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The Impact of Polycyclic Aromatic Compounds Pollution and its Future Effects on Human Health

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Annotation: There are two main classifications of organic substances Aliphatic organic substances and Aromatic organic substances. These are cyclic compounds and consist of at least one benzene ring. Some polycyclic compounds are manufactured and pure polycyclic aromatic compounds are usually colorless, white, or pale green to yellowish solids..

In this research, we will discuss in the first chapter what these compounds are and what they include in terms of properties. The second chapter will discuss the extent of the impact of aromatic compounds on life, the environment, and humans, and the causes of their impact on humans in particular.

Introduction

Aromatic compounds are also known as aromatic compounds, which are hydrocarbon organic chemical compounds, meaning that they consist of hydrogen and carbon atoms, but what distinguishes them from the second class of hydrocarbon compounds, which are called aliphatic compounds (alkanes, alkenes, and alkynes); is that aromatic compounds always contain one or more benzene rings, unlike aliphatic compounds that lack the presence of a benzene ring, and aromatic compounds are more stable than aliphatic.

In the nineteenth century, chemists classified hydrocarbons into aliphatic hydrocarbons and aromatic hydrocarbons based on their sources and properties. These names were then retained, but these compounds were now classified based on their composition, not their source. Accordingly, aromatic or aromatic compounds were named after their source, as they are obtained through the chemical decomposition of some plant extracts with a pleasant aromatic smell. [2[

It is noteworthy that the vast majority of aromatic or aromatic compounds in nature are produced by plants and microorganisms. It is worth noting that animals depend on plants to obtain many aromatic compounds either directly or indirectly, [1] as plants can manufacture the benzene ring from carbon dioxide, water, and inorganic materials.

What is the most famous example of aromatic compounds?

Benzene is the most famous example of aromatic or aromatic compounds, in addition to the fact that benzene is also considered the basis of aromatic compounds, as all of these compounds contain at least one benzene ring, which is why they are also called benzene compounds. It is worth noting that the chemical formula of benzene is (C6H6), and from this formula it is noted that the benzene compound consists of 6 hydrogen atoms and 6 carbon atoms; arranged in a regular ring with 6 sides, where all distances between each carbon atom and the other atom are equal.

What are the types of aromatic compounds?

Aromatic compounds are divided into two main types based on the presence of the benzene ring, as follows:

- Arenes: They are called (Benzenoids) and are hydrocarbon compounds that contain at least one benzene ring as a structural unit, and they can be classified into several subtypes; Some of them are single-ring (containing one benzene ring), some are double-ring (containing two benzene rings), and some are tri-ring (containing 3 benzene rings), and there are compounds that contain a larger number of benzene rings as well.

- Non-Benzenoid Aromatic Hydrocarbons: They are called (Non-Benzenoids) and are hydrocarbon compounds that have special stability, but lack the presence of a benzene ring as a structural unit.

In general, organic substances are classified according to the arrangement of their molecular structure and the entanglements of other atoms relative to the main carbon atom in them, while hydrogen atoms are assumed to occupy all empty valences of carbon atoms, if they are not occupied by another carbon atom or the atom of another element.

Research problem:

There are more than a hundred dangerous polycyclic aromatic hydrocarbons (PAHs) that affect human health through the use of water, inhalation of air, or indirectly through the use of food and animal products.

Research importance:

Polycyclic aromatic hydrocarbons may be expected to be a cause of cancer, and concluded that some people who inhaled or touched mixtures of polycyclic aromatic hydrocarbons or other chemicals for long periods of time developed cancer. Some polycyclic aromatic hydrocarbons caused cancer in laboratory animals when they inhaled air.

Chapter One

Definition of Aromatic Compounds

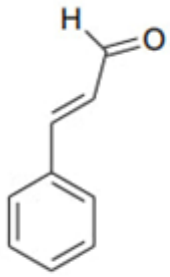
Some natural products extracted from plants, such as dyes, resins, etc., were of unknown composition at the beginning of the development of organic chemistry, but they were characterized by special qualities and were distinguished by their aromatic smell, which is why they were called aromatic compounds to distinguish them from some other odorless compounds.

This name was derived from the Greek word (Aroma), which means aromatic smell, and therefore they were called aromatic compounds. It is preferable to use this name because some of these compounds are far from the aromatic smell.

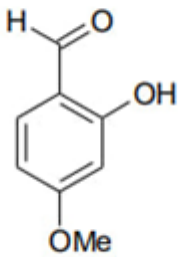
In the past, the term aromatic (aromatic) was used for benzene derivatives that have an aromatic smell, such as ethers and aromatic aldehydes. After the discovery of many odorless benzene derivatives, this name no longer had any meaning.

