

INDUSTRIAL CASE STUDY

# Semiconductor-Grade Silicon Carbide (SiC) Powder Recovery from Wafer Dicing & Grinding Waste

Continuous Industrial-Scale Thermal Processing System — 0.1 Tonne Per Hour Capacity  
Designed, Engineered & Validated by KERONE Engineering Solutions Limited

|                                                                         |                                                                            |                                                                            |
|-------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------|
| <div>0.1 TPH</div> <div>PLANT CAPACITY</div> <div>SiC Swarf Input</div> | <div>850°C</div> <div>PROCESS TEMP.</div> <div>Controlled Atmosphere</div> | <div>45 min</div> <div>RESIDENCE TIME</div> <div>Optimal Hold</div>        |
| <div>99.62%</div> <div>SiC PURITY</div> <div>XRD Verified</div>         | <div>95.1%</div> <div>ORGANIC REMOVAL</div> <div>Mass Basis</div>          | <div>~3.2 Yrs</div> <div>PAYBACK PERIOD</div> <div>At Market Premium</div> |

Project Reference Detail

|                     |                                                                                                         |
|---------------------|---------------------------------------------------------------------------------------------------------|
| Client Organisation | VedaSemicon Materials Pvt. Ltd. — Leading Indian SiC substrate & power-semiconductor wafer manufacturer |
| KERONE Reference    | KRDC/ICS/SiCReclaim/2025-02   Based on KRDC Lab Report 52/KRDC/LAB/22                                   |
| Technology          | Continuous Rotary Tube Furnace with Controlled Inert (Argon) Atmosphere & Active Cooling                |
| Feedstock           | SiC Wafer Dicing & Grinding Swarf (dried filter cake) — 15.80% Organic/Volatile Matter (as-received)    |
| Product Output      | High-Purity Reclaimed Silicon Carbide (SiC) Powder — 99.62% SiC Purity (XRD)                            |
| Plant Location      | Client facility (SiC substrate fab) — Inline with existing wafer dicing/grinding line                   |
| Document Date       | July 2026   Validated on KRDC Lab Data — May 2026                                                       |

Semiconductor Materials | SiC Powder Recovery | Circular Economy | Thermal Processing | Power Electronics | Chemical / Materials

Executive Summary

VedaSemicon Materials Pvt. Ltd., a growing Indian manufacturer of silicon carbide (SiC) substrates and power-semiconductor wafers, faced a commercially significant challenge: their wafer dicing and grinding operations generate large volumes of SiC swarf — a high-value ceramic material — which, in its raw dried state, contains 15.80% organic binder/coolant residue and surface oxide contamination that dramatically reduce its usability and restrict it to low-grade abrasive filler applications.

KERONE Engineering Solutions Limited was engaged to design, validate, and specify an industrial-scale continuous thermal processing system capable of upgrading this raw SiC swarf to high-purity reclaimed SiC suitable for reuse in semiconductor and power-electronics-grade applications — at a throughput of 0.1 Tonne Per Hour (0.1 TPH).

Following rigorous laboratory validation at KRDC (Kerone Research & Development Centre) using a controlled tube furnace at 850 degrees C across multiple hold times (20 min, 45 min, 90 min), the optimal industrial process parameters were established. The KERONE continuous rotary tube furnace system — operating at 850 degrees C with a 45-minute material residence time under argon atmosphere — delivers organic/volatile matter reduction from 15.80% to below 0.8%, and SiC purity improvement from 91.40% to 99.62%.

| CHALLENGE                                                                                                                                   | KERONE SOLUTION                                                                                                               | OUTCOME ACHIEVED                                                                                                                            |
|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Raw SiC swarf with 15.80% organic/volatile content and 91.40% purity — viable only as low-value abrasive filler at INR 40,000-60,000/tonne. | Continuous 0.1 TPH rotary tube furnace at 850 degrees C, argon atmosphere, 45-min residence — validated from KRDC lab trials. | Reclaimed SiC with 99.62% SiC purity, <0.8% organics — commanding INR 2,50,000-3,50,000/tonne in semiconductor & power-electronics markets. |

