



LABPARK

Vocational Chemical Engineering Pilot Plants Catalog

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COMPANY PROFILE

>>> About Us

Labpark is a high-tech enterprise serving universities, research institutes, and enterprises in fields such as chemical engineering, biotechnology, and environmental science. Our main product lines are Educational Unit Operations Pilot Plants and Practical Training Unit Operations Pilot Plants, designed to support practical engineering education. Supported by our own R&D platforms and 209 technical patents, we operate a production facility with a planned area of 49,000 square meters, dedicated to helping institutions enhance laboratory infrastructure and practical training capabilities.



Dual-Mode Gas Absorption And Desorption Unit Operations Training Pilot Plant

Item Number: LPK-SMTXS



Introduction

Industrial-scale pilot plant for gas absorption and desorption training in chemical engineering. Features dual-mode operation with real and simulated materials, transparent columns for flow visualization, and customizable design. Supports independent or combined loops for hands-on unit operations experiments.

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Parameter / Component	Specification / Detail
Footprint Dimensions	Approximately 3930 mm × 2560 mm × 4060 mm (L × W × H) <i>[Customizable to fit lab space]</i>
Structural Frame	Steel construction with powder-coated finish; 3 mm checkered plate flooring for non-slip operation
Safety Features	1.2 m high safety handrails on the upper platform; integrated angled safety ladder
Columns Included	1 × Packed Absorption Column, 1 × Packed Desorption Column
Column Construction	Transparent, corrosion-resistant sections for visual observation of packing and fluid dynamics
Control System	PC-based SCADA system supporting real-time data acquisition and dual-mode simulation

Experimental Module	Core Textbook Topic	Key Learning Outcome
Hydrodynamics of Packed Columns	Pressure Drop & Flooding	Determine pressure drop as a function of gas and liquid flow rates; identify loading and flooding points.
Absorption Coefficient Determination	Interphase Mass Transfer	Calculate volumetric mass transfer coefficients under varying liquid spray densities.
Desorption (Stripping) Operations	Stripping & Solvent Regeneration	Evaluate the efficiency of solute removal from the liquid phase using gas stripping.
Closed-Loop Absorption-Desorption	Continuous Unit Operations	Understand steady-state recycle systems, solvent regeneration loops, and material balances.

Green Anhydrous Ethanol Refining Practical Training Pilot Plant

Item Number: LPK-IDES



Introduction

Advanced integrated pilot plant for university labs demonstrating extractive distillation to produce high-purity absolute ethanol from crude feedstock, featuring multi-column continuous operation, closed-loop solvent recycling, and customizable controls for hands-on engineering education, ideal for chemical engineering training and research.

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Parameter	Specifications / Details
Feed Material	Crude ethanol (approximately 20% to 40% concentration)
Target Product	Anhydrous (absolute) ethanol
Crude Refining Unit	Refines 20% ethanol to 95% ethanol; power or pressure-controlled reboiler
Extractive Distillation Unit	Supports extractive and ordinary distillation, solvent separation, and recovery
Footprint Dimensions (per unit)	≤ 2200 mm × 1120 mm × 2940 mm (Length × Width × Height)
Structural Frame	High-quality aluminum alloy frame with mobile casters
Control System	Integrated industrial HMI touchscreens and PLC control

Experimental Module	Key Learning Objectives	Associated Textbook & Core Concepts
Crude Ethanol Distillation	Refining low-concentration feed; determination of optimal reflux ratio and operating parameters.	<i>Unit Operations of Chemical Engineering</i> - Continuous distillation - Fractionating columns - Plate efficiency
Extractive Distillation	Addition of ethylene glycol to alter relative volatility and break the ethanol-water azeotrope.	<i>Transport Processes and Unit Operations</i> - Azeotropic and extractive distillation - Vapor-liquid equilibrium (VLE) modification
Solvent Recovery & Recycle	Separation of water and ethylene glycol for continuous cyclic reuse.	<i>Unit Operations of Chemical Engineering</i> - Reboiler heat transfer - Multicomponent separation
Industrial Process Control	Operational control (power vs. pressure modes), piping layout logic to prevent cross-contamination.	<i>Chemical Engineering Design</i> - Process flow diagram development - Piping and instrumentation design - Material and energy balances

General Purpose Cosmetics Production Unit Operations Training Pilot Plant

Item Number: LPK-IFMC



Introduction

Integrated pilot-scale cosmetics production training plant for chemical engineering education featuring utility supply emulsification blending and filtration modules with dual touchscreen manual control customizable mobile design ideal for practical hands-on unit operations and advanced process control learning.

