Ch2.
Air pollution

- وهذه البيئة أحكم الله خلْقَها، وأتقن صُنْعَها كمًّا ونوعًا ووظيفة؛ قال تعالى: (صُنْعَ اللَّهِ الَّذِي أَتْقَنَ كُلَّ شَيْءٍ) [النمل: 88]، وقال - جل شأنه -: (وَخَلَقَ كُلَّ شَيْءٍ فَقَدَّرَهُ تَقْدِيرًا) [الفرقان: 2]، وقال أيضًا: (إِنَّا كُلَّ شَيْءٍ خَلَقْنَاهُ بِقَدَرٍ) [القمر: 49].
-
- وهذه الآيات الكريمة تعني أن البيئة الطبيعية في حالتها العادية، دون تدخُّل مُدمِّر أو مُخرِّب من جانب الإنسان، تكون مُتوازنة على أساس أن كلَّ عنصرٍ من عناصر البيئة الطبيعية، قد يُخلق بصفات محدَّدة وبحجم مُعيَّن، يَكفُل تَوزُان البيئة،
-

رابط الموضوع:
http://www.alukah.net/culture/0/65616/#ixzz3i32LTNrF

What is the importance of Atmosphere?

1-The atmosphere is considered the protective cover for the organisms that live on Earth. It protected them from the harmful effects of outer space by absorbing the cosmic rays and the sun electromagnetic harmful ray that is shorter than 300 nm. The atmosphere transmit only non-harmful radiation which is located in the area longer than 300 nm

2-The atmosphere is the main source of carbon dioxide consumed by plants in photosynthesis, and oxygen consumed by living organisms for respiration, and nitrogen that is used in various industries

3-The atmosphere transport water from the ocean to land through the processes of water evaporation, condensation, and convert it to rain respectively.

4-Atmosphere is necessary to maintain the heat balance of the earth, by absorbing infrared ray that is either emitted by the sun or that is reflected back from the earth. Unlike other planets that lack atmosphere, the earth heat is stabilized, and the major decrease or increase in the earth temperature is prevented.

The main layers of the atmosphere:

The Atmosphere is divided into layers according to major changes in temperature and their chemical structure, based on the difference in the type of solar radiation absorbed in each layer.

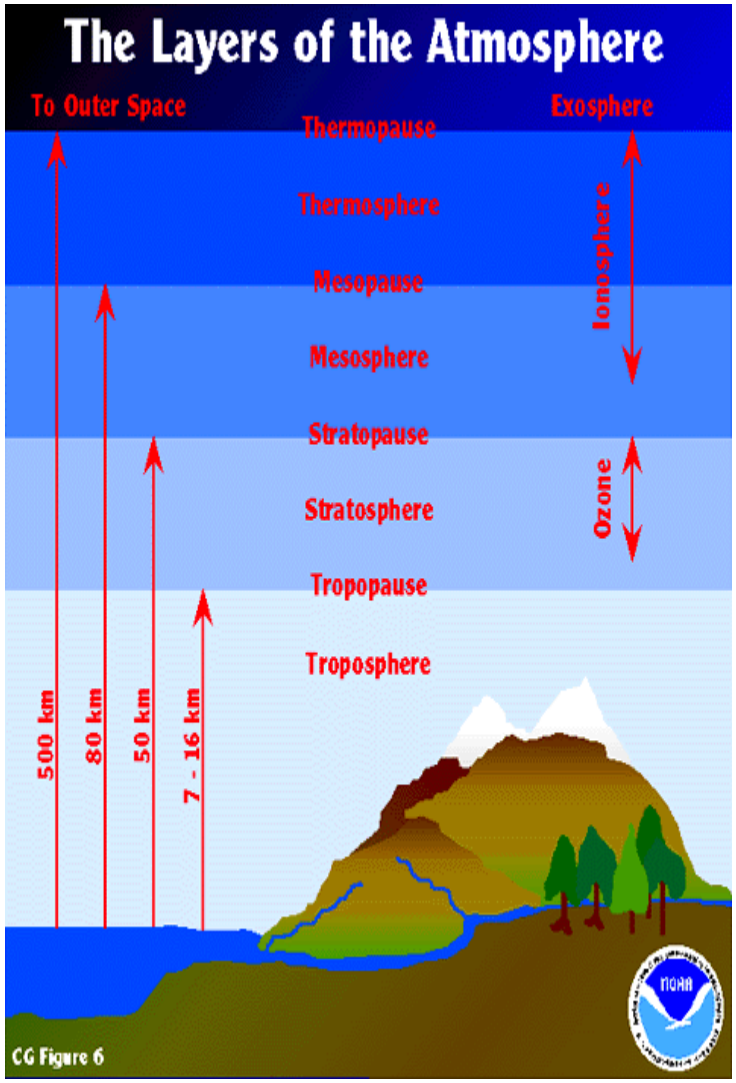
The visible solar radiation is absorbed at the surface of the earth, the near UV ray is absorbed in the central region of the atmosphere, and the far UV ray is absorbed in the upper atmosphere.

Gravity pushes the layers of air down on the earth's surface. This push is called air pressure.

99% of the total mass of the atmosphere is below 32 kilometers.

Troposphere: 0 to 12 km - Contains 75% of the gases in the atmosphere. This is where you live and where weather occurs. As height increases, temperature decreases. The temperature drops about 6.5 degrees Celsius for every kilometer above the earth's surface.

Stratosphere: 12 to 50 km - in the lower part of the stratosphere. The temperature remains fairly constant (-60 degrees Celsius). This layer contains the ozone layer. Ozone acts as a shield for in the earth's surface. It absorbs ultraviolet radiation from the sun. This causes a temperature increase in the upper part of the layer.