Key Performance Summary

| KPI                                | Raw Feedstock (Baseline) | After KERONE Processing (0.1 TPH Plant)     | Improvement        |
|------------------------------------|--------------------------|---------------------------------------------|--------------------|
| Organic/Volatile Content           | 15.80%                   | < 0.8%                                      | 95% reduction      |
| SiC Purity (XRD)                   | 91.40%                   | 99.62%                                      | +8.2 pts increase  |
| Surface Oxide Content              | 6.20%                    | < 0.3%                                      | 95% reduction      |
| Free Carbon Content                | 2.10%                    | ~ 0.5%                                      | 76% reduction      |
| Market Value (Reclaimed SiC Grade) | INR 40,000-60,000/t      | INR 2,50,000-3,50,000/t                     | 5-6x price premium |
| Product Classification             | Abrasive-grade filler    | Semiconductor / power-electronics grade SiC | Grade uplift       |
| Annual Revenue Potential           | INR 2.8-3.6 Cr/yr        | INR 13-17 Cr/yr at 7,200 hr/yr operation    |                    |

## Industry Context & The Business Challenge

India's semiconductor and power-electronics manufacturing base is expanding rapidly under the national semiconductor mission, with SiC substrate and power-device capacity additions targeting electric-vehicle inverters, traction motors, and renewable-energy converters. SiC wafer slicing and grinding is highly material-intensive: kerf loss and grinding swarf account for 35-45% by weight of the SiC boule input, generating substantial volumes of high-value ceramic waste at every fab.

The global SiC materials market (substrates and power devices) is valued in the multi-billion-dollar range and is projected to grow significantly through 2030, driven by sustainability and localisation mandates from EV OEMs and power-electronics manufacturers targeting higher SiC device adoption. However, the critical barrier for Indian processors is quality: raw dicing/grinding swarf does not meet the purity specifications required for reuse in wafer manufacturing or premium abrasive markets, due to organic binder residue, coolant contamination, and surface oxidation.

### The Commercial Problem — Why Raw Swarf Has Low Value

| Quality Parameter        | Raw SiC Swarf (VedaSemicon) | Market Requirement (Reclaimed SiC, Semiconductor Grade) | Gap                              |
|--------------------------|-----------------------------|---------------------------------------------------------|----------------------------------|
| Organic/Volatile Content | 15.80%                      | < 1%                                                    | FAIL — 15.8x over limit          |
| SiC Purity (XRD)         | 91.40%                      | > 99%                                                   | FAIL — 7.6 pts below requirement |
| Surface Oxide Content    | 6.20%                       | < 0.5%                                                  | FAIL — 12.4x over limit          |
| Market Price Realised    | INR 40,000-60,000/t         | INR 2,50,000-3,50,000/t                                 | 5-6x revenue gap                 |

Table 1: Raw SiC swarf quality parameters vs market specification for reclaimed SiC | Source: KRDC Analysis & ASTM/industry SiC grade requirements

### Revenue Opportunity — Upgrading Existing Waste Stream

The Opportunity: At 0.1 TPH throughput operating 300 days/year (7,200 hours), the annual feedstock volume is approximately 720 tonnes of SiC swarf. At current raw swarf prices of INR 45,000/tonne, this generates INR 3.24 Cr/year. Post-processing with KERONE's system, the same volume (yielding approximately 674 tonnes of high-purity reclaimed SiC after organic/oxide removal) at INR 2,20,000/tonne generates INR 14.8 Cr/year — a revenue increase of over INR 11.5 Cr annually, from existing wafer-fab waste.

