Distillation System Project Planner

How to Use

This planning sheet is useful in pre-planning a distillation system before approaching design/fab firms for detailed engineering work or cost estimates. Fill in as many project details below as you can to help streamline the planning and quotation process. An experienced design and build engineer can help you build out and specify unknown project elements and is essential to commercial project success.

General Project Information

Timeline: ______
Budget: ______
Desired ROI over __ years: ______
Electrical Area Classifications: ______
(ex. Class I, Class II, Div I, Div II, Zone 1, Zone 2)
Piping specifications: ______
Will any of the following be required (circle all that apply)
Fireproofing | Heat tracing | Lighting
Seismic zone: ______
Wind loads: ______

Materials of Construction (MOC): ______
Industry standards and codes: ______
(ex. GMP, Sanitary, 3A, Food grade, etc.)
Dimensions of available space: ______
Maximum height: ______
NDA required? Yes or No
Accessibility requirements: ______
(ex. None, ladders, platforms, manways, etc.)
Future expansion: ______
(ex. Packing changes, tray/stage additions, additional processing steps, etc.)

Process Operating Parameters

Process objective: ______
Major unit operations: ______
Any specific equipment requirements: ______
(ex. Certain brands, materials of construction, special classifications or uncommon features)
Desired heating and cooling mediums: ______
Desired operating temperature ranges for:
Heating: ______
Separation: ______
Cooling: ______

Target operating pressure range during: ______
Desired end product specifications: ______
(ex. Purity, composition, etc.)

Feed Composition: Properties of your distillation feed (fill out below). If you expect to have more than one column, please attach a sheet with an relevant specifications for those columns not covered here.

Feed Composition: ______
Weight % of every component (mix/max): ______
______
______
Flow rate: ______
Extra considerations: ______
Non-condensables? ______
Azeotrope? ______
Chlorides (PPM) ______
Feed PH: ______

Distillate composition: ______
Weight % (min/max): ______
______
______
Flow rate: ______
Temperature: ______
Bottoms composition ______
Weight % (min/max): ______
______
______
Flow rate: ______
Temperature: ______

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Instrumentation

Preferred control systems: ____________________
(ex. DCS, PLC, PAC, etc.)
Desired level of automation: ____________________
(ex. Fully, partially, mostly manual, etc)
Instrument communication type: ____________________
(ex. Analog, Fieldbus, Profibus, AS-I, DeviceNet, Ethernet, etc.)

Manufacturer preferences or requirements?
Specific instruments to consider:
Control valves: ____________________
Transmitters: ____________________
Pressure gauges: ____________________
Relief valves: ____________________
Thermometers: ____________________
Flow meters: ____________________
Other: ____________________

Additional System Scope

Distillation and bottoms composition (min/max): ____________________

Are any additional storage tanks required? ____________________

Any additional system scope past distillation? Added processing steps? ____________________
(Describe in detail) ____________________

Utilities

Which of the following utilities are available onsite? How much capacity is available and at what temperature and pressure?
High pressure steam: ____________________
Low pressure steam: ____________________
Hot oil: ____________________
Cooling water: ____________________
Chilled water: ____________________
Coolants/Chilled glycol/brine refrigerants: ____________________
Air supply (for instrumentation): ____________________
Nitrogen pressure: ____________________
Electrical power free (volts, phase, frequency, current): ____________________

How to turn this information into a cost estimate or basic design package

The easiest way to get a cost estimate is to contact a distillation system design and build firm and discuss these project parameters with them. EPIC Systems, Inc. specializes in distillation column/system design, fabrication and automation. Visit www.epicmodularprocess.com or call 314-845-0077 to talk to an engineer.

If you prefer to go the DIY route, you'll need to start with basic system design and column modeling. We recommend Aspen modeling software, which will give you material balances, measurements and equipment suggestions. From there, you'll need to calculate a project timeline and estimate: labor costs, material costs, equipment costs, fabrication costs, installation costs, shipping costs, and startup/delay costs.

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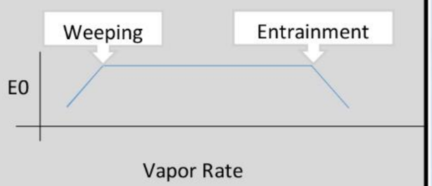
Column Design Factors

Distillation column design best practices are guidelines to help you size and design distillation columns that perform optimally within your process parameters. The starting point of all column design is to determine the relative volatility of the key substances to be separated.

Using a mass and energy balance simulation program the physical and chemical properties of the substances you are trying to separate are modeled and the following ratios are applied to determine final column design:

Distillation Column Design Factors			
Factor	**What does it measure?**	**When Applied?**	**Limits/Formulas**
Flood Ratio	Accumulation of liquid in the column		
Jet Flood		To all packing types	Design for 85% for new trays and packing
Downcomer Flood		Only applies to columns with trays	Design for 85% for new trays
Weeping Point/Turndown	The point at which liquid begins falling through the tray perforations	To all columns	Less than 50% is acceptable
Reflux Ratio/Entrainment Ratio	Precentage of liquid passed from the tray below to the tray above	To any column, except some columns where feed enters above the top tray or stage only	Less than 10% is acceptable
Efficiency Ratio	Seperation efficiency, based on weeping ratio, reflux ratio and vapor rate	Most useful for trayed columns	There are many formulas that can be applied here. In general, the relationship should be visualized as: 
HETP	Height Equivalent of a Theorhetical Plate	Used for packed columns	HETP = (Height of Packing)/(No. TS)
Fs Vapor	Ratio used to determine preliminary column sizing	To all columns	Fs = Us * SQRT (Rhov) where: Fs = Vapor F Factor Us = Vapor superficial velocity, ft/s
GPM/FT2 Liquid Ratio	Ratio used to find column area requirements and to determine initial equipment sizing	To all columns	gpm/ft2 = (liquid gpm)/(column area) where: gpm = gallons per minute area = ft2

Further resources for column design and sizing:

1. A step-wise procedure for distillation column design
2. A lengthy guide for engineers from Research Gate
3. Video Tutorial of distillation column design
4. A handy cheat-sheet for the design ratios
5. Sulzer's guidelines for optimal column design
6. Engineering Design Guidelines from KLM Technology Group
7. Costello's explanation of basic design principles

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