

Minimizing Lab-Pilot Plant Testing R&D-Scaleup Costs and Time by Standard Reactor Solutions and Advanced Conceptual Process Design (CPD)

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Global R&D Co., Ltd.

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Agenda



Why are R&D and scaleup costs skyrocketing? → 3 Critical Factors

How can **Conceptual Process Design (CPD)** help researchers save costs?

Super-Strategies to **minimize R&D costs & time by 30-60%**

How to easily adapt **standard reactor solutions** to your R&D!!



Let Global R&D Show You How to Reduce Your R&D Costs & Time by 30-50%!!

Why Global R&D?

“ASIA’s 1st Integrated **PROCESS ENGINEERING**
Solutions Provider”

GBEST²



Charles – Artit - Prof. Wiwut – Prof. Rarey

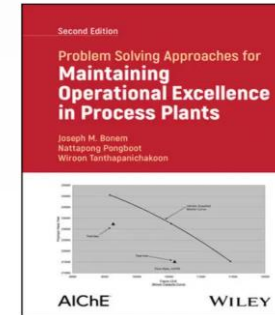


“GB Give **BEST** **PROCESS** Engineering Solutions **Squared**²”

- ✓ GB **E**ngineering
- ✓ GB **E**quipment
- ✓ GB **S**imulation
- ✓ GB **S**afety
- ✓ GB **T**eam
- ✓ GB **T**esting

“We help solve Process Plant Problems
by Exceptional Software & Process Expert”

- **PROCESS SIMULATION**
- **CO₂-NH₃-H₂S GAS TREATING**
- **LIQUID-SOLID-GAS MIXING**
- **FLUID FLOW & PRESSURE DROP**
- **PROCESS SAFETY – FIRE & EXPLOSION**
- **VAPOR DISPERSION – CONSEQUENCE – QRA**





GBEST²

ASIA's 1st Integrated **PROCESS**
ENGINEERING Solutions
Provider"



✓ Engineering

- ❖ Plant Document Updating
- ❖ Process Engineering-R&D
- ❖ HAZOP-SIL-QRA
- ❖ World-Class Software
- ❖ Process & Safety Experts

✓ Equipment:

- ❖ Reactors
- ❖ Distillation
- ❖ Wet Scrubber
- ❖ Mixing Tank
- ❖ Powder Processor
- ❖ Dust Collector



✓ Simulation-Safety

- ❖ CHEMCAD Simulator
- ❖ OGT Gas Treating
- ❖ VISIMIX Mixing
- ❖ FLUIDFLOW
- ❖ GEXCON Safety



✓ Team-Testing

- ❖ Refinery Catalyst Testing
- ❖ Vapor-Liquid-Solid Equilibrium (VLE)



AFG Jet Mill



ACM Pulverizer



SOLTEQ®

Virtual Lab for Students



Digital Twin

Glass/SS Rotary & Wiped Thin Film Evaporator



Why are R&D and scaleup costs skyrocketing?

- Misconception about **pilot plant EPC standards/ safety standards**
- Misconception about **customized lab-pilot plant design by researchers & fabricators**
- Misconception about **vendor brands - fabricator selection**

And partly because of this??



Unnecessary Excessive Lab-Pilot Plant Safety Standards

Myth 1: Explosion Proof Equipment Really Necessary?

“GOOD VENTILATION” with “HIGH DILUTION” can turn even Zone 0 into “NON-HAZARDOUS”!!.

Grade of release	Effectiveness of Ventilation						
	High Dilution			Medium Dilution			Low Dilution
	Availability of ventilation						
	Good	Fair	Poor	Good	Fair	Poor	Good, fair or poor
Continuous	Non-hazardous (Zone 0 NE) ^a	Zone 2 (Zone 0 NE) ^a	Zone 1 (Zone 0 NE) ^a	Zone 0	Zone 0 + Zone 2 ^c	Zone 0 + Zone 1	Zone 0
Primary	Non-hazardous (Zone 1 NE) ^a	Zone 2 (Zone 1 NE) ^a	Zone 2 (Zone 1 NE) ^a	Zone 1	Zone 1 + Zone 2	Zone 1 + Zone 2	Zone 1 or zone 0 ^c
Secondary ^b	Non-hazardous (Zone 2 NE) ^a	Non-hazardous (Zone 2 NE) ^a	Zone 2	Zone 2	Zone 2	Zone 2	Zone 1 and even Zone 0 ^d

^a Zone 0 NE, 1 NE or 2 NE indicates a theoretical zone which would be of negligible extent under normal conditions.

^b The Zone 2 area created by a secondary grade of release may exceed that attributable to a primary or continuous grade of release; in this case, the greater distance should be taken.

^c Zone 1 is not needed here. I.e. small Zone 0 is in the area where the release is not controlled by the ventilation and larger Zone 2 for when ventilation fails.

^d Will be Zone 0 if the ventilation is so weak and the release is such that in practice an explosive gas atmosphere exists virtually continuously (i.e. approaching a 'no ventilation' condition).

'+' signifies 'surrounded by'.

Availability of ventilation in naturally ventilated enclosed spaces is commonly not considered as good.

Reference: IEC60079:10-1

PSM Auditor insists on switching to explosion-proof equipment???



PROJECT: VENTILATION STUDY FOR EXPLOSION PREVENTION AT BOSS PHARMACARE FACILITY	LOCATION: BOSS PHARMACARE, THAILAND
TECHNICAL CONSULTANCY REPORT AND CALCULATION FOR ETHANOL MIXING ROOM VENTILATION STUDY FOR EXPLOSION PREVENTION AT BOSS PHARMACARE FACILITY	
	

Possible to Use Ventilation to Reduce Flammable Vapor Concentration to 25% of L.E.L.

19-Jun-26

Unnecessary Excessive Lab-Pilot Plant Safety Standards

Myth 2: Vent Gas Burner Really Necessary?

Ethanol for Covid-19



VS

Ethylene from fruit ripening



Ethanol Dehydration to Ethylene Catalyst Pilot Plant



**500,000 THB just for
the vent gas burner!!**



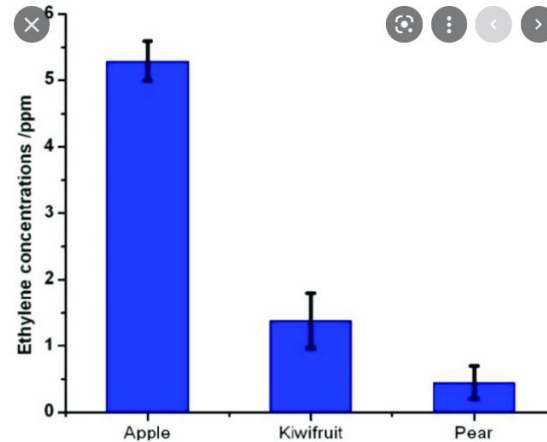
Unnecessary Excessive Lab-Pilot Plant Safety Standards

Myth 2: Vent Gas Burner Really Necessary?