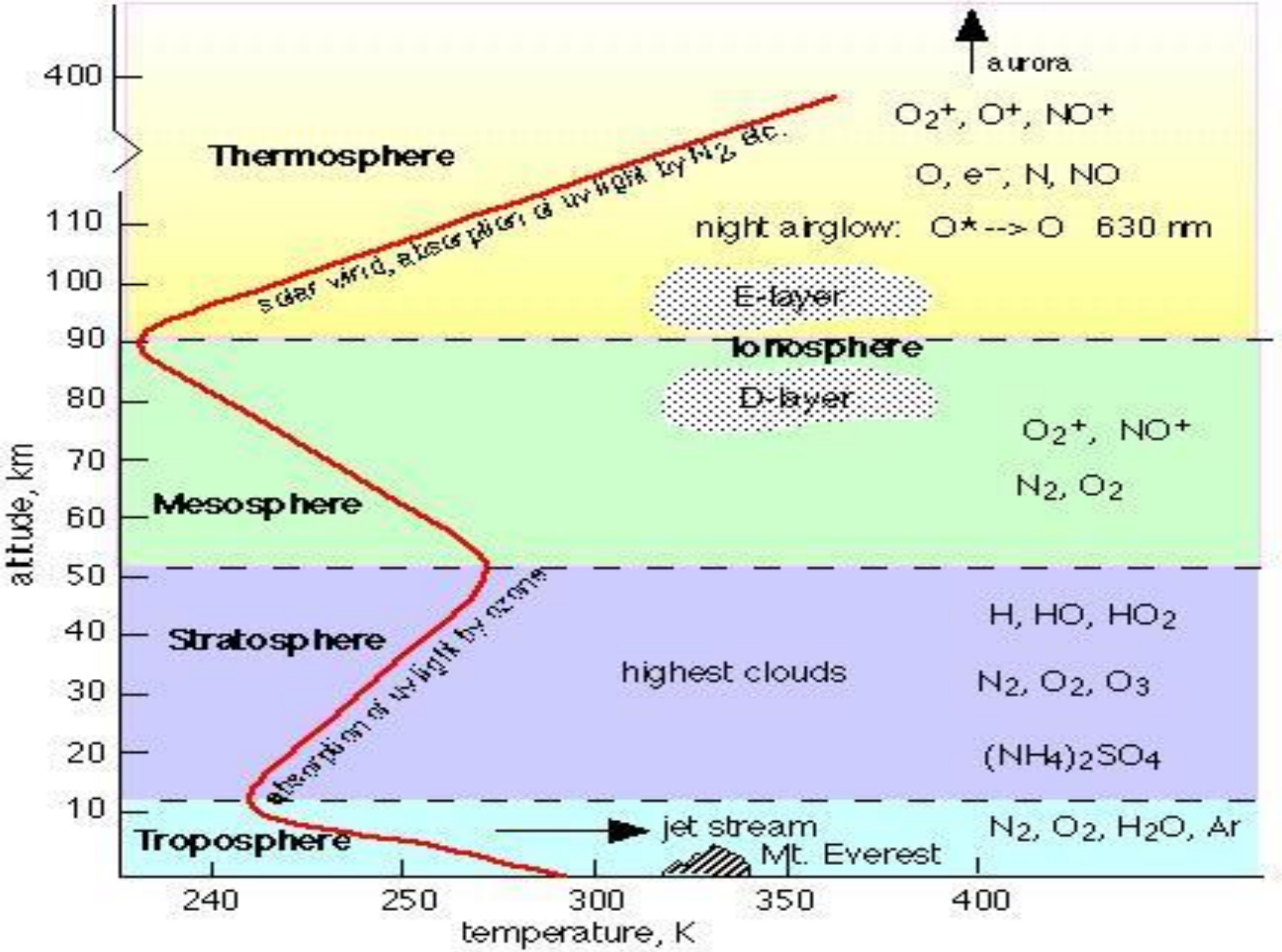


Mesosphere: 50 to 80 km - in the lower part of the stratosphere. The temperature drops in this layer to about -100 degrees Celsius. This is the coldest region of the atmosphere. This layer protects the earth from meteoroids. They burn up in this area.

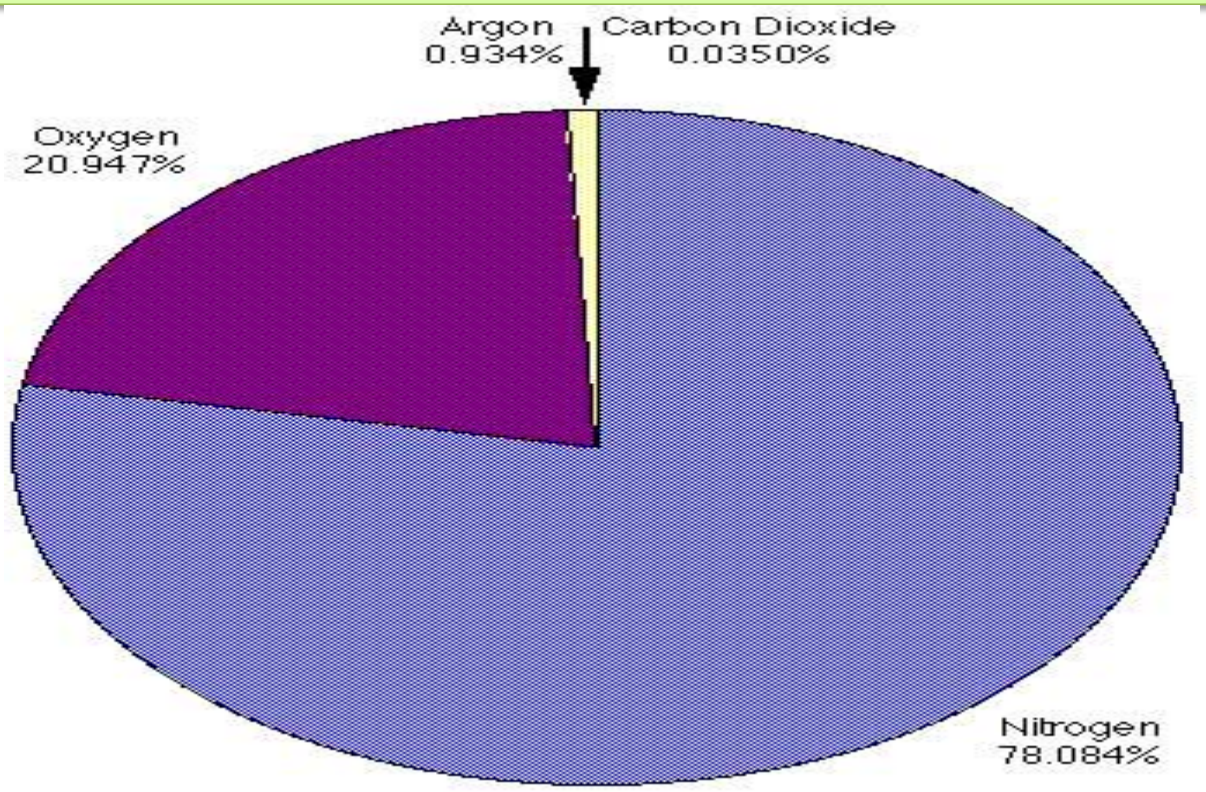
Thermosphere : 80 km and up - The air is very thin. Thermosphere means "heat sphere". The temperature is very high in this layer because ultraviolet radiation is turned into heat. Temperatures often reach 2000 degrees Celsius or more. This layer contains:

Ionosphere : This is the lower part of the thermosphere. It extends from about 80 to 550 km. Gas particles absorb ultraviolet and X-ray radiation from the sun. The particles of gas become electrically charged (ions). Radio waves are bounced off the ions and reflect waves back to earth. This generally helps radio communication. However, solar flares can increase the number of ions and can interfere with the transmission of some radio waves.

Exosphere: the upper part of the thermosphere. It extends from about 550 km for thousands of kilometers. Air is very thin here. This is the area where satellites orbit the earth.


400
110
100
90
80
70
60
50
40
30
20
10
altitude, km
Thermosphere
aurora
O_2^+, O^+, NO^+
O, e^-, N, NO
night airglow: O* --> O 630 nm
E-layer
Ionosphere
D-layer
O_2^+, NO^+
N_2, O_2
Mesosphere
Stratosphere
H, HO, HO_2
highest clouds
N_2, O_2, O_3
$(NH_4)_2SO_4$
Troposphere
jet stream
Mt. Everest
N_2, O_2, H_2O, Ar
240
250
300
350
400
temperature, K

The atmosphere is normally composed of 78 percent nitrogen, 20 percent oxygen and one percent as a mixture of carbon dioxide, water vapor and trace amounts of several other gases such as neon, helium, methane\, krypton, hydrogen and xenon. The general structure of the atmosphere has several important features that have relevance to environmental problems



Lect 3.

Types and sources of Air Pollution

What is air pollution?

Air pollution occurs due to the presence of undesirable solid or gaseous particles in the air in quantities that are harmful to human health and the environment.

The substances that cause air pollution are called **pollutants**.

A source of air pollution is any activity that causes pollutants to be emitted into the air.

Air may get polluted by **natural causes** **(biogenic sources)** such as volcanoes, which release ash, dust, sulphur and other gases, or by forest fires that are occasionally naturally caused by lightning.

Or by **human activity** **(anthropogenic sources)** which are categorized in **two ways:** mobile and stationary sources. **Mobile sources** of air pollution include most forms of transportation such as automobiles, trucks, and airplanes. **Stationary sources** of air pollution consist of non-moving sources such as industrial facilities.

However, unlike pollutants from human activity, naturally occurring pollutants tend to remain in the atmosphere for a short time and do not lead to permanent atmospheric change.

Other classifications for air pollutants are
Primary and Secondary Pollutants

Pollutants can be classified as primary or secondary.

1- Primary pollutants are substances that are directly pumped into the atmosphere from sources and directly pollute the air.

The main primary pollutants known to cause harm in high enough concentrations are the following:

- Carbon compounds, such as CO, CO_2, CH_4, and VOCs
- Nitrogen compounds, such as NO, N_2O, and NH_3
- Sulfur compounds, such as H_2S and SO_2
- Halogen compounds, such as chlorides, fluorides, and bromides

• Particulate Matter (PM or “aerosols”), either in solid or liquid form, which is usually categorized into these groups based on the diameter of the particles.

2- Secondary pollutants are not directly pumped from sources, but instead form in the atmosphere from primary pollutants (if primary pollutants in the atmosphere undergo chemical reactions.)

