Experience (1)

Conversions of units of measurement for gaseous pollutants and particulates

Objective Of the Experiment: To teach students to use measuring devices for gaseous and particulate pollutants and to make conversions between units of gaseous and particulate pollutants.

Theoretical Part :

Gas concentrations other than ozone are measured in Volumetric units or mass units. Specifies the mixing ratio of the volume of the polluted gas for example to the volume of the original air, It is the ratio of the number of pollutant gas particles to the total number of air particles There are three criteria:(ppm parts per million, ppb parts per billion, parts per terrilion ppt) . As for mass units, the mass of a substance is specified for a unit of air volume, for example (g/m^3) or (mg/m^3). It is recommended to use these units when extracting a gas concentration from the treated filter for chemical analysis or health effects related to the mass of the inhaled pollutant. Sometimes we use particles/m^3 to measure suspended particles, and the concentration of particulate pollutants can be measured by weighing them per unit area, such as mg/cm^2 or tun/$mile^2$.
These units of measurement can be converted at will (from volume to mass and vice versa), but this conversion must take into account standard weather conditions. For non-standard conditions, for example, under standard conditions (temperature 0 ° C and 1 atmospheric pressure), the conversion from mass to volume is from the relationship [1]:

$$C_x\left(\frac{mg}{m^3}\right) = \frac{C_x * ppm}{22.4} * M_x \qquad (1)$$

As for the non-standard conditions (temperature in Kelvin and pressure in Pascals), the conversion is:

$$C_x(ppm) = \frac{R * T}{P * M_x} * C_x\left(\frac{mg}{m^3}\right) \qquad (2)$$

Where 22.4 represents the volume of one mole of a pure gas with a relative molar mass at standard atmospheric conditions, Mx: molecular weight, R is the general constant for gases and its value is 8.314 J.mol^{-1}.K^{-1} [2].

Note: The amount of ozone in the atmosphere is measured using the Dobson unit, which is the weight of the ozone column from the surface to the top of the atmosphere. It is equal to about 2.7 * 1016 molecules/cm^2.

Materials and Tools used

1. Gas pollutants measuring devices, for example, a measuring device CO_2, SO_2, NO_2.
2. Particulate matter measuring devices such as aerosol meter or physical particle meter, filters, optical number use and other devices
3. Hand calculator.

Method of Work

1. We operate the pollutant and aerosol measuring devices located in the air pollution laboratory, after making sure that the battery is working well.
2. We record the readings every two minutes that you get from each of the devices and record the measurements in the table below.
3. We carry out the procedures for converting the units measured by these devices, according to the following table:

Unit Conversion (Average)	Readings the device in units used				pollutants
	Average	3	2	1	
					CO_2
					NO_2
					SO_2

Discussion

1. Discuss the results we obtained from the readings of the different devices, and what does reading each of these devices mean?
2. Discuss conversions for this reading from volumetric to mass and vice versa?
3. Is there an impact of weather factors on these readings and why?
4. Evaluate the readings you obtained and compare them with the internationally permissible limits, and what is the percentage of error in them and why?
5. How do you expect the readings of these devices to be if they are installed in other places, such as near the public street, intersection of cars, or in the university corridors, and why?