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Unit Module	Key Operations & Teaching Capabilities	Key Components & Technical Parameters	Connected Engineering Concepts
Public Utility Unit	Supply of utility lines, system pressure control, fluid transport dynamics.	Softened water system, cooling water loop, compressed air supply, and integrated vacuum system.	Fluid flow, utility distribution, pressure drop, piping design.
Emulsification & Formulation Unit	Quantitative feeding, jacketed reactions, high-shear emulsification, and mechanical separation.	High-quality stainless steel reaction vessel, metering systems, variable-speed agitator, filtration unit.	Agitation and mixing of liquids, heat transfer via jackets, liquid-liquid dispersion.
Blending & Cooling Unit	Product cooling, degassing, blending, and sanitary processing.	Blending vessel, jacketed cooling system, degassing system, inline sterile filtration.	Mass transfer, thermal processing, sanitization protocols, process control.

Dual Mode Heat Transfer Pilot Plant For Unit Operations Training

Item Number: LPK-SMTCR



Introduction

Engineering-scale dual-mode heat transfer pilot plant for hands-on unit operations training in chemical engineering. Features real and simulated modes, multiple heat exchanger types, comprehensive coefficient determination, and advanced process control with data acquisition for engineering students and researchers.

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Specification	Details
System Footprint	Approx. 3930 mm × 2560 mm × 3900 mm (L × W × H) (Customizable to site requirements)
Structural Framework	Two-tier steel structure with powder-coated finish; 1.2 m safety handrails on Level 2; 3 mm checkered plate flooring; integrated safety inclined ladder
Exchanger Types	Tubular/Shell-and-Tube heat exchangers, Plate heat exchangers, and other partition wall types (4 types total)
Operation Modes	Real-Material Mode: Real-time sensor data acquisition and direct physical control of pumps and electric heaters. Simulated-Material Mode: Uses safe media (water/air) coupled with mathematical models to simulate process dynamics based on physical valve positions.
Control Interface	Industrial computer with SCADA/configuration software for real-time monitoring and process control
Customizability	Fully customizable hardware (piping, sensors, dimensions) and software (interfaces, simulation algorithms)

Experimental Module	Key Unit Operation / Knowledge Point	Corresponding Academic Concepts in Classic Textbooks
Heat Exchanger Characterization	Conduction and Convection in Pipes	Steady-state heat transfer through multi-layered walls, individual and overall heat transfer coefficients, fouling factors.
Co-current vs. Counter-current Operation	Logarithmic Mean Temperature Difference (LMTD)	LMTD correction factors, thermal efficiency comparison, heat exchanger effectiveness (ϵ -NTU method).
Multi-Media Heat Switching	Process Design & Thermal Utilities	Energy balances, utility consumption calculations, switching mechanisms between different heating and cooling media.
Dual-Mode Process Control	Process Dynamics and Modeling	Sensor calibration, data acquisition, valve flow characteristics, transition from physical process behavior to simulated dynamic models.

Comprehensive Multi-Modal Heat Transfer Unit Operations Pilot Plant For Engineering Training

Item Number: LPK-DMTCR



Introduction

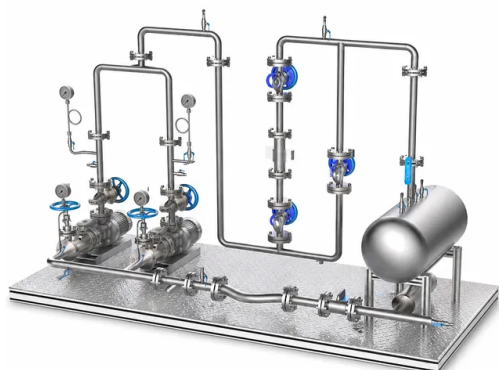
Comprehensive multi-modal heat transfer unit operations pilot plant for engineering training. Features four heat exchanger types, multi-media switching, and three operating modes. Hands-on experience in safety, optimization, and process control. Industrial-grade design with real-time data acquisition for chemical engineering labs.