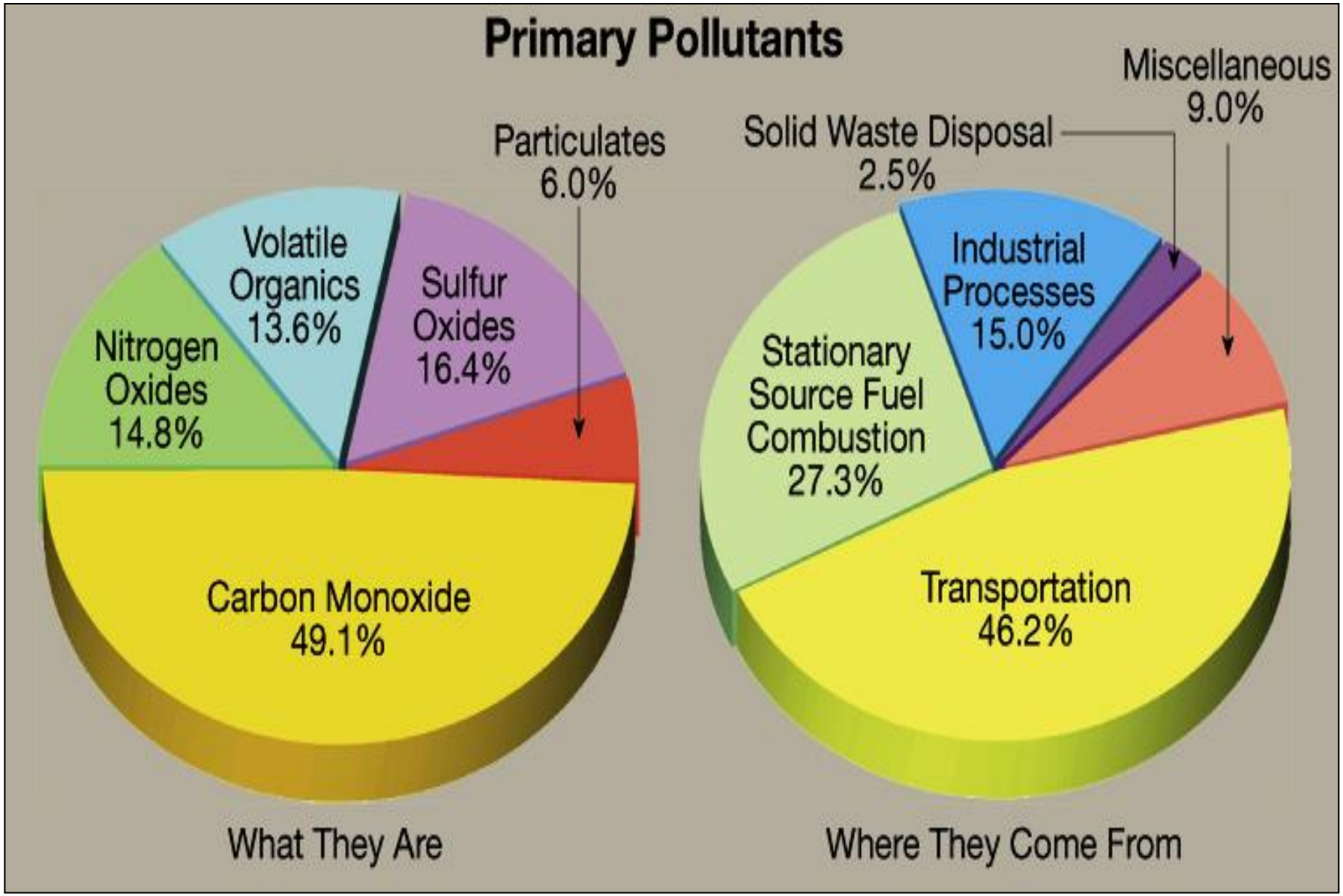
The main secondary pollutants known to cause harm in high enough concentrations are the following:

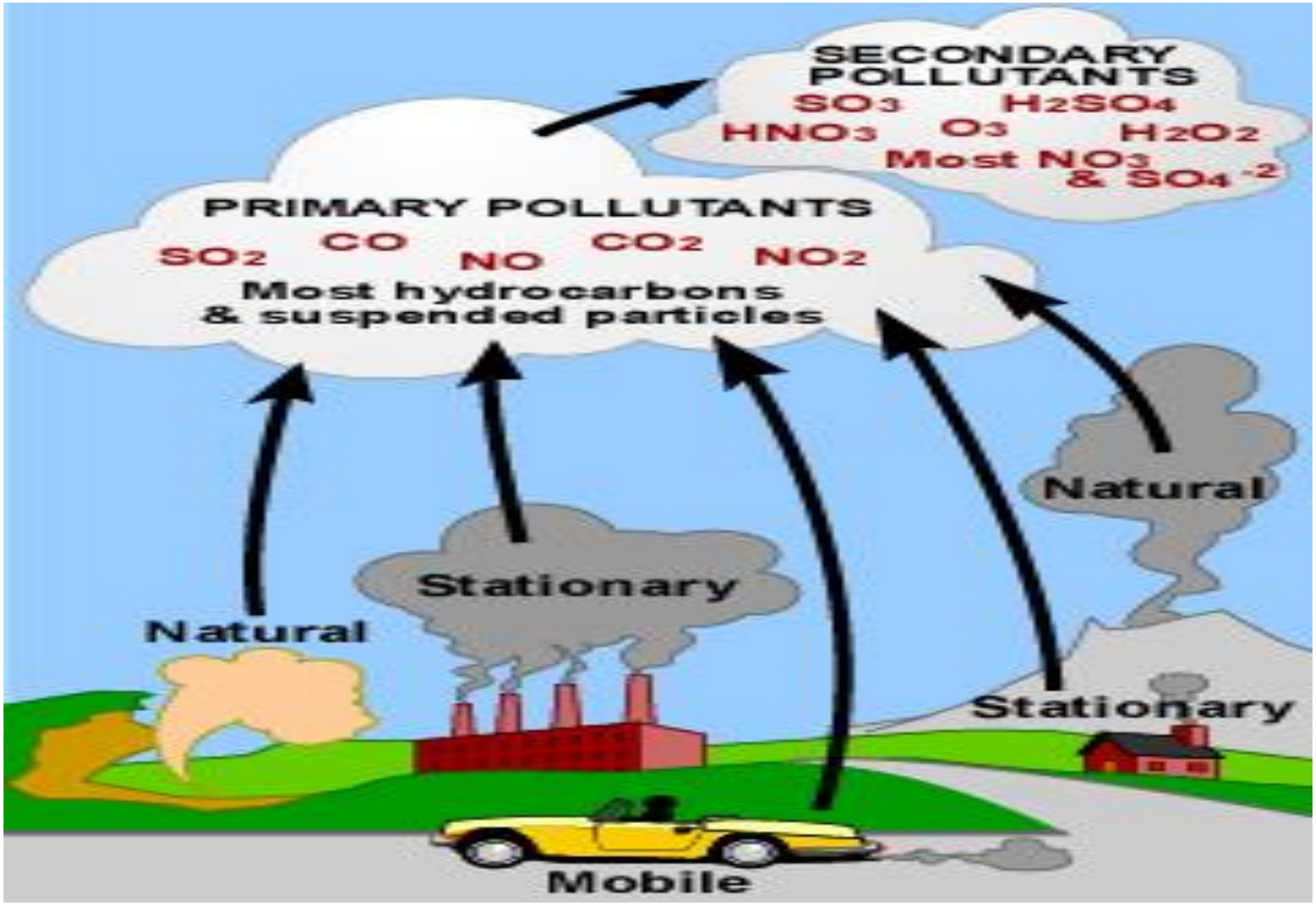
• Ozone (O_3) formed from photochemical reactions of nitrogen oxides and VOCs

• Sulfuric acid droplets formed from SO_2 and nitric acid droplets formed from NO_2

• Sulfates and nitrates aerosols (e.g., ammonium (bi)sulfate and ammonium nitrate) formed from reactions of sulfuric acid droplets and nitric acid droplets with NH_3, respectively.

• Organic aerosols formed from VOCs in gas-to-particle reactions


Primary Pollutants
Particulates
6.0%
Volatile
Organics
13.6%
Sulfur
Oxides
16.4%
Nitrogen
Oxides
14.8%
Carbon Monoxide
49.1%
What They Are
Miscellaneous
9.0%
Solid Waste Disposal
2.5%
Industrial
Processes
15.0%
Stationary
Source Fuel
Combustion
27.3%
Transportation
46.2%
Where They Come From


SECONDARY POLLUTANTS
SO_3 H_2SO_4
HNO_3 O_3 H_2O_2
Most NO_3 & SO_4^{-2}
PRIMARY POLLUTANTS
SO_2 CO NO CO_2 NO_2
Most hydrocarbons & suspended particles
Natural
Stationary
Natural
Stationary
Mobile

Air Quality Index AQI

: Indicates whether pollutant levels in air may cause health concerns.

