

Scale-Up of Chemical Engineering Process

Chapter 3: Review of Chemical and Bio Processes

by

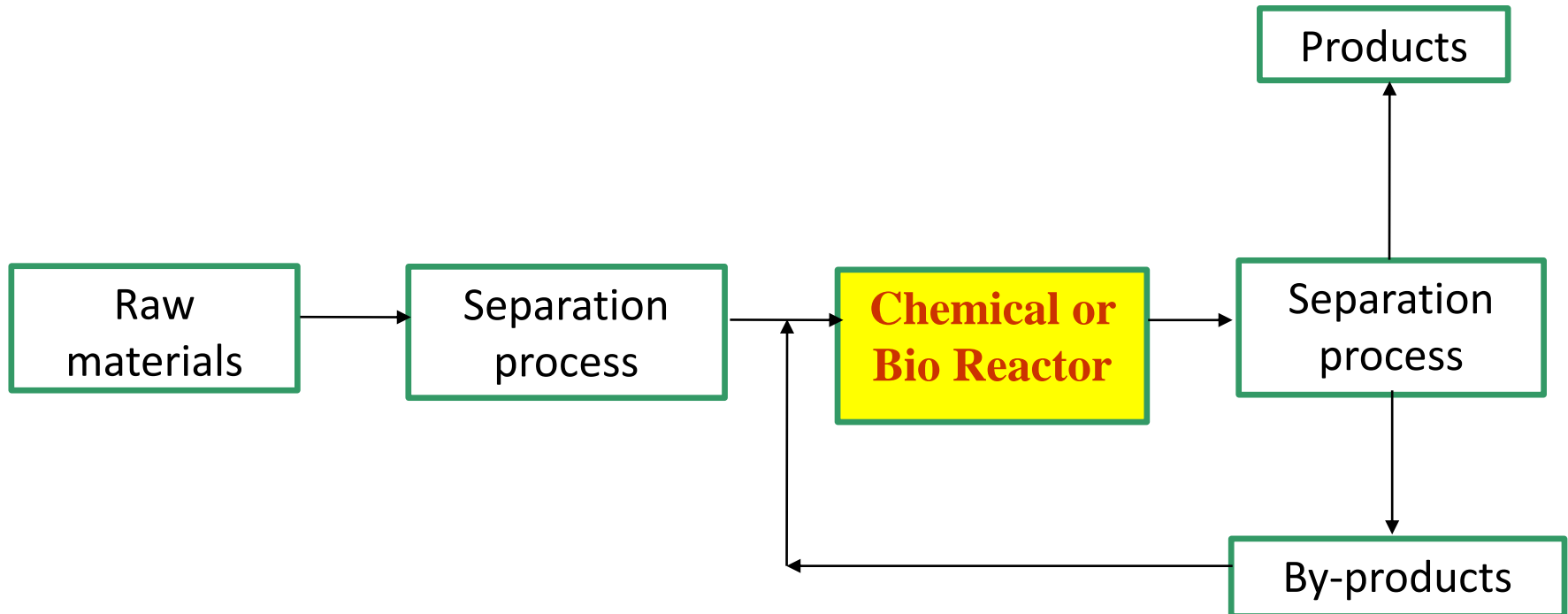
Nurul Sa'aadah Sulaiman

Faculty of Chemical and Natural Resources Engineering
saaadah@ump.edu.my



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Chemical and Bio Processes



Chemicals categories

commodities	fine chemicals	specialities
single pure chemical substances ...	single pure chemical substances	mixtures
produced in dedicated plants	produced in multi-purpose plants	formulated
high volume / low price	low vol. (< 1000 mtpa) high price (> \$ 10/kg)	undifferentiated
many applications	few applications	undifferentiated
sold on specifications	sold on specifications „what they are“	sold on performance „what they can do“

[Source: Wikipedia]



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Structure of Chemical Industry

Consumer products

Plastics, electronic materials, fibers, solvents, detergents, insecticides, pharmaceuticals

Intermediates

Acetic acid, formaldehyde, urea, ethene oxide, acrylonitrile, acetaldehyde, terephthalic acid

Basic Chemicals

Ethene, propene, butene, benzene, synthesis gas, ammonia, methanol, sulfuric acid, chlorine