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Parameter / Module	Specification / Operational Capability	Associated Textbook Concepts & Unit Operations
Physical Dimensions	3930 mm × 2560 mm × 3900 mm (Length × Width × Height); adjustable based on laboratory space.	Plant Layout, Piping and Instrumentation Diagram (P&ID) design, Scale-up principles.
Structural Frame	Two-story carbon steel powder-coated framework, 1.2m yellow safety guardrails, 3mm checkered platform plates.	Industrial Safety Standards, Process Plant Design, Ergonomics in Unit Operations.
Heat Exchanger Types	Features 4 distinct partition-wall heat exchangers (including Plate and Tubular types).	Co-current and Counter-current Flow, Logarithmic Mean Temperature Difference (LMTD), Heat Transfer Coefficients.
Media Configurations	2 heating media and 2 cooling media circuits with manual/automated switching control.	Process Utilities, Energy Conservation, Heat Integration, Thermal Energy Balances.
Control & Acquisition	Industrial-grade sensors for temperature, pressure, flow, and level; PC-based data acquisition software.	Process Dynamics, Feedback Control Loops, Sensor Calibration, Data Logging and Analysis.
Experimental Modules	Determination of overall heat transfer coefficients (\$U\$); comparison of heat exchanger efficiencies; system startup and emergency shutdown protocols.	Steady-state and Unsteady-state Heat Conduction, Convection Heat Transfer, Fouling Factors, Film Coefficients.

Chemical Pipeline Assembly And Fluid Transport Practical Training Unit Operations Pilot Plant

Item Number: LPK-GLCZ



Introduction

Integrated skid-mounted engineering training pilot plant for university labs offers hands-on experience in chemical pipeline assembly, fluid transport, centrifugal pump operation, and pressure testing. Customizable system bridges academic theory and industrial practice with digital pre-lab resources and comprehensive tools.

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Academic Course / Discipline	Reference Textbook	Aligned Unit Operations & Knowledge Points
Chemical Engineering / Fluid Mechanics	<i>Unit Operations of Chemical Engineering</i>	Fluid flow in pipes; frictional losses in fittings and valves; centrifugal pump performance curves; cavitation and NPSH; flow measurement devices.
Process & Environmental Engineering	<i>Transport Processes and Unit Operations</i>	Momentum transfer; liquid transport systems; piping design and sizing; pressure drop calculations in turbulent flow.
Plant & Process Design	<i>Chemical Engineering Design</i>	Piping and Instrumentation Diagrams (P&IDs); valve and fitting selection; piping layout design; industrial safety standards and leak testing protocols.

Category	Description / Specification
Structure & Materials	Industrial-grade stainless steel piping, robust metal structural skid with an integrated checker-plate work platform, and dedicated tool/component storage racks.
Fluid Transport Equipment	Industrial centrifugal pumps arranged for parallel/series configuration studies; integrated horizontal liquid storage tank.
Instrumentation & Controls	Industrial pressure gauges, vacuum gauges, and inline flowmeters for real-time process monitoring.
Connections & Fittings	A diverse selection of flanged connections, threaded joints, globe valves, ball valves, and industrial sealing gaskets.
Safety & Testing Auxiliary	Manual/electric hydrostatic pressure-test pump for pipeline integrity verification; complete set of assembly hand tools and PPE.
Core Laboratory Modules	1. Pipeline blueprint reading and physical assembly. 2. Threaded and flanged joint installation and sealing. 3. Centrifugal pump commissioning, startup, and operational monitoring. 4. Flowmeter and pressure gauge installation and calibration. 5. Pipeline pressure testing, leak detection, and troubleshooting.

