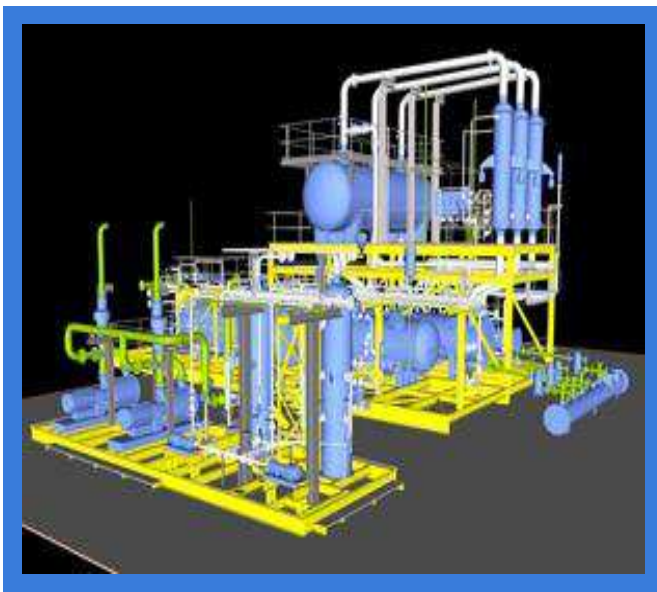




Pilot Plant Design:

Steps for Successful Process Scale-up



EPIC



Non-linear sizing

- Multiplying required output by five does not require a five-fold increase across the board
- System sizes for equipment, chemical inputs and other factors do not increase in a 1:1 fashion

Reaction Kinetics & Chemical Equilibrium

- Equilibrium = the point at which your reaction becomes productive
- Increased chemical volume = longer time to chemical equilibrium
- Kinetics = how efficiently molecules are mixing which effects how fast equilibrium is reached

Material Properties

- Material selection for equipment & instrumentation must avoid corrosion, erosion & excess expense

Fluid & Thermodynamics

- Flow should be kept at the correct Reynolds number for efficient heat transfer and molecule mixing
- Controlled reactions = good thermodynamics that balance heat loss with reaction speed

Agitation Challenges

- Larger mixing tanks = more required horsepower to achieve the same turbulence and flow
- Costs may be reduced through baffles, angled agitators or other agitation equipment

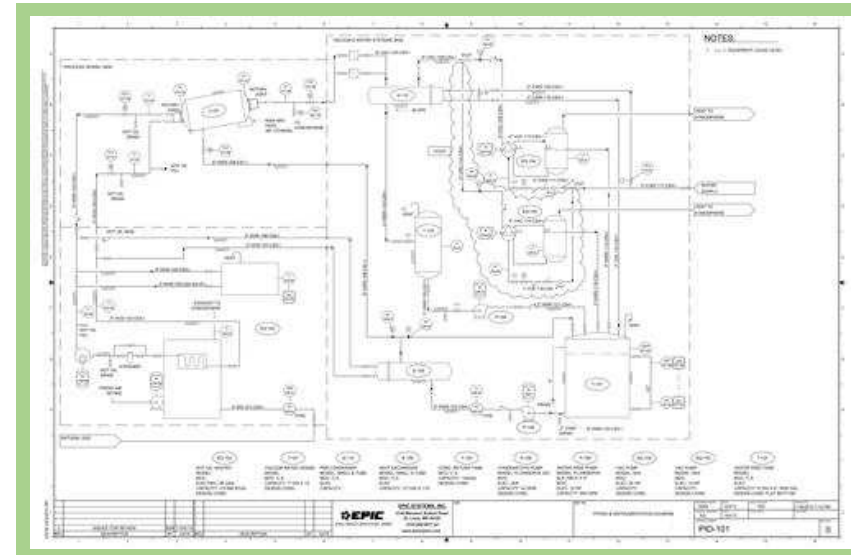
Process Scale-up Challenges 

Pilot plant design steps

- Find a process system engineering & design firm
- Discuss details of your process technology with potential partner
- Get a refined quote by paying a small percentage for a base design effort
- Receive design deliverables and process simulation results
- Commit to full project development, including fabrication effort
- Partner firm completes process, electrical and controls design
- Fabrication and assembly of pilot plant begin

Design Documents & Deliverables

- Scope and boundary limit description
- Process flow diagrams (PFD's) & general arrangement drawings
- Cost estimate (accuracy between +/- 5-25%)
- Base Piping and Instrumentation Diagrams (P&ID's)
- Estimated project timelines
- Equipment, instrumentation and valve lists
- Technical peer review
- Contingency plan
- Process simulation (see next slide for deliverables from this)