Fuels

LPG, gasoline, diesel, kerosene

Raw materials

Oil, natural gas, coal, biomass, rock, salt, sulfur, air, water

Specialty
Chemicals

Bulk/
Commodities
Chemicals



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Fine Chemicals

- Fine chemicals are identified according to specifications of “what they are”. For instance:
 - Advanced intermediates
 - Bulk drugs
 - Bulk pesticides
 - Active ingredients
 - Bulk vitamins
 - Flavour and fragrance



Differences in Process Development for Bulk and Specialty Chemicals

FEATURE	BULK CHEMICALS	SPECIALTY CHEMICALS
Product Life Cycle	Long (> 30 yrs)	Short (<10 yrs)
Focus on R&D	Driven by cost & environment; Process Improvement	Product Improvement
Competing Processes	One route usually the best	Competitors may use variety of routes
Patent Protection	On process or technologies	On chemistry; often to block competitors
Technology	Usually continuous	Batch and continuous
Scale-up	Pilot plants and simulation tools	Rule of thumbs

(Source : Chemical Process Technology by Moulijn etc. 2001)



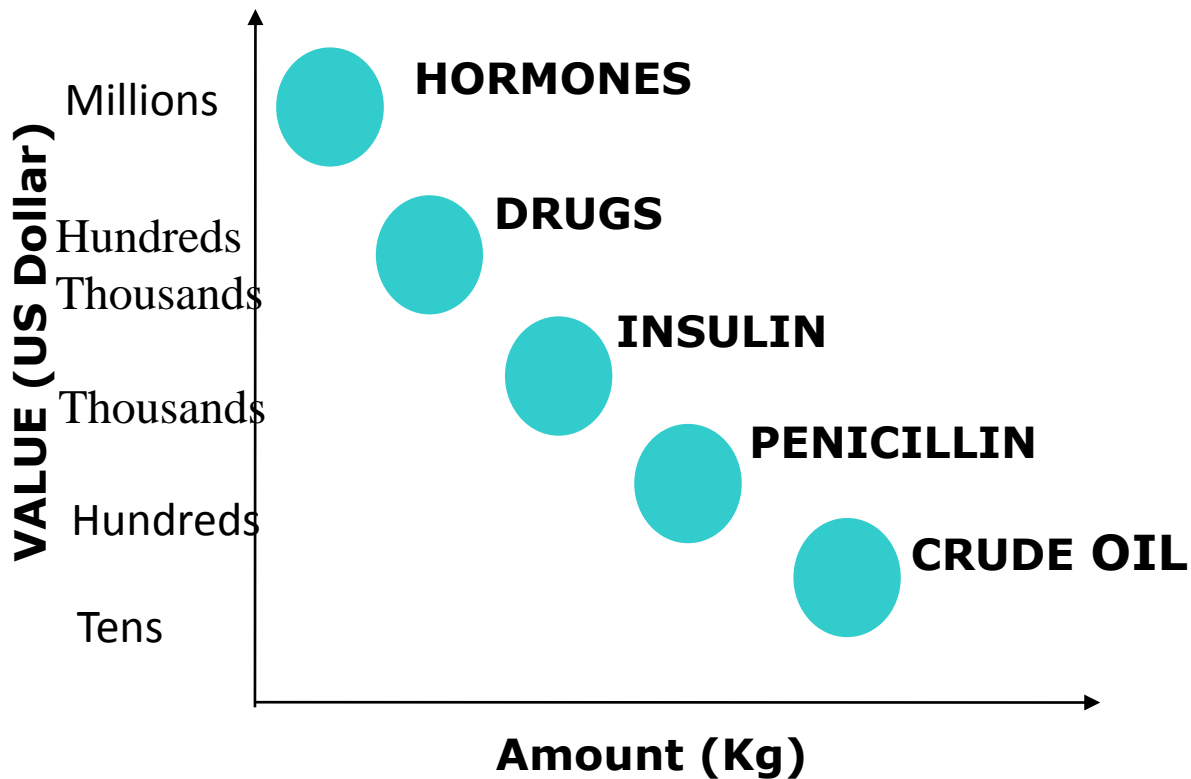
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Production and By-product Formation

INDUSTRY SEGMENT	PRODUCTION (mt/yr)	BY-PRODUCT (kg by-product/kg product)
Oil Refining	1 millions to 100 millions	0.01 - 0.1
Bulk Chemicals	10,000 to 1 million	< 1-5
Fine Chemicals	100 to 10,000	5 - 50
Pharmaceuticals	10 to 100	25 - 100