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

Multi-Modal Distillation Unit Operations Training Pilot Plant

Item Number: LPK-DMTJL



Introduction

Multi-modal distillation pilot plant for practical unit operations training in chemical engineering education. Features real, analog, and semi-physical simulation modes, industrial construction, customizable for university labs. Hands-on fractionation columns, SCADA control, safety systems. Includes sight glasses, sampling ports, closed-loop recycling.

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Feature / Specification	Technical Details / Capability	Aligned Textbook & Core Unit Operations
Column Configuration	Sieve tray design, single-pass downcomer with visual sight glasses, and multi-point sampling ports.	<i>Unit Operations of Chemical Engineering</i> - Plate column hydraulics, tray efficiency calculations, vapor-liquid contact mechanisms, weeping, and flooding phenomena.
Variable Reflux Control	Manual reflux ratio control system with real-time feedback and calculation capabilities.	<i>Transport Processes and Unit Operations</i> - McCabe-Thiele method, determination of minimum and operating reflux ratios, and column mass balances.
Feed Thermal Control	Integrated pre-heater with adjustable temperature settings for the raw feed liquid.	<i>Unit Operations of Chemical Engineering</i> - Influence of feed thermal state (q-value) on operating lines and energy requirements.
Multi-Modal Simulation	SCADA configuration software with Real Material, Analog, and Dry Simulation algorithms.	<i>Chemical Engineering Design</i> - Process control systems, piping and instrumentation diagrams (P&ID), plant start-up/shut-down procedures, and process safety management.
Physical Platform	Overall dimensions: 3930 × 2560 × 3900 mm (customizable). Two-tier steel frame with safety handrails and textured floor plates.	<i>Chemical Engineering Design</i> - Industrial plant layout, equipment spacing, structural accessibility, and plant safety regulations.

Ethyl Acetate Synthesis Unit Operations Pilot Plant For Practical Training

Item Number: LPK-IKDD



Introduction

Modular and customizable pilot plant for ethyl acetate synthesis practical training. Integrates esterification reaction, liquid-liquid extraction, neutralization, and sieve-plate distillation unit operations. Bridging theory and real-world industrial processes. Designed for university chemical engineering labs

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Unit Module	Key Operations & Physical Functions	Maximum Equipment Dimensions (L × W × H)
Public Utility Unit	Delivers stable softened water, cooling water, compressed air, and vacuum; manages continuous run configurations.	2200 mm × 1120 mm × 2310 mm
Esterification Reaction Unit	Handles quantitative reactant feeding, in-line catalytic esterification, condensation reflux, and vacuum material transfer.	2200 mm × 1120 mm × 3600 mm
Neutralization & Extraction Unit	Manages liquid-liquid extraction, gravity two-phase separation, and automatic constant-temperature control for the extraction vessel.	2200 mm × 1120 mm × 2300 mm
Sieve Plate Distillation Unit	Performs batch and continuous distillation, fractional distillation, reflux ratio adjustments, and solvent purification.	2200 mm × 1120 mm × 2900 mm

Fluid Transport And Piping Dynamics Practical Training Unit Operations Pilot Plant

Item Number: LPK-LTSS



Introduction

This industrial-scale fluid transport and piping dynamics training pilot plant provides essential hands-on experience with pump operations, cavitation, piping resistance, flow metering, and process control. Customizable to fit specific academic engineering curricula.

