

# CHAPTER 15 Koracademy.com

## ORGANIC COMPOUNDS

### VITAL FORCE THEORY

"Organic compounds could be manufactured only by and within living things and these compounds could never be synthesized from inorganic materials as these compounds required vital force for their synthesis"

### WORK OF WOHLER

In 1828, a German scientist Friedrich Wohler rejected Vital Force Theory. He obtained urea  $(\text{NH}_2)_2\text{CO}$  from ammonium cyanate  $(\text{NH}_4\text{CNO})$ , a substance of known mineral origin.



### FOSSIL REMAINS

Fossil fuels are formed by the anaerobic decomposition of buried plants and animals.

#### 1) COAL

- black or brownish-black
- normally occurring in rock strata in layers called coal beds.
- Main Component: Carbon

Other Elements: Hydrogen, Oxygen, Sulphur, Nitrogen

Wood → Peat : Bacterial and chemical Reactions  
Peat → Lignite : High Temperature  
Lignite → Bituminous coal : Pressure  
Bituminous → Anthracite : Pressure

# CARBONIZATION OR DESTRUCTIVE DISTILLATION OF COAL

Thermal decomposition of a substance at high temperature in absence of air is called carbonization or destructive distillation.

Carbonization of coal produce :

- 1) Coke
- 2) Coal Tar
- 3) Ammoniacal liquor
- 4) Coal Gas

## 1. COKE

→ Solid fraction

→ a good reducing agent for extraction of metals from their ores.

## 2. COAL TAR

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→ Liquid Fraction

→ mixture of organic compounds and can be separated by fractional distillation

→ On fractional distillation coal tar gives important organic compounds such as benzene, toluene, xylene, phenol, cresol, naphthalene, anthracene etc.

## 3. AMMONIACAL LIQUOR

→ Inorganic liquid Fraction

→ It is ammonia solution used for making fertilizers like ammonium sulphate, ammonium super phosphate etc.

## 1) COAL GAS

- Also called town gas
- contains a mixture of hydrogen, carbon monoxide

## 2) PETROLEUM

- 'petra' means rock and 'oleum' means oil
- also called mineral oil, crude oil, liquid gold
- present in underground porous rocks
- exist as a viscous liquid having dark brown colour
- Composition:
  - Mixture of HCs (Alkanes, cycloalkanes, aromatic HCs)
  - Other organic compounds containing nitrogen, oxygen, sulphur
  - Trace Metals: Nickel, Copper, Vanadium

## 3) NATURAL GAS

- mixture of low boiling HCs: methane, ethane, propane and butane
- formed by dead decay of animal matter
- usually found above underground deposits of petroleum

# PRODUCTS OF BIOTECHNOLOGY

Antibiotic : benzylpenicillin

Hormones : ethanol, ethylene glycol, insulin

Biodegradable thermoplastic : polyhydroxy butyrate

Enzyme : Rennin

Chemosensory protein

## PLANTS AND PRODUCTS

1. Anticancer agent palliate (Taxol) from the yew tree
2. Anti malarial agent artemisinin from Artemisia annual.

## CONVERSION OF COAL TO PETROLEUM

→ Coal gas, obtained from destructive distillation of coal can be converted into petroleum by a process known as Fischer-Tropsch (FT) process.



→ The conversion of CO to alkanes in presence of hydrogen involves hydrogenolysis of C-O bond and formation of C-C bond

→ Catalyst : Cobalt, Iron, Ruthenium, Nickel

→ Temperature : 150 - 300°C

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# CHARACTERISTICS OF ORGANIC COMPOUNDS

1. Catenation (self-linkage of carbon atoms)
2. Show isomerism
3. Generally non-polar
4. Organic Reactions are slow
5. Covalent nature (non-ionic character)
6. Soluble only in non-polar solvents

## IMPORTANT POINTS

1. CNG → Compressed Natural Gas
2. Quinine → Antimalaria
3. Aspirine → Cardiac Diseases, pain killer
4. Borneol → Anti-inflammatory
5. Benzyl benzoate → Scabicide
6. Galantamine hydrobromide → Alzheimer's disease

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# BUCKY BALL

- New Allotrope of Carbon
- Fullerenes are solid allotropes of carbon and very rare in nature
- Bucky ball is a member of fullerenes
- Fullerenes are molecules composed entirely of carbon in the form of hollow sphere, ellipsoid or tube
- Spherical fullerenes are known as bucky balls
- Bucky balls and other fullerenes are similar in structure to graphite, which consist of hexagonal, pentagonal and sometimes heptagonal rings.
- Molecules of bucky balls are  $C_{20}$ ,  $C_{60}$ ,  $C_{70}$ ,  $C_{76}$ ,  $C_{84}$
- Smallest Member:  $C_{20}$
- Most common Member:  $C_{60}$

