



BITS Pilani
K K Birla Goa Campus

Chemical Process Technology CHE F419

Dr. Jegatha Nambi Krishnan

Department of Chemical Engineering

16th Jan. 2016

Course Description – BITS Pilani

- Chemical industries Facts and Figures
- Unit operations & processes involved
- Separation task selection and examples
- Production of Sulfuric acid
- Production of Nitric acid
- Production of Fertilizers
- Production of Pulp and Paper
- Production of Cement

Course Description – BITS Pilani

- Manufacturing process involved in Edible & essential oil, Soap, detergents etc
- Coal based technologies
- Crude oil refining processes
- Petrochemical processes
- Polymerization processes

Text (T), Reference book (R)

T1: “Dryden’s Outlines of Chemical Technology for the 21st Century” Edited by M. Gopala Rao and Marshall Sittig. East West Press, 3rd Ed., **1997**.

References suggested based on the topic of discussion

LECTURE PLAN

Lecture No.	Learning Objectives	Topics to be covered	Text Book Chap.
1-2	Overview	Chemical Process Technology	T. Ch1
2	To know the present status of chemical industries in India	Chemical Industries – Facts and figures	Ch. I A- B, T1
3 , 4 & 5	To understand the species allocation and separation task selection	Unit operations and Unit Process concepts, General Principles applied in studying an Industry	Ch.IC-D, T1
6 & 7	Example of the separation task selection and to understand the task integration	Unit operations and Unit Process concepts, General Principles applied in studying an Industry	Ch.IC-D, T1
8, 9, 10 & 11	To understand the chronological development in the sulfuric acid production	Chamber Process, Contact Process, DCDA Process,	ChII A, T1; R1

Lecture No.	Learning Objectives	Topics to be covered	Text Book Chap.
12 & 13	To understand the chronological development in the Nitric acid production	Ammonia Oxidation Processes: Mono Pressure and Mixed Pressure Processes	ChII E, T1; R1
14, 15 & 16	To understand the chronological development in the Nitrogen based fertilizers production	Urea Production Processes; Ammonium Nitrate Production Processes;	ChII E, T1; R1
17 & 18	To understand the importance of NPK fertilizer and its production	Phosphate and Potash based fertilizers production processes; Phosphoric acid manufacturing processes	ChII F, T1; R1
19, 20 & 21	To understand the pulp and paper production processes	Kraft Process, sulfite Process, Mechanical Pulping; Paper making, Production of lignin chemicals	ChIII F, T1; R1

Lecture No.	Learning Objectives	Topics to be covered	Text Book Chap.
22, 23	To understand the cement manufacturing processes	Dry and wet cement manufacturing processes	ChIIK, T1
24, 25 & 26	To understand the extraction of edible and essential oils	Mechanical and solvent based extraction processes, Hydrogenation of oils; isomerization, interesterification	ChIII A, T1; R1
27, 28 & 29	To understand the soap manufacturing processes and detergent making	Soap manufacturing processes, glycerin recovery process, alfol process of detergent production	ChIII B, T1; R1
30, 31 & 32	To understand the coal based technologies	Coal combustion, carbonization and liquefaction technologies	ChIII G, T1;

Lecture No.	Learning Objectives	Topics to be covered	Text Book Chap.
33, 34 & 35	To understand the crude oil refining processes	Origin and classification of petroleum, atmospheric and vacuum distillation processes; Reforming, Solvent deasphalting , solvent dewaxing	ChIII H, T1;
36 – 39	To understand the petrochemical processes	Chemicals from C ₁ compounds, Chemicals from C ₂ compounds, Chemicals from C ₃ compounds, Chemicals from C ₄ compounds,	ChIV B-E, T1;
40 & 41	To understand the polymerization processes	Various polymerization processes	ChV A-B, T1

Evaluation Scheme

Evaluation Component	Duration (min)	Weightage (%)	Date & Time	Nature of Component
Test I	60	20%	25-02-16 (4.00-5.00 AM)	CB
Test II	60	20%	31 -03-16 (4.00-5.00 AM)	CB
Seminar (1)/ Assignments (2)	-	20%	To be announced by I/C	
Compre	180	40%	May 9 th 2016 (AN)	CB

Aspects of Industrial Chemical Processes

- Products
- Types of process
- Flowsheets
- Mass balances
- Energy balances
- Heat transfer and heat exchangers
- Reactor design and operation
- Separation and purification processes

Aspects of chemical processes cont.