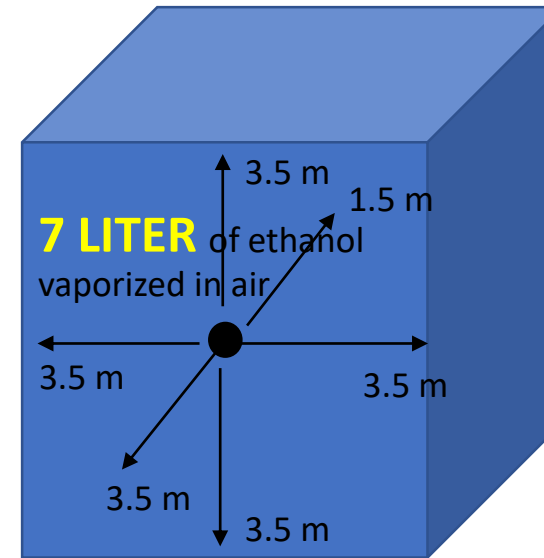
Ethylene venting rate of 2 kg/hr from stack

- Even for 24-7 release, max conc. at ground level **< 5 ppm level @ ONLY 5 m stack height**
- Much lower than ethylene L.E.L. of **2.7 vol%**. Thus, **negligible risk of explosion**.
- Same level as **fruits' ethylene emission level**.

Gas Dispersion Stack Venting Calculation			
Ethylene max vent flow rate	kg/hr	2	
Short tons (2000 lb) of polluting gas per day, M	short-ton	0.048	
Air velocity at grade, U	m/s	1	
	miles/hr	2.25	
Gas density	lb/ft ³	0.099216	
Gas specific volume, V	ft ³ /lb	10.07902	
Stack height, h	m	5	
	ft	16.4042	
Vertical diffusion coefficient, Dz		0.14	
Horizontal diffusion coefficient, Dy		0.24	
Environmental Factor, n		0.2	
Max conc, ppmvol of polluting gas, Cmax	ppmv	1.7	
	%vol	0.000172	
Max Conc. at Ground level - 2.0 ppm vol < Ethylene LEL 2.7 mol% = 27000 molppm			
Conclusion: Negligible risk of explosion			



Ethanol Holdup of Only 7 L



Assume 7 liter of ethanol spilled, 100% vaporized at once, then diluted by 343 m³ of volume air

= 3.5 m³ of ethanol vapor in 343 m³ of volume

= 1 mol% < **3.3 mol% L.E.L. of ethanol!!**

A senior engineer requested study using > 400,000 THB

license software + additional engineering man-hours!!



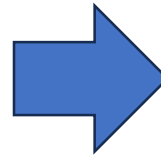
Estimate max hold-up & concentration risks before specifying a vent gas burner.

Customized Design Idea by Fabricators = Risk!!

Fabricator's idea **vs.** vendor catalogue



Affordable-price magnetic seals
not possible with existing magnetic
drive brands in Thailand market



Lift-and-Filp design easy
to pour out components
from reactor (viscous)

