**Environmental Monitoring of Particulate Matters concentration (PM10) on Babylon province/ Iraq**

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**Abstract**

Particulate matter (PM) and other air pollutants can affect greatly on the health and quality of life of people, PM10 is of more concern to human health as the particles can enter the lungs, causing respiratory problems. Ambient particulate matter pollution investigated monthly by using Bam1020 for maturing PM10 concentrations on two stations of air monitoring (Hillah water project station and Babylon University station) in Babylon province at 2012 year.

The results showed that most of monthly average concentrations of PM10 were more than150μg/m3. Whereas the great concentrations of PM10 was at station of Hillah water project within April (576.25 μg/m3) and station of Babylon university within July (467.40 μg/m3).There are positive correlation between concentrations of PM10 with wind speed and air temperature, and negative correlation with relative humidity.

**Keywords**; particulate matter, air monitoring, PM10, Air pollution, Babylon

**Introduction**

**Air pollution occurs when gases, dust particles, fumes (or smoke) or odor are introduced into the atmosphere in a way that makes it harmful to humans, animals and plant**. The sources of air pollutants may be divided into anthropogenic and natural. However, as human activity disturbs natural systems, the distinction may become blurred[1]. Particle pollution is a mixture of microscopic solids and liquid droplets suspended in air, this pollution, also known as particulate matter, is made up of a number of components. Major sources of fugitive PM10 emissions are windblown dust emissions from the soil, roads and vehicles. High efficiency of street washing in reducing road dust loads was found by performing periodic samplings both on the treated and the untreated areas [2].

Many studies have demonstrated a close relationship between particulate matter (PM10) pollution and deterioration in human health. PM10 is one of the air contaminants that can be harmful to human health [3]. Generally, only fine particles of dust are of health concern. Dust particles PM10 or less in size are likely to have the greatest health effects because they may be drawn deep into the lungs. Particles larger than PM10 tend to be trapped in the nose, mouth, throat or major bronchi and are typically expelled from the body. There was a positive correlation between PM10 concentrations and number of children complaining about cough [4].

Therefore, in Europe the short-term limit value for PM10 (i.e. not more than 35 days per year with a daily average concentration exceeding 50 μg/m3) is the limit value most often exceeded in European cities and urban areas [5]. Levy et al [6] reported that the effects of PM10 were greater in cities where PM2.5 comprised a higher proportion of PM10. The PM10 range of the association is approximately a 0.5-1.6% increase in mortality per 10 μg/m3 increment of PM10. However, when longer exposure averaging time are examined, using distributed lags several days or cumulative exposures of up to several months, the estimated effects may be approximately a 2% increase in mortality per 10 μg/m3 increment of PM10 [7].

Dust particles originating from desert areas and transported around the globe are a subject of increasing scientific interest due to their effects on climate, biogeochemistry, and air quality ( [8]. Along with meteorological factors, the influence of the heating season and weekdays on the air pollution was considered [9].Moreover, Hussein et al.[10] suggests that traffic emissions are one of the main sources in the urban/suburban atmosphere.

