Environmental Chemistry

Organic Chemistry

Lecture 5

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Lecture Outline

- Introduction, history
- Elements, properties, sources, C atom, isomerism
- Aliphatic compounds
- Heterocyclic compounds
- Common foods and related compounds
- Pesticides
- Trace organics
- Behavior of organics in environment

Introduction

- Engineers are looking at organics as the main pollution source , and degradation process
- Organic chemistry deals with compounds of carbon, originated in 1685 by Nicholas Nemery, a French chemist.
- Organics derived from living, inorganics from non-living things.

Organic Chemist vs Environmental Engineers

Organic Chemist	Chemical Engineer	Environmental Engineer
Concern on synthesis of compounds	Production of synthetic compounds	Concern on the way organic compounds can be destroyed and how they react in environment
Only interested on the main products of reactions	Process control and optimization	Also interested on by-product of reactions
High durability and reliablity of products	Cheaper and high quality of synthesis	Risk assessment of the products

Elements

All organics contain C in combination with one or more elements.

Hydrocarbons only C and H

Many organics contain C, H and O

Minor natural compounds also contain N, S and P, sometimes contain halogens and metals

Properties

Organics vs Inorganics

Organics are normally combustible
Organics are normally have lower melting and boiling points
Organics are less soluble in water
Several organic compounds exist for a given formula – ISOMERISM
Reactions of organics are normally molecular rather than ionic, and as result at slower rate
Molecular weight of organics are high, >> 1000
Most organics are substrate for bacteria

Sources of Organics

NATURE: fibers, vegetable oils, animal oils and fats,alkaloids, cellulose, starch, sugar etc.

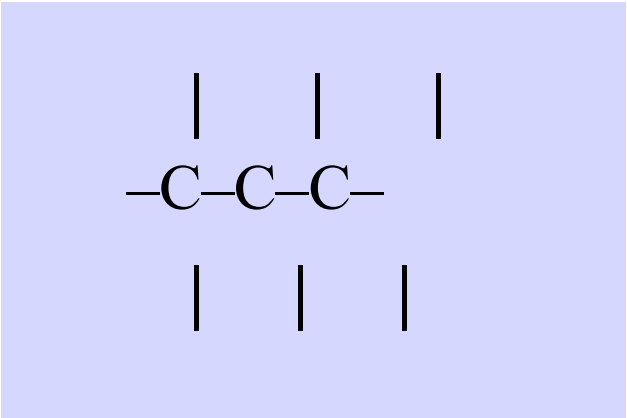
SYNTHESIS: manufacturing processes

FERMENTATION: Alcohols, acetone, glycerol, antibiotics, acids and others that derived from action of microorganisms

The C Atom

Why so many C compounds?

- C normally has 4 covalent bonds
- Many possibilities for for C atoms to link together by covalent bonding in various ways.



Isomerism

Compounds having the same molecular formula
3 major types of organics:

- ALIPHATICS – characteristic groups are linked with straight or branched C chain
- AROMATICS – linked to a particular type of six-member C ring which contains 3 double bonds
- HETEROCYCLICS- have a ring structure in which one member is an element other than C

Aliphatic Compounds

- Hydrocarbons
- Alcohols
- Aldehydes and ketones
- Acids
- Ethers
- Alkyl halides and other halogenated aliphatic compounds
- Simple compounds containing nitrogen
- Cyclic aliphatic compounds
- Merkaptans or trioalcohols

Aromatic Compounds

- Hydrocarbons – benzene and polyring series
- Phenols
- Alcohols, aldehydes, ketones and acids
- Simple compounds containing nitrogen

Heterocyclic Compounds

- Have one other element in the ring in addition to C
- Many compounds are of importance in biological processes
- Example: Dyes – textile wastewater