- Process instrumentation and process control
- Materials handling
- Process economics
- Safety and environmental issues
- Quality etc

Classification of chemical products

- Bulk chemicals e.g. sulphuric acid
- Fine chemicals e.g. 'ibuprofen'
- Speciality chemicals e.g. adhesives
- Inorganic/organic

Chemical processes

Chemical processes consist of a number of sequential and integrated operations carried out in appropriate equipment.

For example **chemical reaction** carried out in a **chemical reactor**.

The precise operations, sequence of operations and equipment specifications depend on the nature of the process, operating conditions, materials used and product produced.

Chemical processes

Operation

Chemical reaction

Distillation

Filtration

Drying

Fluid transport

Process control measurement devices, controllers, control valves etc

Evaporation

Centrifugation

Heat transfer

Granulation

etc

equipment

reactor

distillation column

filter units

dryers (various types)

pipes, valves, pumps etc

evaporators

centrifuges

heat exchangers

granulator

Flowsheets

Flowsheets are used to describe the operating details of chemical processes. There are a number of basic types:

Flowcharts (or block diagrams),

Process flowsheets (or Process Flow Diagram),

Piping and Instrumentation Diagrams (PID).

Flowsheets

- Schematic representations
- Arrangement of equipment
- Interconnections
- Movement of material
- Stream connections
- Stream flows/quantities
- Stream compositions
- Operating conditions

etc

Process flowsheet

- Symbols
- Stream information
- Layout

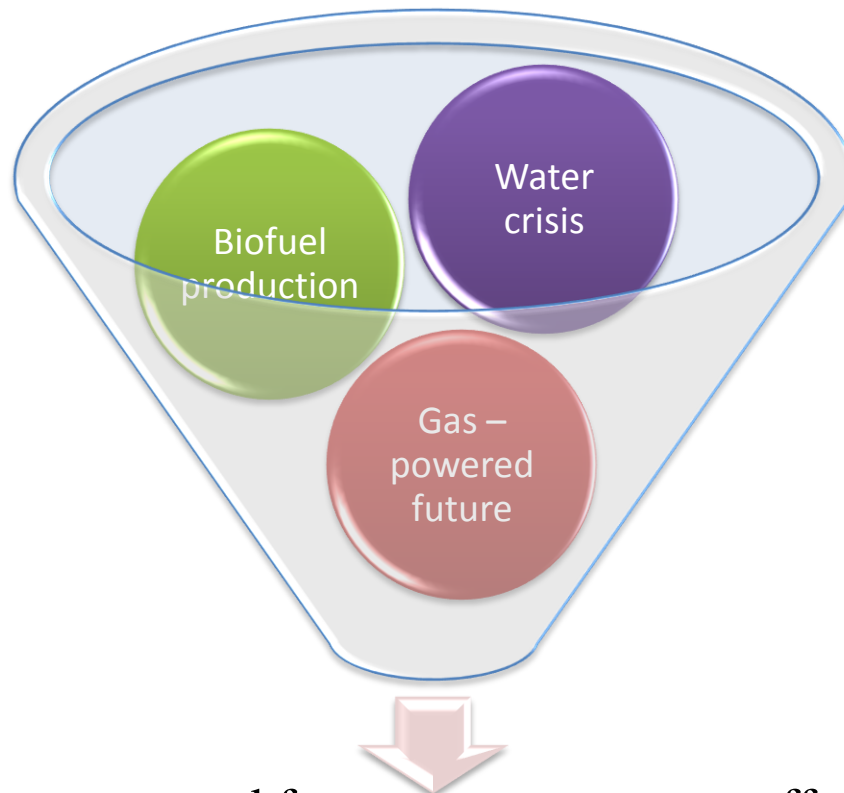
Exercise

Construct a process flow sheet for a batch esterification reaction from the information given.

Scope and Objective

- Insight into various manufacturing technologies.
- Apply knowledge gained in chemical technology in the manufacturing plants.
- Branch of chemical engineering that applies physical science/life science together mathematics and economics to process that convert raw materials /chemicals into more useful or valuable forms.

