Kimia Fisika IV

Modul 8

KATALIS ENZIMATIS

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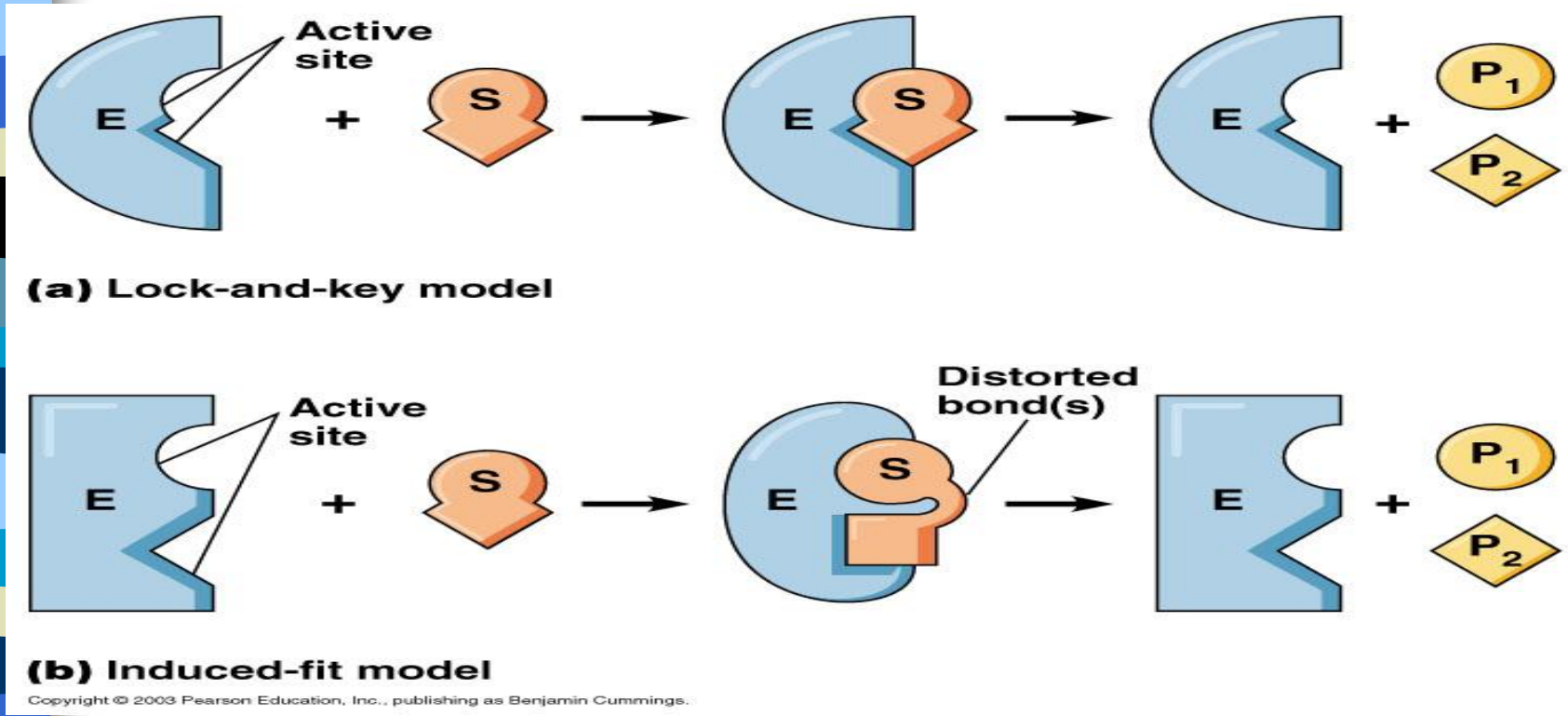
Model Ikatan Enzim

Mekanisme kerja enzim :

- $E + S \rightleftharpoons ES \longrightarrow E + P$

Dua model ikatan enzim:



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Sifat sifat enzim

- Enzim merupakan biokatalisator yang mempercepat jalannya reaksi tanpa ikut bereaksi
- Thermolabil. Mudah rusak bila dipanaskan > 60 C