Aromatic compounds: They are unsaturated hydrocarbon organic compounds that share with each other the fact that they contain a benzene ring.

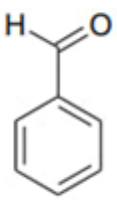
This is because many of these compounds were found in the pleasant-smelling oils found in spices, fruits, and other parts of plants, such as; Bitter almond oil (benzaldehyde), cinnamon (cinamaldehyde), and vanilla (vaniline).



Cinamaldehyde



Vaniline



benzaldehyde

It turns out that all these aromatic compounds share special properties that distinguish them from aliphatic compounds. These properties are summarized as follows:

1. The aromatic compound contains in its composition a ring consisting of six carbon atoms (aromatic nucleus) known as the aromatic nucleus.
2. It does not react by addition and is not easily reduced despite the presence of double bonds.
3. It is characterized by reacting by substitution.
4. The aromatic compound is not easily oxidized unless the aromatic compound contains a side ring.
5. The presence of the aromatic ring affects the properties of the active groups to which it is attached.

Types of aromatic compounds are divided into:

1. A single-ring aromatic compound such as benzene and its derivatives
2. Polycyclic aromatic compounds

Polycyclic aromatic compounds include a large group of compounds containing two or more substituted or unsubstituted benzene rings. These compounds are divided into two sections, the first of which includes isolated aromatic compounds such as diphenyl.

The second category includes aromatic compounds containing two or more rings fused at two adjacent carbon atoms, such as naphthalene and anthracene, which are considered important compounds.

Aromatic compounds have come to include all cyclic compounds that resemble benzene in their chemical properties, especially chemical stability compared to alkenes.

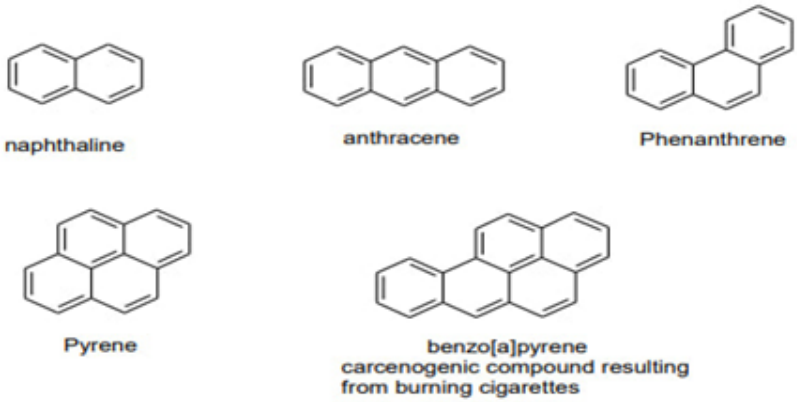
Aromatic property is a law that calculates aromaticity:

For a compound to be aromatic, it must meet the following conditions:

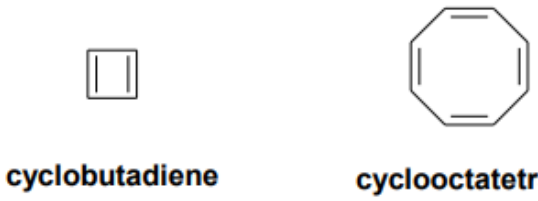
1. It must be cyclic.
2. It must be planar (i.e. all atoms in the ring are sp2 hybridized): i.e. each atom in the ring has a p2 orbital.
3. The pi bonds must be in an exchange position.
4. The number of pi electrons must be equal to 24, where:

M=0, 1,2,3 and n symbolizes the number of rings.

Aromatic compounds



-Nonaromatic compounds:



As for chemical reactions, the most important feature of aromatic compounds is that they do not undergo addition reactions, but rather undergo electrophilic substitution reactions.

Benzene:

Benzene is the simplest of the aromatic compounds (patent aromatic compound) and was isolated in 1825 by the scientist Faraday by separating it from the luminescent gas that was used for lighting. In 1834, it was found that the initial formula of this compound is (CH), and after that, the molecular formula was determined as (C6H6), and several structural forms of benzene were proposed during these years, and it was later found that these forms were incorrect until the incorrect form of benzene was proposed in 1865 by the American scientist Kekule, and therefore benzene in this form is usually called Kekule benzene .

