

# ChE 308

## Study of Chemical Process Industries

### Introduction

# Basic Information

## **A. Country Perspective-Local Information**

1. Which is the most abundant natural resource available for the industry?
2. What are the raw materials? Are all of them available in Bangladesh?
3. What is the most suitable location for such an industry?
4. Does such an industry exist in Bangladesh?

# Basic Information cont'd

## **B. Process Information**

1. Which reactions are involved?
2. What are the thermodynamics of the reactions, and what operating temperature and pressure should be applied?
3. What is the kinetics, and what are the optimal conditions with respect to kinetics?
4. Is a catalyst used, and if so, is it heterogeneous or homogenous? Is the catalyst stable? If not, what is the deactivation timescale? What are the consequences for process design? Is regeneration required?

# Basic Information cont'd

## **B. Process Information** cont'd

5. Apart from the catalyst, what are the phases involved? Are mass and heat transfer limitations important?
6. Is a gas or liquid recycling necessary?
7. Is feed purification necessary?
8. How are the products separated?
9. What is the energy intensity? Which fuels are used?



## Basic Information cont'd

### **C. Environment, Safety & Health**

1. What are environmental issues?
2. Is it a polluting industry? What kind of pollution?
3. Is it dangerous to work in the industry?
4. What are the health hazards?

# Basic Information cont'd

## **D. Product and Market**

1. What are the final products? Are there any by products? Any intermediate product?
2. How important is product purity? Which factors ensure purity?
3. What is the demand structure for the products in the country? Any global or foreign market?
4. What are the possibilities of product diversification? Any new possibilities? Can the process adjust to changing demand and developing technology?
5. Future market



# Basic Information cont'd

## **E. Investment and Profit Maximization**

# Discipline in Process Development

In Chemical process technology various disciplines are integrated. They can be divided according to their scale:

- **Scale independent**
  - Chemistry, Biology, Physics, Mathematics
  - Thermodynamics
  - Physical Transport Phenomena
- **Micro level**
  - Kinetics
  - Catalysis on a molecular level
  - Interface Chemistry
  - Microbiology
  - Particle Technology



# Discipline in Process Development cont'd

- **Meso level**
  - Reactor Technology
  - Unit Operations
  - Scale-up
- **Macro level**
  - Process Technology and Process Development
  - Process Integration and design
  - Process Control and Operation