Chemical Process Eng. – University of Surrey



From detergents and fast computers to cost effective cost effective drugs to safer air travel- Chemical engineering make tangible difference across industries

Why Chemical Process Technology?



The general goal of the programme is to give students sufficient scientific and technological knowledge for the career of chemical and process engineer in different fields of the process industry. Moreover, the students will attain the basis for doctoral studies and for continuous education in the field. A specific goal of the programme is to promote and develop students' abilities to create innovations and new technology.

Table 1.1 *Chemical process technology disciplines*

Scale	Discipline
Scale independent	Chemistry, biology, physics, mathematics Thermodynamics Physical transport phenomena
Micro/nanolevel	Kinetics Catalysis on a molecular level Interface chemistry Microbiology
Mesolevel	Particle technology Reactor technology Unit operations
Macrolevel	Process technology and process development Process integration and design Process control and operation

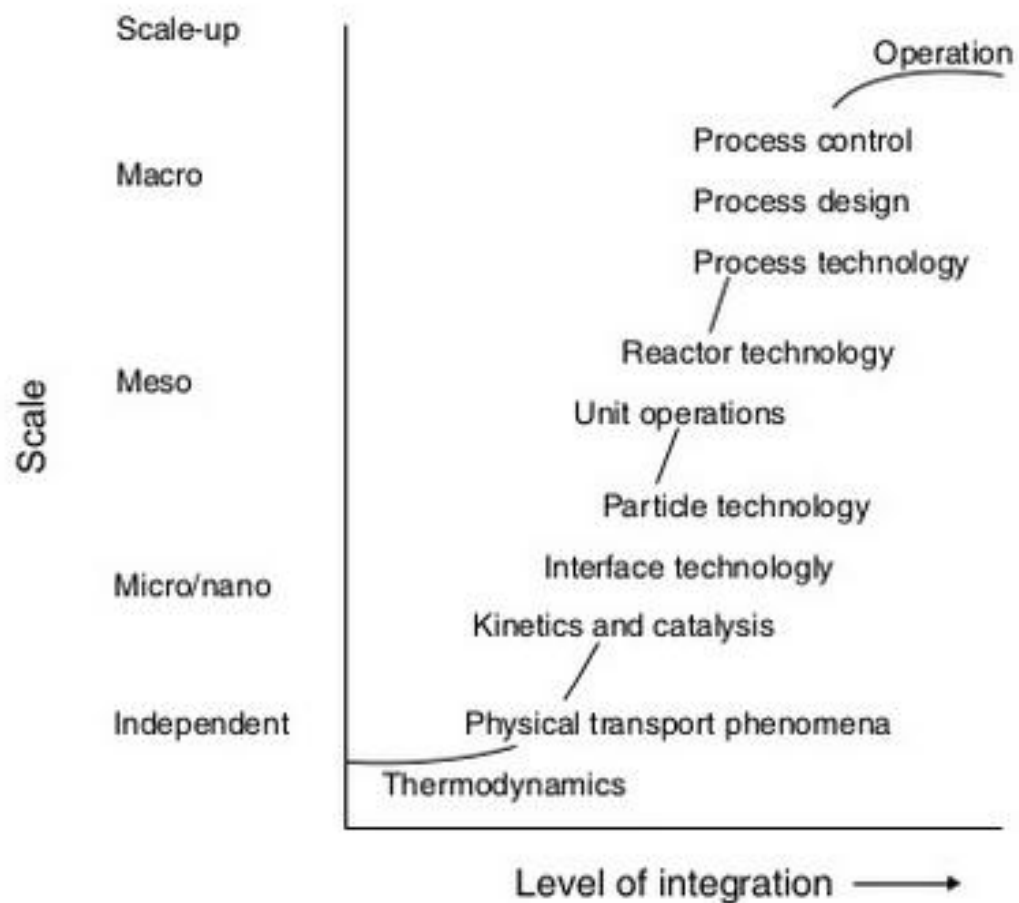


Figure 1.1 Disciplines in process development organized according to level of integration.