•Ranges from 0 (least concern) to 500 (greatest concern)

Air Quality	Air Quality Index	Protect Your Health
Good	0-50	No health impacts are expected when air quality is in this range.
Moderate	51-100	Unusually sensitive people should consider limiting prolonged outdoor exertion.
Unhealthy for Sensitive Groups	101-150	Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion.
Unhealthy	151-200	Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion, everyone else, especially children should limit prolonged outdoor excretion.
Very Unhealthy (Alert)	201-300	Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion everyone else, especially children, should limit outdoor exertion.

Air sample collection:

One of the most important steps in air analysis is the collection of the sample.
Generally, samples are collected for one of three important reasons:
1- To evaluate the efficiency of pollution control measures.
2- To determine the source of pollutant.

Size of sample:

The volume of air sample is governed by:

- the minimum pollutant concentration that must be measured.
- The sensitivity of the measurement.
- The information desired.

Rate of sampling:

The useful sampling rate will vary with the sampling device and should be determined Experimentally.

Duration of sampling:

The time of day and duration of sampling will be determined by the information that is desired.

Sample storage:

Storage of air samples should be kept to a minimum. They should be protected from heat and Light . Care should be taken that the desired test compound does not react with other constituent or with the container. Gasses samples sometimes collected by adsorption onto a solid .

The sampling train

The requirements for air sampling devise are:

Vacuum sources: used to draw the sample through the collection device. Motor or hand-driven vacuum pumps, aspirators are commonly used.

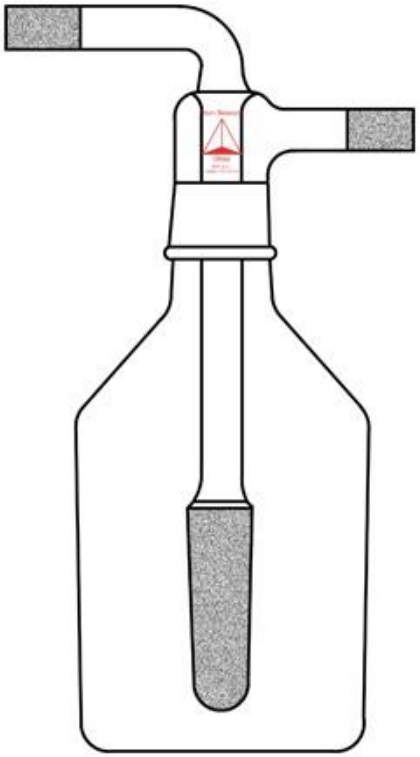
Metering device : there are two types, the first measures rate and the second measures volume.

Sampling device: Is the collector, which may be of variety of type, depending on the particular application. Included are filters and fritted-glass scrubbers.

Gases and vapours may be collected by absorption in a liquid, adsorption on a solid Surface and freezing or condensation.

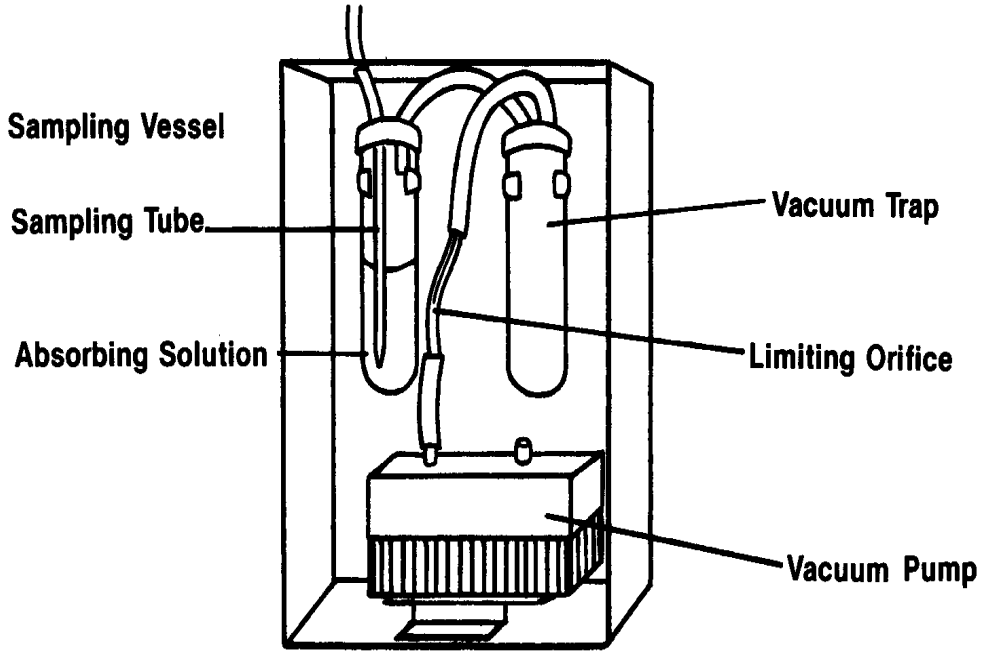

703
703
SKC
25 ML
20
15
10
5
3262
3262
SKC
25 ML
20
15
10
5


SAMPLER
0012
START
HOLD
SET-UP
MODE
FLOW
ADJ



Source Sampling

- introduce a probe into a waste gas stream flowing in smokestack - probe withdraws sample of waste gas, which is analysed in laboratory
- Gaseous pollutants collected by absorption in impingers, adsorption on charcoal or other media, or condensation in collecting traps



Lect.2

Types of Major Air Pollutants:

- **Carbon oxides** (CO)
- **Nitrogen oxides and nitric acid** (NO, HNO_3)
- **Sulfur dioxide and sulfuric acid** (SO_2, $H_2SO_{4)}$
- **Particulates** (SPM)
- **Ozone** (O_3)
- **Volatile organic compounds (VOCs)**

1-Carbon monoxide

Carbon monoxide is an odorless, colorless and toxic gas. Because it is impossible to see, taste or smell the toxic fumes.

Sources:

1-Natural sources

$$O_3 \xrightarrow{\text{Sun light}} O_2 + {}^{\cdot}O$$

$${}^{\cdot}O + H_2O \longleftrightarrow {}^{\cdot}OH + {}^{\cdot}OH$$

$$CH_4 + {}^{\cdot}OH \longleftrightarrow H_2O + {}^{\cdot}CH_3$$

$$CH_4 + {}^{\cdot}O \longleftrightarrow {}^{\cdot}OH + {}^{\cdot}CH_3$$

Then The $\cdot CH_3$ free radicals react to produce the final product **CO**

2- Incomplete combustion of carbon or its product

$$2C + O_2 \longleftrightarrow 2\,CO \qquad \text{fast}$$

$$2CO + O_2 \longleftrightarrow 2\,CO_2$$

3-As indoor-pollutants from domestic combustion appliance , particularly when the air supply is inadequate.

4- Industrial operation

$$CO_2 + C \longleftrightarrow 2\,CO$$

Health effect of CO gas:

1- Carbon monoxide decrease the ability of the blood to carry the oxygen from lung to cells. This may occur due to binding of CO very strongly to the iron in hemoglobin. The complex is called carboxyhemoglobin, and is represented as COHb.

2-The affinity of human hemoglobin for CO is about 210 times greater than for O_2.

