

# PETROLEUM MICROBIOLOGY

## (MCB 410)

# **BIOGENESIS OF FOSSIL FUELS WITH EMPHASIS ON THE ROLE OF MICRO-ORGANISMS.**

What is Fossil Fuel ?

Examples: coal, crude oil, natural gas.

Importance of fossil fuels in various industries including transportation, industrial activities, and petrochemical production.

# Theories of Origin of Fossil Fuel

- Biogenic theory

- Abiogenic theory

# Biogenic theory

## Process of Formation

.Diagenesis

.Catagenesis

.Metanogenesis

# Abiogenic Theory

- An overview of the theory
- Inorganic hydrocarbon formation
- Mantle-derived hydrocarbon

# Role of Microorganisms

- Importance of microorganisms in the biogenic theory of fossil fuel formation.
- Anaerobic microorganisms involved in the decomposition of organic matter.
- Production of biogenic methane gas during decomposition processes.

# PETROLEUM PROSPECTING AND SECONDARY RECOVERY

- Definition of petroleum prospecting and secondary recovery.

- Importance of these techniques in maximizing oil extraction from reservoirs.

Traditional petroleum prospecting

vs

Microbial petroleum prospecting



# Secondary Recovery Techniques

- .Definition of secondary recovery: methods used to increase oil production from existing reservoirs.
- .Common secondary recovery techniques:
  - .Water flooding
  - .Gas injection (carbon dioxide, nitrogen)
  - .Enhanced oil recovery (EOR) methods (thermal, chemical, microbial)

# METHANOGENESIS AND METHANOTROPHY

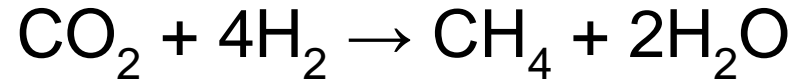
## Methanogenesis

- Definition: the biological production of methane by microorganisms known as methanogens.
- Overview of methanogen metabolism:
- Anaerobic process
- Production of methane from organic compounds such as acetate, hydrogen, and carbon dioxide
- Occurrence in environments lacking oxygen, such as wetlands, rice paddies, and the digestive systems of animals

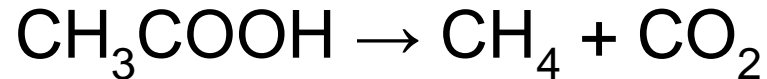
# Methanogenesis Pathways

Description of the three main pathways of methanogenesis

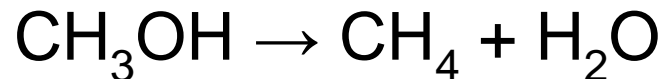
Hydrogenotrophic methanogenesis:



Acetoclastic methanogenesis:



Methylotrophic methanogenesis:



# Environmental Implications of Methanogenesis

- Role of methanogenesis in carbon cycling and greenhouse gas emissions.
- Contribution of methanogens to methane production in anaerobic environments.

# Methanotrophy

Definition: the biological consumption of methane by microorganisms known as methanotrophs.

- Overview of methanotroph metabolism:

- Aerobic process

- Utilization of methane as a carbon and energy source

- Occurrence in environments with sufficient oxygen, such as soils, sediments, and aquatic systems

# Methanotrophy Pathways

Description of the main pathways of methanotrophy:

Aerobic methane oxidation:  $\text{CH}_4 + \text{O}_2 \rightarrow \text{CH}_3\text{OH} \rightarrow \text{formaldehyde} \rightarrow \text{formate} \rightarrow \text{CO}_2$

Anaerobic methane oxidation:  $\text{CH}_4 + \text{SO}_4^{2-} \rightarrow \text{HCO}_3^- + \text{HS}^- + \text{H}_2\text{O}$

# Environmental Implications of Methanotrophy

- .Role of methanotrophy in mitigating methane emissions and reducing greenhouse gas concentrations.
- .Contribution of methanotrophs to methane oxidation in various ecosystems.
- .Potential applications of methanotrophy in bioremediation and methane bioconversion processes.

# **EFFECT OF OIL SPILLAGE ON MICROBIAL ACTIVITIES IN AQUATIC AND TERRESTRIAL ECOSYSTEM**

- . Oil contamination as a global menace
- . The Nigerian oil spillage situation
- . Adverse effect on the well being of the environment
- . Importance of studying microbial activities in oil contaminated environment

## **Impact on microbes in aquatic ecosystems**

- . Alteration of microbial community
- . Change in metabolic pathway and pattern
- . Impact on the biogeochemical cycle
- . Alteration of microbial community interaction



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Implications on the aquatic life in the water and soil health and fertility in the terrestrial environment.

# BIODETERIORATION AND BIOTRANSFORMATION OF HYDROCARBON

- What is biodeterioration of hydrocarbon?
- Mechanisms of biodeterioration
- Identity of spoilage organisms
- Economic implication of biodeterioration in the petroleum industry
- Preventive measures

# Biotransformation

- What is biotransformation of hydrocarbon?
- Relevance in environmental clean up and bioremediation
- Mechanisms of biotransformation
- Factors influencing biotransformation
- Applications and implication in the industry