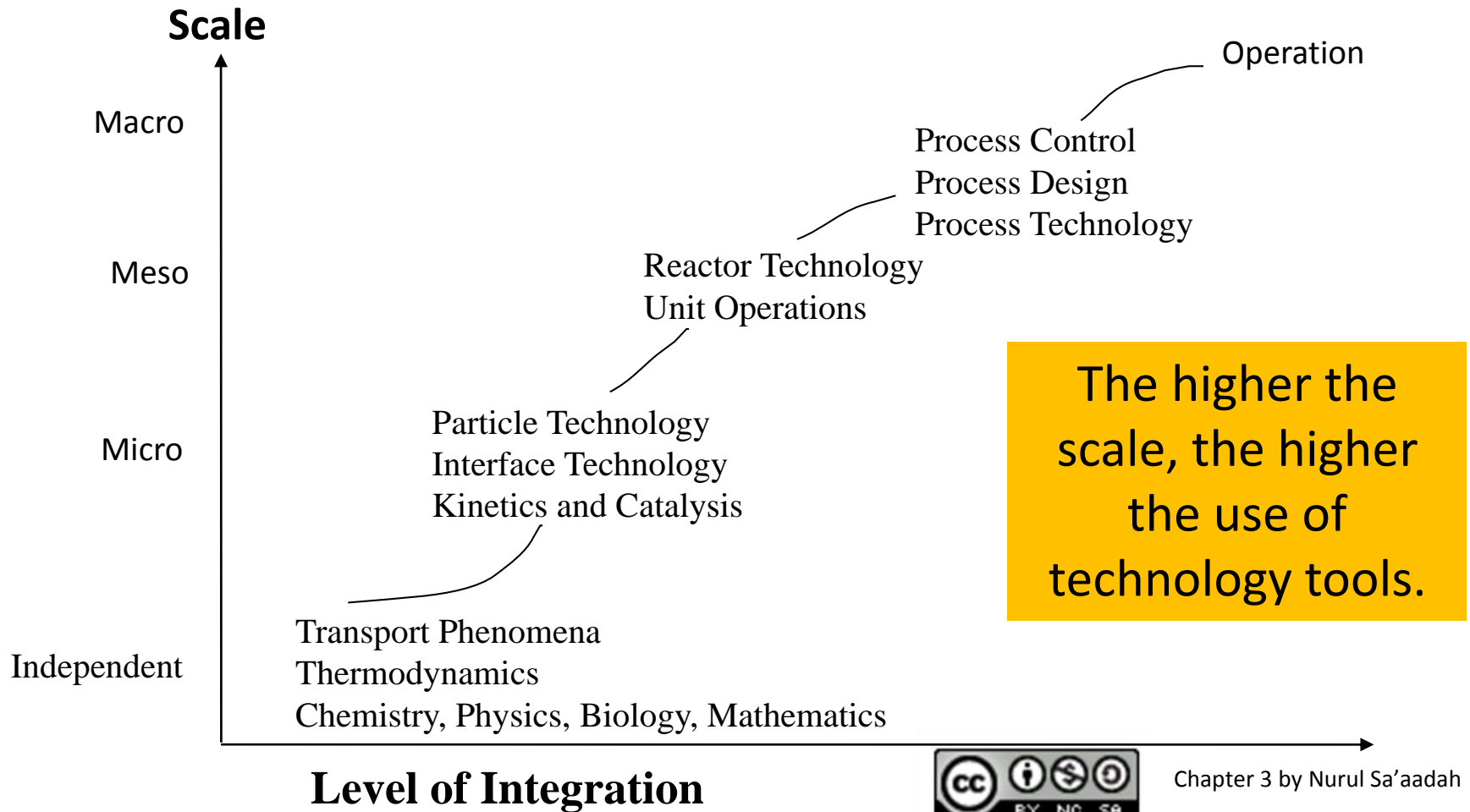
Comparison of Values Vs Amount of Production



Fine chemicals have the highest market value. Meanwhile the lowest market values are the bulk chemicals.



Chemical Process Technology



Author Information

Credit to the author:

Prof Ir Dr Badhrulhisham Abdul Aziz



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