Control CO in the air:

تطوير صناعة وسائل مواصلات لتقليل نسبة أول أكسيد الكربون والهيدروكربونات المنبعثة من عوادمها بعدة طرق منها:

1-استخدام مخلوط من الوقود والهواء تكون نسبة الوقود فيه عالية

2- استخدام نظام يحتوي على مضخة لضخ هواء مؤكسد الى عادم السيارات وذلك لأكسدة اول اكسيد الكربون الى ثاني اكسيد الكربون

3- استخدام محولات محفزة التى تحول الغازات الضارة الى غازات اقل ضررا

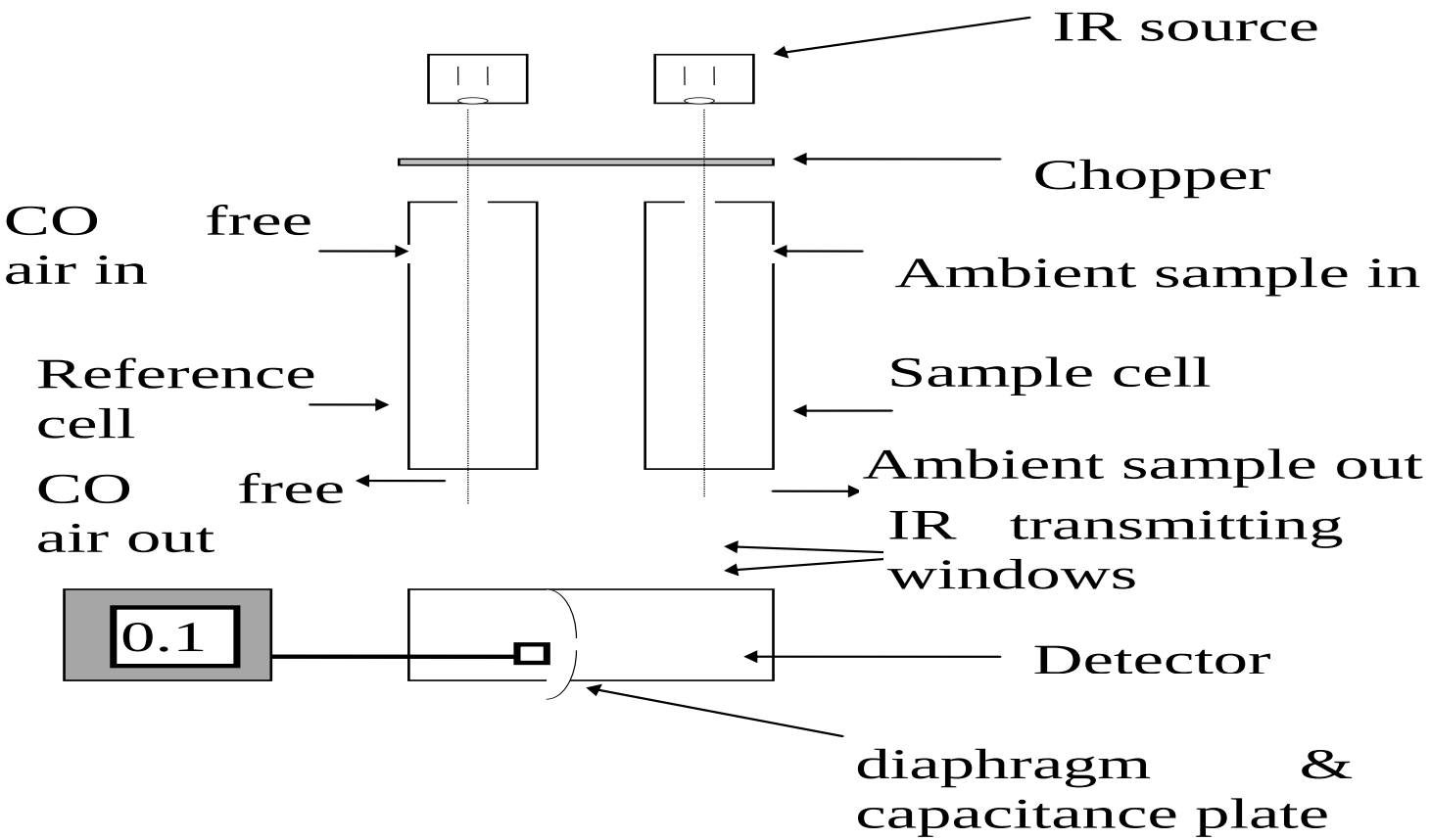
CO Analysis:

1- Non-dispersive infrared spectrometry

- It is measured by non-dispersive infrared absorption.
- Non-dispersive infra red (NDIR) devices, suitable for detection from 0-500 ppm by volume
- Non-dispersive mean that the IR is not dispersed by a prism.
- Absorption of IR radiation by CO
- Detection due to energy difference signal.

2- Gas Chromatography:

Using flame ionization detector or Atomic absorption detectors


IR source
Chopper
CO free air in
Ambient sample in
Reference cell
Sample cell
Ambient sample out
CO free air out
IR transmitting windows
0.1
Detector
diaphragm & capacitance plate

2-Carbon dioxide CO_2:

Carbon dioxide (CO_2) is a naturally occurring, colorless, odorless, usually ranging in concentrations from 300-600 ppm (parts per million).

Carbon dioxide occurs naturally in the atmosphere. It is an essential ingredient in photosynthesis, the process by which plants make food and energy. Levels of atmospheric carbon dioxide have increased since the Industrial Revolution.

Water Vapor, carbon dioxide and climate:

1- The atmosphere is essential in maintaining a uniform and moderate temperature on the surface of the planet.

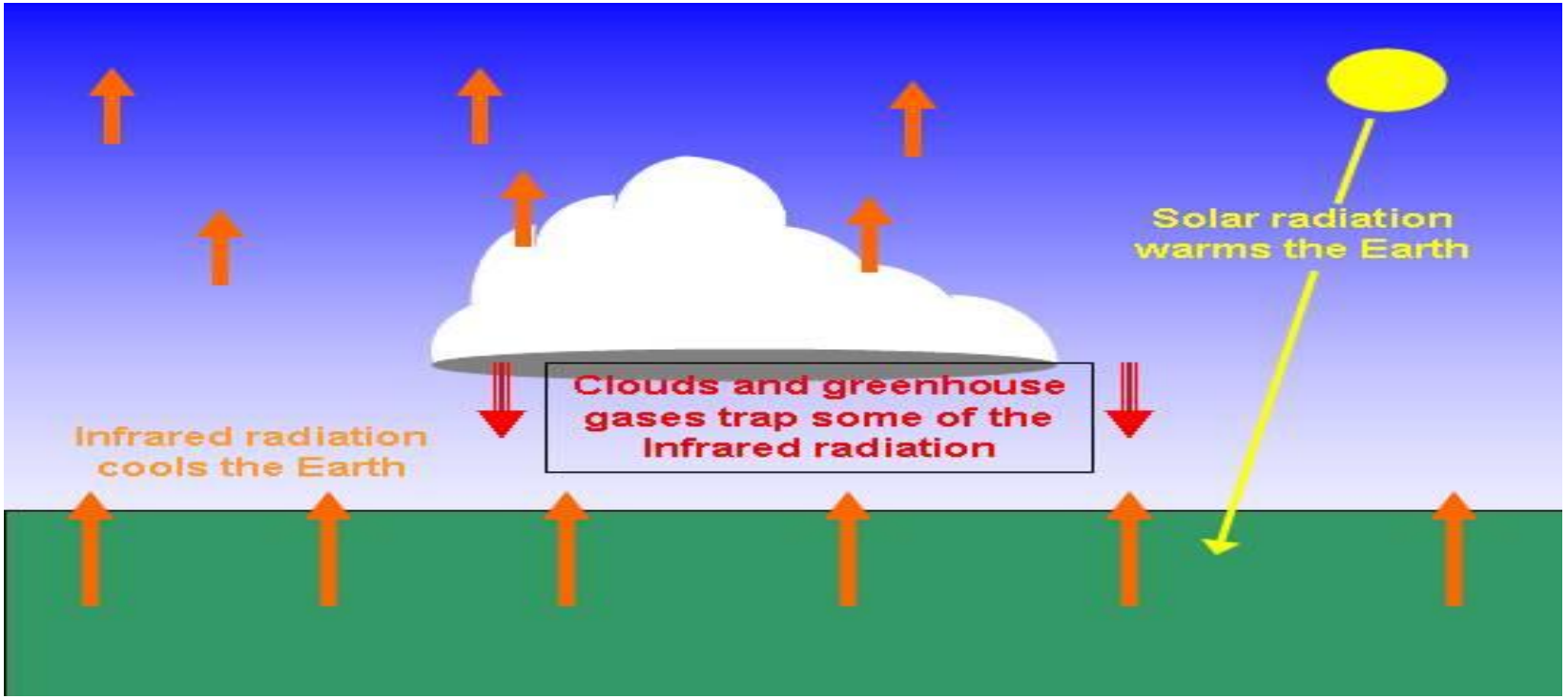
2- The two atmospheric components of major importance in maintenance of the earth's surface are CO_2 and water vapor

carbon dioxide may turn out to be a harmful air pollutant at higher levels. This is because of its role in re-absorbing the infrared radiation by which Earth radiates back into space the solar energy received from the sun.

