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Air pollution by solid plankton TSP in Basra governorate, review

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Abstract

Particulates (TSP), often termed "solid plankton," in the Basra Governorate in southern Iraq. Basra serves as a pivotal economic hub thanks to its oil sector, maritime operations, and expanding urbanisation. Nonetheless, these industrial and anthropogenic activities, together with natural phenomena like dust storms, have substantially contributed to increased levels of air pollution, especially from total suspended particulates (TSP). TSP denotes airborne particles of diverse sizes and chemical compositions that stay suspended in the atmosphere for prolonged durations. These particles emanate from several sources, including building sites, unpaved roads, industrial pollutants, vehicular exhaust, and natural dust. In Basra, these pollutants are exacerbated by dryness and recurrent sandstorms, which further elevate particle concentrations in the atmosphere. The environmental repercussions are also highlighted. TSP may diminish sight, hinder plant development by obstructing sunlight, and contaminate soil and water bodies with hazardous compounds. The particles may transport heavy metals and other toxic substances, impacting the ecology and agricultural output in the area. In Basra, air quality monitoring is inadequate, and the regulatory frameworks for pollution management are insufficiently developed. The assessment highlights the pressing necessity for robust air quality monitoring systems capable of properly measuring TSP and other contaminants. It further promotes public awareness initiatives, enhanced environmental regulations, and the implementation of cleaner technology in industry and transportation. The analysis also addresses prior research in the region that indicate excessively high levels of particulate matter, frequently beyond the thresholds established by the World Health Organisation (WHO). These studies emphasise the persistent nature of air pollution in Basra and its possible enduring impacts on public health and the environment.

Keywords: Air pollution, total suspended particulates (TSP), solid plankton, Basra Governorate

Introduction

The problem of air pollution with solid plankton TSP in Basra governorate, the study area, is one of the most serious environmental problems that the governorate is exposed to, as studies and research came to show us the importance of preserving the environment from the risks of air pollution, as the damage caused by environmental pollutants resulted in economic, health and other damage, and as a result of the damage to the environment in Basra governorate, which exceeded the limit and because of the pressure on the environment resulted in damage and imbalance of the environment and ecosystems, and the environment is no longer able to withstand the pressure as a result of widespread environmental pollutants. Air pollution has become a severe problem for Public Health and Environmental Quality ^[1], while international organizations warned of the danger of air pollution, the World Health Organization estimated the number of deaths due to air pollution by about (1.3) million people per year ^[2], and the death toll rose to (7) million in 2012 due to air pollution and the increased risk of respiratory and cardiovascular diseases ^[3]. The increasing expansion of urban areas, population density, and modes of transport will certainly increase the risk of air pollution, especially suspended particulate matter ^[4]. The US Environmental Protection Agency ^[5] has defined air pollution as a deterioration in air quality due to undesirable substances or any substance in higher concentrations than their natural concentrations in the atmosphere, which affects humans, animals, and vegetation. One of the most dangerous types of environmental pollution is air pollution because it is difficult to control and a major factor in damaging other ecosystems, such as soil and water ^[6].

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First / the concept of tsp solid suspended particles in the air, the method of collecting them, global and Iraqi Environmental Determinants (local):

1. The concept of solid suspended minutes TSP in the air

The concept of solid suspended particles TSP Total Suspended particles means total suspended particles, as well as aeroplankton or aeroplankton, which is a mixture of several living and non-living forms floating and drifting in the air, carried by the wind from one place to another, and their sizes are very small, they may not be seen with the naked eye except with electron microscopes, as it is difficult to identify many of them because of their small size, which helps diseases, especially respiratory diseases, including allergies [7]. They are also defined as atmospheric microelements (PM) in the form of a mixture of solid or liquid microelements, which are dispersed individually in the air, and can be emitted to the atmosphere by wide sources that affect their physical properties (size, surface area, density, and chemical composition) [8]. The term total suspended minutes TSP is called for minutes whose sizes reach about 50 microns; large minutes cannot penetrate the respiratory openings and larynx, including minutes with sizes PM10 and PM2.5 microns that are small and capable of penetrating the respiratory tract and reaching the lungs [9].

