

CM4861 Design Heuristics

January, 2010

- Temperatures for cooling water:** 80°F to 120°F. Above 120°F the heat exchanger will scale.
- Temperatures and Pressures:** Assume 80°F and 1 atm unless you have a reason for another value.
- Service Factor:** Most plants have annual turnarounds, usually 1 to 2 weeks, depending on maintenance load. Refineries today typically operate 100%.
- Labor Posts:** 2 process posts per operating section of your plant.
- Tank trucks:** 8,700 gallons
- Railroad cars:** 34,500 gallons
- Raw material inventory:** 2 x size of largest shipping container. Cannot use shipping container as storage.
- Product inventory:** 1.5-2 x largest customer order.
- Intermediate Storage:** Kept to a minimum, particularly with hazardous materials.
- Pumps:** Line lengths and height changes are not known for this level of design.
For liquids: If change in pressure and liquid density are known, can use ME balance to determine work. If pipe diameter and flow rate are known, the KE term can be estimated. Also, assume 30 ft of friction head. Pump efficiencies are 70 to 80%.
- Time periods:** Costs are usually reported in \$/year. Flows rates are reported on hourly basis - flow sheets show the actual flow rate and does not include the service factor.
- Heat Exchangers:** Put greater pressure fluid tubeside - reduces cost
Put more corrosive fluid tubeside - reduces cost
Put greater fouling fluid tubeside - easier to clean
Put more viscous fluid shellside - baffles induce turbulence and raise heat xfer.
For a double pipe exchanger, area must be less than 150 ft².
For a 1-shell, 2 tube pass exchanger, want the correction factor, F , to be greater than 0.75 to 0.80.
- Compressors:** No more than 5 to 1 compression ratio per stage.
- Distillation Columns:** Use vapor velocity of 3 ft/sec at ave. T and P to size diameter.
Use tray height of 16 to 24 inches
Use tray efficiency from 50 - 75%, use 70% as a nominal value.
- Barrel Sizes:** Petroleum - 42 gallons
Others - 55 gallons
- Heat capacities:** Use published values, if available
Use something that is close.
See Section 8.3 in T&S for data sources.
See Section 8.9 in T&S for more detailed estimation methods.
See tables in back of Geankoplis, or tables in Perry's
Otherwise "ballpark" by using common values shown below:
Water – 1 BTU/lb deg F = 1 cal/gm deg. C = 1 kcal/kg deg C
Oils – 0.7 to 0.8
Sand, steel – 0.7
- Heats of Reaction:** Use published values, if available
Use heats of formation of reactants and products, if available.
- Reaction Rates:** Rarely have this information in any detail.
- Reaction Conversion:** Use published values if known.
Use equilibrium calculation to determine max. conversion.

See www.knovel.com for more info, particularly Walas, *Selection and Sizing of Process Equipment*