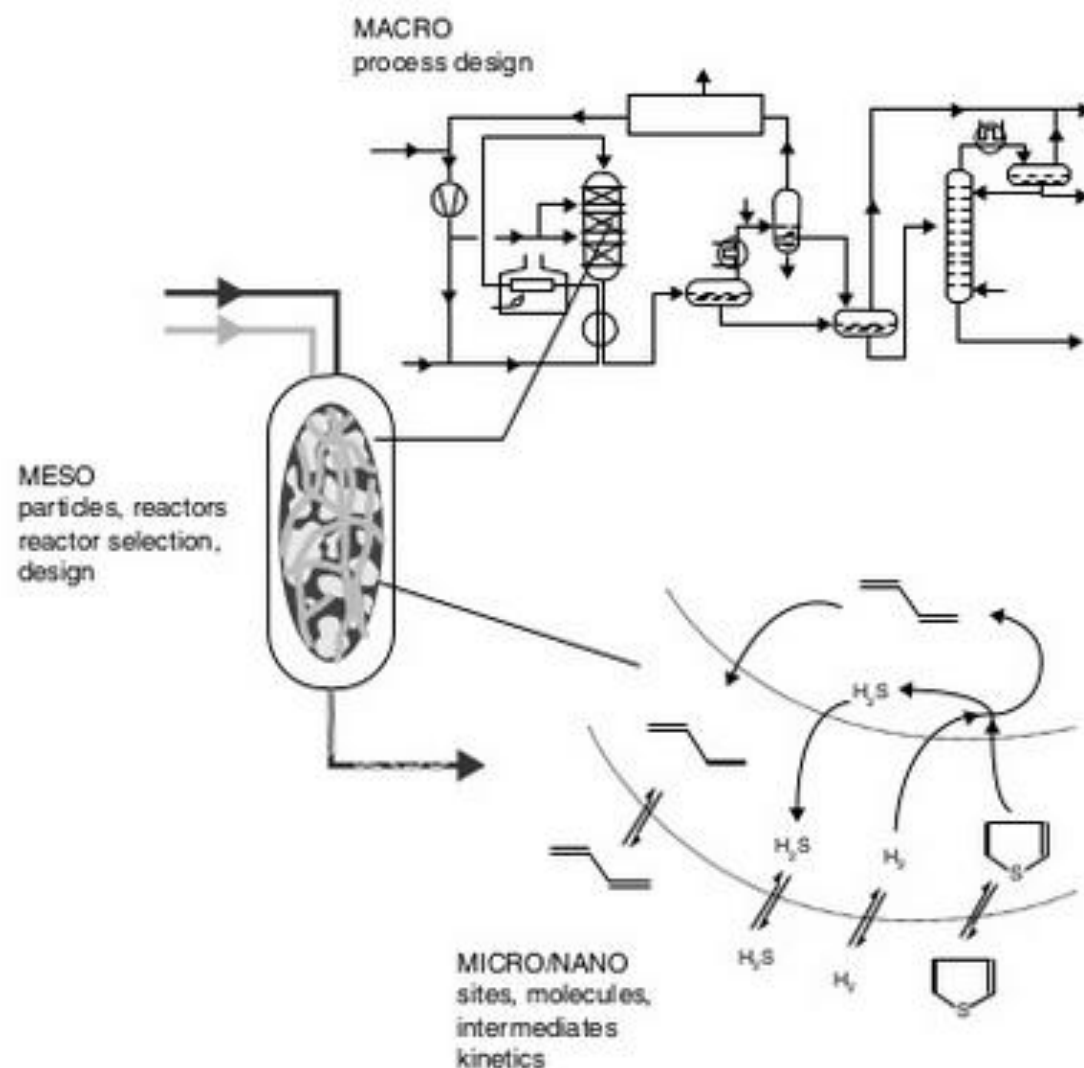


Figure 1.2 Relationship between different levels of development.