### About VedaSemicon Materials Pvt. Ltd.

VedaSemicon Materials Pvt. Ltd. is a privately-held Indian manufacturer of silicon carbide (SiC) substrates and power-semiconductor wafers, supplying electric-vehicle traction-inverter and power-electronics OEMs. Their operations span SiC boule growth, wafer slicing, lapping & grinding, and polishing — positioning them as an ideal anchor client for KERONE's SiC reclaim technology. The KRDC trial was conducted on VedaSemicon's actual production dicing/grinding swarf (15 kg sample, dispatched 12 May 2026) to ensure industrial relevance of all process parameters.

Process Validation — From KRDC Lab to Industrial Scale

KERONE's engineering approach mandates laboratory-scale validation before any industrial system specification. The KRDC (Kerone Research & Development Centre) conducted a structured experimental programme on VedaSemicon's actual SiC swarf over 5 days (12-16 May 2026), using a precision tube furnace to establish the process envelope that informs the 0.1 TPH industrial plant design.

KRDC Experimental Programme — Key Findings

| Test Condition    | Hold Time | Mass Reduction | SiC Purity (XRD) | Assessment                          |
|-------------------|-----------|----------------|------------------|-------------------------------------|
| Control (no hold) | 0 min     | < 0.5%         | 91.40%           | Baseline — raw swarf                |
| Short hold        | 20 min    | ~2.30%         | 96.10%           | Insufficient — rejects grade spec   |
| OPTIMAL           | 45 min    | 6.40%          | 99.62%           | Premium semiconductor grade         |
| Extended hold     | 90 min    | 5.70%          | 99.71%           | Marginal gain — diminishing returns |

Table 2: KRDC Laboratory Results — 850 degrees C tube furnace trials on VedaSemicon SiC swarf | KRDC Test Report 52/KRDC/LAB/22 | SiC purity via XRD phase analysis

Scale-Up Methodology — Lab to 0.1 TPH

KERONE's scale-up process follows a structured engineering framework where laboratory parameters are translated to industrial equipment specifications using validated thermal engineering models. The key translation factors for this project are:

| Parameter             | KRDC Lab (Tube Furnace) | Industrial Plant (0.1 TPH Rotary Furnace) | Scale-Up Factor      |
|-----------------------|-------------------------|-------------------------------------------|----------------------|
| Treatment Temperature | 850 degrees C           | 850 degrees C                             | 1:1 (direct)         |
| Optimal Hold Time     | 45 min                  | 45 min residence                          | 1:1 (direct)         |
| Throughput            | ~8 g/run                | 100 kg/hr                                 | 12,500:1             |
| Atmosphere            | Ar / N2 (selectable)    | Continuous Ar purge                       | Direct               |
| Ramp Rate             | 5.0 degrees C/min       | Zone-controlled (3 zones)                 | Adapted              |
| Heating Mode          | Batch (static)          | Continuous rotary drum                    | Configuration change |
| Cooling               | Natural (in-furnace)    | Active Ar-jacketed cooler                 | Enhanced             |
| Feed System           | Manual loading          | Screw conveyor + auto control             | Automated            |

Industrial Plant Design — 0.1 TPH Continuous Processing System

Continuous Industrial Rotary Tube Furnace — Process Flow

Feedstock Intake → Feed Preparation (Screening & Pre-Drying) → Rotary Tube Furnace (850°C | 45 min residence) → Controlled Ar-Jacketed Cooling → Quality Analysis (XRD / TGA) → Product Storage & Packing

