.2 m/min to compensate for cold zones.	Re-zoned burner/recirculation system, upgraded insulation, zoned PID control, validated via KRDC thermal-profiling trials.	$\pm 3^{\circ}\text{C}$ uniformity, 0.9% reject rate, 32% energy reduction, line speed raised to 3.5 m/min — 59% throughput gain.

Key Performance Summary

KPI	Before Optimization (Baseline)	After KERONE Optimization	Improvement
Chamber Temperature Uniformity	$\pm 18^{\circ}\text{C}$ spread	$\pm 3^{\circ}\text{C}$ spread	83% tighter control
Coating Reject Rate	6.8%	0.9%	87% reduction
Line Speed (Throughput)	2.2 m/min	3.5 m/min	+59% throughput
Combined Energy Use (kWh+LPG eq./hr)	~412 kWh-eq/hr	~280 kWh-eq/hr	32% reduction
Cure Compliance (Cross-hatch Adhesion)	~91% pass	100% pass	Full OEM compliance
Annual Energy Cost	INR 68-74 Lakh/yr	INR 46-50 Lakh/yr	INR ~22 Lakh/yr saved

Industry Context & The Business Challenge

India's automotive component sector processes an estimated 8-10 million square metres of powder-coated surface area per month across Tier-1 and Tier-2 suppliers, with curing ovens accounting for 55-65% of total process energy consumption on a typical coating line. Ageing oven installations — many commissioned 10-15 years ago with uninsulated ducting and single-zone burner control — are a well-recognised source of both energy waste and quality variability across the industry.

OEM quality mandates (cross-hatch adhesion per ASTM D3359, gloss retention, and salt-spray corrosion resistance) require a minimum metal temperature and dwell time to be reliably achieved across every point of every component passing through the oven. Where temperature uniformity is poor, suppliers are commercially forced to over-cure — running hotter or slower than necessary — which increases energy cost, reduces line throughput, and can itself degrade coating properties through over-bake embrittlement.

The Commercial Problem — Why Uneven Curing Erodes Margin

Quality / Process Parameter	Existing Oven (Suryaa Auto)	OEM / Industry Requirement	Gap
Temperature Uniformity	±18°C across chamber	±5°C or better	FAIL — 3.6x tolerance exceeded
Reject Rate (Adhesion/Cure)	6.8%	< 2%	FAIL — 3.4x above target
Line Speed	2.2 m/min	3.0-3.5 m/min (target)	FAIL — throughput-limited
Specific Energy Use	~1.85 kWh-eq/kg part	< 1.3 kWh-eq/kg part	FAIL — 42% excess consumption

Table 1: Existing oven performance vs OEM/industry benchmark | Source: KRDC Thermal Audit & ASTM D3359 Adhesion Requirements

Revenue & Cost Opportunity — Optimizing an Existing Asset

At the pre-optimization line speed of 2.2 m/min, the coating line processed approximately 1,450 tonnes of components per year across 300 operating days. Rework and scrap arising from the 6.8% reject rate cost the client an estimated INR 38-42 Lakh annually in reprocessing, stripping, and re-coating labour, in addition to INR 68-74 Lakh in annual oven energy spend. The retrofit converts an existing capital asset into a higher-throughput, lower-cost production line without the capital cost of a full oven replacement.

Process Validation — From KRDC Audit to Site Retrofit

KERONE's engineering approach mandates a structured thermal audit before any retrofit specification is issued. The KRDC (Kerone Research & Development Centre) team conducted an on-site thermal-profiling programme over 5 days (14-18 April 2026), instrumenting the existing oven with a 12-point traversable thermocouple array logging chamber and part-surface temperatures across three line speeds and two burner configurations.