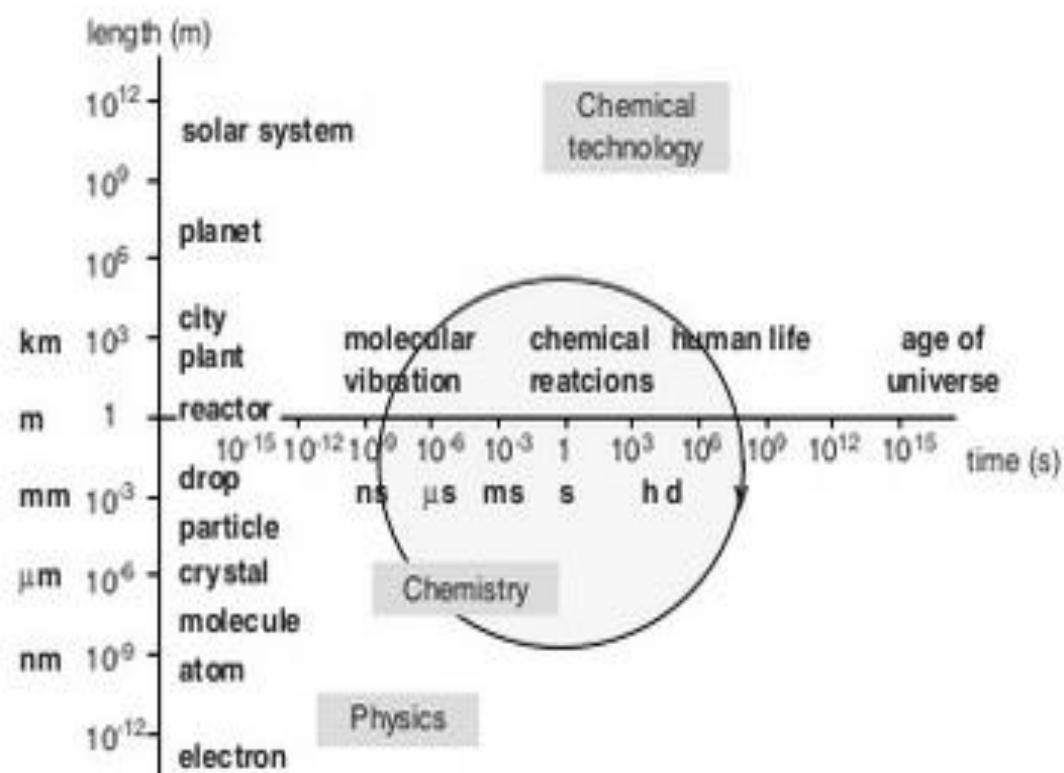


Figure 1.3 Space and time scales [J. Villermaux, personal communication].