The green house effect:

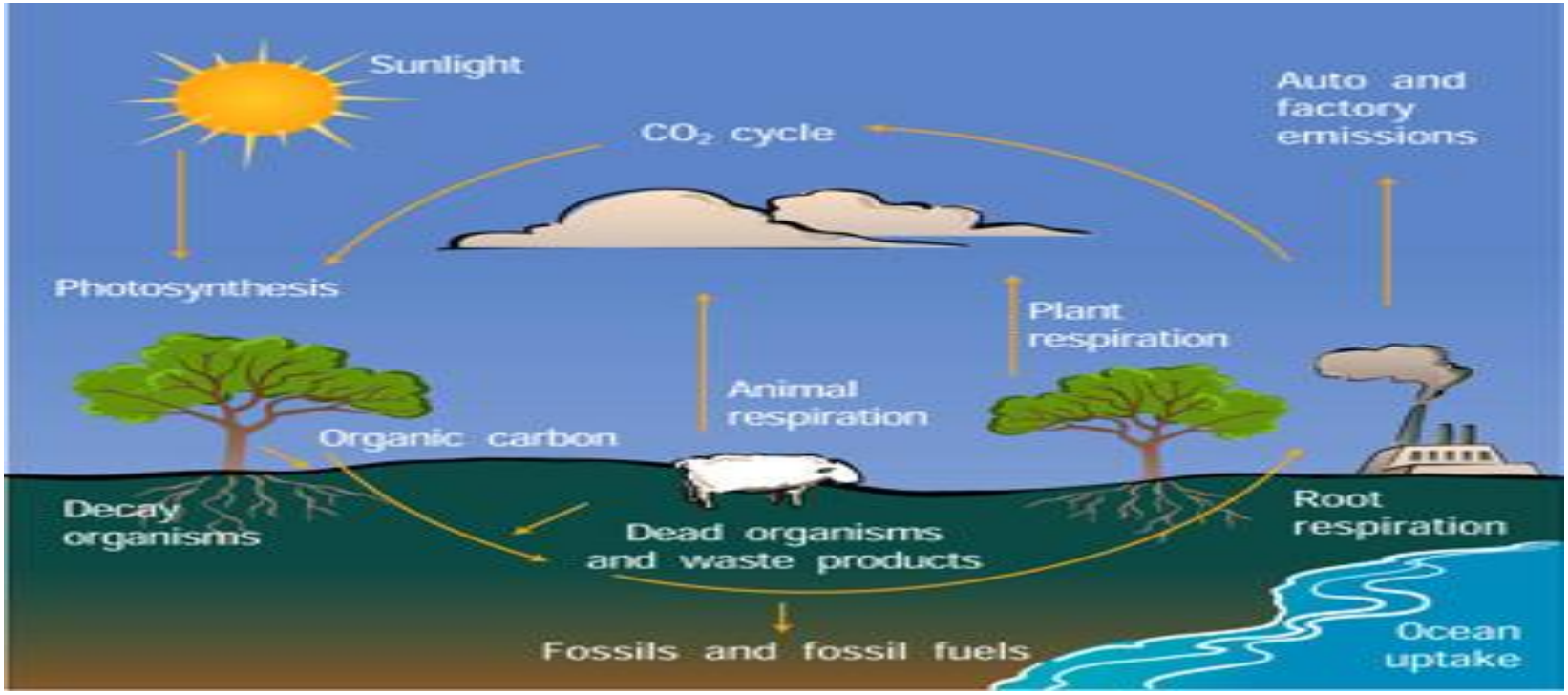
It describe the trapping of heat near the earth's surface by gases in the atmosphere particularly carbon dioxide.

This greenhouse effect is essential to life on Earth because it keeps the surface warm enough for living organisms to thrive. However, if too much carbon dioxide is present in the atmosphere, Earth's surface will become too warm, bad greenhouse effect leading to melting of polar ice caps and glaciers.



Sources of CO_2

1- Complete combustion of fossil fuel.
2- Forest fires.
3- Human activity in the industrial processes.



Analysis of CO_2:

1-A sensitive colorimetric method has been used to obtain the quantity of CO_2 in air. The method depends on the bleaching of the ph.ph. Color of a standard alkali solution after shaking fixed volumes of the solution and air.
2-Chromatoghraphic methods
3- IR spectroscopy

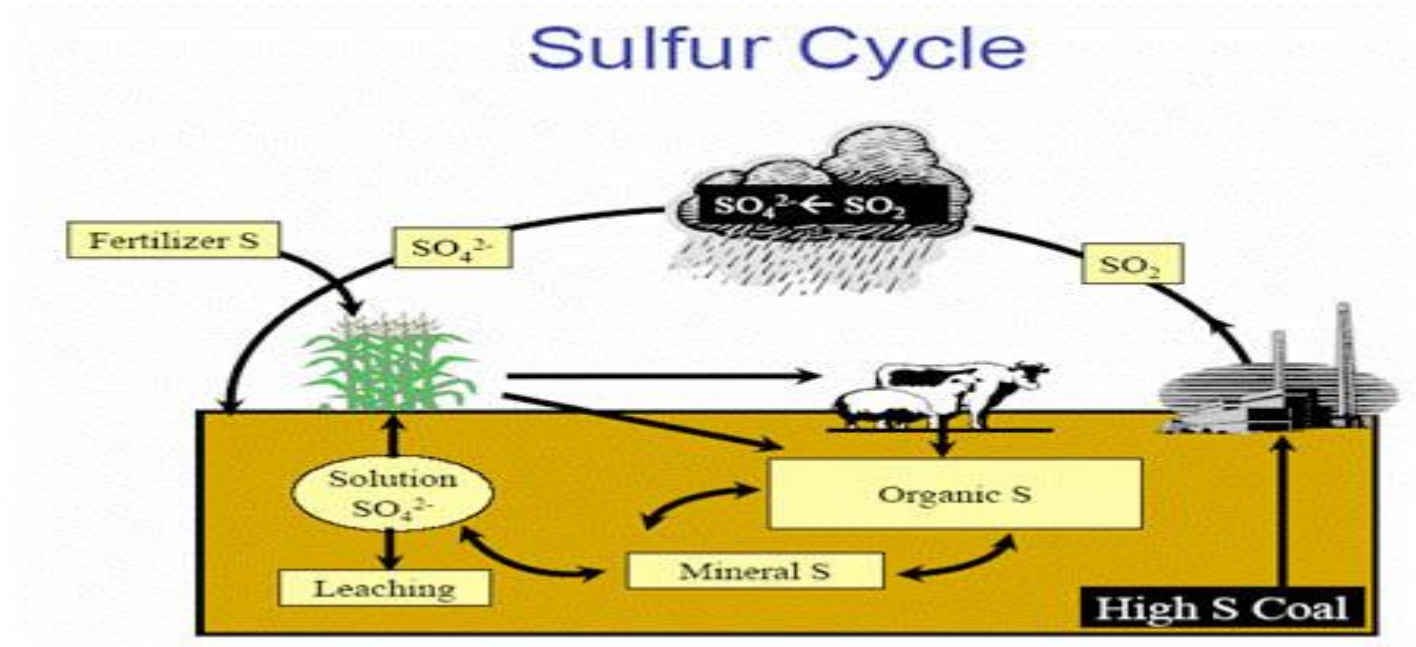
Health effect of CO_2 gas:

Carbon dioxide is not poisonous, but too high concentration in the air is unhealthy because it lowers the O2 concentration and has harmful physiologic effect .

3-Sulfur compounds:

كمية أكاسيد الكبريت في الجو تتكون أساسا من غاز ثاني أكسيد الكبريت بينما لايشكل ثالث أكسيد الكبريت سوى 1-2 % من كمية ثاني أكسيد الكبريت

غاز ثاني أكسيد الكبريت لالون له غير قابل للاحتراق وله رائحة لاذعة ومهيجة عند التراكيز العالية , أما غاز ثالث أكسيد الكبريت فهو غاز سريع التفاعل ولا يوجد في الهواء تحت الظروف العادية لانه يتفاعل بسرعة مع بخار وقطرات الماء ويتحول الى حمض الكبريتيك.



