Methanol Synthesis And Catalyst Performance Evaluation Educational Unit Operations Pilot Plant

Item Number: LPK-JCPJ

Introduction

Bench-scale methanol synthesis and catalyst evaluation educational pilot plant for chemical engineering labs to study catalytic kinetics, high-pressure operations, process control, and unit operations under realistic conditions with industrial safety features, precision gas delivery, data acquisition, and intelligent monitoring.

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Technical System / Experimental Module	Functional Specification & Parameters	Core Academic Concept & Associated Textbook
High-Pressure Reactor Vessel	316L stainless steel construction; design pressure up to 10 MPa; max temperature of 1000°C; quick-disassembly mechanism.	**Chemical Engineering Design** • High-pressure vessel safety and wall thickness calculations • Materials selection for corrosive or high-temperature environments
Precision Feed Delivery Unit	Four-channel thermal mass flow controllers (CO, CO_2, H_2, N_2); accuracy of $\pm1\%$; working pressure range matching reactor specifications.	**Transport Processes and Unit Operations / Transport Processes and Separation Process Principles** • Multi-component fluid dynamics • Packed bed pressure drop and gas flow modeling
Catalytic Synthesis & Evaluation Module	Real-time calculation of catalyst conversion rates, space-time yield, selectivity, and space velocity.	**Elements of Chemical Reaction Engineering** • Solid-catalyzed gas-phase reaction kinetics • Fixed-bed catalytic reactor design and modeling • Temperature profiles in exothermic reactions
Condensation and Separation Loop	High-efficiency gas-liquid separator; downstream chilled condenser; liquid collection vessel.	**Unit Operations of Chemical Engineering** • High-pressure vapor-liquid phase equilibrium (VLE) • Condensation heat transfer and heat exchanger performance
Data Acquisition and Control Center	15-inch PLC touchscreen system; automated temperature loops; data storage and export capabilities.	**Process Dynamics and Control** • Closed-loop temperature and pressure control systems • Sensor calibration and industrial instrumentation protocols