2. Collection method

The method of collecting suspended TSP minutes, scientists collecting them in several ways to study their dispersion, and this is done by:

Traps and sweeping nets from airplanes, kites or balloons [7], and photo No. 1 shows one of the plankton collection devices.



Fig 1: The cascading impact device used by scientists to collect aerosols consisting of six stages of the Andersen model [10].

The quantity and quality of dust, suspended and falling dust, and the sizes of its atoms and heavy metals contained in it are determined by the device (senefer) image (2), which pulls samples of air at a height of (120 cm) above the ground. Image filters are used (3) are placed inside the device weight of the filter is measured before starting work and placed in a bag marked (W1), that is, the weight of the filter before use, then air samples are drawn by operating the

device for at least an hour for each air sample, after which the filter is extracted from the device and its weight is measured after use, which represents the weight of the filter with impurities and placed in a bag marked (W2) and through an equation the weight of the filter before use is subtracted from its weight after use to find out the concentrations of dust and heavy metals in each air sample.



Fig 2: Senefer device for collecting suspended dust samples from atmospheric air. Source/ [11].



Fig 3: Air intake filters. Source/ [11].

The method of digesting filters, through which the filters used are digested and converted into a liquid substance, which is placed in ampoules made of polyethylene material figure (3) to preserve the quantities of samples and send them to the laboratory for measuring the quality of heavy metals present in each sample by an atomic flame device to extract suspended particles with dust and dust present in each sample.

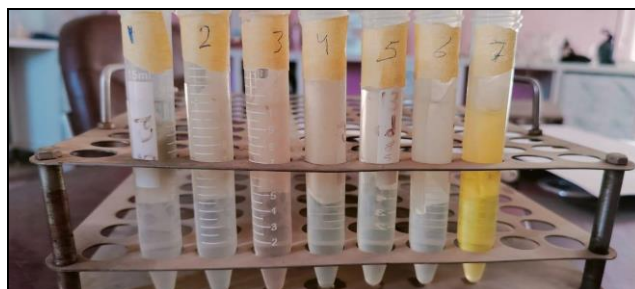


Fig 3: Polyethylene ampoules for digesting filters source/ [11].



Fig 4: Atomic flame apparatus for heavy metals source/ ^[11].

A device (Temtop) is used to measure air quality and the amount of suspended dust contained in air samples, and it measures dust minutes and their different sizes image (5), small hand-held device that is operated to take a sample of air to find out the amount of minutes with a size of (2.5 PM) Micron/ meter, the amount of dust minutes with a size of (10 PM) Micron/ meter.



Fig 5: TEMTOP device for measuring the amount of dust suspended in the source atmospheric air/ ^[11].

Second: Types of suspended solid particles (TSP) and their sizes

The suspended dust consists of small-sized clay and silt particles ^[12], the suspended dust also includes plant and animal fibres, bacteria, fungi, parasites, soft soil rich in organic and inorganic substances and also contains combustion materials, ash, wool, cotton, industrial fabric, paper, silk, glass particles, Glue, Hair and human scales animals, salt and sugar crystals ^[11], as the wind carries them to the atmospheric air, and aeroplankton is found everywhere in the atmosphere, It is the processes of aerosols and wind movement that determine how these plankton are distributed in the atmosphere image (6). The air cycle in nature disperses huge numbers of plankton floating in the atmosphere. the survival and stability of substances and particles suspended in the atmosphere or descending to the ground due to climate elements may play a role in the formation of clouds and precipitation, a role in the formation of the atmosphere and affect vast terrestrial habitats in the food cycle ^[10].