Although benzene is aromatic, cyclobutadiene is non-aromatic, with a delocalized pi electron count of 4, which does not yield any integer when applying Hückel's rule, but the cyclobutadiene ion (-2) is aromatic. Non-aromatic molecules are called aliphatic. Heterocyclic aromatics:

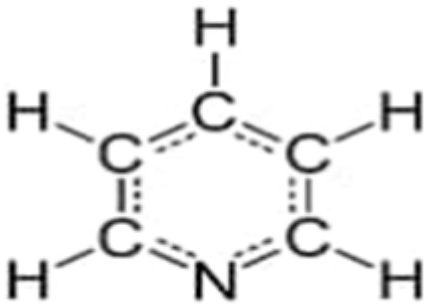
In which one or more of the carbon atoms in the aromatic ring are replaced by another element, and these elements are either oxygen, sulfur, or nitrogen.

Pyridine: is an organic compound with the chemical formula C5H5N and is a heterocyclic aromatic compound. It is used as a solvent and as an intermediate in reactions. Furan: Also aromatic, but not as aromatic as benzene, and thus more reactive. The compound tetrahydrofuran derived from it is widely used as a solvent and reactant and also as a chemical intermediate. It is a carcinogen.

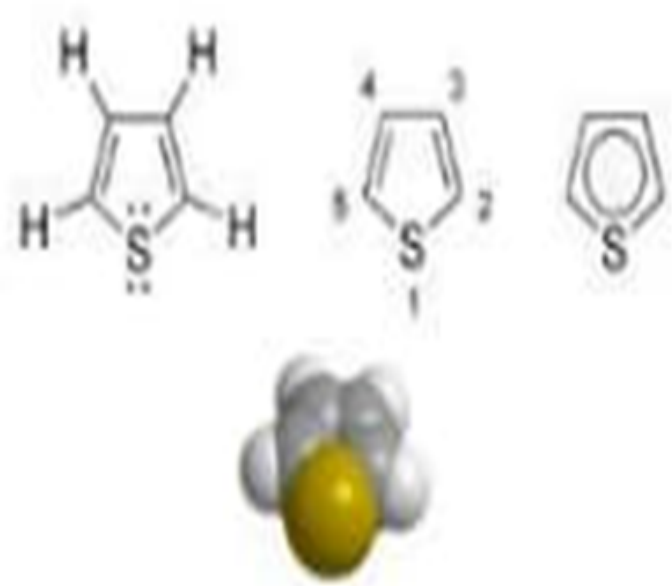
Chemical Properties

- Pyridine is miscible with water, and also with most organic solvents such as ethanol, chloroform, diethyl ether, and acetone.
- Pyridine is a basic aromatic ring, as pyridine reacts with strong acids such as hydrochloric acid to form a hydrochloride salt that melts at 145°C.

Due to the presence of the electronegative nitrogen atom (electron-withdrawing), the pyridine ring is relatively poor in electrons, which consequently inhibits the occurrence of electrophilic substitution reactions (electrophilic substitution) typical of aromatic compounds.



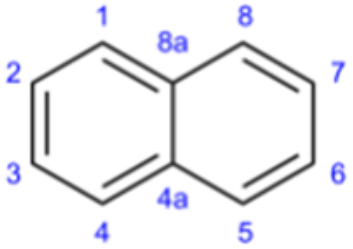
Furan: Furan, also known as furfuran, is an organic compound with the formula C4H40. It is a heterocyclic aromatic compound whose structure consists of an unsaturated five-membered ring containing an oxygen atom. It is also aromatic, but not as aromatic as benzene, and therefore it is more active. The compound tetrahydrofuran derived from it is widely used as a solvent and reactant, and it is also used as a chemical mediator. It is a carcinogenic substance, and it is an aromatic compound, with six pi electrons, four of which are for the two double bonds and the remaining two are the electron pair for the oxygen atom, so it fulfills the Hückel rule. Neophene: Thiophene is an organic compound with the formula C4HAS. It is one of the current heterogeneous aromatic compounds. The structure of thiophene is an unsaturated five-membered ring containing the element sulfur. Thiophene compounds are used as basic units for preparing other compounds in many chemical industries such as the agricultural chemical industry and the pharmaceutical industry.



Polycyclic aromatics:

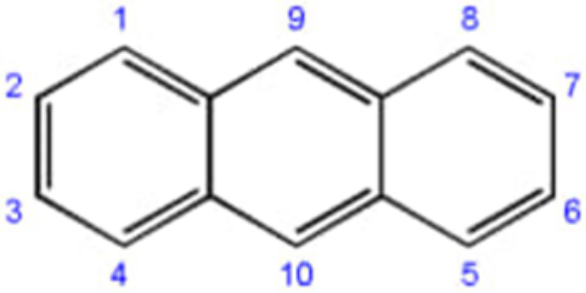
They are molecules that contain two or more simple aromatic rings fused together with the participation of two adjacent carbon atoms .

Naphthalene: It is a white, crystalline, aromatic hydrocarbon with the formula C10H8, where the molecule consists of two benzene rings. Naphthalene is a volatile compound and is manufactured from coal tar and converted into phthalic anhydride in the plastics, dyes and solvents industries.