KRDC Thermal Audit — Key Findings

Test Condition	Line Speed	Chamber ΔT (Uniformity)	Metal Temp. Achieved	Assessment
Baseline (existing burners)	2.2 m/min	±18°C	185-203°C	Non-uniform — forces over-cure
Re-zoned burners, no insulation upgrade	2.8 m/min	±11°C	190-201°C	Improved — still out of spec
Re-zoned burners + insulation upgrade	3.2 m/min	±5°C	196-201°C	Meets OEM uniformity spec
OPTIMAL — Full retrofit + PID zoning	3.5 m/min	±3°C	198-201°C	Recommended production setpoint

Table 2: KRDC Thermal Audit Results — 12-point thermocouple traverse, existing oven at Suryaa Auto facility | KRDC Audit Report 63/KRDC/AUD/09

Retrofit Methodology — Audit Findings to Site Specification

KERONE's retrofit process follows a structured engineering framework in which audit measurements are translated into site-installable equipment upgrades using validated combustion and airflow models. The key translation factors for this project are:

Parameter	Existing Oven (As Found)	Retrofit Specification	Change Type
Supply Air Temperature	205°C (setpoint), 185-223°C (actual)	200°C, held to ±3°C	Zoned PID re-control
Burner Zoning	Single zone, 1 burner	3 independent zones, modulating burners	Configuration upgrade
Recirculation Airflow	Uneven, single duct	Balanced multi-nozzle plenum, CFD-verified	Ducting redesign
Insulation	75mm mineral wool, degraded	150mm ceramic-fibre blanket, sealed joints	Full replacement
Dwell Time	27 min (at 2.2 m/min)	20 min (at 3.5 m/min)	Line-speed increase
Control System	Single thermostat, manual	PLC with 3-zone PID + datalogging	Automation upgrade

Retrofit Design — Continuous Curing Oven System

The retrofit scope covers the burner and combustion system, recirculation ductwork, insulation envelope, and process control architecture, while reusing the existing conveyor, oven shell, and building footprint wherever structurally sound. This targeted approach delivers the performance uplift of a new oven at a fraction of full-replacement capital cost.

System Architecture — Major Retrofit Units

Unit / Section	Equipment	Design Parameters	Function
U-01: Combustion System	3x Modulating Gas Burners (LPG/PNG dual-fuel)	150,000 kcal/hr each, 10:1 turndown	Independent zone heat input, fine modulation
U-02: Recirculation Plenum	Multi-nozzle balanced air plenum + blowers	3x 5.5 kW centrifugal blowers, CFD-verified nozzle layout	Even airflow distribution across chamber width
U-03: Insulation Envelope	Ceramic-fibre blanket + sealed panel joints	150mm thickness, sealed expansion joints	Minimise heat loss, eliminate cold spots
U-04: Exhaust & Makeup Air	Balanced exhaust fan + fresh-air makeup damper	Modulating damper, 0-100% makeup control	VOC/solvent removal, chamber pressure balance
U-05: Conveyor (retained)	Existing overhead power-and-free conveyor	3.5 m/min rated (upgraded drive VFD)	Part transport through cure zones
U-06: Process Control	PLC with 3-zone PID + HMI	Siemens S7-1200, 12-point thermocouple logging	Automated zone temperature control, data logging
U-07: Instrumentation	12-point traversable thermocouple array (commissioning)	Type-K, ±1°C accuracy	Uniformity verification during FAT/commissioning

Table 3: Retrofit Unit Descriptions — Suryaa Auto Continuous Curing Oven | U-01 to U-03 are the primary retrofit scope; U-05 is retained with drive upgrade only

Core Equipment Specification — Retrofit Combustion & Airflow System

The re-engineered combustion and recirculation system is the core of the oven upgrade. Designed and specified by KERONE's thermal engineering team, it directly implements the zone layout and airflow balance validated during the KRDC on-site audit, targeting the ±3°C chamber uniformity demonstrated in trials.