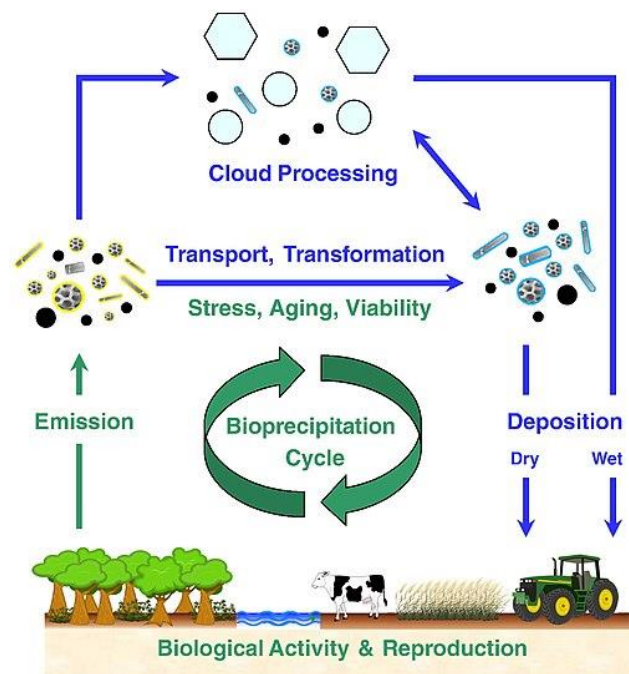


Fig 6: Aerosol cycle in natural sources ^[13].

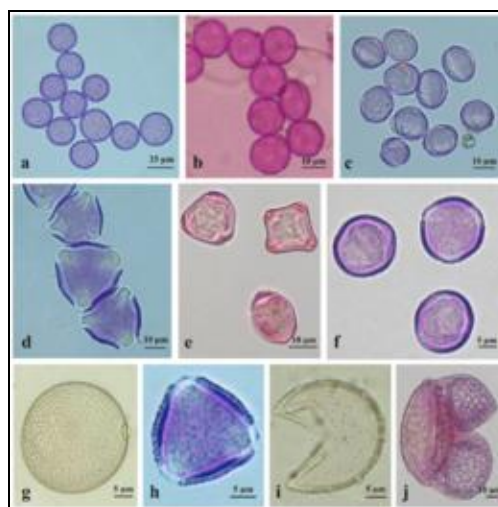


Fig 7: Pollen grains observed in southern European plankton source ^[30].

Air pollutants include solid and liquid substances circulating in the atmosphere, as the size of air-polluting particles ranges between (0.0001 - 500) micrometres, and these particles can remain suspended in the air for a time ranging from several seconds to several years. Particles can be classified according to their size into the following:

A. Falling particles

They are called falling dust, as the diameter of these particles exceeds 10 micrometres, they affect the eyes, industrial facilities and buildings, and have a mild effect on the human respiratory system because the nasal bristles work to trap and deposit a large part of them, especially particles with a diameter of more than 100 micrometres ^[14].

B. Total suspended particles TSP

TSP means Total Suspended particles, which are particles with a diameter ranging from (0.1 - 10) micrometers, and it has the ability to remain stuck for a long time in the air, and its deposition is relatively slow, and this is according to

natural conditions of moisture, wind or heat, and it is one of the most dangerous air polluting particles, as it can reach the lungs and settle in them, some of them are large or dark enough in color and can be seen with the naked eye like smoke, and some are very small that can only be seen with an electron microscope, The low speed of the wind and sometimes the stillness and the light weight of the suspended minutes gives it the opportunity to stay stuck in the air for (1-15 hours)^[15], and the sources of production of suspended particles with a diameter of no more than (2.5 micrometers) are from the combustion of fuel in car engines, power plants, factories and wood burning, as for particles larger than (2.5 micrometers), their source is usually from the movement of cars on unpaved roads, crushers, wind erosion and volcanoes, suspended particles in the air accumulate in the respiratory tract and result in multiple health effects, As exposure to large suspended particles irritates the respiratory system, as is the case in asthma patients, as for fine suspended particles, it results in an increase in emergency cases that require urgent first aid and stay in hospitals, especially cases of heart and lung patients, as it leads to a decrease in the efficiency of the lungs, and sometimes early death, and the impact of these particles goes beyond health problems, which may include reduced vision, destruction of colors, paints and building materials^[16].

C. Fine suspended particles: Particulate Matter

They are defined as solid microparticles with small sizes ranging from (2.5-10 microns) and are suspended in the air or rising from the surface or falling to the ground according to the wind speed that carries them^[17], and are also defined as particles with a diameter of less than (0.1 micrometers), and they are difficult to deposit and have random movement, and may cluster with each other to increase their size to more than (1 micrometer), and their number in the fresh air reaches several hundred in cubic centimeter, but in polluted atmospheres it reaches more than (100 thousand) per cubic centimeter, These particles do not pose a threat to

human life, although they reach the lungs easily, as the lungs can exhale them during exhalation^[18], and particulate matter microparticles can also be defined as a complex mixture of liquid and solid particles of different sizes and are kept suspended in the air^[19].

