

Green Anhydrous Ethanol Purification Extractive Distillation Unit Operations Training Pilot Plant

Item Number: LPK-YCJZ



Introduction

Modular pilot plant produces high-purity anhydrous ethanol from crude ethanol via extractive distillation in a zero-emission closed-loop process providing hands-on training in unit operations with PLC-based control SCADA software and digitalized process management focusing on green engineering principles

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Training Module	Key Unit Operations & Engineering Tasks	Textbook Alignment & Core Concepts
Crude Distillation Unit	Continuous fractional distillation, reflux ratio optimization, mass and energy balances.	Unit Operations of Chemical Engineering - Fractional distillation principles - Reflux ratio and McCabe-Thiele method - Plate and column efficiencies
Extractive Distillation Unit	Separation of azeotropic mixtures, solvent (entrainer) selection, adjustment of solvent-to-feed ratios, and feed tray location.	Transport Processes and Unit Operations - Vapor-liquid equilibrium (VLE) deviation - Azeotropic and extractive distillation systems - Multi-component mass transfer
Heat Exchange & Utility Systems	Evaluation of different condenser and reboiler configurations, heat transfer coefficient determination.	Unit Operations of Chemical Engineering / Transport Processes and Unit Operations - Shell-and-tube heat exchangers - Condensation and boiling heat transfer
Process Control & Instrumentation	Calibration and wiring of sensors; PID loop tuning for temperature, flow, level, and pressure.	Chemical Engineering Design / Process Control Curricula - Piping and Instrumentation Diagrams (P&ID) - Loop control strategies and safety interlocks
Plant Design & Sustainability	Plant zoning (utility, process, and piping layouts), material recycling, and environmental impact assessment.	Chemical Engineering Design - Equipment layout and piping design - Green engineering and waste minimization - Process safety and hazard analysis

Parameter	Specification
Feed Capacity	5 – 20 L/h (adjustable)
Product Purity	Anhydrous ethanol ≥ 99.5%
Columns Included	Crude distillation column, extractive distillation column, solvent recovery column
Material of Construction	SUS304 / SUS316L Stainless Steel and Borosilicate Glass (for key visualization areas)
Instrumentation	Digital temperature transmitters, turbine flowmeters, differential pressure sensors, electronic level transmitters
Control System	PLC-based control with touchscreen HMI and remote PC workstation (SCADA software)
Safety Features	Overpressure relief valves, emergency stop buttons, high-temperature cutoff, electrical overload protection