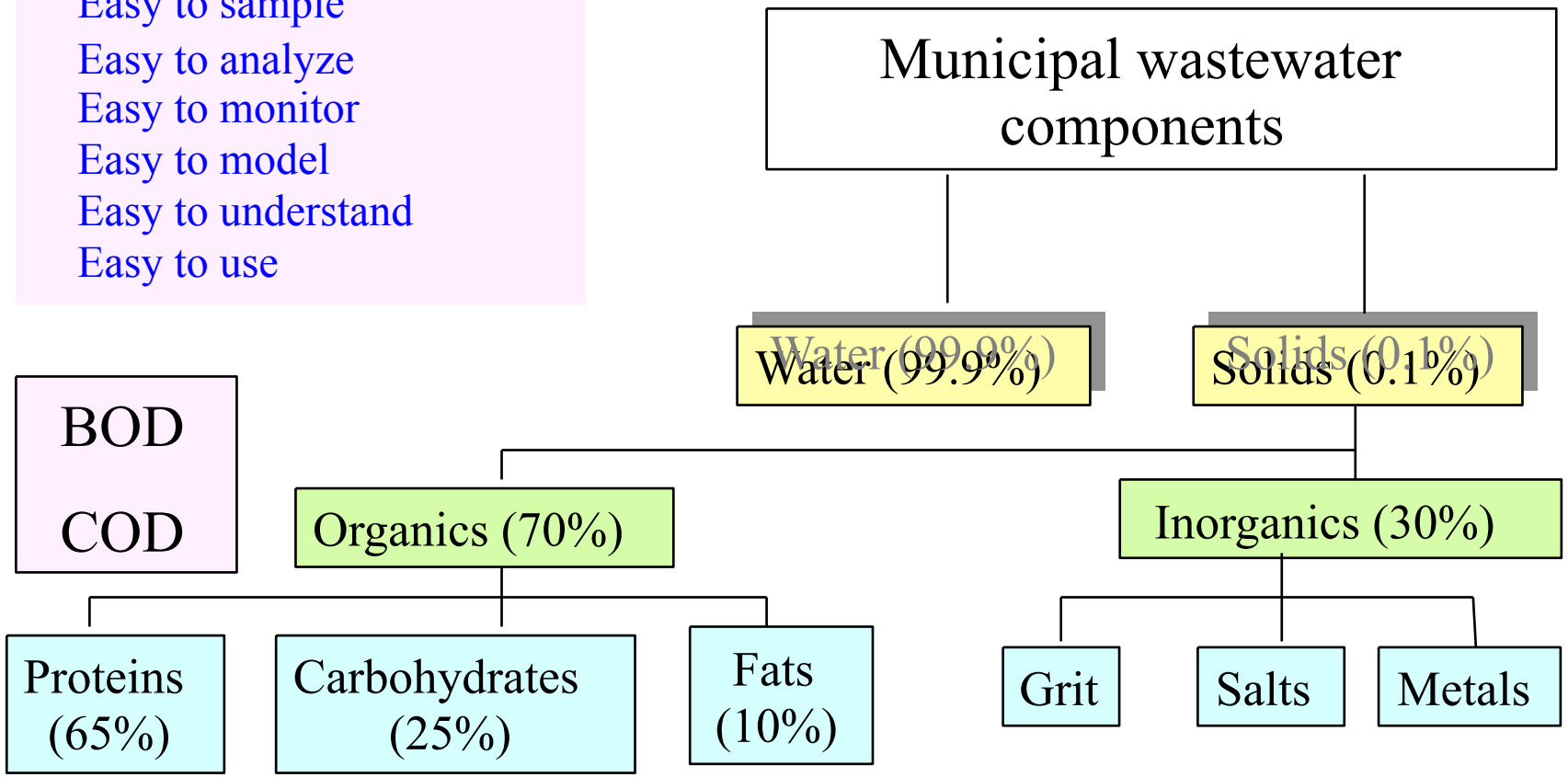
Food and Related Compounds

- Carbohydrates
- Fats
- Proteins

Characterization

Important parameters?

- Easy to sample
- Easy to analyze
- Easy to monitor
- Easy to model
- Easy to understand
- Easy to use



Carbohydrates

- Monosaccharides (simple sugar)
- Disaccharides (complex sugar)
- Polysaccharides

Simple sugar or monosaccharides:

- Pentoses and hexoses
- Glocose
- Fructose
- Galactose an mannose

Carbohydrates

- Monosaccharides (simple sugar)
- Disaccharides (complex sugar)
- Polysaccharides

Complex sugar or Dissaccharides:

- Sucrose
- Maltose
- Lactose
- Galactose an mannose

Carbohydrates

- Monosaccharides (simple sugar)
- Disaccharides (complex sugar)
- Polysaccharides

Polysaccharides:

- Starch
- Cellulose
- Hemicellulose