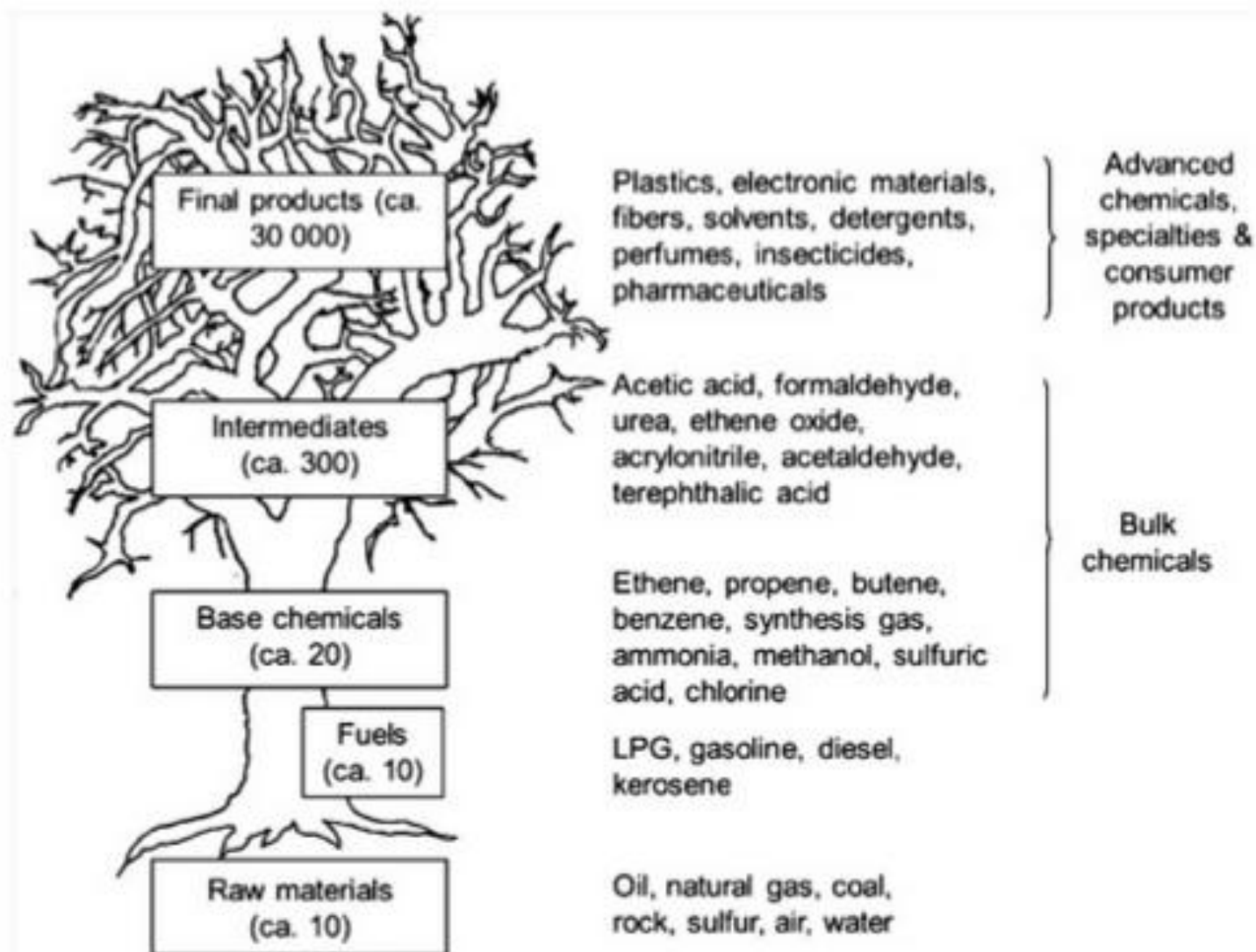


Figure 2.1 Structure of the chemical industry.

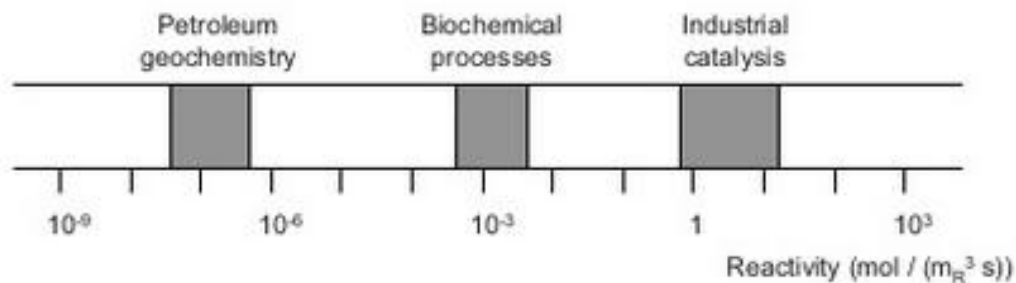


Figure 1.4 Windows on reality for useful chemical reactivity [1].

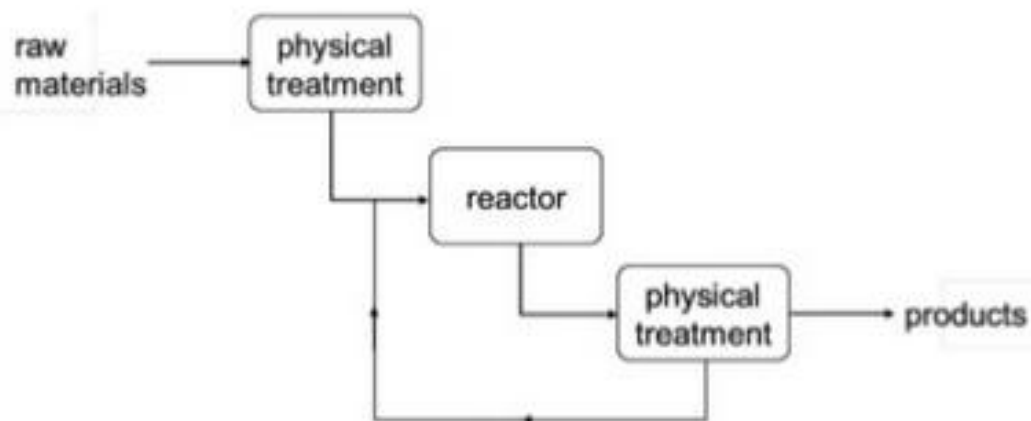


Figure 1.5 Typical chemical process structure.