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System / Module	Specifications & Equipment	Educational & Practical Training Value
Physical Infrastructure	Dimensions: 3930 × 2560 × 3900 mm (customizable to site dimensions). Carbon steel frame with protective powder coating. Two-level operating deck with 3mm anti-slip checker plate flooring and 1.2m safety guardrails. Access stairs included.	Practical understanding of industrial plant layouts, spatial awareness, safe high-altitude operations, and routine plant inspection protocols.
Pumping & Transport Systems	Centrifugal pump, vortex pump, gear pump, vacuum pump, electromagnetic metering pump, and industrial air compressor. Supports series/parallel configurations and gravity, pressure, or vacuum-driven transport.	Hand-on familiarity with diverse fluid machinery, pump selection criteria, performance curve generation, and transport dynamics.
Cavitation & Air Binding Demonstration	Suction line equipped with controlled air injection valves and transparent observation sections.	Visual and diagnostic identification of air binding and cavitation, and training on proper pump priming and troubleshooting.
Piping Resistance & Hydraulics	Straight pipes of varying diameters, standard elbows, reducers, and diverse valves (gate, globe, ball). Equipped with differential pressure transmitters and manometers.	Direct measurement of major and minor friction losses, calculation of friction factors, and evaluation of valve resistance coefficients.
Flow Metering & Calibration	Glass rotameter, orifice plate flowmeter, metal float flowmeter, and turbine flowmeter. Calibrated volumetric collection vessel.	Comparative study of flow measurement principles, calibration techniques, and metering pump stroke-versus-flow rate calibration.
Level Control Loop	Vertical process vessels and storage tanks with level transmitters (differential pressure or ultrasonic), pneumatic/electric control valves, and manual bypasses.	Practical exposure to manual level regulation and automated loop control, sensor feedback, and control valve characteristics.

Multimodal Absorption And Desorption Pilot Plant For Unit Operations Training

Item Number: LPK-DMTXS



Introduction

Multimodal absorption and desorption pilot plant for higher education labs. Bridges theory and industrial practice with transparent packed columns, three operational modes (real-material, simulated, semi-physical), and SCADA control. Students explore mass transfer, column hydraulics, and process control. Customizable.

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Parameter	Description
Footprint (L × W × H)	Approx. 3930 × 2560 × 4060 mm (Adjustable to site-specific laboratory dimensions)
Frame Material	Powder-coated structural carbon steel square tubing
Platform Construction	Two-tier layout with 3mm non-slip checkered plates and 1.2m yellow safety handrails
Column Type	Transparent packed absorption and desorption columns
Operation Modes	Real-material, Simulated-material, and Semi-physical simulation modes
Control Interface	Industrial PLC with PC-based SCADA supervisory control and data acquisition
Measurement Variables	Temperature, pressure drop, liquid/gas flow rates, and liquid levels

Experimental Training Module	Key Theoretical Concepts Covered	Relevant Textbook Concepts
Volumetric Mass Transfer Coefficient Determination	Gas-liquid mass transfer rates, concentration gradients, HTU and NTU calculation	Packed Column Design & Mass Transfer (<i>Unit Operations of Chemical Engineering</i>)
Column Hydraulics Study	Pressure drop vs. gas velocity, loading point, flooding point, wetting rate	Fluid Flow through Packed Beds (<i>Transport Processes and Unit Operations</i>)
Continuous Absorption-Desorption Loop	Solvent regeneration, recycling loops, steady-state process simulation	System Material Balances & Separation Processes (<i>Chemical Engineering Design</i>)
Process Control & Automation	Sensor calibration, cascade loop control, SCADA programming, interlock logic	Process Instrumentation & Control (<i>Chemical Engineering Design</i>)

Multi Pump Fluid Transport Process Piping Unit Operations Training Pilot Plant

Item Number: LPK-SMTLT



Introduction

Industrial-scale multi-pump pilot plant for unit operations training in fluid transport and process piping, featuring real-material and semi-physical simulation modes, comprehensive pump and flowmeter calibration, and safety-enhanced two-tier platform, bridging academic theory and industrial practice for chemical engineering education.

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Parameter	Specification Details
Overall Dimensions	3930 × 2560 × 3900 mm (Length × Width × Height) <i>[Subject to customization based on site space]</i>
Structural Frame	Two-tier industrial steel platform, powder-coated finish, square tube structural columns, 3mm anti-slip checkered steel floor plates
Safety Features	1.2m yellow carbon steel safety guardrails, safety inclined ladder with secure interlocking joints
Pump Technologies	Centrifugal pump, Vortex pump, Gear pump, Vacuum pump, Metering pump, Air compressor
Flow Instrumentation	Glass rotameter, Metal tube rotameter, Orifice plate flowmeter, Turbine flowmeter
Process Control Systems	Manual and automated PID regulation of storage tank liquid levels; digital flow and pressure loop control
Operation Modes	Physical fluid circulation (Real-Material) & Mathematical-model-driven dry run (Semi-Physical Simulation)