System Architecture — Major Process Units

| Unit / Section                                   | Equipment                                           | Design Parameters                                                                                  | Function                                                                                         |
|--------------------------------------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| U-01: Feed Preparation                           | Vibro Screen + Belt Conveyor                        | 75 micron mesh   120 kg/hr rated                                                                   | Remove oversized particles/binder lumps; ensure uniform feed to furnace                          |
| U-02: Pre-drying                                 | Indirect Hot-Air Dryer (optional bypass)            | 150 degrees C   Reduce feed moisture to <0.5%                                                      | Minimise steam generation inside furnace tube; improve thermal efficiency                        |
| U-03: Rotary Tube Furnace (Primary Process Unit) | KERONE Continuous Rotary Tube Furnace               | 110 kg/hr capacity   850 degrees C, 45 min residence   L/D = 14:1   Ar atmosphere   3-zone heating | Core thermal processing — organic/oxide removal, purity upgrade, controlled atmosphere treatment |
| U-04: Atmosphere System                          | Ar Generator/Cylinder Bank + Purge Control Manifold | 99.999% purity Ar   <0.1% O2 inside   Flow: 25 Nm3/hr                                              | Prevent oxidation of SiC during high-temp treatment; maintain inert environment                  |
| U-05: Volatile Collection                        | After-burner / Thermal Oxidiser + Scrubber          | 950 degrees C afterburner   2-sec residence   Wet scrubber for organic off-gas                     | Combust VOC-laden off-gas from furnace tube; meet emission norms (CPCB)                          |
| U-06: Cooling Zone                               | Jacketed Rotary Cooler (Water-cooled)               | Inlet: 850 degrees C   Outlet: <60 degrees C   100 kg/hr   Ar maintained                           | Cool SiC powder under inert atmosphere before exposure to air; prevent re-oxidation              |
| U-07: Product Handling                           | Screw Conveyor + Big Bag/Drum Filler                | SS contact parts   Load cell-based auto filling   Clean packing                                    | Transfer cooled SiC to storage containers; prevent contamination and airborne dust               |
| U-08: Emission Control                           | Pulse-jet Bag Filter + Induced Draft Fan            | Efficiency: >99.9%   PM < 20 mg/Nm3   Compliant: CPCB Stack Norms                                  | Capture fine SiC dust from cooler and handling; zero visible emissions                           |
| U-09: Process Control                            | PLC/SCADA Control Panel                             | Siemens S7 / Allen Bradley   Remote monitoring capable                                             | Automated temperature, flow, residence time, and atmosphere control; data logging                |

Table 3: Process Unit Descriptions — KERONE 0.1 TPH Continuous SiC Swarf Processing Plant | U-03 (Rotary Tube Furnace) is the primary process unit; all others are ancillary

Core Equipment Specification — KERONE Rotary Tube Furnace

The KERONE Continuous Rotary Tube Furnace is the heart of the SiC swarf upgrading system. Designed and manufactured in-house at KERONE's Ambernath facility, it directly scales the validated laboratory parameters from KRDC trial 52/KRDC/LAB/22 to industrial throughput while maintaining the identical thermal profile, residence time, and atmosphere control that produced the 99.62% SiC purity result.

| ROTARY TUBE FURNACE   | CORE SPECIFICATIONS                                        |
|-----------------------|------------------------------------------------------------|
| Design Throughput     | 110 kg/hr (SiC swarf input)                                |
| Operating Temperature | 850 degrees C (max design: 1,100 degrees C)                |
| Residence Time        | 45 min (adjustable 20-90 min via RPM)                      |
| Tube Dimensions       | ID 300 mm x L 4,200 mm (high-temp alloy, refractory-lined) |
| Heating Zones         | 3 independent electric heating zones                       |
| Atmosphere            | Ar purge (continuous)   O2 < 0.1%                          |
| Drive System          | VFD-controlled 3.7 kW gear motor                           |
| Installed Power       | ~95 kW (total connected load)                              |
| Shell Material        | SS 310 with high-alumina refractory lining                 |
| Insulation            | Ceramic fibre blanket — 200 mm                             |
| Sealing               | Carbon-ring mechanical seals (gas-tight)                   |

KERONE Tube Furnace (KRDC laboratory scale) — industrial unit scaled to ID 300 mm x 4,200 mm L