# Discipline in Process Development cont'd

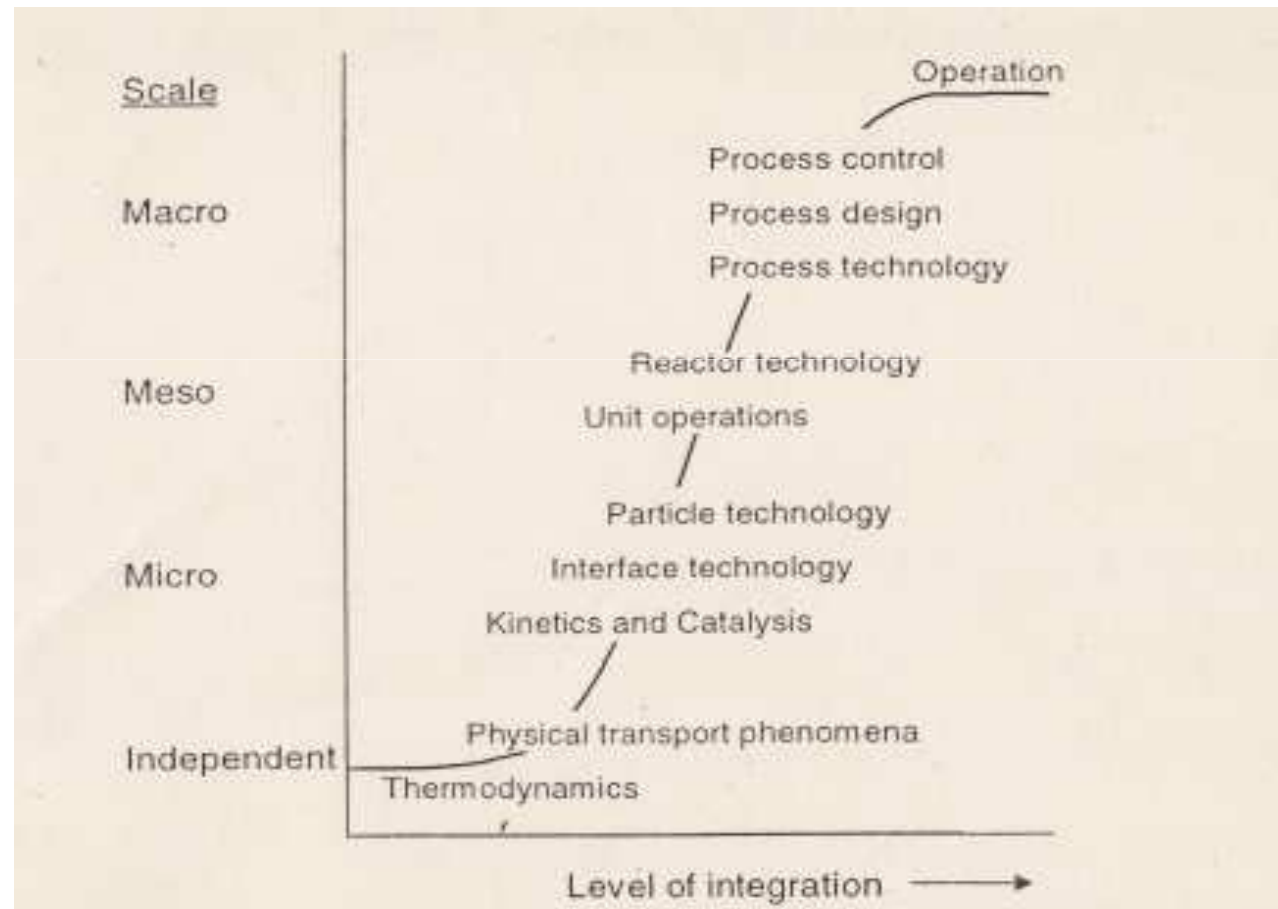
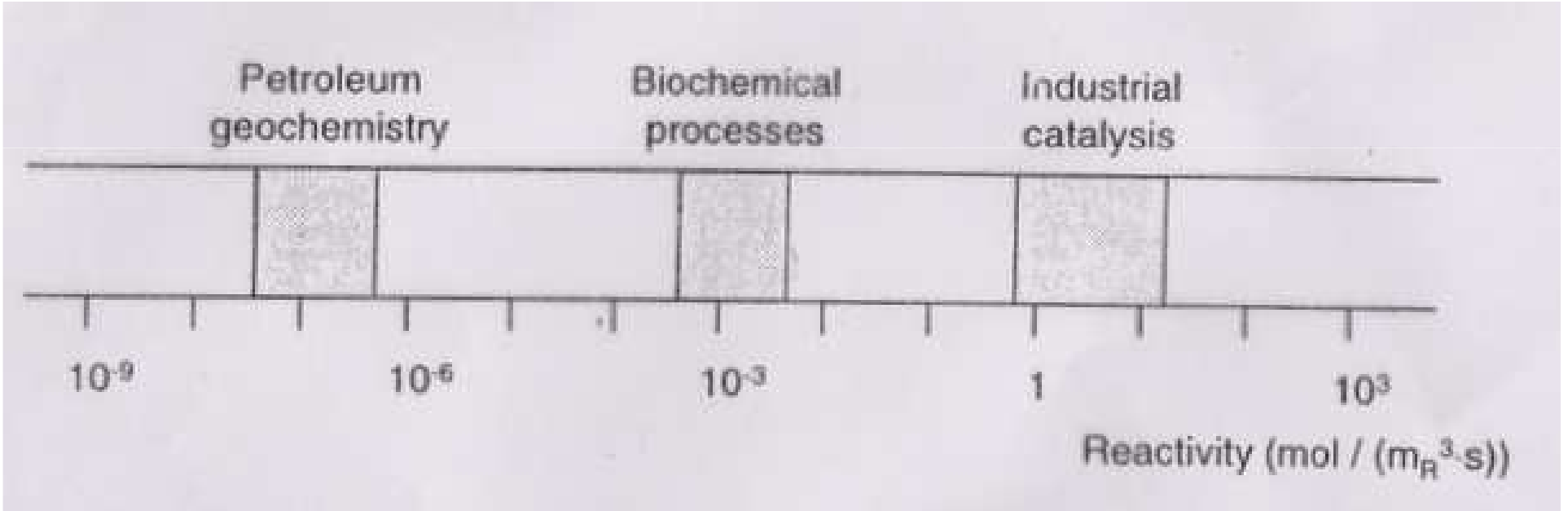


Fig1: Disciplines in process development organized according to level of integration

# Discipline in Process Development cont'd

- In the development stage of a process or product all necessary disciplines are integrated.
- The **initial phase** depends on thermodynamics and other scale independent principles.
- As time passes, other disciplines become important. e.g. kinetics and catalysis on a **micro level**, reactor technology, unit operations. and scale- up on the **meso level**, and process technology. process control. etc. on the **macro level**.



# Structure of Chemical Industry

- The vast majority of chemicals (about 85%) is produced from a very limited number of simple chemicals called *base chemicals*.
- *Base chemicals*, in turn, are produced from only about ten raw materials (the most important hydrocarbon ones being oil, natural gas etc.)
- Conversion of base chemicals can produce about 300 different *intermediates*, which are still relatively simple molecules.
- Both the *base chemicals* and *intermediates* can be classified as *bulk chemicals*.