**Pilot Reactor with
Magnetic Seal**



Lifting and Flipping Reactor



5L Electric Lifting Titanium Lined Lab Reactor



2L high temperature Manual Lifting Reactor

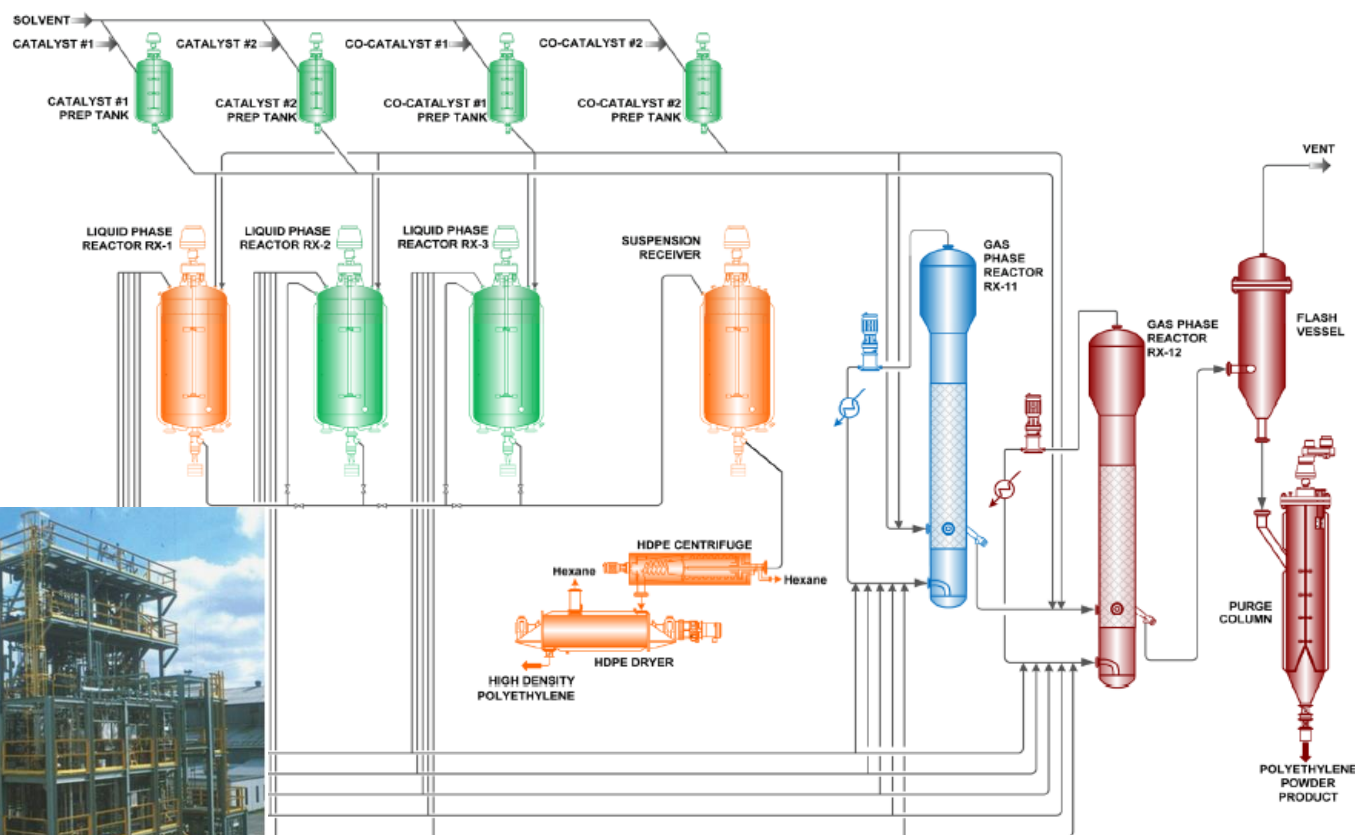


30L High Temperature Electric Lifting Reactor

High Pressure – High Temp Polymerization Reactor Design Gone Wrong

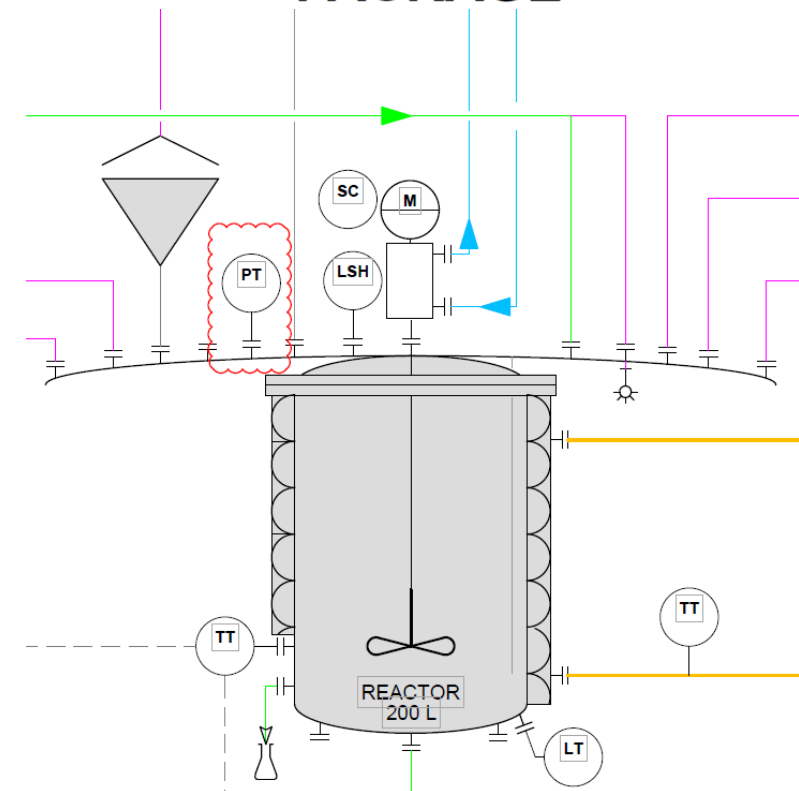
Is Multi-Purpose Reactor Worth It?

- Is multi-purpose pilot plant really a good idea?



VS

MATERIAL REQUISITION FOR MULTI-PURPOSE REACTOR PACKAGE



Too many nozzles & utilities!!

19-Jun-26

Too multi-purpose = Either "Too Expensive" or "Not best at anything"

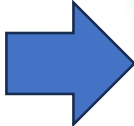


Multipurpose Polypropylene Demonstration

Vendor Brands and Fabricators Selection

- Use high-end brands only for a few critical components worth \$\$.
- Select only vendors & local suppliers that understand TECHNICAL SPECS deeply!!

Rotary Evaporator (European Brand)



- | | |
|-----------------------------------|--------------------------------------|
| ① Heating Bath | ⑦ One-way Valve |
| ② Rotary Flask | ⑧ Collection Flask |
| ③ Motor Head (Optional: Ex-proof) | ⑨ Discharge Valve |
| ④ Ruffle Bottle | ⑩ Control Panel (Optional: Ex-proof) |
| ⑤ Main Condensers | ⑪ Rack with Motorized Lift Inside |
| ⑥ Vice Condenser | |

Model	VRT-2PRO	VRT-3PRO	VRT-5PRO	VRT-10PRO	VRT-20PRO	VRT-50PRO
Recovery Rate	Water≥1L/Hr Alcohol≥2L/Hr	Water≥2L/Hr Alcohol≥4L/Hr	Water≥2L/Hr Alcohol≥4L/Hr	Water≥3L/Hr Alcohol≥6L/Hr	Water≥5.5L/Hr Alcohol≥11L/Hr	Water≥10L/Hr Alcohol≥20L/Hr
Glass Material	Sanitary Grade High Borosilicate 3.3					
Evaporating Flask Capac	2L	3L	5L	10L	20L	50L
Receiving Flask Capacity	1L	1L	2L	5L	10L	20L
Rotation Motor	DC brushless, 40w DC brushless, 60w DC brushless, 80w DC brushless, 180w DC brushless, 180w DC brushless, 250w					
Rotation Speed	0~200 rpm			0~120 rpm		
Control panel	Integral control for bath heating and rotation speed with LCD display					
Condensers	1 main condenser (Vertical Double Helix)			1 main condensers +1 Auxiliary condenser (Vertical Double Helix)		
Cooling Area	0.17m²	0.26m²	0.5m²	0.6m²	0.7m²	1m²
Vacuum Seal	PTFE plus FV rubber and Viton sealing ring					
Maximum Vacuum Press	< 3 torrs					
Bath Material	Stainless steel corrosion resistant coating with insulation cover					
Bath Temp. Control Rang	Room temperature to 200℃					
Heating Power	1.2KW	1.5KW	2KW	3KW	5KW	6KW
Power Supply	220V, 50/60Hz (Optional: 110V), Single Phase; 380V, 50/60Hz, 3 phase				220V, 50/60Hz, Single Phase; 380V, 50/60Hz, 3 phase	
Lift Mode	Auto motorized lift					

Turn-Key Solution!!