- Merupakan senyawa protein, sehingga sifat protein masih melekat pada enzim
- Dibutuhkan dalam jumlah sedikit, sbg biokatalisator, rekasinya menjadi sangat cepat dan berulang ulang
- Bekerja didalam sel (endoenzim) dan diluar sel (ektoenzim)

Lanjutan

- Umumnya enzim bekerja mengkatalis reaksi satu arah, meskipun ada yang mengkatalis reaksi dua arah
- Bekerjanya spesifik, karena sisi aktif enzim setangkup dengan permukaan substrat tertentu
- Umumnya enzim tidak dapat bekerja tanpa adanya suatu zat non protein tambahan yang disebut kofaktor.

Michaelis Menten Equation

1913, Michaelis and Menten proposed: specific ES complex is an intermediate in an enzyme reaction

$$E + S \underset{k-1}{\overset{k1}{\rightleftharpoons}} ES \underset{k-2}{\overset{k2}{\rightleftharpoons}} E + P$$

For simplicity we consider the above at V_0 (negligible product formation and no back reaction)

$$E + S \underset{k-1}{\overset{k1}{\rightleftharpoons}} ES \xrightarrow{k2} E + P$$

Km = the Michaelis konstant

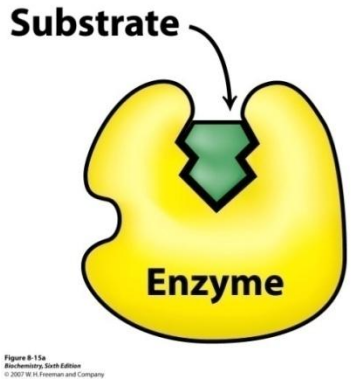
$$Km = \frac{K\text{-}1 + k2}{k1}$$

Leonor Michaelis
1875–1949

Maud Menten
1879–1960

INHIBISI
Reaksi Enzimatis

A



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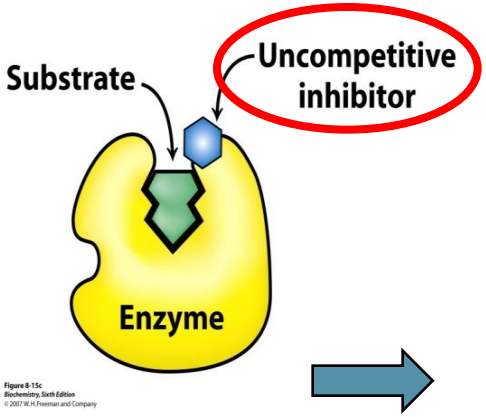

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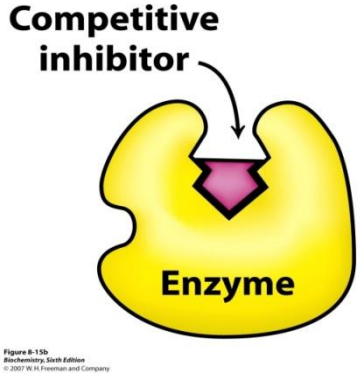

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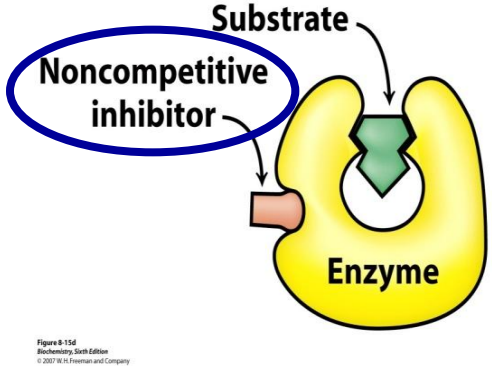

Modul

APLIKASI KATALIS

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Application of Catalysts

A) Usage of Catalysts in Chemical Industries

- **Cost is always the greatest concerns of manufacturers**
- **How can we get the highest yield of product?**

High pressure

High temperature

High Concentration

- **Haber Process**

  $3H_2 + N_2 \Longrightarrow 2NH_3$ (Fe)