LINE NO.	SUFFIX	TAG NO.	INSTRUMENT TYPE	EQUIPMENT FUNCTION	PRODUCT SERVICE	LINE SIZE
1	03	XV-101-03	ELECTRIC ACTUATED BALL VALVE	WATER FEED TO T-101	WATER	1"
3	13	XV-101-13	ELECTRIC ACTUATED BALL VALVE	PRIMARY FRAGRANCE DRUM SELECT	FRAGRANCE	1/2"
3	14	XV-101-14	ELECTRIC ACTUATED BALL VALVE	SECONDARY FRAGRANCE DRUM SELECT	FRAGRANCE	1/2"
1	02	LT-101-02	ULTRASONIC LEVEL PROBE	T-101 LEVEL	WATER	-
2	03	PT-102-03	PRESSURE TRANSDUCER	WATER LOOP BACK PRESSURE	WATER	1"
3	05	PT-103-05	PRESSURE TRANSDUCER	COMBINED PRODUCT LINE PRESSURE	WATER + FRAGRANCE	1"
3	15	WT-103-15	DRUM SCALE	PRIMARY FRAGRANCE DRUM SCALE	FRAGRANCE	-
2	18	FT-102-18	WATER FLOW METER	WATER LOOP FLOW	WATER	1"
3	02	FT-103-02	MAG FLOW METER	FRAGRANCE FLOW	WATER	1/2"
3	04	FT-103-04	MAG FLOW METER	WATER FLOW	WATER	1/2"
3	07	FT-103-07	MAG FLOW METER	SPRAY LINE ONE FLOW	WATER + FRAGRANCE	1/2"
3	09	FT-103-09	MAG FLOW METER	SPRAY LINE TWO FLOW	WATER + FRAGRANCE	1/2"

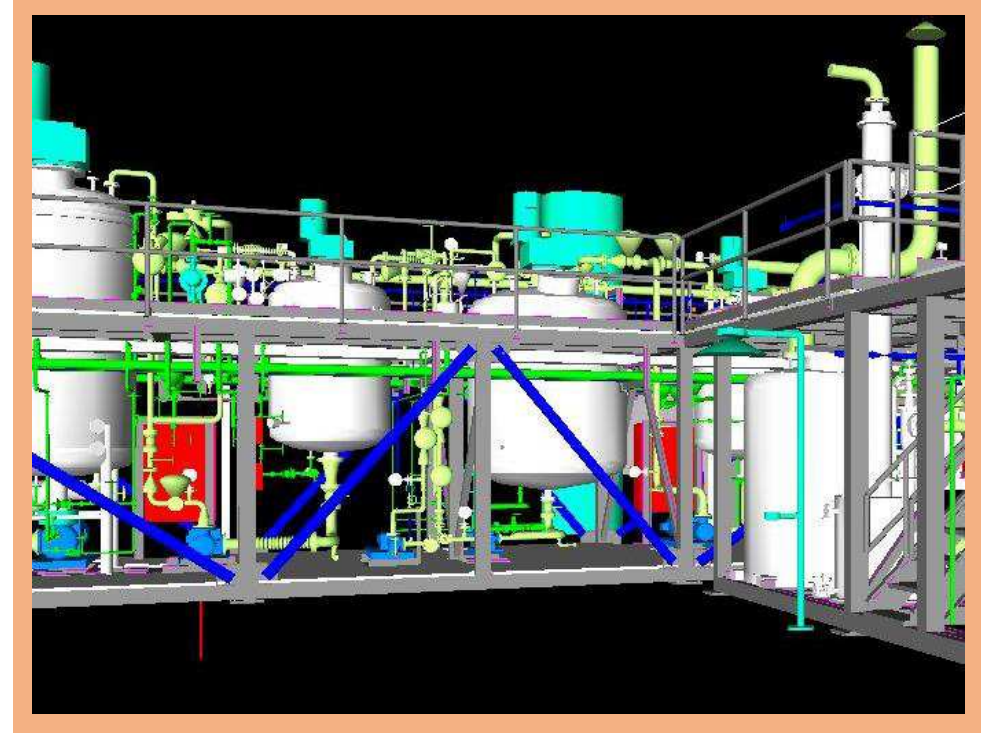
Basic Pilot Plant Design

3D Modeling & Simulations

- Chemical similitude studies
- Aspen/HYSYS modeling
- Finite Elemental Analysis (FEA)
- Computational Fluid Dynamics (CFD)
- CADworx Plant & AutoCAD modeling

Deliverables from Modeling

- Increased accuracy of budgetary numbers (+/- 5-15%)
- Complete Piping and Instrumentation Diagrams (P&ID's)
- Mass (material) and energy balances
- Material compatibility & corrosion studies
- Module size form factors
- Plan and elevation drawings



Demo Plant Modeling



Fabrication & Testing

- ✦ Modular process system fabrication
- ✦ Factory Acceptance Testing (FAT)



Installation & Startup

- ✦ Pilot plant shipment
- ✦ Installation and plant commissioning



Steps Following Design

Looking for a pilot plant design & fabrication company?

➤ Speak with an expert pilot plant designer today: **314-845-0077**

➤ Learn more about pilot plants at: www.epicmodularprocess.com/pilotplant



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