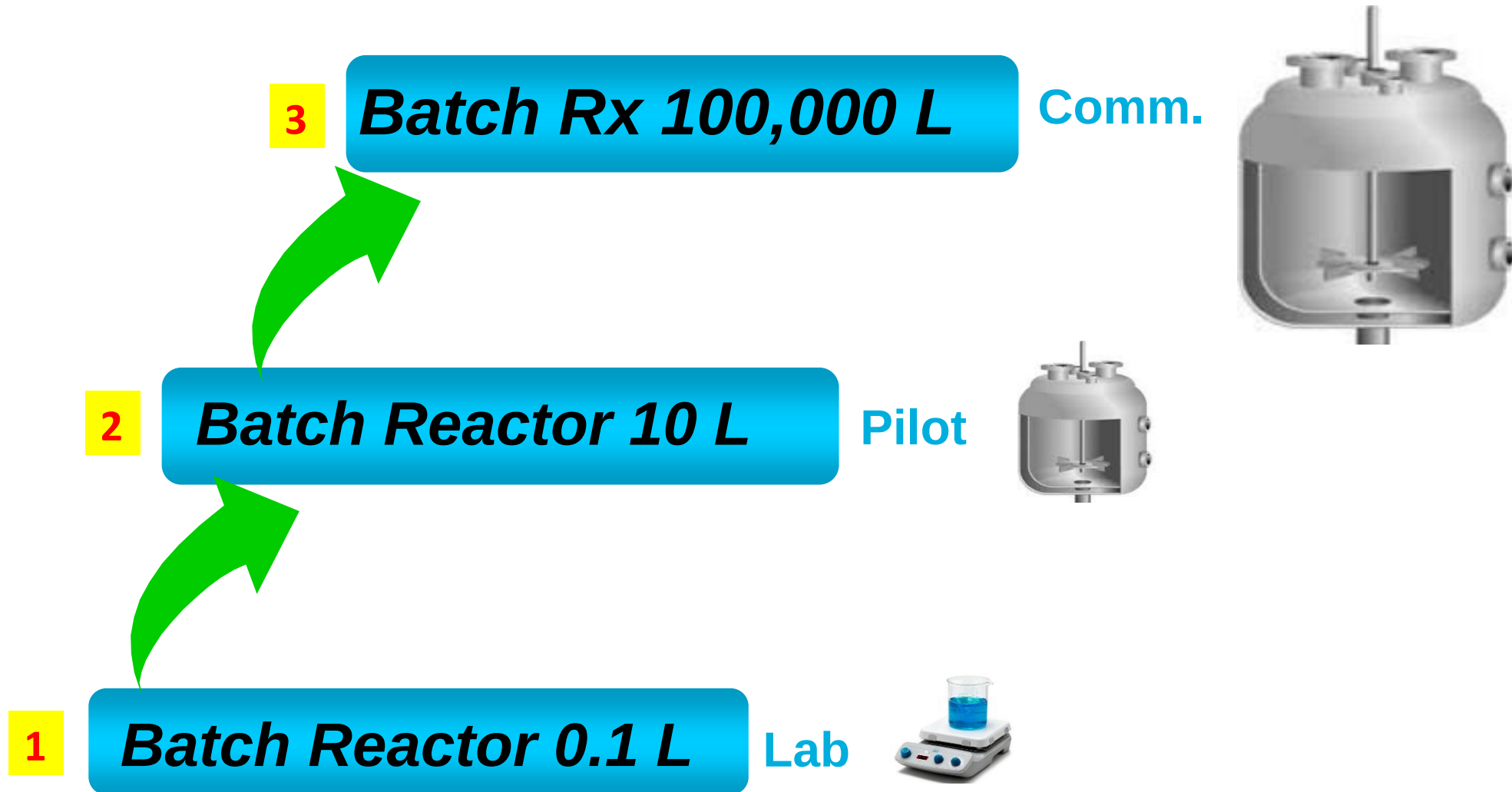


- We have obtained ISO9001, CE, atex and other certifications, and our products have been recognized by international certification laboratories such as TUV and SGS.

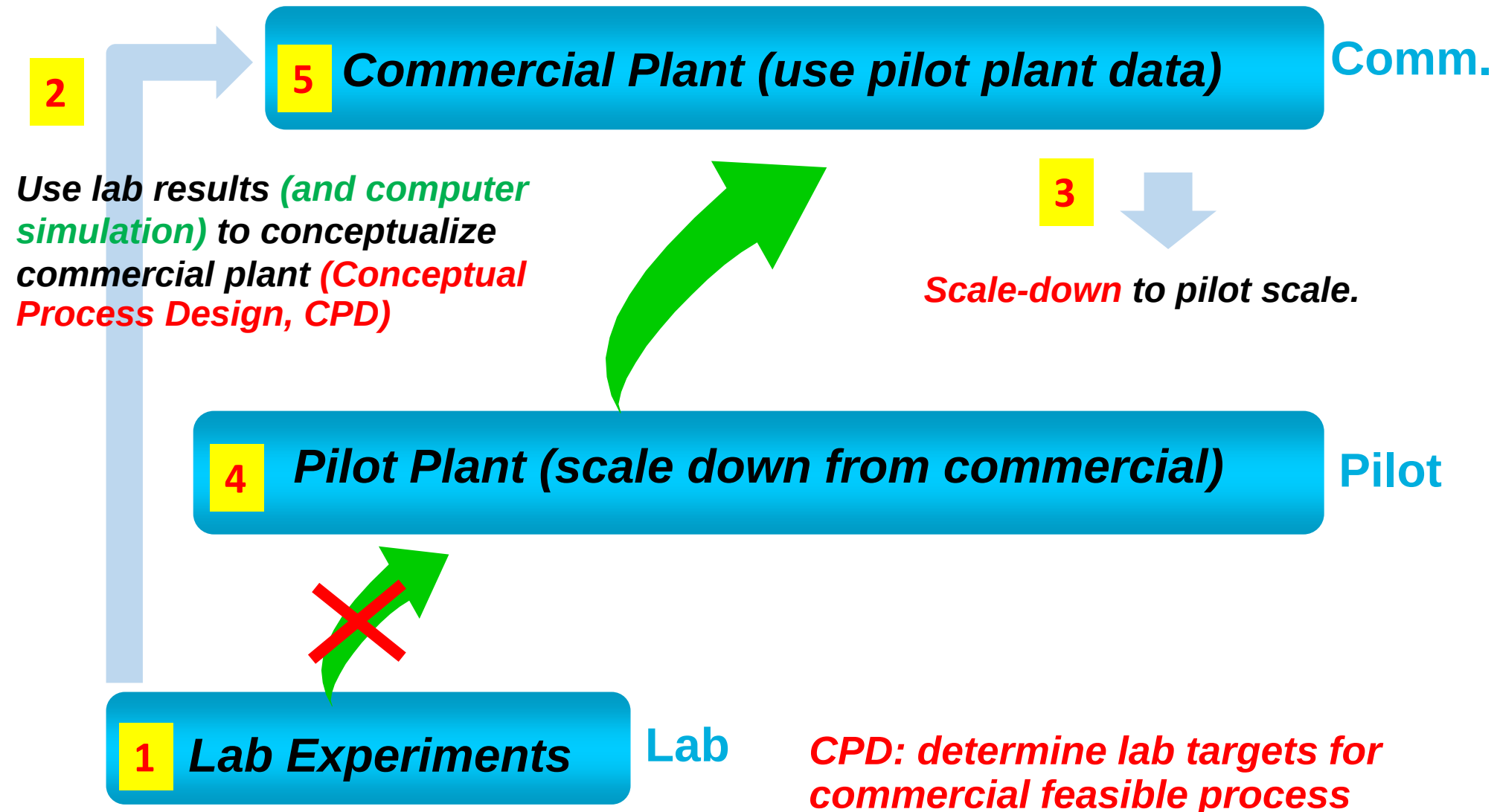


Pre-Qualification by ASME U-Stamp and CE Mark Certificates

Common Misunderstanding About Scaleup



What is Conceptual Process Design (CPD)?