Utilities & Ancillary Requirements

| Utility           | Specification                     | Consumption (at 0.1 TPH)             | Source                              |
|-------------------|-----------------------------------|--------------------------------------|-------------------------------------|
| Electrical Power  | 415V, 3-phase, 50Hz               | ~95 kW connected   ~72 kW avg demand | Site utility                        |
| Argon (Ar)        | 99.999% purity   5-7 bar supply   | 25 Nm3/hr (furnace + cooler)         | Bulk cylinder bank / cryogenic tank |
| Cooling Water     | 25 degrees C supply   closed loop | 6 m3/hr   32 degrees C return        | Cooling tower                       |
| Compressed Air    | 6 bar dry   instrument grade      | 8 Nm3/hr                             | Air compressor (site)               |
| Space Requirement | Building / covered area           | L 18m x W 8m x H 5m                  | New shed or existing bay            |

Emission Compliance

| Emission Point                         | Pollutant              | Expected Level | CPCB / MoEF Limit | Status    |
|----------------------------------------|------------------------|----------------|-------------------|-----------|
| Furnace off-gas (after afterburner)    | PM10                   | < 15 mg/Nm3    | 50 mg/Nm3         | COMPLIANT |
| Furnace off-gas                        | VOC / TOC              | < 8 mg/Nm3     | 20 mg/Nm3         | COMPLIANT |
| Cooling + handling (bag filter outlet) | SiC / Particulate Dust | < 20 mg/Nm3    | 50 mg/Nm3         | COMPLIANT |

Mass Balance & Energy Analysis — 0.1 TPH Operation

Detailed Mass Balance — Per Hour at Full Load

| Stream                | Material                                  | Flow Rate (kg/hr) | Notes                                                       |
|-----------------------|-------------------------------------------|-------------------|-------------------------------------------------------------|
| Feed (IN)             | Raw SiC swarf (dried, as-received)        | 100               | 15.80% organic/volatile, 1.2% moisture, VedaSemicon quality |
| Volatile Loss         | Organic binder/coolant residue + moisture | ~6.4              | ~6.4% of feed at 45-min hold; passed to afterburner         |
| Moisture (pre-drying) | Surface moisture removal                  | ~1                | Removed in pre-dryer if feed moisture >2%                   |
| Product (OUT)         | High-purity reclaimed SiC                 | ~91               | < 0.8% organics; 99.62% SiC purity (XRD); bagged            |
| Fines (recycled)      | Bag filter fines                          | ~1.5              | Collected from U-08; recycled to product or waste stream    |
| Combustion products   | CO2, H2O, trace organics                  | Stack             | Post-afterburner stack; meets CPCB emission limits          |

Table 4: Mass balance — 0.1 TPH continuous SiC swarf processing plant | Based on validated KRDC lab data scaled to industrial throughput

Energy Consumption Estimates

| Energy Category               | Equipment / Unit                                  | Power (kW)   | Load Factor | Consumption (kWh/tonne SiC) |
|-------------------------------|---------------------------------------------------|--------------|-------------|-----------------------------|
| Furnace Heating (Ramp + Hold) | Electric resistance heaters (3-zone, 95 kW total) | 95           | 70%         | ~730                        |
| Drive Systems                 | Rotary drum drive + conveyor drives               | 6            | 75%         | ~49                         |
| Cooling System                | Cooling water pump + jacketed cooler              | 7            | 85%         | ~65                         |
| Afterburner                   | Thermal oxidiser (burner fuel: LPG)               | LPG: 2 kg/hr | 100%        | ~175 kWh eq.                |
| Emission Control              | ID fan + bag filter + scrubber pump               | 9            | 80%         | ~79                         |
| Utilities & Controls          | Ar flow control + SCADA + lighting + misc         | 5            | 55%         | ~30                         |
| TOTAL                         |                                                   | ~122 kW      |             | ~1,128 kWh/tonne            |

Table 5: Energy consumption estimate — 0.1 TPH SiC swarf plant | Based on KERONE engineering estimates; actual values to be confirmed during detailed engineering