Third: Components of solid plankton: total suspended particles

It is possible to classify air-polluting particles according to their nature into^[11].

1. Soot particles are a collection of carbon atoms emitted by penetrating fuel and organic matter.
2. Dust particles: Solid fine materials are often chemically inert.
3. Ash particles: they are particles that are released with flue gases, and may carry incomplete fuel for combustion with them
4. Vapor particles: They are produced by condensation or chemical reactions, and their diameter is often less than (1 micrometre).
5. Spray particles: they consist of liquids suspended in the air and do not exceed a diameter of (2 micrometers)
6. Aerosols: they are solid or liquid micro-particles that never accumulate, and have a diameter of less than (1 micrometre), and include all solid and chemical particles, and are produced by processes (chemical reaction), and biological particles (pollen grains, bacteria, fungi of all kinds, chemical salts, liquid water droplets released from the surface of the Earth), and these particles lead to the turbidity of the atmosphere.

Global and Iraqi Environmental Determinants (local)

The research was based on the subject of Basra air pollutants by studying solid plankton polluting the tsp air and comparing them with the national and global allowed limits to find out the extent of exceeding these pollutants on the air of Basra governorate and Table (1) shows the local and global limits of the proportions of plankton and solid pollutants as follows:

Table 1: Local and global determinants of some source air pollutants / Ministry of Environment, air pollution section, published data, 2008^[28].

Air pollutants	Proposed local determinants	Determinants of the World Health Organization WHO
Carbon monoxide CO ppm	35 ppm/hour 9 ppm / 8 hours	mg/m ³ 10 / 8 hours Ppm 9 / hour mg/m ³ 100 / year
Nitrogen dioxide, NO ₂ ppm	0.25 ppm/hour 0.05 ppm/year	ppm 0.11 / hour µg/m ³ 150/ 24 hours µg/m ³ 40 / year
Sulfur dioxide, SO ₂ ppm	0.14 ppm/hour 0.002 ppm/year	ppm 0.01 / hour ppm 0.03 / year
Total outstanding minutes TSP µg/m ³	350 µg/m ³ / 24 hours 150 µg/m ³ / year	µg/m ³ 150 / hour µg/m ³ 90-60 / year
Lead element Pb µg/m ³	2 µg/m ³ / 24 hours 1.5 µg/m ³ / six	µg/m ³ 1-0.5 / six
Hydrocarbons (VOC) HC ppm	0.24 ppm / 3 hours	ppm 0.25 / 3 hours
Ozone O ₃ ppm	0.12 ppm / hour	ppm 0.12 / hour
Zinc element Zn µg / m ³	6 µg/m ³ / hour	µg/m ³ 6 / hour
Hydrogen sulfide H ₂ S ppm	ppm 0.01 / hour	ppm 0.01 / hour

Fourth / sources of tsp solid suspended minutes in Basra governorate (natural and human)

A. Natural Sources

They are natural sources of air pollution that are difficult for humans to control or control, such as gases emitted from

soil, volcanoes, forest fires, as well as dust resulting from dust storms and wind-borne pollutants, dust and plankton, and the most important gases that escalate from these sources^[20] are:

1. Precipitation of dust left over from meteors and

- meteorites in the surface layers of the atmosphere.
2. Salts are spread in the air by winds and storms, and those are carried by depressions, atmospheric fronts, and convection.
3. 3-fungi, bacteria, microbes, and various viruses that spread in the air, whether their source is soil or as a result of rotting dead animals, birds, and human waste [23].
4. The spread of pollen in the atmosphere of plants that grow naturally in biological environments, and microorganisms, bacteria, fungi, and viruses, which naturally spread in the atmosphere.
5. Dust storms blowing from dry areas, dust of all sizes.

