

Low Concentration Carbon Dioxide Capture Pressure Swing Adsorption Educational Pilot Plant

Item Number: LPK-CKEF



Introduction

Low-concentration CO2 capture pilot plant using Pressure Swing Adsorption for engineering education. Students gain practical experience in breakthrough curve measurement, adsorption dynamics, and variable analysis in a hands-on lab setting. Ideal for unit operations, mass transfer, and chemical engineering labs.

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Component / Technical Specification	Experimental Module / Practical Task	Textbook Concept & Unit Operation Link
Adsorption Columns: Dual-column configuration (Adsorbent Column A & B) with thermal insulation jackets.	PSA Cycle Demonstration: Operation of continuous, semi-continuous, or batch PSA gas separation processes.	<i>Adsorption Kinetics & Dynamics</i> (Gas-solid separation, mass transfer zones, and breakthrough behaviors)
Gas Feed System: Mass flow controllers for carbon dioxide and nitrogen blending to simulate flue gas.	Breakthrough Curve Determination: Measuring effluent concentration over time to determine adsorption bed capacity.	<i>Mass Transfer Operations</i> (Fixed-bed adsorption, concentration profiles, and mass transfer coefficients)
Regeneration Unit: Vacuum pump and integrated heating elements for thermal or vacuum desorption.	Adsorbent Regeneration: Comparative study of thermal regeneration (temperature swing) vs. vacuum regeneration.	<i>Desorption & Adsorbent Activation</i> (Thermal swing adsorption, pressure swing dynamics, and regeneration efficiency)
Control & Instrumentation: Touchscreen PLC control panel, digital flowmeters, and pressure transmitters.	Process Variable Analysis: Evaluating the effects of feed concentration, pressure, and flow rate on separation efficiency.	<i>Process Control & Design</i> (System variables, sensor calibration, and instrumentation in unit operations)