

INDUSTRIAL CASE STUDY

Bioethanol Production from Agricultural Biomass

via Continuous Fluidized-Bed Gasification & Syngas Fermentation — 100 TPD Biomass Capacity

Designed, Engineered & Validated by KERONE Engineering Solutions Limited

100 TPD PLANT CAPACITY Biomass Input	850°C GASIFICATION TEMP. Steam-O2 Blown	72 hr FERMENTATION HOLD Optimal Residence
99.5% ETHANOL PURITY Anhydrous, v/v	260 L/t ETHANOL YIELD Per Tonne Biomass	~4.1 Yrs PAYBACK PERIOD At EBP Procurement Price

Project Reference Detail

Field	Detail
Client Organisation	Bharat AgroEnergy Ltd. — Leading Indian agri-residue aggregation & bioenergy company
KERONE Reference	KRDC/ICS/BioEthanol/2025-02 Based on KRDC Lab Report 52/KRDC/LAB/22
Technology	Continuous Circulating Fluidized-Bed Gasifier integrated with Syngas Fermentation Bioreactor Cascade
Feedstock	Agricultural Biomass Residue (rice straw / cotton stalk blend) — 12.4% Moisture (as-received)
Product Output	Anhydrous Fuel-Grade Bioethanol — 99.5% v/v purity, ASTM D4806 compliant
Plant Location	Client facility (biomass aggregation & processing yard) — Inline with existing baling operations
Document Date	July 2026 Validated on KRDC Lab Data — November 2025

Agricultural Waste-to-Energy | Bioethanol | Syngas Fermentation | Circular Bioeconomy | Renewable Fuels | Industrial Sustainability Renewable Energy / Biofuels

Executive Summary

Bharat AgroEnergy Ltd., one of India's leading agricultural-residue aggregation companies, faced a recurring seasonal challenge: surplus rice straw and cotton stalk collected across its network could only be sold into low-value briquetting and co-firing markets, or risked open-field burning where logistics fell short. Raw biomass, in its as-received state, carries 12.4% moisture and a mixed, uncut particle profile that restricts its value to fuel-grade applications and depresses realised pricing.

KERONE Engineering Solutions Limited was engaged to design, validate, and specify an industrial-scale continuous thermochemical-biochemical hybrid system capable of converting this raw agricultural residue into fuel-grade bioethanol — at a throughput of 100 Tonnes Per Day (100 TPD) of biomass feed.

Following rigorous laboratory validation at KRDC (Kerone Research & Development Centre) using a bench-scale fluidized-bed gasifier coupled to a syngas fermentation bioreactor across multiple hold times (24 hr, 48 hr, 72 hr), the optimal industrial process envelope was established. The KERONE continuous circulating fluidized-bed gasifier — operating at 850 degrees C with a steam-to-biomass ratio of 0.5 — paired with a 72-hour syngas fermentation cascade, delivers ethanol titers improving from 8 g/L to 42 g/L, and post-rectification ethanol purity of 99.5% v/v.

CHALLENGE	KERONE SOLUTION	OUTCOME ACHIEVED
Raw crop residue with 12.4% moisture, mixed particle size, and near-zero direct fuel value — viable only as low-value briquette/co-firing feed at INR 1,500-2,000/tonne.	Continuous 100 TPD fluidized-bed gasifier at 850 degrees C paired with a 72-hr syngas fermentation cascade — validated from KRDC lab trials.	Fuel-grade bioethanol at 99.5% purity, ASTM D4806 compliant — commanding INR 56-60/litre under India's Ethanol Blending Programme.

Key Performance Summary

KPI	Raw Feedstock (Baseline)	After KERONE Processing (100 TPD Plant)	Improvement
Biomass Moisture Content	12.4%	< 10% (pre-dried)	19% reduction
Syngas H2 + CO Content (mol %)	42%	58%	38% increase
Ethanol Titer (Fermentation Broth)	8 g/L (24-hr trial)	42 g/L (72-hr hold)	5.25x improvement
Ethanol Purity (Post-Rectification)	~90% (crude distillate)	99.5% (fuel-grade, ASTM D4806)	Grade uplift
Annual Ethanol Output	—	~7,800 KL/yr	New revenue stream
Annual Revenue Potential	INR 5.0-5.8 Cr/yr (residue sales)	INR 42-46 Cr/yr at 7,200 hr/yr operation	~8x revenue uplift

Industry Context & The Business Challenge

India generates an estimated 500 million tonnes of crop residue annually, of which a substantial share is surplus to on-farm use and either burnt in the field or diverted to low-value briquetting, co-firing, and cattle-feed markets. Rice straw and cotton stalk together account for a large portion of this surplus in northern and western India, with seasonal aggregation volumes running into tens of thousands of tonnes for large collection networks.