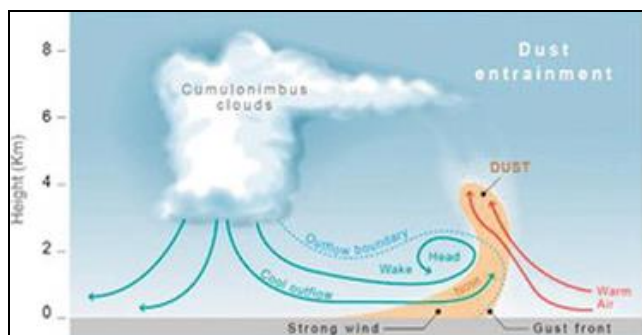


Fig 8: Dust storms source/ (Kim, 2014, p136-143).

B. human resources

The most important sources of suspended solids are road dust and construction, as they produce the primary particles of suspended solids in the air, and this causes concern and increased attention due to their components, which have become multiple and diverse because they have caused an imbalance in the natural air components and have greatly affected the environmental balance [21]:

1. The burning of fossil fuels for energy production, electric power plants, and oil refineries releases pollutants into the atmospheric air, such as sulfur dioxide and suspended nitrogen oxides, which react with water vapor and form fine particles that remain suspended in the air.
2. Increase the means of land, sea, and air transportation.
3. Population activity and related to household waste of solid and liquid materials and the frequent use of pesticides and industrial solvents.
4. Agricultural activity and frequent use of chemicals for fertilization and agriculture.
5. Excessive population growth, the expansion of urban areas, residential communities, cities, and rapid economic growth.
6. The enormous industrial and technological development, the increase in transport and traffic, and the multiplicity of other activities and professions.
7. Industrial enterprises for mining and major construction sites that use methods of crushing, grinding, and processing raw materials, and cement factories release large quantities of solid plankton into the atmospheric air.
8. Waste incinerators, as well as furnaces and private factories within cities that use fossil fuels
9. Exhaust emissions from gasoline and diesel engines of vehicles that emit fine particles such as black carbon and hydrocarbons, as well as congestion in urban areas.
10. Substances are emitted by paints, hairspray, varnish,

aerosols, and other solvents.

11. Landfill waste, which results in methane gas, and methane is not one of the toxic gases, but it is one of the flammable gases, which in turn leads to the formation of some explosive compounds with air, which is also one of the gases causing suffocation. military activities from the use of nuclear weapons, toxic gases, germ warfare and the use of missiles [22].

Fifth. / The relationship between stuck minutes and weather conditions (weather condition)

The city of Basra is exposed annually to dust storms, as climate data indicate that the Basra sky is exposed annually on average to (223.5 days) of dust, as this rate is high considering that the Basra sky remains about two-thirds of the days of the year tainted with dust, and Table (2) shows the concentrations of suspended particles in the air of the city of Basra, as the annual rate is about (1608) micrograms / m³, despite the high concentrations of suspended particles during the summer months, especially the months (June and July) due to increased wind speed and the frequency of dust storms. However, suspended matter particles did not experience a noticeable decrease during the winter, especially monthly (November and December) with a decrease in wind speed. the increase in suspended matter concentrations during the winter is due to reflection factors, temperature drop and increased cloudiness, which together reduce wind activity and entrapment of suspended particles in the lower layers of the atmosphere^[29]. the concentrations of suspended whether the land is agricultural, industrial, commercial or residential, Their concentrations rise or fall depending on the prevailing season, and the wind affects through its speed and direction, as well as the relative humidity, which increases the weight of atmospheric plankton, as well as the nature of land uses, has a major role in the level of concentrations of suspended matter^[11].

Table 2: Monthly rates of total suspended particle concentrations (microgram/m³) in Basra for 2009. Basra Environment Directorate, Urban Environment Division, Air Quality Control Unit, air pollutant testing register, 2009 (unpublished) [23].

Months	Concentrations
May	334.5
June	3905.3
July	2322.7
Father	885.1
September	999.6
October	610.3
November:	269.3
December	1113.6
The rate	1608

Sixth / The impact of tsp minutes on human health (diseases caused by them)

The effect of suspended minutes in vital systems is manifested by causing harmful effects in those natural vital systems such as air, especially humans, animals and plants, as their effects are obvious in the general health of the population, as they affect human health by entering the respiratory tract through the inhalation and exhalation processes and to the respiratory tract, pulmonary capillaries can get rid of those particles that have a size of (0.5) microns, as for particles that have a size of (0.1) microns, they are not affected much, which remain stuck in the air,

they enter the lung and exit with exhalation but particles whose size is between (0.1- 0.5) microns can penetrate deep into the lung and stay for up to several years, in addition, these particles cause fetal malformations when they are transmitted from the expectant mother to the fetus through the placenta and from it to the fetal bloodstream ^[24].