## Product Quality Specification & Market Applications

### Expected Product Specification — KERONE Processed Reclaimed SiC

| Parameter                 | Test Method       | Raw Swarf (Input)          | Processed SiC (45-min hold)              | Processed SiC (90-min hold)   | Semiconductor-Grade SiC (Reference) |
|---------------------------|-------------------|----------------------------|------------------------------------------|-------------------------------|-------------------------------------|
| Moisture Content          | ASTM C1798        | 1.20%                      | < 0.3%                                   | < 0.2%                        | < 0.5%                              |
| Organic / Volatile Matter | TGA (ASTM E1131)  | 15.80%                     | ~0.8%                                    | ~0.6%                         | < 1.0%                              |
| Surface Oxide Content     | XPS               | 6.20%                      | ~0.4%                                    | ~0.3%                         | < 0.5%                              |
| SiC Purity                | XRD / ICP-OES     | 91.40%                     | 99.62%                                   | 99.71%                        | > 99.5%                             |
| Free Carbon               | ASTM C1624        | 2.10%                      | ~0.5%                                    | ~0.4%                         | < 0.5%                              |
| Particle Size (D50)       | Laser Diffraction | 18 microns                 | ~16 microns                              | ~15 microns                   | 10-20 microns                       |
| Product Grade             | Classification    | Abrasive-grade filler only | Power-electronics/abrasive premium grade | Semiconductor substrate-grade | Virgin SiC (semiconductor grade)    |

Table 6: Product quality specification — raw swarf vs processed reclaimed SiC vs virgin semiconductor-grade SiC | 90-min processed column highlighted = recommended for high-value applications

### Market Applications for Processed Reclaimed SiC

- **Power Semiconductor Substrates** — Reclaimed SiC at >99.5% purity qualifies as feedstock blend for substrate sintering aid and crucible packing in SiC power-device manufacturing (MOSFETs, Schottky diodes) for EV inverters.
- **Abrasives & Grinding Wheels** — Reclaimed SiC at 98-99% purity substitutes virgin SiC grit in bonded and coated abrasives, and grinding wheel manufacturing.
- **Refractories & Technical Ceramics** — High-purity SiC is used as an additive in refractory castables and technical ceramic components requiring thermal-shock resistance.
- **Solar & LED Substrate Polishing Compounds** — Reclaimed SiC powder is used in lapping/polishing slurries for solar wafer and LED substrate manufacturing.
- **Advanced Composites** — SiC reinforcement filler in carbon-ceramic brake discs and metal-matrix composites represents a premium growth opportunity.

Financial Analysis & Return on Investment

CAPEX Estimate — 0.1 TPH Plant

| Cost Head                                | Scope                                            | Estimated Cost (INR Lakhs) | Notes                                                                |
|------------------------------------------|--------------------------------------------------|----------------------------|----------------------------------------------------------------------|
| Rotary Tube Furnace (Primary Equipment)  | KERONE supply, factory tested                    | 22-26                      | FOT Ambernath; includes drive, seals, controls, high-temp alloy tube |
| Afterburner / Thermal Oxidiser           | VOC destruction, LPG fired                       | 7-9                        | 950 degrees C, 2-sec residence, SS construction                      |
| Argon Supply System                      | Cylinder bank / cryo tank + manifold             | 5-6                        | 99.999% purity, 40 Nm3/hr capacity                                   |
| Cooling System                           | Jacketed rotary cooler + CT                      | 3-4                        | Water-cooled, Ar maintained, SS contact parts                        |
| Emission Control (Bag filter + Scrubber) | CPCB-compliant stack system                      | 4-5                        | Pulse-jet BF + ID fan + wet scrubber                                 |
| Feed Handling & Product Packing          | Belt conveyor, vibro screen, big bag/drum filler | 3-4                        | Load cell filling, SS contact parts, clean packing                   |
| Electrical & Instrumentation             | MCC panel, SCADA, cabling, transformer           | 5-6                        | PLC/SCADA by KERONE; site electrical by client                       |
| Civil & Structural                       | Foundation, shed, utilities connections          | 3-4                        | Client scope; KERONE to provide layout drawing                       |
| Commissioning, Training & Startup        | KERONE commissioning team, 15-day site support   | 2-3                        | Includes operator training and performance test                      |
| TOTAL CAPEX                              |                                                  | INR 54-67 Lakhs            | Approx. range; detailed quote on enquiry                             |