OVEN RETROFIT — CORE SPECIFICATIONS	
Oven Chamber Length (retained)	24 metres (3 zones of 8m each)
Operating Temperature	200°C (max design: 260°C)
Dwell Time	20 min (adjustable 15-30 min via line speed)
Burner Configuration	3 independent modulating burners, 150,000 kcal/hr each
Fuel	LPG (existing) / PNG-ready (future conversion)
Recirculation Blowers	3x 5.5 kW centrifugal, VFD-controlled
Insulation	Ceramic fibre blanket — 150mm, sealed joints
Temperature Uniformity (validated)	±3°C across chamber cross-section
Control System	Siemens S7-1200 PLC, 3-zone PID, HMI touchscreen
Line Speed (post-retrofit)	3.5 m/min (from 2.2 m/min)

Retrofit scope reuses the existing 24m oven tunnel and conveyor; combustion, airflow and control systems are replaced

Utilities & Ancillary Requirements

Utility	Specification	Consumption (Post-Retrofit)	Source
LPG / Fuel Gas	Dual-fuel burner, 10:1 turndown	~38 kg/hr at full load	Site bulk LPG / future PNG
Electrical Power	415V, 3-phase, 50Hz	~24 kW connected (blowers + drives)	Site utility
Compressed Air	6 bar dry, instrument grade	8 Nm3/hr (control valves, dampers)	Air compressor (site)
Exhaust / Makeup Air	Balanced draft, modulating damper	~4,500 Nm3/hr at full load	Ambient / roof exhaust

Emission Compliance

Emission Point	Pollutant	Expected Level	CPCB / MoEF Limit	Status
Oven exhaust stack	VOC / TOC	< 12 mg/Nm3	20 mg/Nm3	COMPLIANT
Oven exhaust stack	PM10	< 15 mg/Nm3	50 mg/Nm3	COMPLIANT
Combustion flue	CO	< 50 ppm	100 ppm	COMPLIANT

Energy Balance & Consumption Analysis

The retrofit's energy savings arise from three combined effects: tighter chamber uniformity (eliminating the need to over-fire cold zones), improved insulation (reducing standing heat loss), and higher line speed (spreading fixed thermal losses over more throughput). The table below breaks down energy consumption before and after retrofit.

Energy Consumption — Before vs After Retrofit

Energy Category	Before Retrofit (kWh-eq/hr)	After Retrofit (kWh-eq/hr)	Change
Burner Fuel (LPG, heat input)	~340	~228	-33%
Recirculation Blowers	~18	~22	+22% (higher airflow, balanced)
Conveyor Drive	~6	~8	+33% (higher line speed)
Controls & Instrumentation	~3	~4	+33% (added PLC/HMI)
Standing Heat Loss (insulation)	~45	~18	-60%
TOTAL	~412 kWh-eq/hr	~280 kWh-eq/hr	-32%

Table 4: Energy balance — Suryaa Auto curing oven, before vs after retrofit | Based on KRDC audit data and post-commissioning trial measurements

Throughput & Specific Energy Impact

Metric	Before Retrofit	After Retrofit	Notes
Line Speed	2.2 m/min	3.5 m/min	+59% throughput
Annual Part Throughput	~1,450 t/yr	~2,305 t/yr	At 300 days, 2-shift operation
Specific Energy (kWh-eq/kg part)	~1.85	~0.85	-54% per unit part
Reject Rate	6.8%	0.9%	Fewer parts require rework energy

Cure Quality Specification & Compliance

Cure quality is assessed against the OEM's powder-coat specification, which requires full cross-hatch adhesion (ASTM D3359), minimum gloss retention, and freedom from under-cure or over-bake defects across every part position in the oven, including the historically under-performing outer conveyor tracks.

Expected Quality Specification — Post-Retrofit

Parameter	Test Method	Before Retrofit	After Retrofit	OEM Requirement
Metal Temperature Range	Traversable thermocouple	185-223°C	198-201°C	195-205°C
Cross-hatch Adhesion (Pass Rate)	ASTM D3359	~91%	100%	100%
Gloss Retention	ASTM D523 (60°)	~88%	~97%	> 95%
Reject Rate (Under/Over-cure)	Visual + adhesion test	6.8%	0.9%	< 2%
Chamber Uniformity	12-point thermocouple traverse	±18°C	±3°C	± 5°C or better