Air Pollution Diseases

As a result of air pollution, many diseases, especially the respiratory system, have spread in Basra governorate through the direct impact of polluted air during the inhalation and exhalation processes, from the bronchi to the lungs, the most important of which are diseases:

First/ Respiratory System Diseases

1. Chronic sinusitis chronic sinusitis

Polluted air causes sinusitis through inhalation through the nose as a result of pollutants that remain stuck in the nose or spread to the sinuses, resulting in inflammation that leads to swelling of the sinuses inside the nose, which in turn affects the voice, and sinusitis in our time has become a chronic disease and its symptoms include high body temperature, headache and some pain in the affected sinuses ^[23], and sometimes the affected area above the sinuses is accompanied by weakness and sensitivity, and when the severity of the inflammation of the sinuses it leads to the destruction of the small openings leading to the nasal passages and the feeling of pain and difficulty breathing, Sinusitis syndromes include several conditions graded according to the severity of inflammation, including acute sinusitis, recurrent acute sinusitis and chronic sinusitis ^[25].

2. Pneumonia Pneumonia

Pneumonia is one of the common and acute diseases that affect the respiratory system in the depths of the lungs, severity of the disease depends on the severity of the inflammation that affects the lungs and the body's immunity and tolerance, as it is one of the serious diseases that lead comparable to cancer and diabetes ^[26], and the incidence of it increases in cities when inhaling polluted air in suspended minutes ^[27].

3. Bronchitis Bronchitis

It is one of the chronic diseases caused by allergens from air irritants from dust and pollen grains (pollen), and it occurs in all seasons of the year, but it intensifies in winter because the germ of the disease is active at low temperatures, which causes symptoms that may last more than three months ^[27], and the symptoms of the disease include intermittent dry cough, not accompanied by phlegm, the occurrence of a cold, inflammation in the eyes, nose and chest pain increases with increased coughing and sneezing, indicating studies show that the probability of human infection with this disease increases if exposed to fine suspended pollutants, and studies also indicate that infection with this disease may lead to death ^[31].

4. Bronchial Asthma

It is considered one of the chronic diseases affecting the bronchi of the lungs that carry air inside and outside the body ^[32], and it is one of the common respiratory diseases in the world as a result of polluted air, as it occurs as a result of dust that causes sensitivity of the respiratory tract due to irritants, allergens and pollutants from suspended substances

that enter the respiratory tract when inhaling polluted air, and this leads to obstruction of air flow inside the respiratory tract, especially for people with early asthma, as it causes in the case of an infected person ^[33].

• Skin Diseases

Human skin is affected when exposed to polluted air, especially suspended particles that remain in the air for a long time, causing skin diseases, including

• Eczema

The disease occurs as a result of chronic non-infectious allergic inflammation of the human skin and is in the form of small oval-shaped red spots, or dry areas accompanied by severe permanent itching, or wet areas tend to darken, and this disease is not limited to a certain age group as it affects adults, children, males and females, and the most people who are exposed to this disease are the owners of dry skin when they are in direct contact with the atmosphere and airborne pollutants for at least 24 hours, especially suspended particles TSP, the upper and lower extremities of the body ^[34].

• Eye diseases, eyes Illnesses

The eye is the most sensitive organ of the body, so when it is exposed to polluted atmospheric air, especially with solid and fine suspended particles TSP, this leads to some diseases, including:

• Treatment of ophthalmia: Conjunctivitis

It is an allergy that affects the conjunctiva of the eye and occurs with the heat of the atmosphere and the spread of dust in the spring and early summer. The direct cause of the injury is the lingering minutes of TSP of pollen, dust, and impurities, and the symptoms of the disease are pain and itching. this type of eyelash is called (Spring Eyelash), the other type is viral eyelash and its main cause is the lingering minutes TSP spread in the air, which leads to damage and both affect the eye and may lead to vision loss ^[35].

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