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# DETECTION OF ELEMENTS IN ORGANIC COMPOUNDS

## 1. CARBON

- The organic substance is mixed with dry copper oxide in 1:3 ratio and heated in a test tube fitted with delivery tube.
- The other end of which is dipping into lime water  $\text{Ca(OH)}_2$
- Carbon converts to  $\text{CO}_2$  which reacts with lime water and turn it milky due to formation of  $\text{CaCO}_3$

→

## 2. HYDROGEN

- Same setup as for carbon. Instead of  $\text{Ca(OH)}_2$   $\text{CuSO}_4$  is used
- Hydrogen oxidizes to  $\text{H}_2\text{O}$  which by passing from anhydrous copper sulphate is turned blue as copper sulphate converts to hydrated form ( $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ )

## 3. NITROGEN, SULPHUR AND HALOGEN

### LASSAIGN'S SOLUTION:

Put a small piece of freshly cut Na metal in a fusion tube. Melt the Na metal then add small amount of given organic compound. Heat it strongly till base of fusion tube is red hot. Plunge the fusion tube into about 20ml distilled water taken in china dish. Stir the solution and filter. Filtrate is called Lassaign's solution or sodium extract. Divide it into three portions.

## NITROGEN

- Lassaigne's solution +  $\text{FeSO}_4$  +  $\text{FeCl}_3$  +  $\text{HCl}$
- Confirmation: Prussian blue or green color

## SULPHUR

- Lassaigne's solution +  $\text{CH}_3\text{COOH}$  +  $\text{Pb}(\text{CH}_3\text{COO})_2$
- Confirmation: A black ppt is formed ( $\text{PbS}$ )

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## HALOGENS

- Lassaigne's solution +  $\text{HNO}_3$  +  $\text{AgNO}_3$
- Chlorine: white ppt soluble in  $\text{NH}_4\text{OH}$
- Bromine: pale yellow ppt slightly soluble in  $\text{NH}_4\text{OH}$
- Iodine: Deep yellow ppt insoluble in  $\text{NH}_4\text{OH}$

## 5. OXYGEN

→ cannot be detected by direct method

1. Substance is heated alone in dry test tube usually in nitrogen atmosphere. Formation of water droplets confirms the presence of oxygen
2. Test for presence of certain functional groups e.g carbonyl, ketone, aldehyde, carboxylic acids confirm the presence of oxygen.
3. Combustion Analysis:  
$$\% \text{ of Oxygen} = 100 - (\% \text{ of C} + \% \text{ of H})$$



# IMPORTANT ORGANIC COMPOUNDS

Pyridine



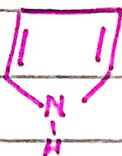
Thiophene



Furan



Pyrole



Toluene



Phenol

-OH

Aniline

-NH<sub>2</sub>

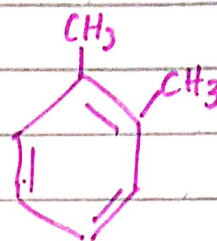
Benzoic Acid

-COOH

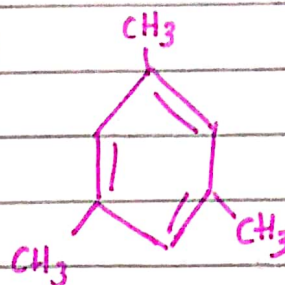
Benzaldehyde

-CHO

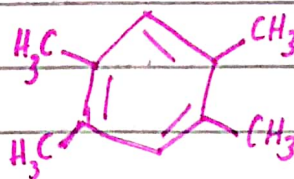
ortho-xylene



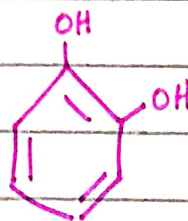
Mesitylene



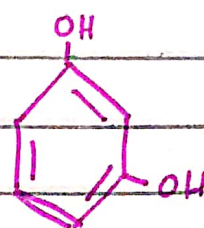
Durene



Catechol

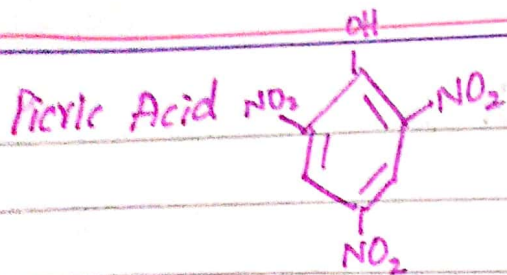


Resorcinol

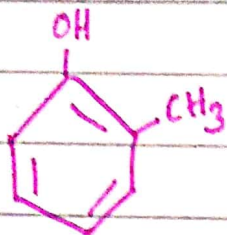


Hydroquinone (Quinol)

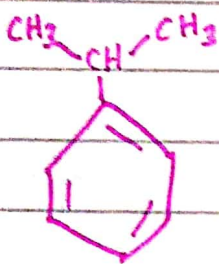




Cresol

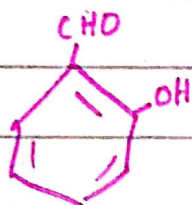


Cumene



Salicyl Aldehyde

(Hydroxy benzaldehyde)



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