SKF4153- PLANT DESIGN

RULE OF THUMB

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Raw Materials and Chemical Reactions

Select raw materials and chemical reactions to avoid, or reduce, the handling and storage of hazardous and toxic chemicals.

- A water spill into an ethylene-oxide storage tank could lead to an accident similar to the Bhopal incident.

- So the main issue here is the risk associated with the storage of hazardous intermediate (ethylene-oxide).

Distribution of Chemicals

Use an excess of one chemical reactant in a reaction operation to completely consume a second valuable, toxic, or hazardous chemical reactant.

- To completely consume the hazardous and toxic reactant (chlorine)
- To absorb excess heat of reaction hence maintaining moderate temperature

Distribution of Chemicals

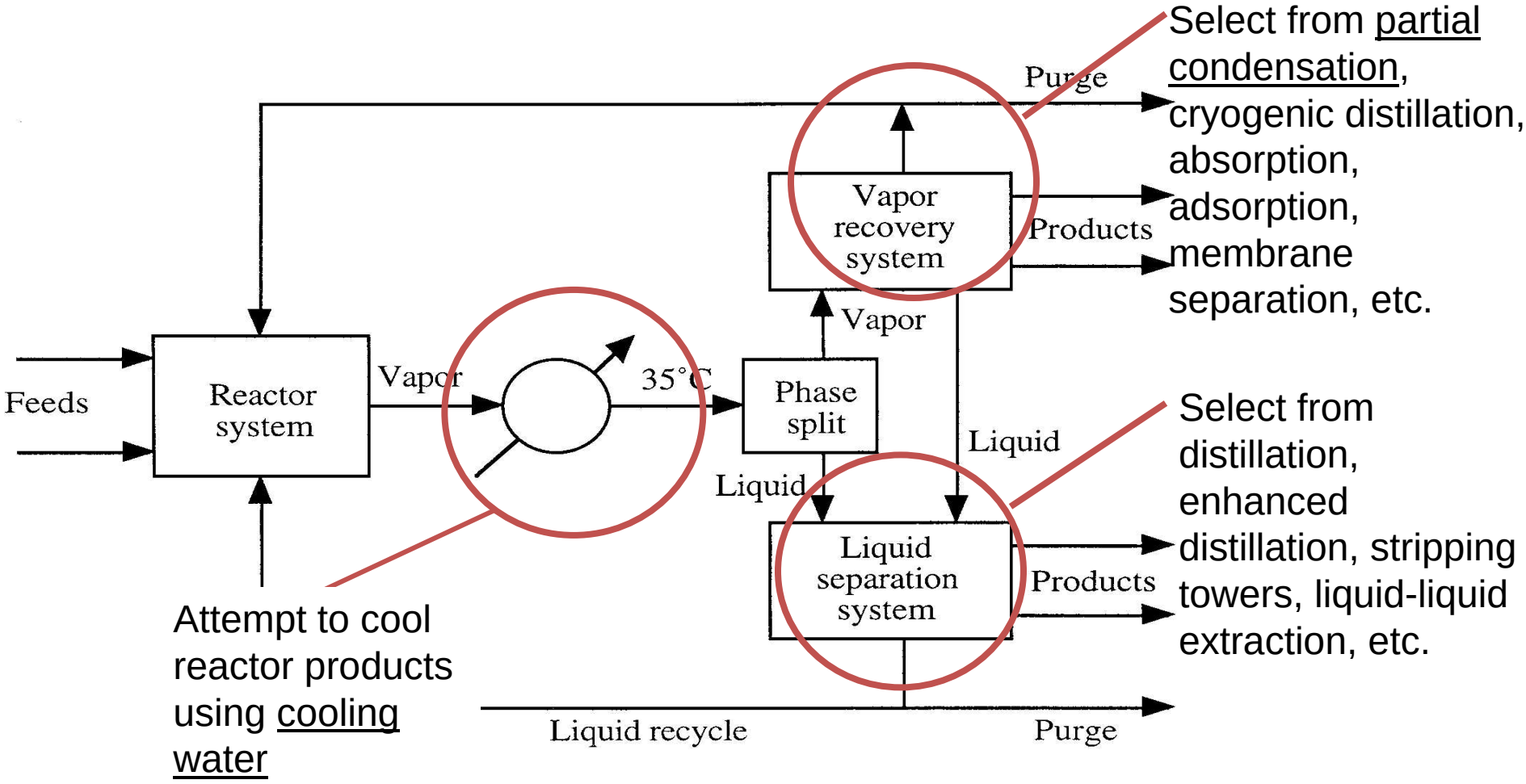
Eliminate inert species before the reaction

- When the separations are easily accomplished
- When the catalyst is adversely affected by the inert
- Exothermic heat of reaction is small

Do not purge valuable species or species that are toxic and hazardous, even in small concentrations

- Add separators to recover valuable species
- Add reactors to eliminate toxic and hazardous species
- By-products of reversible reactions, even in small quantities, are usually recycled to extinction

Separation



Reference:J.M. Douglas, Conceptual Design of Chemical Processes, McGraw Hill, 1998.

Pumping and Compression

To increase the pressure of a stream, pump a liquid rather than compress a gas; through condense a vapor, as long as refrigeration (and compression) is not needed, before pumping.

- More efficient (cheaper) to pump a liquid than to compress a gas.
- Exception: if condensation requires refrigeration.

$$\dot{W} = \int_{P_1}^{P_2} \dot{V} dP$$

SUMMARY

- Select reaction paths that do not involve toxic or hazardous chemicals, and avoiding their storage in large quantities.
- Purge species that would otherwise build up to unacceptable concentrations, to achieve a high selectivity to the desired products.
- Apply rule of thumb in selecting separation processes to separate liquids, vapors, and vapor-liquid mixtures.
- Distribute the chemicals, by using excess reactants, inert diluents, and cold shots, to remove the exothermic heats of reaction.
- Advantages of pumping a liquid rather than compressing a vapor.

References

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