Case Studies: Time & Cost Savings from CPD

- Petrochem company A



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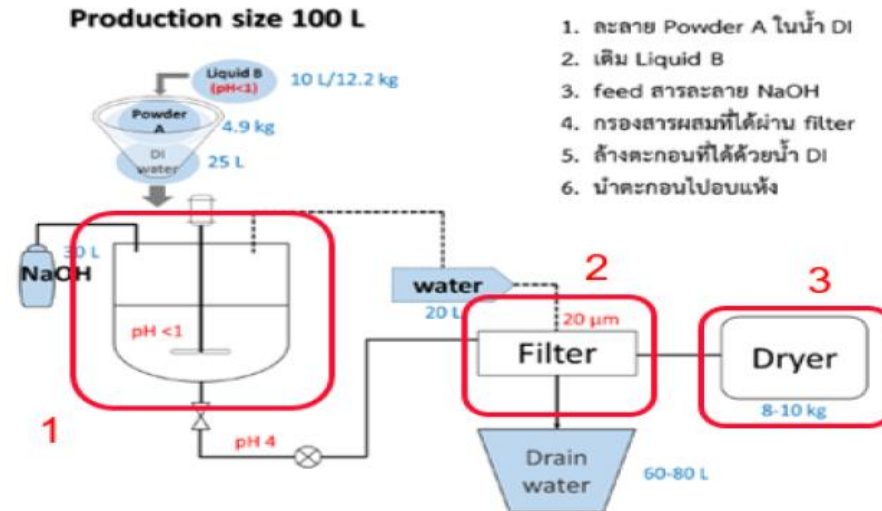
PROJECT: Alkylation of ARENES Catalyst Scale-Up	LOCATION: RAYONG, THAILAND
Conceptual Process Design Report For Alkylation of [REDACTED] Catalyst Scale-Up Concept Study and Conceptual Process Design	

Benefits:

- Find a **new solvent** matching **commercial scale toller**, which is much different from lab scale
- CAPEX & OPEX** for catalyst mass production plant from ONLY LAB results!!
- UNEXPECTED reaction mechanism** confirmed by CPD reaction analysis

- Bio R&D Organization B

Animal Nutrition Production Scale-Up



Benefits:

- Mixing tank, filter, and dryer equipment all checked against **commercial equipment types**
- Additional DOE of lab experiments** required to proof of concept (PoC) & right equipment type selection!!

- Petrochem company C



Benefits:

- CPD reveals **UNEXPECTED toxic CO by-product and separation processes** required
- CPD reveals that even ideal best case economics **cannot justify multi-million THB catalyst testing** in next phase.

Real Project References for CPD & Scaleup

- Alkylation catalyst production conceptual process design and economics (GC 2017)
- Pilot adsorber and reactor design P&ID review and hydraulic calc (GC 2017)
- HDPE Slurry polymerization reactor scale-down from commercial to lab (GC 2017)
- Side-stream fixed bed pilot plant scale-down design reviews (GC 2018)
- Esterification reaction scale-up (GC 2019)
- Polymerization catalyst waste treatment process design from lab results (GC 2019)
- High-value alcohol synthesis scale-up (GC 2019)
- High-value alcohol synthesis scale-up Phase 2 (GC 2020-2021)
- Emulsion & suspension polymerization pilot plant feasibility study (AGC 2020)
- Project engineering & management consultant for EECi pilot plant building and pilot plant facility setup project (NSTDA สวทช. BIOTEC 2018)
- Ethanol to high-value chemicals – Conceptual process analysis & techno-economics (SCG Chem 2019)
- Chelate animal nutrition production mixing tank-filter-dryer scale-up (NSTDA 2017)
- EECi pilot plant complex project consulting (NSTDA 2019)
- EECi Non-GMP & GMP pilot plant project consulting (NSTDA 2019)
- Batch mixing tank reactor for zeolite synthesis (VISTEC 2022)
- Fixed bed reactor for catalytic ethanol dehydration to ethylene (VISTEC 2022)
- PTT LNG Battery cryogenic grinding machine (PTT LNG 2023)
- Crude oil desalting pilot package (THAIOIL 2023)



- ✓ 1 completed project for EGAT CO2 capture pilot plant project A
- +
- ✓ 1 on-going project for EGAT CO2 capture pilot plant project B



Capital Cost Reduction by 30-50% is typical!! From 4-6 months DDP to 2-4 months DDP

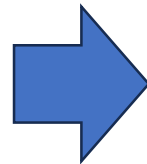
Super-Strategies to Minimize Costs & Time

- CPD reveals critical sections that only require pilot plant as a scale-down from commercial.
- Find 2-3 vendors with **standard equipment in catalogue** matching best with our P&ID
- Select from vendor's **standard equipment model & specifications** whenever possible.
- Consider buying **as-is model and then modifying by local supplier** as an option.
- Discuss **key modifications needed** with supplier in advance.

- ✓ **Capital Cost Reduction by 30-50% is typical.**
- ✓ **Lead Time Reduction by 40-60% is typical. From 4-6 months DDP to 2-4 months DDP.**

1) Buchi-Style Reactor Alternatives

Buchi-Glass Reactor



Model	VRR02G	VRR05G	VRR10G	VRR20G
Boiling Flask Capacity	2L	5L	10L	20L
Receiving Flask Capacity	0.5L	2L	2L	5L
Receiving Flask Quantity	1-4 pcs (quantity customizable as collected fractions)			
Glass Material	High Borosilicate Glass 3.3 (Sanitary Grade)			
Heating for the Tank	Heating Mantle or Oil Bath Heater			
Distillation Column Height	Height customizable as required theoretical plates quantity			
Distillation Column Diameter	40mm, 50mm, 80mm, 100mm or other customizable size			
Heating for the Distillation Column (Optional)	Heating Tape or Coils			
Stirring Mode	Magnetic Stirring via magnetic rotor or Top Head Stirrer (Magnetic or Mechanical Sealing)			
Working Temperature Range	Room Temperature to 250°C			
Control System	Digital Display Stirring speed controller, Controller of reflux-receiving dispenser, Heating temperature controller for heating coils or tape, Heating temperature controller if boiling flask heated by oil bath			
Utilities (Optional)	Cooling Circulator for Condenser, and Vacuum Pump			
Power Supply	220V, 50/60Hz, Single Phase; 220V or 380V, 50/60HZ, 3 Phase			



Chiller



Vacuum Pump

Cost Saving > 40-60% and Time Saving > 50% are Possible!!