Sources of sulphur compound:

1-Volcanic gases

2- forest fires

3-fossil-fuel combustion

$4FeS_2 + 11O_2 \longleftrightarrow 2Fe_2O_3 + 8SO_2$

4- bacterial decay of organic compounds containing sulfur

$H_2S + 3/2\ O_2 \longleftrightarrow SO_2 + H_2O$

$H_2S + O_3 \longleftrightarrow SO_2 + H_2O$

$H_2S + O \longleftrightarrow HS + HO \longleftrightarrow SO_2 + H_2O$

5- Industrial process (roasting and smelting of ores)

$2ZnS + 3O_2 \longleftrightarrow 2\ ZnO + 2SO_2$ (roasting process)

require catalysis by aerosol particles

All of these reaction can occur rapidly in photo chemical smog since O, O_3 and particulate are present in greater concentration

Oxidation of SO_2:

More than 30 million tons of So_2 are released into the atomosphere. This material does a great deal of damage to both property and human health. The main problem is the conversation of SO_2 to SO_3 by first -atomospheric oxygen.
The oxidation process may occur as follow:

$$SO_2 + O_2 \longrightarrow SO_3$$

But this reaction does not occur in clean air. Dust or metal oxide must be present (which act as catalyst).

A second pathway for SO_2 oxidation is via fog or cloud (photochemical oxidation). The photochemical oxidation of SO_2 may be written as a two step

$$SO_2 + hv \longrightarrow SO_2 \quad \text{(excited molecules)}$$

$$SO_2 + O_2 \xrightarrow{hv} SO_3 + O$$

Once SO_3, is formed it dissolved in water droplets, forming sulfuric acid, H_2SO_4 (acid rains) Which has corrosive effect on metals, buildings, paints and soil.

$$SO_3 + H_2O \longrightarrow H_2SO_4$$

effect of sulfur compounds:

1-Formation of Industrial smog or London smog

In some area (the industrial area) the atmosphere also contain ammonia NH_3, an acid base reaction may occur, producing ammonium hydrogen sulfate, NH_4HSO_4, or ammoniumsullfate, $(NH4)_2\ SO_4$. Dispersion of these salts in air reduces or decreases the visibility by formation of fog.

$$NH_3 + H_2SO_4 \longrightarrow NH_4HSO_4$$

$$NH_4HSO_4 + NH_3 \longrightarrow (NH4)_2SO_4$$

2-Acid rain:

Sulfuric acid and HCl produced and hydrolysis of ammonium sulphate all reduce the pH of rain water.

$$H_2SO_4 + Nacl \longrightarrow Na_2SO_3 + 2HCl$$

$$(NH4)_2SO_4 \longrightarrow 2NH_4^+ + SO_4^{-2}$$

$$\downarrow$$

$$2NH_3 + 2H^+$$

3-Health effect of SO_2

1- It is likely that sulfur dioxide contributes to respiratory symptoms and redused lung function.

2- Exposure to high levels of the sulfur dioxide over a long period produces structrual changes in the lung.

Control of SO_2 emission:

1- By removal of the sulphur content from the fossil fuel during its production, but it Highly expensive.

2- By addition of limestone ($CaCO_3$) powder to the combustion chamber of fuel, where the following reaction may occur.

$$CaCO_3 \longrightarrow CaO \text{ (lime)} + CO_2$$

$$CaO + SO_2 \longrightarrow CaSO_3$$

This method removes about 50% of SO_2 so it is necessary to scrub the furnace gas with an aqueous suspension of lime to remove the $CaSO_3$ formed and to remove any unreacted SO_2.

Measurement of SO_2 gas:

threetechniques are commonly used for the determination of sulfur dioxide in the atmosphere:

1- Simple method:

It involves absorption of SO_2 in hydrogen peroxide solution to form H_2SO_4, followed by titration of the acid product with standard base. But the other acidic and alkaline gases may interfere, so ion- chromatographic determination of sulphate anion gives more accurate results.

2- Fluorescence method:

This method is bases on excitation of SO_2 by radiation with UV, followed by measurement of the fluorescence emission by the gas it self.

3- استخدام جهاز تحليل يعتمد على تمرير عينة الهواء عبر محلول نترات الزئبق الأحادي حيث يحدث التفاعل التالي:

$$SO_2 + 2\,H_2O + Hg_2^{2-} \longrightarrow Hg(SO_4)_2^{-2} + Hg^{\circ} + 4\,H^+$$

4-Nitrogen compounds:

يكون النيتروجين ثمانية مركبات مع الأوكسجين ولكن لايوجد في الهواء منها غير ثلاثة مركبات فقط وهى:

Nitrogen dioxide NO_2, nitric oxide NO , nitrous oxide N_2O

غاز لالون له ولايحترق وغير سام وله طعم ورائحة يميلان الى الحلاوة وقد استخدم كمخدر ويسمى الغاز N_2O المضحك

Nitrogen oxides NO and NO_2 are known as noxious gases and they components of smog phenomenon.

Sources:

أغلب كمية أكاسيد النيتروجين , أول اوكسيد النيتروجين وثاني أوكسيد النيتروجين تأتي من المصادر الطبيعية أما فيأتي جميعه تقريبا من المصادر الإنسانية: N_2O

1-تحلل المركبات المحتوية على النيتروجين في التربة بفعل البكتريا

2- يتسبب البرق في تفاعل N_2 و O_2 في الهواء بعدة طرق لإنتاج N_2O NO_2 NO لكن بكميات قليلة لاتذكر

3- إحتراق الوقود في السيارات وفي محطات توليد الطاقة

$$N_2 + O_2 \longrightarrow 2NO$$

$$2NO + 2O_2 \longrightarrow 2NO_2$$

يلاحظ أن غازي النيتروجين والأوكسجين موجودان جنبا الى جنب في الهواء ولكنهما لايتفاعلان مع بعضهما إلا عند درجات الحرارة العالية, وذلك لان التفاعلماص للحرارة أما التفاعل الثاني فلا يحدث تحت ظروف الاحتراق وذلك لأن ثاني اوكسيد النيتروجين غير ثابت عند درجات الحرارة العالية ويتفكك الى الأوكسجين وأول اكسيد النيتروجين , لذلك فإن .كمية ثاني أوكسيد النيتروجين في المحاليط الغازية الناتجة من عمليات الأحتراق قليلة جدا

formation of photochemical smog:

1- Dissociation of NO_2 into NO by sun light

$$NO_2 + hv \longrightarrow NO + {}^{\cdot}O$$

2- The atomic oxygen formed undergoes several possible. One of these is formation of ozone

$$O + O_2 + M \longrightarrow O_3 + {}^{\cdot}M$$

3- Ozone is capable of rapidly oxidizing NO to NO_2

$$O_3 + NO \longrightarrow NO_2 + O_2$$

إذا لم تتدخل في هذه الدورة مواد منافسةتظل تراكيز أول وثاني أوكسيد النيروجين ثابتين تقريبا لإن الأوزون واول اكسيد النيتروجين تتكون وتتلف بكميات متساوية إلا أن وجود الهيدروكربونات والتي غالبا تنفثمن نفس المصدر الذي ينفث منه أكاسيد النيتروجين تجعل هذه الدورة غير متوازنة حيث تجعل تحول اول اكسيد النيتروجين الي ثاني اوكسيد النيتروجين اسرع من التحول العكسي وينتج عن ذلك تراكم مايعرف بالمواد المؤكسدة وهى جزء هام في تكون الضباب.

Control of smog:

Reduction or elimination of smog requires removal of the No_x and hydrocarbons by using control system. This system involves complete oxidation of hydrocarbon by selective catalyst to CO_2 and reduction noxious gasses to N_2.

إزالة أكاسيد النيتروجين من الجو:

أهم عملية لإزالة أكاسيد النيتروجين الموجودة في الغلاف الجوي تكون عن طريق تفاعل هذة الأكاسيد مع مياة الأمطار وتحولها الى حمض النيتريك لتكوين مايدعى بالأمطار الحمضية.

$$2NO_2 + H_2O \longleftrightarrow HNO_3 + HNO_2$$

كما أن التربة لها المقدرة على إزالة هذه الأكاسيد من الجو وثبيتها على هيئة نترات لذا يمكن اعتبار التربة مزيل طبيعي لأكاسيد النيروجين من الجو.