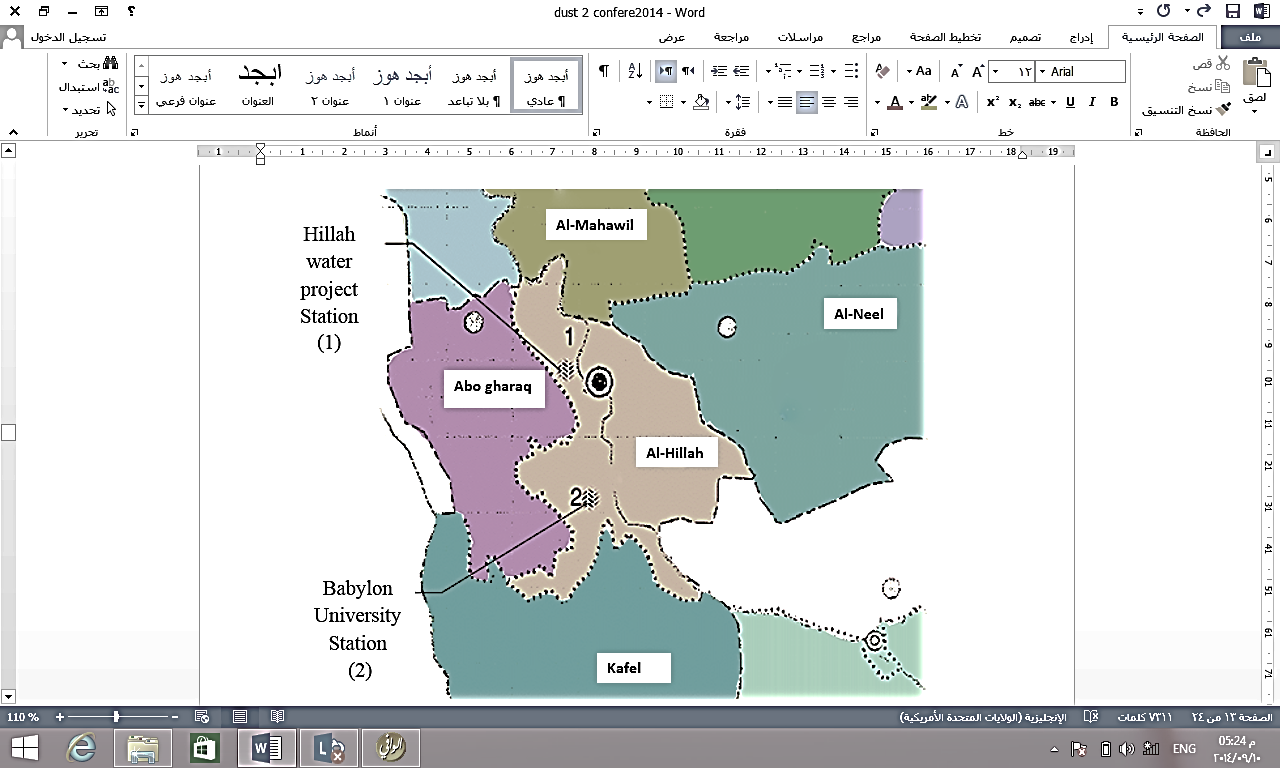
Brno and Graz, the second largest cities of Czech Republic, observe in each winter season PM10 concentrations of daily means, which regularly exceed the limit value of 50 μg/m3, this is mainly caused by unfavorable dissemination conditions of the ambient air [11].Air pollution consists of chemicals or particles in the air that can harm the health of humans, animals, and plants. PM10 levels of the mineral components Si, Al, Fe, Ca, Mg and some trace metals were measured at three different sites in the urban area of Vienna (Austria). Observed trace metal concentrations varied between less than 0.1 ngm-3 (Cd) and approximately 200 ngm-3 (Zn) [12]. Besides the reduction of visibility and the deposition of trace elements, the direct impact on human health via inhalation is an important issue [13].

Most importantly, these measures of particulate air pollution have been used in many epidemiological studies from around the world, of both mortality and morbidity of air pollution, and so provide the best overall indicator of exposure for our purposes. PM has been linked to serious effects on health after both short-term exposure (days to weeks), and more prolonged exposure (years), although there remains some uncertainty as to the distribution of induction times with regard to mortality. Ambient PM10 pollution was investigated in Korea from 1996 to 2010, the highest mean value for the whole study period is seen from the capital city, Seoul (63.2±17.9 μg m–3), while the lowest is from Ulsan (46.7±14.8 μg m–3) [14]. Padre et al [15] were concluded that knowing the history of air quality was not sufficient enough for prediction since the meteorological conditions also played an important role in the accumulation or removal of PM10 on the day of prediction. Quality of the air is one of the basic indicators of the overall quality of the environment [9]. Hence, the main objectives of this study are to PM10 measurements and investigate variations of PM10 concentrations within the months of years and relationship between PM10 concentrations and atmosphere premature .

