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AEROBIC AND ANAEROBIC CHEMICAL DEGRADATION OF MICROORGANISMS

A project

submitted to the Department of Building and construction Engineering university of Technology in partial fulfillment of science in civil Engineering

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بسم الله الرحمن الرحيم

قالوا سبحانك لاعلم الا ماعلمتنا

انك انت العليم الحكيم

صدق الله العظيم

سورة البقرة(32)

الإهداء

الى من لاتكفي لشكرها الكلمات

ولاتوفي حـــــــبها العبارات

الى من تحت اقدامها الجـــنات

الى احن واطيب الـــــوالدات

إلى أمي

الى من معي سار الطريق

وكان لي نعم الرفيق

سندي في الفرح والضيق

إلى أخي

الى من زرعوا على شفاهي البسمات

ورافقوني بأجمل اللحظات ... الى زملائي وزميلاتي

واخيرا... الى كل من علمني حرفا الى اساتذتي مع التقدير

acknomleogment

I want to express my deeb gratitude to my supervisor lecturer Dr. omar najdat for his big support , encouragement, invaluable suggestion, and guidance through this project

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CIVIL ENGINEERING

Chapter one

1. introduction: Characteristics of Aerobic Microorganisms Capable of Degrading Organic Pollutants

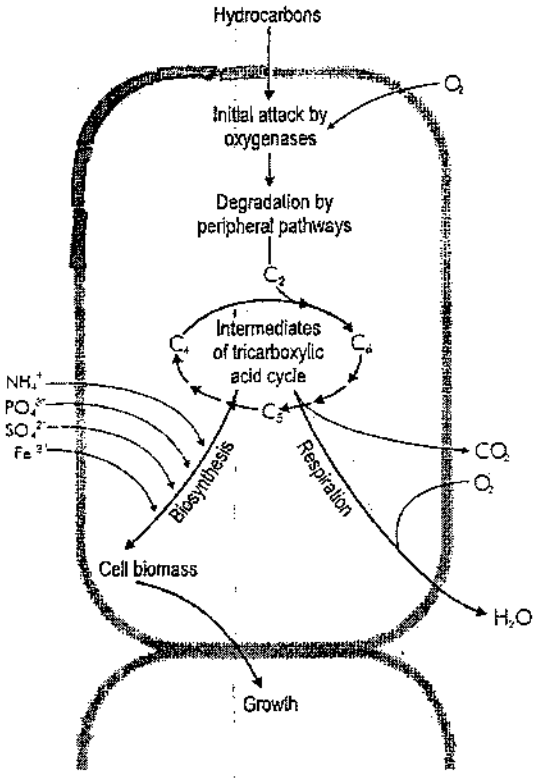
The most important classes of organic pollutants in the environment are mineral oil constituents and halogenated products of petrochemicals. The capacities of aerobic microorganisms are of particular relevance for the biodegradation of such compounds and are described as examples with reference to the degradation of aliphatic and aromatic hydrocarbons as well as their chlorinated derivatives. The most rapid and complete degradation of the majority of pollutants is brought about under aerobic condition.

The following are essential characteristics of aerobic microorganisms degrading organic pollutants (Fig 1.1)

- Metabolic processes for optimizing the contact between the microbial cells and the organic pollutants. The chemicals must be accessible the organisms having biodegradation activities. For example, hydrocarbons are water-insoluble and their degradation requires the production of biosurfactants.
- The initial intracellular attack on organic pollutants is an oxidative process; the activation and incorporation of oxygen is the enzymatic key reaction catalyzed by oxygenases and peroxidases.
- Peripheral degradation pathways convert the organic pollutants step by step into intermediates of the central intermediary metabolism, e.g., the tricarboxylic acid cycle.
- Biosynthesis of cell biomass from the central precursor metabolites, e.g., acetyl-coA, succinate, pyruvate. Sugars required for various biosyntheses and growth must be synthesized by gluconeogenesis.

A huge number of bacterial and fungal genera possess the ability to degrade organic pollutants. Biodegradation is defined as the biologically catalyzed reduction in complexity of chemical compounds (Alexander 1994). It is based on two processes: growth and cometabolism. In growth, an organic pollutants is used as sole source of

Fig 1.1 Main characteristics of aerobic degradation of hydrocarbons: processes associated with growth of microorganisms.



carbon and energy. This process results in a complete degradation (mineralization) of organic pollutants. Cometabolism is defined as the metabolism of an organic compound in the presence of a growth substrate that is used as the primary carbon and energy source.

Key enzymatic reactions of aerobic biodegradation are oxidations catalyzed by oxygenases and peroxidases. Oxygenases are oxidoreductases that use O_2 to incorporate oxygen into the substrate. Degradative organisms need oxygen at two metabolic sites the initial attack on the substrate and the end of the respiratory chain (Fig 1.1). Certain higher fungi have developed a unique oxidative system for the degradation of lignin based on extracellular ligninolytic peroxidases and laccases. This enzymatic system possesses increasing significance for the cometabolic degradation of persistent organopollutants. Thus, the basidiomycetous fungi require deeper insights and extensive consideration. Therefor, this chapter is divided into two sections: bacterial and fungal degradation.