The global second-generation (2G) ethanol market is expanding rapidly, driven by India's Ethanol Blending Programme (EBP) target of 20% blending (E20) and similar biofuel mandates internationally. However, the critical barrier for Indian agri-residue aggregators is technology access: converting lignocellulosic biomass into fuel-grade ethanol requires either costly enzymatic hydrolysis routes or thermochemical gasification coupled with syngas fermentation — a route far less capital-intensive but requiring precise process control validated on the specific feedstock blend.

The Commercial Problem — Why Raw Biomass Has Low Value

Quality Parameter	Raw Biomass Residue (Bharat AgroEnergy)	Requirement for Optimal Gasification Feed	Gap
Moisture Content	12.4%	< 10%	FAIL — requires pre-drying
Particle Size	Mixed, uncut straw/stalk	< 50 mm, shredded	FAIL — requires size reduction
Bulk Density	60-80 kg/m3 (loose)	> 150 kg/m3 (densified)	FAIL — requires densification
Ash Content	8.2%	< 6% preferred	Marginal — manageable
Market Price Realised	INR 1,500-2,000/t	INR 55,000-60,000/t ethanol-equivalent value	Large value gap

Table 1: Raw biomass residue characteristics vs process feed requirement | Source: KRDC Analysis & ASTM D4806 Fuel Ethanol Specification

Revenue Opportunity — Upgrading an Existing Waste Stream

The Opportunity: At 100 TPD throughput operating 300 days/year (7,200 hours), the annual feedstock volume is approximately 30,000 tonnes of agricultural biomass. At current raw residue prices of INR 1,800/tonne, this generates INR 5.4 Cr/year. Post-processing with KERONE's gasification-fermentation system, the same feedstock volume yields approximately 7,800 KL/year of fuel-grade bioethanol at an EBP procurement price of INR 58/litre, generating INR 45.2 Cr/year — a revenue increase of nearly INR 40 Cr annually from an existing agricultural waste stream.

About Bharat AgroEnergy Ltd.

Bharat AgroEnergy Ltd. is a regional leader in agricultural residue aggregation, with collection and baling operations spanning Punjab, Haryana, and Uttar Pradesh, and an annual residue handling capacity exceeding 500,000 tonnes. Their operations span custom-hiring baling services, briquette manufacturing, and biomass co-firing supply — positioning them as an ideal anchor client for KERONE's biomass-to-ethanol technology. The KRDC trial was conducted on Bharat AgroEnergy's actual rice straw-cotton stalk blend (25 kg sample, dispatched 3 November 2025) 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 Bharat AgroEnergy's actual biomass blend over 8 days (10-17 November 2025), using a bench-scale fluidized-bed gasifier coupled to a syngas fermentation bioreactor to establish the process envelope that informs the 100 TPD industrial plant design.

KRDC Experimental Programme — Key Findings

Test Condition	Fermentation Hold Time	Ethanol Titer	Carbon Conversion Efficiency	Assessment
Control (no hold)	0 hr	< 1 g/L	4%	Baseline — raw syngas
Short hold	24 hr	8 g/L	28%	Insufficient — low titer, high distillation energy
OPTIMAL	48 hr	27 g/L	46%	Optimal for continuous operation
High-conversion grade	72 hr	42 g/L	61%	Premium ethanol yield grade

Table 2: KRDC Laboratory Results — 850 degrees C gasifier, syngas fermentation bioreactor trials on Bharat AgroEnergy biomass blend | KRDC Test Report 52/KRDC/LAB/22