Anthracene: It is an organic semiconductor and it is used as a scintillator for photons, electrons, and high-energy alpha particles. Plastics such as polyvinyl toluene can be mixed with anthracene to produce scintillators that are approximately equivalent to water for use in radiation dose measurement in radiotherapy.

Epirubicin is an anthracycline and is used as a chemotherapy in the treatment of cancerous tumors. Epirubicin inserts its molecules between the cellular DNA molecules, which disrupts its function and thus the cell's function and stops its reproduction.



Chapter Two

Types of Polycyclic Aromatic Hydrocarbon Pollution

The topic of environmental pollution, its types, causes, and methods of treatment is currently the main concern of major industrialized and developing countries, due to the direct threat that environmental pollution poses to human health and other living organisms.

There are more than a hundred dangerous polycyclic aromatic hydrocarbons (PAHs) that affect human health through the use of water, inhalation of air, or indirectly through the use of food and animal products.

The Centers for Disease Control and Prevention (CDC) report indicated that polycyclic aromatic hydrocarbons may be expected to be a cause of cancer, and concluded that some people who inhaled or touched mixtures of polycyclic aromatic hydrocarbons or other chemicals for long periods of time developed cancer. This center has also conducted several experiments on how PAHs are converted in the body into chemicals that can bind to substances in the body. There are special tests that can detect PAHs bound to these substances in body tissues and blood. However, these tests cannot show whether any health effects will occur or not, or show the extent of exposure to PAHs or its source. These tests are not always available in the doctor's office because special equipment is required to perform them. The results obtained from the study showed that the air of the cycle filter was contaminated with the following cyclic compounds at concentrations that exceeded the permissible limits set by the Occupational Safety and Health Organization.

Compound	Molecular Weight (g/mol)	Melting Point (C°)	Boiling Point (C°)	Aqueous solubility (µg/l)at25 C°	Carcinogenic Activity
Naphthalene	128.00	81	200	31700	0
Fluorene	166.22	115	298	1980	0
Chrysene	228.29	254	448	2	+
Acenaphthene	154.21	96.2	279	3930	0
Benzo(a)anthracene	228.3	158.4	400	14	+
Fluoranthene	202.26	107	384	260	0
Benzo(k)fluoranthene	252.32	217	480	-	++
Indeno(1,2.3-cd)pyrene	276	161-163.5	-	-	+
Phenanthrene	178.23	99-101	340	1290	0
Pyrene	202.26	156	393	135	0
Benzo(a)pyrene	252.3	179	495	3800	++
Acenaphthylene	152.21	92	265-275	16100	0
Anthracene	178.23	216.4	340	73	0
Benzo(b)Fluoranthene	252.32	168	-	-	++

Impact on the aquatic environment

The effect on humans varies around the world and depends on factors such as smoking rates, types of fuel, including those for cooking, pollution in power plants, industrial plants, vehicles that run on gasoline, kerosene, electricity, and even coal or fuel plants. After burning solid fuels such as coal and biofuels at home for cooking and heating purposes, a dominant global source of PAH emissions leads in developing countries to high levels of exposure to indoor particulate air pollution containing hydrocarbons, especially for women and children who spend more time at home. Polycyclic aromatic hydrocarbon pollutants are considered dangerous pollutants, as some of them have a toxic effect and others have a carcinogenic effect on humans. These pollutants are disposed of in the air by dry or wet deposition due to rain, which transfers the problem of pollution with these pollutants from the air to water bodies and soil, especially in urban and industrial areas, as well as areas adjacent to and far from the sources of emission of these pollutants, such as agricultural areas.

Conclusion

After we have come to the end of the research, we must extract the most important results that came in the text of this research, which are as follows:

1. That aromatic compounds are unsaturated hydrocarbon organic compounds that share with each other the presence of a benzene ring, and that all of these aromatic compounds share special properties that distinguish them from aliphatic compounds.
2. Benzene is the simplest aromatic compound, and although benzene is aromatic, butadiene is a non-aromatic cyclic compound, as the number of delocalized pi electrons is equal to 4.
3. There are more than a hundred compounds of dangerous polycyclic aromatic hydrocarbons (PAHs) that affect human health through the use of water, inhalation of air, or indirectly when using food and animal products.
4. Most of the (PAHs) family are insoluble in water, which limits their movement in the aquatic environment.
5. The factors causing pollution are smoking, types of fuels including those used for cooking, pollution in power plants, industrial plants, vehicles that run on gasoline, kerosene, electricity, and even coal or fuel plants. Burning solid fuels such as coal and biofuels in the home for cooking and heating purposes is a dominant global source of PAH emissions.

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