وكما ذكر سابقا ايضا يمكن ازالتها بتحويلها الى مركبات النيتروجين العضوية اثناء تكون الضباب

Measurement of No_x :

1- Determination is based on chemiluminescent reaction of nitrogen oxides and Ozone

$$NO + O_3 \longrightarrow NO_2^* + O_2$$

$$NO_2^* \longrightarrow NO_2 + hv$$

The excited No_x emits radiation within range 600- 3000 nm (wavelength max is 1500)

2- Determination of NO_2 is free from interference and may be used to measure NO, by prior conversion of NO_2 to NO in a heated stainless steel or molybdenum converter.

Health effect of Nox gas:

1- Nitrogen dioxide is an oxidizing agent and can damage lung tissu via its oxidizing properties.

2- Long –term exposure to high concentration may produce lung scarring (fibrosis)

بعد دراستك لبعض ملوثات الهواء, تكونت لديك بعض المعلومات عن الأمطار الحمضية, المطلوب منك أن تقرأي أكثر في هذا المجال ثم تشرحي لزميلاتك فكرة تكون الأمطار الحمضية واثارها البيئية المحتلفة

5-Ozone O_3:

Ozone is a pale blue gas, slightly soluble in water and much more soluble in inert non-polar solvents such as carbon tetrachloride or fluorocarbons, where it forms a blue solution.
Ozone is a gas that occurs both in the Earth's upper atmosphere and at ground level. Ozone can be "good" or "bad" for people's health and for the environment, depending on its location in the atmosphere.

Ozone occurs in two layers of the atmosphere. The layer closest to the Earth's surface is the troposphere. Here, ground-level or "bad" ozone is an air pollutant that is harmful to breathe and it damages crops, trees and other vegetation. It is a main ingredient of urban smog. The troposphere generally extends to a level about 6 miles up, where it meets the second layer, the stratosphere. The stratosphere extends upward from about 6 to 30 miles. The stratospheric or "good" ozone protects life on Earth from the sun's harmful ultraviolet (UV) rays.

- Tropospheric (“low-level”) ozone is a secondary pollutant.

عمليات إنتاج وإزالة الأوزون:

O_2+ UV light $\longrightarrow$ 2O

$O + O_2 + M \longrightarrow O_3$ in presence of O_2 or N_2

O_3+ visible light $\longrightarrow$ $O + O_2$

يلاحظ إن عمليات إنتاج وإزالة الأوزون تحفز من قبل الاشعة الفوق بنفسجية وتدعى هذة التفاعلات بتفاعلات شابمان

- Also, **Ozone is formed *via.* two main pathways. The first is** by the reaction of NOx with any of a wide range of volatile organic compounds in the presence of sunlight. Such volatile organic compounds are found in motor vehicle exhaust and industrial solvents. **Further ozone is** formed by the decomposition of NO_2 in sunlight and the reaction of the decomposition products with oxygen itself to give ozone:

$$NO_2 \rightarrow NO + \cdot O$$

$$\cdot O + O_2 \rightarrow O_3$$

Ozone is the major constituent of photochemical smog.

Ozone is produced naturally in the stratosphere. But this "good" ozone is gradually being destroyed by man-made chemicals referred to as ozone-depleting substances (ODS), including chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons, methyl bromide, carbon tetrachloride, and methyl chloroform. These substances were formerly used and sometimes still are used in coolants, foaming agents, fire extinguishers, solvents, pesticides, and aerosol propellants.

Once released into the air these ozone-depleting substances degrade very slowly. In fact, they can remain intact for years as they move through the troposphere until they reach the stratosphere. There they are broken down by the intensity of the sun's UV rays and release chlorine and bromine molecules, which destroy the "good" ozone.

$Cl + O_3 \rightarrow ClO + O_2$

$ClO + O \rightarrow Cl + O_2$

Analysis of O_3:

determined either by chemiluminescence methods or direct UV methods.

sample drawn into a mixing chamber mixed with a stream of ethylene - causes a chemiluminescent reaction and the subsequent emitted light at about 430nm

$O_3 + C_2H_4 \longrightarrow$ Ozonide $\longrightarrow CH_2O^*$

$CH_2O^* \longrightarrow CHO_2 + hv$

Or by direct reading UV method - stream of gas in the sample is drawn through a flow cell where it is irradiated with UV light at 254nm


سبحان الله وبحمده

6-Hydrocarbon (HC) pollution:

- Sources of HC:

- 1-Hydrocarbons having C atoms between 1-4 are gaseous in nature, those having more than 5 C atoms are liquids or solids.

- 2-Natural sources of hydrocarbons (HC) are mostly biological in nature.

- 3- Millions tons of volatile HC are coming from incomplete combustion of foil.

- Example of some HC pollutants are methane, ethane, CF2C2, peroxyacetyl-nitrate(PAN)…..etc

Control of hydrocarbon pollution:

1- Complete combustion of fuel by applying sufficient air to the internal combustion machines , turbines and motor vehicles .

Serious effect of hydrocarbons:

1- HC present a major air pollution problem due to the formation of photochemical smog for example CF_2Cl_2 when affected by ultraviolet light it dissociations to active chlorine atoms which consume the ozone layer.

2- HC has no effect on the human health at the concentration found in the atmosphere but they increase the photochemical oxidant which can be affecting on our health.

Measurement of the total hydrocarbons:

HC are collected in a condensation trap immersed in liquid oxygen and determined using infrared spectrophotometry.

7-Particulate pollution

1- particulate are a large variety of substance which have the ability to remain suspended in air for a long period of time.

2-The term particulate is used to mean any dispersed matter solid or liquid (in which the individual aggregates are larger than single small molecules).They include fumes ,dust .mist and aerosols.

3- Particles smaller than 1 m have a random motion in air while particulate larger than 10 m settle quickly as dust .

Types of particulate and their serious effects:

1- smoke and ash (aerosol particle)

Sources:

1- Arising from combustion process

Serious effect

1- Atmospheric aerosol may have a damaging effect on human health due its chemical nature
2- Little damage is caused to the building surfaces due to the deposition on materials especially in presence of acidic mixture of SO_2 in air.

2- Lead

Sources:

1- Combustion of fossil fuel, where tetraethyl lead added to gasoline to increase the octane number

2- Industrial process such as battery and etc….

Serious effect

1- Lead is considered as very toxic material for blood

2- It affects on the brain.

3- Mercury:

Sources:

Coal, paints and plastic industrials.

Serious effect:

1- It is very toxic pollutants

2- Inorganic mercury can be converted to methyl mercury or dimethyl mercury by certain micro organism and then concentrated in the food

3- Elemental mercury vapor in air has a serious effect in the central nervous system.

4- Beryllium

Sources

1- Emission result from manufacturing processes which involve the grinding , burning or cutting of Beryllium.

Serious effect

It is an extremely dangerous, toxic and causes several of lung diseases.

Control of particulate pollution:

1- In air , it may be removed by using filters or electrostatic precipitators where the charged particles are collected on the electrodes

2- Gasoline free from lead must be used by the addition of certain catalyst to increase the efficiency of the machine instead of adding tetraethyl lead

3- Washing the streets every day with water to remove dust.

طرق الوقاية من الملوثات الغازية:

طرق عامة يجب إتباعها لحماية البيئة من تلوث الهواء:

1- التخطيط التنموي السليم للمباني والمصانع وأماكن تواجدها

2- زيادة الرقعة الخضراء المزروعة لتنقية الهواء وتلطيف الجو

3-الإستفادة من مقدرة الكائنات الحية الدقيقة مثل الطحالب على التخلص من بعض الملوثات

4-لتوعية البيئية من خلال المراقبة وتنظيم برامج تعليمية وكتابة تحذيرات ووضع تشريعات ولوائح توضح مقاييس المواد والملوثات المسموح بتواجدها.

5-لتحسين كفاءة وصيانة الأجهزة العامة أو معدات الأحتراق للتقليل من الغازات واستخدام مرشحات للحد من الغازات المنطلقة.

6- البحث عن مصدر بديل ونظيف للطاقة مثل الطاقة الشمسية