Table 5: Cure quality specification — before vs after retrofit vs OEM requirement | 2-hr commissioning trial data, April-May 2026

Applications & Downstream Benefits

- **Chassis & Suspension Components** — Brackets, chassis mounts, and suspension components now meet full OEM cross-hatch adhesion and salt-spray corrosion requirements at every conveyor position, eliminating position-dependent quality sorting.
- **Reduced Rework Burden** — With reject rates at 0.9%, rework labour and re-coating material consumption have fallen sharply, freeing operator time for value-added inspection rather than corrective stripping.
- **Capacity Headroom** — The higher, more consistent line speed (3.5 m/min) allows the client to accommodate volume growth from new OEM programmes without a second oven investment.
- **Coating Durability** — Tighter thermal control reduces the risk of coating embrittlement from historical over-bake practices, supporting longer in-service coating life.

Financial Analysis & Return on Investment

The retrofit was scoped to deliver payback from combined energy savings and reject-rate reduction within two years, without requiring a full oven replacement or extended production downtime.

CAPEX Estimate — Oven Retrofit

Cost Head	Scope	Estimated Cost (INR Lakhs)	Notes
Burner & Combustion System	3x modulating burners, dual-fuel ready	9-11	FOT Ambarnath; factory tested
Recirculation Plenum & Blowers	CFD-designed plenum, 3x blowers, VFDs	6-7	Balanced multi-nozzle design
Insulation Upgrade	150mm ceramic fibre, sealed panels	4-5	Full chamber re-lining
Control System	PLC, HMI, thermocouples, wiring	5-6	Siemens S7-1200 based
Conveyor Drive Upgrade	VFD + drive motor upgrade	2-3	Reuses existing conveyor chain
Installation & Downtime Mgmt	Site retrofit, phased shutdown	3-4	Weekend/planned-shutdown execution
Commissioning, Training & FAT	KERONE commissioning team, 10-day support	2-3	Includes uniformity re-validation
TOTAL CAPEX		31-39	Approx. range; formal quotation on enquiry

Table 6: CAPEX estimate — continuous curing oven retrofit | All figures indicative; formal quotation on receipt of detailed enquiry

Revenue & OPEX Impact — Annual Basis

Item	Basis	INR/Year (Lakhs)	Remarks
SAVINGS / GAINS			
Energy Cost Saving	132 kWh-eq/hr saved x 4,800 hr/yr x INR 8/kWh-eq	~50.7	Combined LPG + electricity
Rework/Reject Cost Avoided	5.9% reject reduction x 1,450 t/yr baseline value	~34	Reduced stripping & re-coating
Additional Throughput Value	855 t/yr incremental capacity x margin	~18-22	At existing order book utilisation
OPERATING COSTS (INCREMENTAL)			
Maintenance & Spares	3% of CAPEX per annum	~1.1	Annual maintenance provision

Item	Basis	INR/Year (Lakhs)	Remarks
Additional Blower/Drive Power	Incremental kWh from higher airflow & speed	~1.8	Included net in energy line above
NET ANNUAL BENEFIT		~INR 100-104 Lakhs/yr	Payback ~1.8 years on INR 35L CAPEX

Table 7: Revenue & OPEX impact model — annual basis at 4,800 operating hours/year (2-shift) | Indicative figures; actual savings depend on fuel pricing and order volume

Project Execution & KERONE Scope of Supply

Implementation Timeline

Phase	Activity	Duration	KERONE Deliverable
Phase 0 — Audit	On-site thermal audit, thermocouple traverse trials, process design freeze	2-3 Weeks	Thermal Audit Report, retrofit design basis
Phase 1 — Engineering	Combustion, ducting, insulation & control system detailed engineering	4-5 Weeks	GA drawings, P&ID, burner/blower selection
Phase 2 — Procurement	Burners, blowers, insulation, PLC/HMI panel fabrication	6-8 Weeks	Material test certificates, FAT invitation
Phase 3 — Site Retrofit	Phased installation during planned line shutdown	2-3 Weeks	KERONE site supervision; minimal downtime plan
Phase 4 — Commissioning	Cold trials, hot trials, uniformity re-validation, operator training	1-2 Weeks	Commissioning report, performance certificate
TOTAL PROJECT TIMELINE	Order to validated commercial production	~15-21 Weeks	From purchase order to first commercial output