2) Parr-Style Reactor Alternatives

50 L & 100 L Stirred Reactor Systems 725 psi (50 bar), 200 °C

Features include

- PID temperature control with ramp and soak programming
- Variable speed motor and gear drive
- Three zone band heater or welded jacket
- Hoist for reactor head (manual or electric options)
- Bottom drain valve (actuated or manual options)
- Control thermocouple
- Standard head fittings & internals include:
 - FKM O-ring head seal
 - Extra heavy duty magnetic drive
 - Stir shaft and stirrer assembly
 - Safety rupture disc assembly
 - Pressure gage with optional pressure relief valve
 - Gas inlet and release needle valves
 - External solids charge assembly
 - Spiral cooling coil



50 L Stirred Reactor System



3L High Temperature Esterification Polycondensation Reactor System



3L polyether Lab reactor System



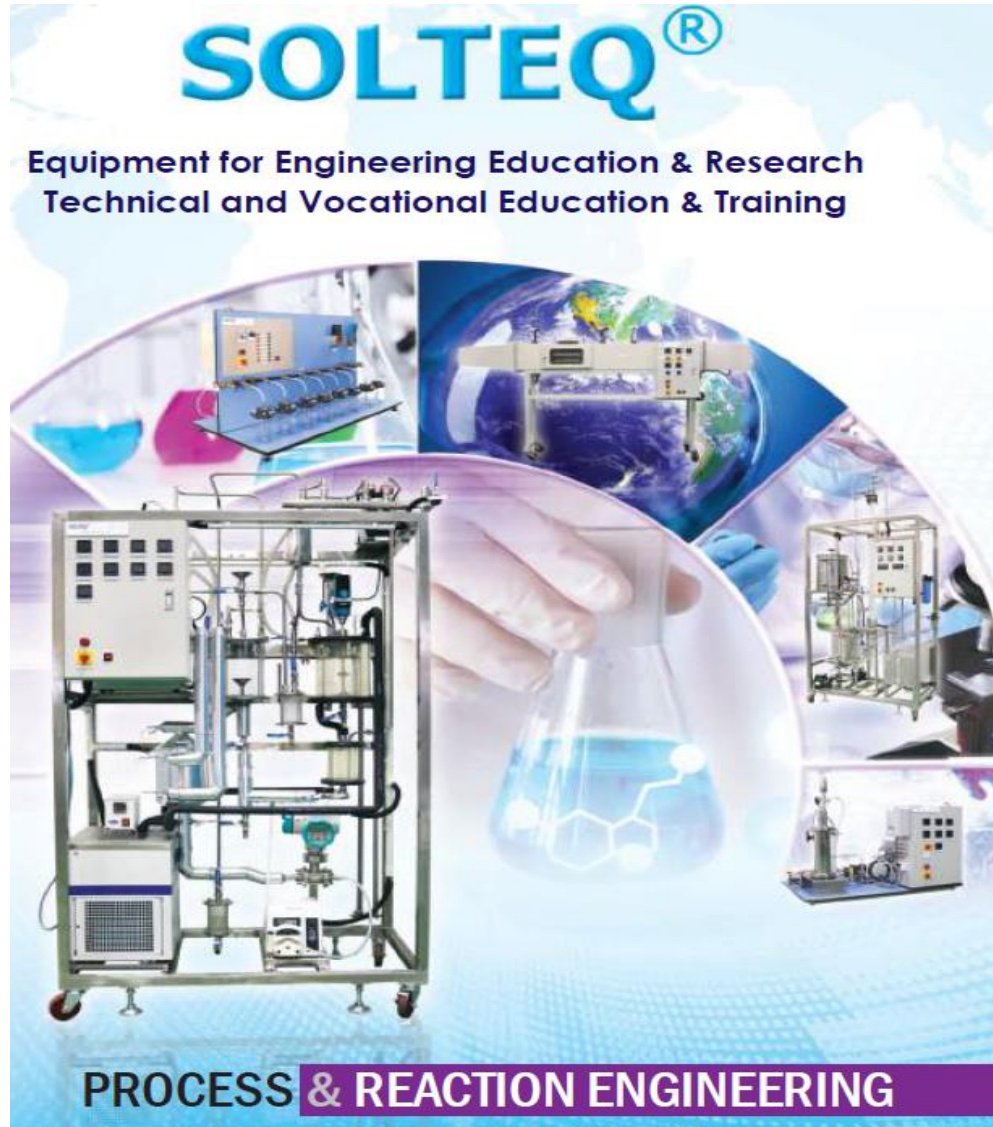
29L High Temperature Stainless Steel Nylon polymerization Reactor



1L High Temperature and High Pressure Reactor System

Cost Saving > 40-60% and Time Saving > 50% are Possible!!

3) Adapting from Education Lab Equipment



MODEL NO.	EQUIPMENT NAME	
Process Engineering		
BP01	Corrosion Study Kits	1
BP02	Falling Film Absorption Unit	1
BP09	Liquid Diffusion Coefficient Apparatus	2
BP10	Gaseous Diffusion Coefficient Apparatus	2
BP16	Vapour Liquid Equilibrium Unit	3
BP23	Fixed and Fluidised Bed Unit	3
BP40	Solid-Liquid Extraction Unit	4
BP41	Solid-Liquid Extraction Unit	4
BP50-80	Gas Absorption Unit	5
BP51-80	Gas Absorption-Desorption Unit	5
BP60	Liquid-Liquid Extraction Unit (With Solvent Recovery)	6
BP61	Liquid-Liquid Extraction Unit (Without Solvent Recovery)	6
BP63	Rotating Disc Liquid-Liquid Extraction Unit (Without Solvent Recovery)	7
BP70	Double Effect Evaporator	7
BP80-50	Continuous Distillation Column Unit	8
BP102	Solids Handling Study Equipment	8
BP123	Crystallisation Unit	9
BP200	Gas Adsorption Unit	9
BP202-A	Pressure Swing Adsorption Column System	10
BP204	Gas-Solid Adsorption Column	10
BP217	Short Path Distillation System	11
BP772	Tray Drier	11
FM103	Liquid Mixing Equipment	12
FD20	Spray Dryer	12
Reaction Engineering		
BP90	Decomposition Reactor	13
BP100	Liquid Phase Stirred Tank Reactor	13
BP101	Tubular Flow Reactor	14
BP105	Catalytic Packed Bed Reactor	14
BP106	Packed Bed Catalytic Reactor	15
BP107	CSTR in Series	15
BP109	Batch Reactor	16
BP112	RTD Studies in Packed Bed Reactor	16
BP150	Reactor Service Unit + 3 Reactors	17
BP151	Benchtop CSTR in Series	17
BP208	Fixed Bed Adsorption Reactor	18
BP400	Reactor Basic Unit (CSTR)	18
BP409	Reactor Basic Unit (Batch)	19

How to set up a crystallizer R&D lab?