Laboratory Experimental Module	Theoretical Concepts Covered	Relevant Textbook Topics
Pump Characteristics & Operations	Pump head, power consumption, mechanical efficiency, NPSH, cavitation, air binding, series and parallel pump configurations	<i>Unit Operations of Chemical Engineering</i> - Fluid Mechanics: Transportation of Fluids <i>Transport Processes and Separation Process Principles</i> - Momentum Transfer: Pumps and Gas-Compressor Devices
Piping System Hydraulic Performance	Frictional pressure drop in straight pipes, local resistance losses in valves (gate, globe, ball) and fittings (elbows, reducers), friction factor estimation	<i>Unit Operations of Chemical Engineering</i> - Fluid Mechanics: Flow of Incompressible Fluids in Conduits and Thin Layers <i>Transport Processes and Separation Process Principles</i> - Momentum Transfer: Friction Losses in Conduits and Fittings
Flow Metering and Calibration	Differential pressure flow measurement, discharge coefficients, rotameter principles, turbine sensor calibration	<i>Unit Operations of Chemical Engineering</i> - Fluid Mechanics: Measurement of Fluids <i>Transport Processes and Separation Process Principles</i> - Momentum Transfer: Flow Measurement

Laboratory Experimental Module	Theoretical Concepts Covered	Relevant Textbook Topics
Storage Tank Level & Process Control	Closed-loop feedback control, PID controller tuning, manual vs. automatic control, valve characteristics, instrument calibration	<i>Chemical Engineering Design</i> - Instrumentation and Control / Process Safety <i>Unit Operations of Chemical Engineering</i> - Process Control Systems
System Operations & Safety Simulation	Process flow diagram (PFD) reading, standard operating procedures (SOPs), plant startup/shutdown, risk mitigation, digital twin simulation	<i>Chemical Engineering Design</i> - Plant Layout and General Process Design Safety

Dual-Mode Rectification Pilot Plant For Practical Training Unit Operations

Item Number: LPK-SMTJL



Introduction

Industrial-scale dual-mode rectification pilot plant for chemical engineering practical training. Features real-material and simulated-material operation modes, sieve-plate column with sight glasses for visual observation of hydrodynamics, and customizable SCADA control for safe, hands-on learning of unit operations and mass transfer.

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Parameter	Specification
Column Type	Sieve-plate column with single-pass downcomer and integrated sight glasses
Operating Modes	Dual-mode: Real-Material (active process) & Simulated-Material (model-driven with water/air)
Structure Layout	Two-tier industrial steel platform with yellow guardrails (1.2m height) and safety staircase
Platform Decking	3mm carbon steel non-slip checkered plate
Control System	PC-based SCADA software with real-time data acquisition, parameter adjustment, and safety interlocks
Key Instrumentation	Flowmeters (rotameters), temperature transmitters, pressure sensors, and liquid level gauges
Auxiliary Equipment	Feed pre-heater, reboiler, overhead condenser, reflux divider, distillate and bottoms collection vessels
Overall Dimensions	Standard footprint of 3930 mm × 2560 mm × 3900 mm (customizable to laboratory ceiling heights)

Textbook Reference	Relevant Unit Operations & Theoretical Concepts
<i>Unit Operations of Chemical Engineering</i>	Fractional distillation, McCabe-Thiele method for calculating theoretical stages, column tray efficiency, reflux ratio effects, and plate column hydrodynamics (weeping, flooding, and loading).
<i>Transport Processes and Separation Process Principles</i> (formerly <i>Transport Processes and Unit Operations</i>)	Vapor-liquid equilibrium (VLE), multicomponent mass transfer, continuous rectification, and heat/mass balances over distillation columns and condensers.
<i>Chemical Engineering Design</i>	Pilot-scale process design, instrumentation and control loops, equipment scaling, and process safety standards within pilot plant operations.



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