- **Contact Process**

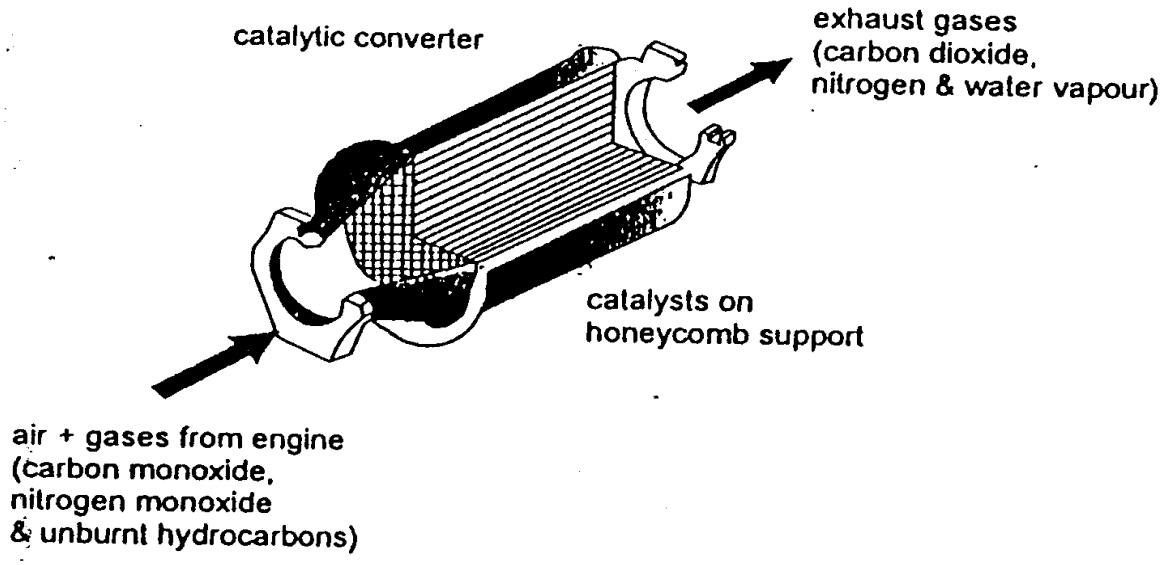
  $2SO_2 + O_2 \Longrightarrow 2SO_3$ (Pt/V_2O_5)

- **Hydrogenation of C=C**

  (hardening of oil - vegetable oil to margarine)

  $CH_2CH_2 + H_2 \Longrightarrow CH_3CH_3$ (Ni/Pd/Pt)

B) Catalytic Converters in Car Exhaust Systems



- **Convert CO, NO_x & hydrocarbons to harmless substances**
- **Catalyst are coated on a honeycomb ==> to increase the surface area**

C. Developing of the catalyst metal is done by impregnation method, cation exchange, coprecipitasi, and deposition

D. Cracking catalysts, used in petroleum refining

Applications of Catalysis

- Industrial applications

Almost all chemical industries have one or more steps employing catalysts

– Petroleum, energy sector, fertiliser, pharmaceutical, fine chemicals

Advantages of catalytic processes

– Achieving better process economics and productivity
  - Increase reaction rates - fast
  - Simplify the reaction steps - low investment cost
  - Carry out reaction under mild conditions (e.g. low T, P) - low energy consumption
– Reducing wastes
  - Improving selectivity toward desired products - less raw materials required, less unwanted wastes
  - Replacing harmful/toxic materials with readily available ones
– Producing certain products that may not be possible without catalysts
– Having better control of process (safety, flexible etc.)
– Encouraging application and advancement of new technologies and materials

- Environmental applications
  - Pollution controls in combination with industrial processes
    - Pre-treatment - reduce the amount waste/change the composition of emissions
    - Post-treatments - once formed, reduce and convert emissio
    - Using alternative materials
  - Pollution reduction
    - gas - converting harmful gases to non-harmful ones
    - liquid - de-pollution, de-odder, de-colour etc
    - solid - landfill, factory wastes

- Other applications
  - Catalysis and catalysts play one of the key roles in new technology development.

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Thanks for attention