Never Guess Lab R&D Setup from Scratch Again!!

3) Adapting from Education Lab Equipment

PROCESS & REACTION ENGINEERING

CRYSTALLIZER

MODEL: BP123



The SOLTEQ® Crystallizer (Model: BP 123) will be designed to demonstrate the basic principles of crystallization and operation of crystallizer itself. Crystallization is a separation process where solid particles form within a homogeneous liquid phase due to supersaturation induced either through cooling or evaporation. Crystallizer utilizes both cooling and evaporation methods, with additional vacuum and reaction features to generate supersaturation for crystallization to occur. Various types soluble salt solutions (example NaCl, NaNO₃, KI, KNO₃, CH₃COOK) will be used within the crystallizer to demonstrate different crystallization patterns, solubility behaviors and phase formations. The work bench will be made of stainless steel and chemical resistance. It is able to uphold the equipment.

SOLTEQ®

MODEL: BP123

EXPERIMENT CAPABILITIES

- Demonstration of crystallization processes using evaporation, surface cooling, vacuum cooling and reaction methods.
- Study of solubility curves and phase diagrams for crystallization.
- Observation of formation of crystals, nucleation and crystal growth.
- Effects of circulation and feed flow rates on the crystallization rates.
- Effects of pressure, temperature and reaction on the crystallization rates.

TECHNICAL SPECIFICATIONS

General Specifications

The system will comply with the following criteria:

1) Reaction/feed vessel

5-L, jacketed cylindrical vessel made of borosilicate glass with stirrer and bottom outlet with a 0.2m² condenser to prevent evaporation losses.

2) Dosing pump

Mohno dosing pump capable of handling solid slurries, with 12 L/hour capacity and integrated with a pressure safety switch.

3) Heat exchanger

Steel tube heat exchanger to supply heat for liquid evaporation, having 0.1 m² exchange area.

4) Crystallizer pump

Axial flow circulation pump with propeller stirrer driven by 0.25 kW motor having up to approximately 1150 rpm. Excellent at handling solid slurries.

5) Crystallization vessel

DN100 Cylindrical vessel with capacity 5-L made of borosilicate glass, having a conical slurry inlet and ports for vapour and liquid outlets.

6) Distillate condenser

High efficiency condenser made of stainless steel with 0.3 m² exchange area.

7) Heating/cooling system (T1/T2)

T1: 2 kW, liquid bath medium with circulation, 20 °C to 150 °C

T2: 2 kW, liquid bath medium with circulation, -50 °C to 100 °C

8) Vacuum pump

0 . 1 5 kW vacuum pump with a capacity of 2.0 m³/h and generating a maximum vacuum pressure 20 mbar (abs)

9) Product vessel

0.5-L cylindrical vessel made of stainless steel with quick removable connections.

10) Condensate vessel

0.5-L cylindrical vessel made of stainless steel.

11) Instruments

Conductivity (conductivity meter), temperature (digital thermometer), and circulation flow rate measuring device .

12) Pipe sections

Made of stainless steel, borosilicate glass or PFA tubings.

13) Electricity

500 Volt (AC) max., 3-phase, 100 Amperes (max) and 50 Hertz

14) Water

Laboratory main water supply at 20 litres/min with 5 m head.

SOLTEQ®

OPTIONAL ITEMS

SOLDAS

Data Acquisition System

- A PC with latest Intel Core Processor
- An electronic signal conditioning system
- A stand alone data acquisition modules
- A windows based software
 - Data Logging
 - Signal Analysis
 - Process Control
 - Real-Time Display
 - Tabulated Results
 - Graph of Experimental Results

SOLCAL

Computer Aided Learning Software

- Interactive multimedia features
- Graphical simulation
- Experiment results samples
- Full experiment manual

REQUIREMENTS

Electricity : 415VAC / 3-phase / 50Hz
Water : Laboratory mains supply

OVERALL DIMENSIONS

Height : 0.91 m
Width : 0.91 m
Depth : 0.61 m

MANUAL

The unit is supplied with Operating and Experimental Manuals in English giving full descriptions of the unit, summary of theory, experimental procedures and typical experimental results.

How To Always Start from Standard Reactors

GB is the SE Asia's 1st equipment supplier offering 300+ variations of lab-pilot equipment to choose!!

ASME-CE Mark Certified Factory Scope:

- Final P&ID design
- Equipment
- Mechanical
- Structure
- E&I + Control-PLC (partial-optional)
- Common modifications + Shop 1st FAT (Factory Acceptance Test)
- Fabricator documentation

Local Supplier Scope:

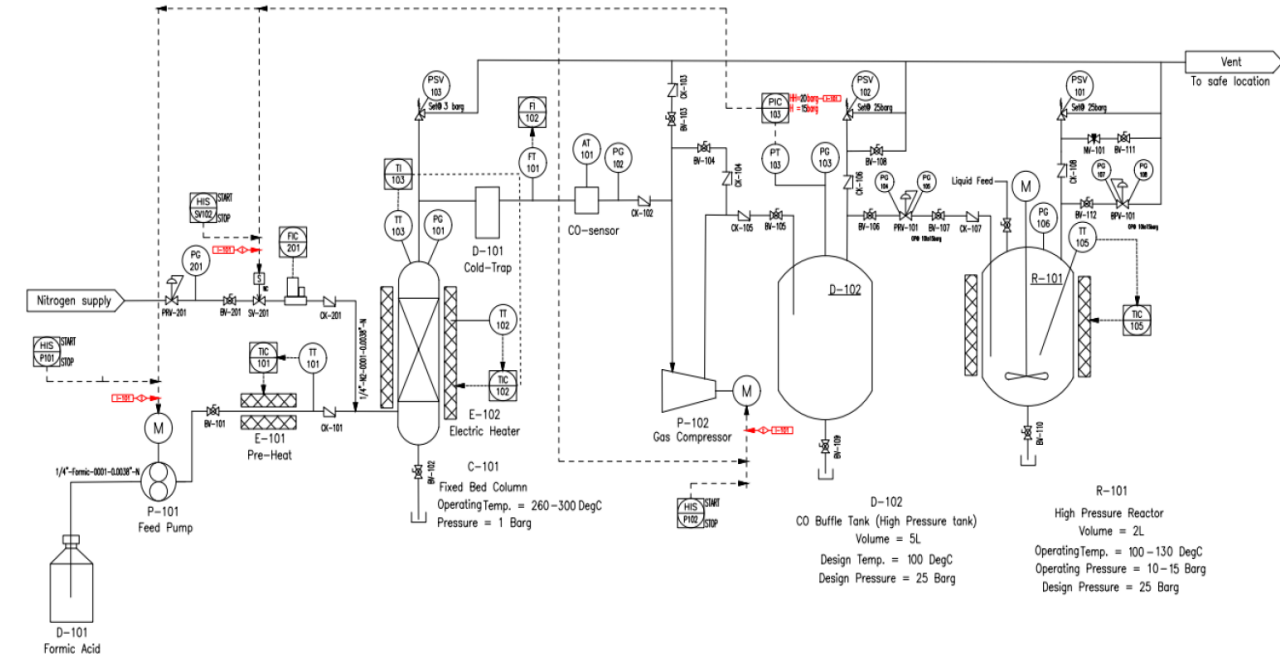
- Process understanding + prelim PFD-P&ID design + sample lab testing
- E&I + Control-PLC (partial-optional)
- Final finishing + specific modification + Local re-FAT
- SAT (Site Acceptance Test)
- Full documentation package