Table 7: CAPEX estimate — 0.1 TPH continuous SiC swarf processing plant | All figures indicative; formal quotation on receipt of detailed enquiry

Revenue & OPEX Model — Annual Basis (7,200 hr/yr operation)

| Item                       | Basis                                | INR/Year (Lakhs) | Remarks                                                         |
|----------------------------|--------------------------------------|------------------|-----------------------------------------------------------------|
| REVENUE                    |                                      |                  |                                                                 |
| Reclaimed SiC Powder Sales | 91 kg/hr x 7,200 hr x INR 2,20,000/t | INR 1,441 Lakhs  | Conservative reclaimed-SiC price; market ranges INR 2.2-3.5 L/t |
| OPERATING COSTS            |                                      |                  |                                                                 |
| Electricity                | 1,128 kWh/t x 655 t/yr x INR 8/kWh   | INR 59 Lakhs     | Based on INR 8/kWh industrial tariff                            |
| LPG (afterburner)          | 2 kg/hr x 7,200 hr x INR 100/kg      | INR 14 Lakhs     | Afterburner fuel; can substitute with natural gas               |

| Item                      | Basis                                      | INR/Year (Lakhs)    | Remarks                                            |
|---------------------------|--------------------------------------------|---------------------|----------------------------------------------------|
| Argon Consumption         | 25 Nm3/hr x 7,200 hr x INR 30/Nm3          | INR 54 Lakhs        | Purity-grade Ar; bulk supply reduces cost          |
| Labour (Operations)       | 3 operators/shift x 3 shifts x 12 months   | INR 18 Lakhs        | At INR 25,000/operator/month CTC                   |
| Maintenance & Spares      | 4% of CAPEX per annum                      | INR 2.5 Lakhs       | Annual maintenance provision                       |
| Miscellaneous & Overheads | XRD/ICP-OES QC testing, consumables, admin | INR 12 Lakhs        | Semiconductor-grade QC is testing-intensive        |
| NET PROFIT BEFORE TAX     |                                            | INR ~1,282 Lakhs/yr | Payback ~3.2 years on INR 61L CAPEX (mid-estimate) |

Table 8: Revenue & OPEX model — 0.1 TPH plant at 7,200 hr/yr | Indicative figures; actual revenue depends on reclaimed-SiC market price and product grade achieved

## Project Execution & KERONE Scope of Supply

### Implementation Timeline

| Phase                         | Activity                                                                              | Duration            | KERONE Deliverable                                                               |
|-------------------------------|---------------------------------------------------------------------------------------|---------------------|----------------------------------------------------------------------------------|
| Phase 0 — Pre-Order           | Technical consultation, site visit, process design freeze, commercial negotiation     | 4-6 Weeks           | Process Design Basis (PDB), GA drawing, utility list, commercial offer           |
| Phase 1 — Engineering         | Detailed engineering: mechanical, electrical, civil layout, P&ID; finalization        | 6-8 Weeks           | Complete engineering package, vendor drawings, DFM approval                      |
| Phase 2 — Procurement         | Long-lead items: furnace shell, high-temp alloy tube, refractory, drives, Ar system   | 8-10 Weeks          | Material test certificates, QC inspection reports, FAT invitation                |
| Phase 3 — Fabrication         | Rotary furnace fabrication, afterburner assembly, bag filter, SCADA panel             | 10-12 Weeks         | Factory Acceptance Test (FAT) at KERONE Ambarnath; client witness invited        |
| Phase 4 — Installation        | Equipment erection at client site; piping, electrical, instrument hook-up             | 4-5 Weeks           | KERONE site supervision; civil and electrical by client as per KERONE drawings   |
| Phase 5 — Commissioning       | Cold trials, hot trials with SiC swarf, performance guarantee test, operator training | 2-3 Weeks           | Commissioning report, performance test certificate, O&M manual, training records |
| <b>TOTAL PROJECT TIMELINE</b> | <b>Order to commercial production</b>                                                 | <b>~34-44 Weeks</b> | <b>From purchase order to first commercial output</b>                            |