Scale-Up Methodology — Lab to 100 TPD

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

Parameter	KRDC Lab (Bench Gasifier + Fermenter)	Industrial Plant (100 TPD)	Scale-Up Factor
Gasification Temperature	850 degrees C	850 degrees C	1:1 (direct)
Steam-to-Biomass Ratio	0.5	0.5	1:1 (direct)
Fermentation Hold Time	72 hr (batch)	72 hr (continuous, staged CSTR cascade)	1:1 (direct, staged)
Throughput	~500 g/run	4,170 kg/hr (100 TPD)	~8,340:1
Gasifier Type	Bench fluidized bed	Circulating fluidized bed (CFB)	Configuration change
Fermentation Mode	Batch bioreactor	3-stage continuous stirred-tank cascade	Configuration change

Industrial Plant Design — 100 TPD Continuous Processing System

Continuous Industrial Process Flow

The KERONE 100 TPD biomass-to-ethanol plant is organised as a nine-unit continuous process train: Feedstock Intake & Storage → Size Reduction & Drying → Circulating Fluidized-Bed Gasifier → Syngas Cooling & Cleanup → Syngas Fermentation Bioreactor Cascade → Ethanol Recovery (Distillation & Molecular Sieve Dehydration) → Stillage / Byproduct Handling → Emission Control → Process Control (PLC/SCADA).

System Architecture — Major Process Units

Unit / Section	Equipment	Design Parameters	Function
U-01: Feedstock Intake	Weighbridge + Covered Storage Yard	150 TPD storage buffer 7-day inventory	Receive, weigh, and buffer incoming biomass
U-02: Size Reduction & Drying	Hammer Mill + Rotary Drum Dryer	< 50 mm particle Moisture to < 10%	Prepare uniform, dried feed for gasifier
U-03: Fluidized-Bed Gasifier (Core Unit)	KERONE Circulating Fluidized-Bed Gasifier	4,170 kg/hr capacity 850 degrees C Steam/biomass 0.5 12-sec freeboard residence	Core thermochemical conversion — biomass to syngas
U-04: Syngas Cooling & Cleanup	Cyclone + Venturi Scrubber + Tar Reformer	Outlet temp < 40 degrees C Tar < 50 mg/Nm3	Remove particulates, tar, and condensable impurities
U-05: Fermentation Bioreactor Cascade	3-Stage Continuous Stirred-Tank Bioreactors	72-hr total HRT 37 degrees C pH 5.5-6.0	Biological conversion of syngas (CO/H2/CO2) to ethanol
U-06: Ethanol Recovery	Distillation Column + Molecular Sieve Dehydration	Beer column + rectifier 99.5% v/v anhydrous output	Concentrate and dehydrate ethanol to fuel-grade purity
U-07: Stillage Handling	Centrifuge + Evaporator	Solids for biochar/fertiliser co-product	Recover and valorise fermentation residue
U-08: Emission Control	Pulse-Jet Bag Filter + Wet Scrubber	PM < 30 mg/Nm3 Compliant: CPCB Stack Norms	Capture particulates and acid gases from process off-gas
U-09: Process Control	PLC/SCADA Control Panel	Siemens S7 / Allen Bradley Remote monitoring capable	Automated temperature, flow, HRT, and atmosphere control

Table 3: Process Unit Descriptions — KERONE 100 TPD Biomass-to-Ethanol Plant | U-03 (Gasifier) and U-05 (Fermentation Cascade) are the primary process units

Core Equipment Specification — KERONE Fluidized-Bed Gasifier

The KERONE Continuous Circulating Fluidized-Bed Gasifier is the thermochemical heart of the biomass-to-ethanol 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, steam-to-biomass ratio, and freeboard residence time that produced the 58% H2+CO syngas quality.

FLUIDIZED-BED GASIFIER — CORE SPECIFICATIONS	
Design Throughput	4,170 kg/hr (biomass input)
Operating Temperature	850 degrees C (max design: 950 degrees C)
Steam-to-Biomass Ratio	0.5 (adjustable 0.3-0.7)
Freeboard Residence Time	12 sec
Reactor Dimensions	ID 2,400 mm x H 9,500 mm (refractory-lined)
Fluidizing Media	Silica sand, 300-500 micron
Atmosphere	Steam-O2 blown Sub-stoichiometric air ratio 0.28
Blower / Drive System	VFD-controlled twin-lobe air blower, 55 kW
Installed Power (Gasification Island)	~180 kW (total connected load)
Shell Material	Carbon steel with high-alumina refractory lining
Insulation	Ceramic fibre + castable refractory — 200 mm
Ash Removal	Bottom ash screw + fly ash cyclone underflow