KERONE Scope of Supply & Services

Category	KERONE Scope (INCLUDED)	Client Scope (EXCLUDED from KERONE supply)
Process Audit	Thermal profiling, uniformity mapping, energy audit report	Access to production line for trial windows
Combustion & Airflow	Burners, blowers, plenum design & fabrication	Existing conveyor mechanical overhaul (if required)
Insulation	Full chamber re-lining, sealed panel joints	Structural steel repairs to oven shell (if needed)
Controls	PLC/HMI, thermocouples, field wiring within oven	Plant-wide SCADA integration beyond oven scope
Commissioning	FAT (where applicable), site commissioning, operator training	Consumables (LPG) for commissioning trials
Documentation	P&ID, GA drawings, O&M manual, uniformity test certificates	Regulatory consent renewals, insurance

Conclusions & Why KERONE

The KERONE-designed retrofit of Suryaa Auto Components' continuous curing oven demonstrates that significant throughput, quality, and energy gains are achievable on an existing thermal asset without the capital cost and downtime of a full oven replacement. The retrofit is built on rigorous KRDC on-site thermal audit data — not assumed performance — and the final zone and control specification directly replicates the exact configuration that delivered $\pm 3^{\circ}\text{C}$ uniformity in trials.

- **Proven Technology** Every retrofit parameter — burner zoning, insulation thickness, PID control bands — is directly derived from KRDC's on-site thermal audit 63/KRDC/AUD/09 on the client's actual oven. No extrapolation; no assumptions.
- **Quantified Outcome** Chamber uniformity improvement from $\pm 18^{\circ}\text{C}$ to $\pm 3^{\circ}\text{C}$, and reject-rate reduction from 6.8% to 0.9%, are measured, certified results from commissioning trials — not marketing claims.
- **Commercial Clarity** The financial model demonstrates a payback period of approximately 1.8 years, converting an underperforming legacy asset into a INR 100+ Lakh/year value line through energy and quality gains.
- **Full Ownership** KERONE audits, designs, supplies, retrofits, and commissions the complete upgrade from a single point of accountability — eliminating multi-vendor coordination risk during a live production shutdown.
- **Scalable Platform** The zoned burner and control retrofit platform is scalable to multi-oven coating lines and to other thermal-process assets (dryers, bake ovens, annealing furnaces) across the client's other facilities.
- **Compliance-Ready** Emission control is verified as part of the retrofit scope — the upgraded system is validated to CPCB stack norms, not retrofitted for compliance after the fact.

ENQUIRE ABOUT YOUR OVEN INSTALLATION OR RETROFIT PROJECT

KERONE Engineering Solutions Limited | KRDC — Kerone Research & Development Centre

B/47 Addl. MIDC, Anand Nagar, Ambarnath (East), Thane - 421 506, Maharashtra, India

Tel: +91-251-2620542 / 13 / 44 / 45 / 46

Email: info@kerone.com | Web: www.kerone.com

To initiate a project discussion, please share: existing oven GA drawing / process specifications + line speed & throughput target + site location + target quality/energy KPIs

ISO 9001:2015 | ISO 14001:2015 | ISO 45001:2018 | CRISIL Rated Company | AIMCAL Member | IHEA Member | EMItch Certified | 50+ Years of Engineering Excellence

DISCLAIMER: All financial projections are indicative and based on prevailing market and energy-cost conditions as of July 2026. Process performance figures are derived from KRDC on-site audit data (Report 63/KRDC/AUD/09) conducted on Suryaa Auto Components Pvt. Ltd.'s existing oven installation. Actual industrial performance may vary. This document is intended for discussion purposes; a formal quotation will be issued following detailed enquiry.