### KERONE Scope of Supply & Services

| Category           | KERONE Scope (INCLUDED)                                                                 | Client Scope (EXCLUDED from KERONE supply)                             |
|--------------------|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Process Design     | Process design basis, mass balance, heat & material balance, P&ID                       | Feedstock quality guarantee; plant operating schedule                  |
| Primary Equipment  | Rotary tube furnace (complete), afterburner, Ar system, rotary cooler, product handling | Feed preparation (screening/crushing) if not included in enquiry scope |
| Emission Control   | Pulse-jet bag filter, scrubber, ID fan (CPCB compliant)                                 | Stack height design and consent-to-operate from CPCB/SPCB              |
| Controls           | PLC/SCADA, MCC panel, all instruments and field wiring                                  | DG set, main power supply connection, transformer                      |
| Civil & Structural | Foundation load drawings, GA layout, anchor bolt drawings                               | All civil work, sheds, platforms, ladders, drains                      |
| Commissioning      | FAT, site commissioning, performance test, operator training (15 days)                  | Consumables (Ar, LPG) for commissioning; feedstock for trials          |
| Documentation      | P&ID, GA drawings, O&M manual, spares list, test certificates                           | Client-side approvals, regulatory consents, insurance                  |

## Conclusions & Why KERONE

The KERONE-designed 0.1 TPH Continuous SiC Swarf Processing System represents a proven, commercially validated solution to one of the most significant value-unlock opportunities in India's growing semiconductor and power-electronics materials industry. The process is built on rigorous KRDC laboratory data — not theoretical projections — and the industrial design directly replicates the exact process conditions that produced measurable, certified results on VedaSemicon's actual production SiC swarf.

- **Proven Technology** — Every process parameter in the 0.1 TPH plant — 850 degrees C, 45-minute residence, argon atmosphere — is directly derived from KRDC lab trial 52/KRDC/LAB/22 on client's actual feedstock. No extrapolation; no assumptions.
- **Quantified Outcome** — SiC purity improvement from 91.40% to 99.62%, and organic/volatile content reduction from 15.80% to below 0.8%, are measurable, certified results — not marketing claims.
- **Commercial Clarity** — The financial model demonstrates a payback period of approximately 3.2 years at conservative reclaimed-SiC pricing, converting an existing fab waste stream into an INR 1,400+ Lakh/year revenue line.
- **Full Ownership** — KERONE designs, manufactures, supplies, installs, and commissions the complete plant from a single point of accountability — eliminating multi-vendor coordination risk.
- **Scalable Platform** — The rotary furnace platform is scalable. A 0.1 TPH system validated at VedaSemicon creates the reference installation for 0.25, 0.5, and 1 TPH systems for other SiC and semiconductor-materials processors across India and internationally.
- **Compliance-Ready** — Emission control is integral to the KERONE supply scope — the system is designed to CPCB stack norms, not retrofitted for compliance after the fact.

## ENQUIRE ABOUT YOUR SEMICONDUCTOR MATERIALS RECOVERY PROJECT

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

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To initiate a project discussion, please share: feedstock quality report + daily/annual tonnage + site location + target SiC/reclaim grade required

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

DISCLAIMER: All financial projections are indicative and based on prevailing market conditions as of July 2026. Process performance figures are derived from KRDC laboratory data (Report 52/KRDC/LAB/22) conducted on VedaSemicon Materials Pvt. Ltd. feedstock. Actual industrial performance may vary. This document is intended for discussion purposes; a formal quotation will be issued following detailed enquiry.