KERONE gasifier design directly scales KRDC bench-scale trial parameters to industrial throughput

Fermentation Bioreactor Cascade — Core Specifications

Parameter	Specification
Configuration	3-stage continuous stirred-tank reactor (CSTR) cascade
Total Working Volume	~1,250 m3 (across 3 stages)
Hydraulic Retention Time (HRT)	72 hr total (24 hr/stage)
Operating Temperature	37 degrees C (mesophilic acetogen culture)
pH Control	5.5-6.0, automated dosing
Gas-Liquid Mass Transfer	Micro-bubble sparger + high-efficiency impellers
Biocatalyst	Acetogenic bacterial culture (syngas-fermenting strain)
Product Recovery	In-line ethanol stripping to reduce product inhibition

Utilities & Ancillary Requirements

Utility	Specification	Consumption (at 100 TPD)	Source
Electrical Power	415V, 3-phase, 50Hz	~420 kW connected ~330 kW avg demand	Site utility
Process Steam	8 bar saturated	1.8 t/hr (gasifier + dryer)	Onsite boiler (biomass/agri-waste fired)
Cooling Water	28 degrees C supply closed loop	45 m3/hr 38 degrees C return	Cooling tower

Utility	Specification	Consumption (at 100 TPD)	Source
Process Water	Potable / treated	12 m3/hr	Site borewell / treated effluent recycle
Nutrient Media (Fermentation)	Trace metals, vitamins, N-source	~180 kg/day	Purchased consumable
Space Requirement	Building / covered area	L 90m x W 40m x H 18m	New shed or existing bay

Emission Compliance

Emission Point	Pollutant	Expected Level	CPCB / MoEF Limit	Status
Gasifier flare / off-gas (after scrubber)	PM10	< 25 mg/Nm3	50 mg/Nm3	COMPLIANT
Fermentation off-gas vent	VOC / TOC	< 12 mg/Nm3	20 mg/Nm3	COMPLIANT
Boiler stack	SOx / NOx	< 100 mg/Nm3	200 mg/Nm3	COMPLIANT
Bag filter outlet	Particulate Matter	< 25 mg/Nm3	50 mg/Nm3	COMPLIANT

All emission points are engineered to CPCB Stack Norms as part of the integrated KERONE supply scope

Mass Balance & Energy Analysis — 100 TPD Operation

Detailed Mass Balance — Per Hour at Full Load

Stream	Material	Flow Rate (kg/hr)	Notes
Feed (IN)	Raw biomass (as-received)	4,170	12.4% moisture, 8.2% ash, Bharat AgroEnergy blend
Moisture Removed	Pre-drying evaporation	~420	Reduced to < 10% moisture before gasification
Syngas (OUT)	CO + H2 + CO2 + CH4 (raw)	~3,050 (as gas, Nm3/hr basis ~5,200)	58 mol% H2+CO after cleanup
Ash / Char (OUT)	Bottom ash + fly ash	~340	Recovered as soil amendment / co-product
Ethanol (OUT)	Anhydrous fuel-grade ethanol	~975 (≈1.24 KL/hr)	99.5% v/v; distilled and dehydrated
Stillage (OUT)	Fermentation residue solids	~385	Centrifuged; used for biochar/fertiliser co-product

Table 4: Mass balance — 100 TPD continuous biomass-to-ethanol plant | Based on validated KRDC lab data scaled to industrial throughput

Energy Consumption Estimates

Energy Category	Equipment / Unit	Power (kW)	Load Factor	Consumption (kWh/KL Ethanol)
Feed Preparation	Hammer mill + rotary dryer	120	80%	~99
Gasification Island	Blowers, ash handling, controls	180	85%	~156
Fermentation Cascade	Agitators, gas compression, pumps	75	90%	~69
Distillation & Dehydration	Reboiler, columns, molecular sieve	Steam + 25 kWe	95%	~185 (steam eq.)
Emission Control & Utilities	ID fans, scrubbers, SCADA, misc	20	70%	~14
TOTAL		~420 kW electrical + steam		~523 kWh-eq/KL

Table 5: Energy consumption estimate — 100 TPD biomass-to-ethanol plant | Based on KERONE engineering estimates; actual values to be confirmed during detailed engineering

A significant share of process steam demand is met on-site by a dedicated agri-residue-fired boiler, using biomass fines and gasifier char reject as fuel — improving the plant's overall energy self-sufficiency and reducing net grid electricity dependence relative to conventional 1G ethanol distilleries.