QR Code:
GB Standard Reactor Solutions

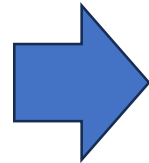


Case Study: GB own-R&D: CO₂ to PGA pilot setup

- Cost down from 3.x to 1.x MB and time shortened from 5 to 2 months



- ✓ Proven reactor design
- ✓ Proven equipment & instrument brands
- ✓ Proven reactor operation & maintenance experience



Case Study: High Viscosity Polymerization Reactor

✓ 5L polymerization reactor price quote from 7.x to 3.x MB and time from 6.5 to 3.5 months (due to much shorter instrument & control lead time)

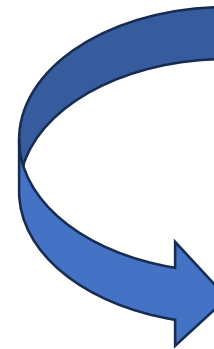
3. Commercial Proposal

PRICE SUMMARY

Estimated Price = 6.8-7.9 MB (excluding VAT 7% and spare parts)

Valid date: 30 Days

Delivery date: 6.5-7 months after PO



5 L

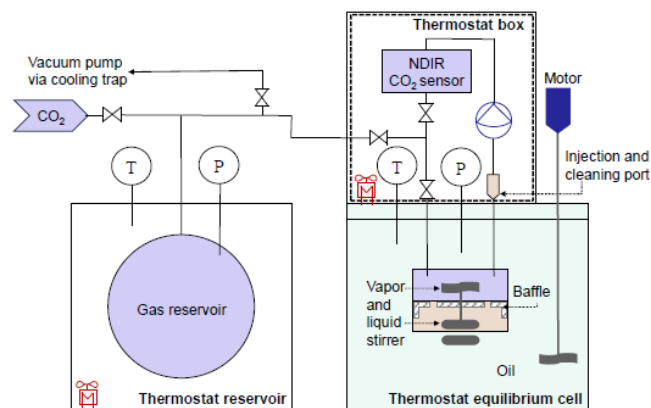
29L High Temperature Stainless Steel Nylon polymerization Reactor 26

Case Study: 1st VLE-Properties Lab in Thailand

✓ **Cost Saving by Using VLE-Properties Lab in Thailand:** Physical properties for accurate process simulations

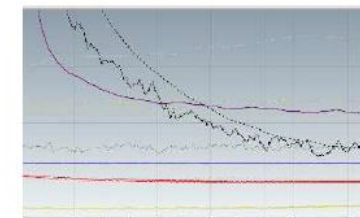


Physical Property Lab



IoT / MQTT Lab Instruments

Affordable, open-source, ESP32-based scientific instruments for school labs and university research — precision without the cost or complexity.



High-accuracy data for process simulation, R&D and industrial applications.

Fully operational since early 2024 — validated measurement techniques:

- Vapor-liquid equilibria (VLE) via headspace GC (HSGC)
- Vapor pressure — static cell & transpiration method
- Gas solubility & activity coefficients at infinite dilution
- Liquid-liquid equilibria (LLE) & solid solubilities
- Ternary VLE for extractive distillation design
- Entrainer evaluation
- Static gas solubility (CO₂, amines, ...)
- Custom experimental data on request

Available Modules

- Temperature — Thermometer / PID controller
- Pressure — Analog & Bosch digital (BMP390/585)
- Flowmeters — Sensodyne interface
- Gas sensors — CO₂ (Sensirion SCD30, Winsen MH-Z16), MQ-xx
- Stepping motor controllers — syringe dosing & vial shaker



Jürgen Rarey
Principal Expert

rarey
tec

- 70+ industrial simulation courses (since 2016)
- Thermodynamics instructor since 1990
- 27 years manager/co-owner at DDBST GmbH
- 10 years teaching at ChEPS-KMUTT, Bangkok
- 60+ peer-reviewed publications

Conclusion: Never Start R&D from Scratch Again!!

QR code for GB Standard
Reactor Solutions

SAVE QR CODE NOW
FOR YOUR FUTURE
R&D – SCALEUP!!



Charles ชวนชิม ลอง
แล้วจะติดใจแน่นอน!!



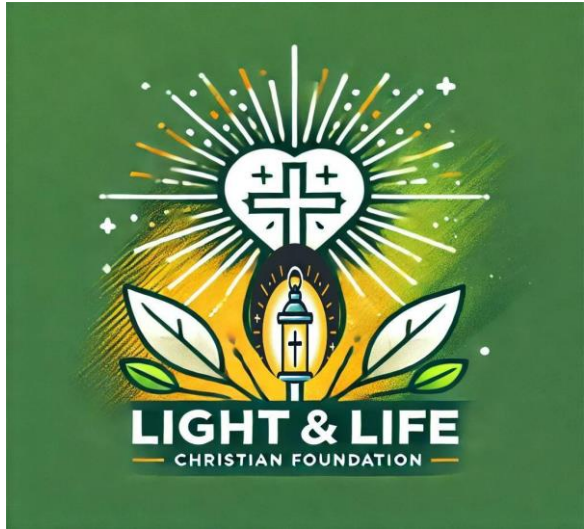
Contact: wiroon.t@globalrd.co.th and LINE ID: wiroont2

Let Global R&D Show You How to Reduce Your R&D Costs & Time by 30-50%!!

19-Jun-26

Business is Also About Giving!!

- ❑ Global R&D CEO (Mr. Wiroon) has been running an Orphanage Foundation “**Light & Life**” from **June 2025**.



Collaboration with Orphanage Home “PIYAWAT”

- **QR code for GB Standard Reactor Solutions**



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THANK YOU FOR LISTENING!! ANY QUESTIONS?