# Structure of Chemical Industry cont'd

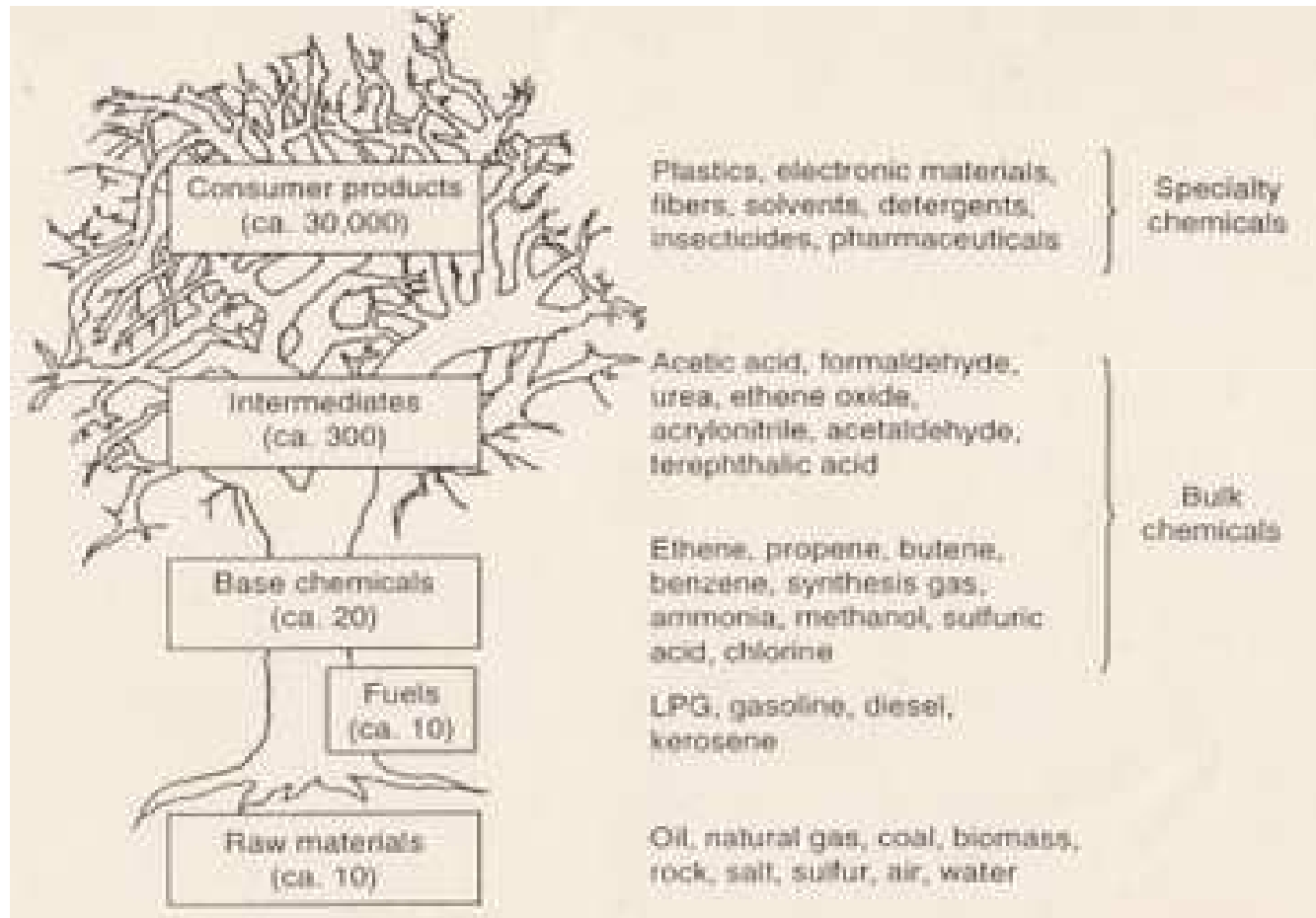


Fig 2: structure of the chemical Industry

Sugar	1933
Distilleries (fermentation of molasses)	1938
Portland Cement	1941
Paper and Pulp	1953
Sulfuric Acid	1953
Sodium Hydroxide & Chlorine (chlor-alkali)	1953
Alum	1953
Bleaching Powder	1953
Lime	1953
Urea and Ammonia	1961
Rayon	1967
Carbon disulfide	1967
Petroleum Refinery	1968
Ammonium Sulfate	1969
Natural Gas Processing Plant	1969
Triple Super Phosphate	1972
Insulator and Sanitary Wares	1980
Visbreaking	1995
Industrial Gases such as CO <sub>2</sub> , O <sub>2</sub> , C <sub>2</sub> H <sub>2</sub> etc.	Exact date not known
Ceramic and Refractories	Exact date not known
Glass	Exact date not known
Pharmaceuticals	Exact date not known
Food products	Exact date not known
Fine chemicals	Exact date not known