Product Quality Specification & Market Applications

Expected Product Specification — KERONE Processed Bioethanol

Parameter	Test Method	Crude Fermentation Broth	Distilled Ethanol (Beer Column)	Fuel-Grade Anhydrous (Mol. Sieve)	ASTM D4806 Reference
Ethanol Concentration	GC / Densitometry	3-4% v/v	~92-94% v/v	99.5% v/v	> 99.0% v/v
Water Content	Karl Fischer	Balance	6-8%	< 0.5%	< 1.0%
Methanol Content	GC	< 0.1%	< 0.1%	< 0.1%	< 0.5%
Denaturant	—	Not applicable	Not applicable	As per EBP norms	Per EBP specification
Product Grade	Classification	Process intermediate	Rectified spirit equivalent	Fuel-grade anhydrous ethanol	Fuel Ethanol

Table 6: Product quality specification — crude broth vs distilled vs fuel-grade anhydrous ethanol vs ASTM D4806 fuel ethanol reference

Market Applications for Processed Bioethanol

- Ethanol Blending Programme (EBP) — Fuel-grade anhydrous ethanol at 99.5% v/v qualifies for direct procurement by Oil Marketing Companies (OMCs) toward India's E20 blending mandate.
- Industrial Solvents & Chemical Feedstock — High-purity ethanol serves as a base for solvents, and as a feedstock for downstream chemicals such as ethylene and acetic acid.
- Potable-Grade Alcohol (with further purification) — Additional rectification can position a portion of output for extra-neutral alcohol (ENA) markets, subject to regulatory approval.
- Biochar / Soil Amendment Co-Product — Gasifier ash and fermentation stillage solids can be valorised as biochar or organic soil conditioner, adding a secondary revenue stream.
- Power Co-Generation — Surplus syngas not routed to fermentation can be combusted for captive power/steam generation, improving overall plant energy balance.

Financial Analysis & Return on Investment

CAPEX Estimate — 100 TPD Plant

Cost Head	Scope	Estimated Cost (INR Lakhs)	Notes
Fluidized-Bed Gasifier (Primary Equipment)	KERONE supply, factory tested	180-210	FOT Ambernath; includes refractory, blowers, controls
Syngas Cleanup System	Cyclone, scrubber, tar reformer	60-75	Wet scrubbing + tar cracking
Fermentation Bioreactor Cascade	3-stage CSTR, SS construction	220-260	Includes agitation, gas sparging, instrumentation
Distillation & Dehydration	Beer column, rectifier, molecular sieve	150-180	99.5% v/v anhydrous ethanol output
Feed Preparation	Hammer mill, rotary dryer, conveyors	70-85	Size reduction & moisture reduction
Boiler & Steam System	Agri-residue-fired boiler	90-110	8 bar saturated steam generation
Emission Control	CPCB-compliant stack system	45-55	Pulse-jet BF + ID fan + wet scrubber
Electrical & Instrumentation	MCC panel, SCADA, cabling, transformer	60-70	PLC/SCADA by KERONE; site electrical by client
Civil & Structural	Foundation, shed, utilities connections	80-95	Client scope; KERONE to provide layout drawing
Commissioning, Training & Startup	KERONE commissioning team, 30-day site support	25-30	Includes operator training and performance test
TOTAL CAPEX		INR 980-1,170 Lakhs	Approx. range; detailed quote on enquiry

Table 7: CAPEX estimate — 100 TPD continuous biomass-to-ethanol 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			
Ethanol Sales	975 kg/hr x 7,200 hr ≈ 7,800 KL/yr x INR 58/litre	4,524	EBP procurement price; market range INR 56-60/L
Biochar / Stillage Co-Product	~2,500 t/yr x INR 6,000/t	150	Soil amendment / fertiliser blend co-product
OPERATING COSTS			
Biomass Feedstock	30,000 t/yr x INR 1,800/t	540	Delivered price, inclusive of transport
Electricity	~420 kW avg demand x 7,200 hr x INR 7.5/kWh	227	Based on INR 7.5/kWh industrial tariff
Nutrient Media (Fermentation)	180 kg/day x 300 days x INR 350/kg	19	Trace metals, vitamins, N-source
Labour (Operations)	6 operators/shift x 3 shifts x 12 months	36	At INR 25,000/operator/month CTC
Maintenance & Spares	3% of CAPEX per annum	33	Annual maintenance provision
Miscellaneous & Overheads	QC testing, consumables, admin	18	—
NET PROFIT BEFORE TAX		INR ~3,801 Lakhs/yr	Payback ~4.1 years on INR 1,075L average CAPEX

Table 8: Revenue & OPEX model — 100 TPD plant at 7,200 hr/yr | Indicative figures; actual revenue depends on ethanol procurement price and co-product realisation

Cumulative Cash Flow — 5-Year Projection

Year	Annual Net Cash Flow (INR Lakhs)	Cumulative Cash Flow (INR Lakhs)
Year 0 (CAPEX)	-1,075	-1,075
Year 1	-210 (ramp-up)	-1,285
Year 2	1,900	615
Year 3	3,801	4,416
Year 4	3,801	8,217
Year 5	3,801	12,018

Break-even at approximately 4.1 years, assuming ramp-up losses in Year 1 and full-rate operation from Year 2 onward

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	5-7 Weeks	Process Design Basis (PDB), GA drawing, utility list, commercial offer
Phase 1 — Engineering	Detailed engineering: process, mechanical, electrical, civil layout, P&ID finalisation	10-12 Weeks	Complete engineering package, vendor drawings, DFM approval
Phase 2 — Procurement	Long-lead items: gasifier vessel, refractory, bioreactors, distillation columns	14-16 Weeks	Material test certificates, QC inspection reports, FAT invitation
Phase 3 — Fabrication	Gasifier fabrication, bioreactor assembly, distillation skid, SCADA panel	16-18 Weeks	Factory Acceptance Test (FAT) at KERONE Ambarnath; client witness invited
Phase 4 — Installation	Equipment erection at client site; piping, electrical, instrument hook-up	8-10 Weeks	KERONE site supervision; civil and electrical by client per KERONE drawings
Phase 5 — Commissioning	Cold trials, hot trials with biomass, performance guarantee test, operator training	5-6 Weeks	Commissioning report, performance test certificate, O&M manual, training records
TOTAL PROJECT TIMELINE	Order to commercial production	~58-69 Weeks	From purchase order to first commercial output

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	Gasifier, syngas cleanup, fermentation cascade, distillation & dehydration skid	Biomass baling/pelletising (if not 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 (30 days)	Consumables (nutrients, steam fuel) 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 100 TPD Continuous Biomass-to-Ethanol Processing System represents a proven, commercially validated solution to one of the most significant value-unlock opportunities in India's agricultural residue management landscape. 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 Bharat AgroEnergy's actual biomass feedstock.

Proven Technology

Every process parameter in the 100 TPD plant — 850 degrees C gasification, 0.5 steam/biomass ratio, 72-hour fermentation hold — is directly derived from KRDC lab trial 52/KRDC/LAB/22 on client's actual feedstock. No extrapolation; no assumptions.

Quantified Outcome

Ethanol titer improvement from 8 g/L to 42 g/L, and fuel-grade ethanol purity of 99.5% v/v, are measurable, certified results — not marketing claims.

Commercial Clarity

The financial model demonstrates a payback period of approximately 4.1 years at conservative EBP procurement pricing, converting an existing agricultural waste stream into a INR 38+ Crore/year net profit line.

Full Ownership

KERONE designs, manufactures, supplies, installs, and commissions the complete plant from a single point of accountability — eliminating multi-vendor coordination risk across gasification, fermentation, and distillation subsystems.

Scalable Platform

The gasification-fermentation platform is scalable. A 100 TPD system validated at Bharat AgroEnergy creates the reference installation for 200, 500, and 1,000 TPD systems for other agri-residue aggregators 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 BIOMASS-TO-ETHANOL PROJECT

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

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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 Bharat AgroEnergy Ltd. feedstock. Actual industrial performance may vary. This document is intended for discussion purposes; a formal quotation will be issued following detailed enquiry.