**Materials and Methods**

**Study Area**

The study was conducted in twoair-monitoring stations in the city of Hillah, which represents the administrative center of the province of Babylon. Air monitoring station (1), Water Hillah Project is located in the northern center of the province on the coordinates (N 32 23 20 – E 44 23 60) and this site is located within the prevailing wind direction Up Wind. Air monitoring station (2) inside campus of University of Babylon is Located in the south of the center of the Babylon province on the coordinates. (N 32 30 56- E44 24 46 46.1), within the wind (Down Wind). Generally, the prevailing wind direction in Iraq is northwest and pass through the station 1 to the station number 2 (Figure 1).



**Fig.(1)** The study sites located on Babylon province, Air monitoring station (1) and Air monitoring station (2)

**Measurements**

Particulate matter pollution investigated monthly on 2012 year at two different sites within the city of Babylon. In each station there is a system of meteorological measuring, the system of temperature air by Met one (Model 592),relative humidity by Metone (Model 594), wind speed and direction by Wind sonic (Crill windsonis).Measurements of PM10 were conducted with the device Bam 1020,these instruments is automatically measures and records airborne particulate concentration levels using the principle of beta ray attenuation. This method provides a simple determination of concentration in units of milligrams or micrograms of particulate per cubic meter of air.

A small C-14 (Carbon 14) element emits a constant source of high-energy electrons known as beta particles. These beta particles are detected and counted by a sensitive scintillation detector. An external pump pulls a measured amount of dust-laden air through a filter tape. After the filter tape is loaded with ambient dust, it is automatically placed between the source and the detector thereby causing an attenuation of the beta particle signal. The degree of attenuation of the beta particle signal is used to determine the mass concentration of particulate matter on the filter tape, and hence the volumetric concentration of particulate matter in ambient air.

**Results and Discussion**

Atmospheric pollution is the presence of one or more contaminants in the air that can cause harmful to human health, animal life and vegetation. However, presents considerable challenges owing to the limited availability of information on both effects on health and on exposures to air pollution in many parts of the world. Indeed, PM is one of the most important pollutants as it penetrates into sensitive regions of the respiratory system and can lead to health problems and premature mortality. PM in the air has many sources and is a complex heterogeneous mixture whose size and chemical composition change in time and space, depending on emission sources and atmospheric and weather conditions [5]. Notable, PM10 a mass fraction of airborne particles with an aerodynamic diameter of 10 microns or less particulate matter comes from both human made and natural sources. Thereby, the aim of this study determine the concentration of particulate matter in outdoor ambient air of Hillah city that is necessary today for work to decrease of PM10.

The result showed that high monthly average of PM10 concentrations found in two stations at all months (figure 2 and 3).Especially, levels of PM10concentrations were very higher at station 1 during April (576.25 μg/m3) than other months, whereas the great concentrations of PM10 was within station 2 within July (467.40 μg/m3), but their most levels of PM10 are exceed than Iraqi suggestion limited concentrations150μg/m3[16]. Also, the data exhibited that the concentrations of PM10attwo stations seasonal variations with the peak values occurring consistently in April and July. Probably due to high temperature increases the activity of particles. It is important to assess whether the reductions that have taken place in the emissions of particulate matter into air and are reflected in the concentrations we measure.

**Fig.( 2)** PM10 concentrations on station of Babylon University during 2012 year

**Fig. (3)** PM10 concentrations on station of Hillah water project during 2012 year

Drought occurrence, climate aridity, lack of vegetation cover, unpaved road and wind speeds the increase PM10 concentrations during recent years in the Hillah region ;therefore, the maximal frequency of PM10 concentrations has been recorder in summer. The high depletion achieved for local deposited dust provoked a decrease of 7–10% of PM10 ambient concentrations, being the remaining measured non-exhaust particles emitted from the untreated stretch and/or the surrounding streets [2]. Accordingly, higher sources could be expected more concentrations belong to unsure faced of roads and land desertification. In addition, increasing of demolition and construction activities, industrial development, and vehicle emission and urbanization transformation has contributed to high amounts of PM10 concentrations at Hillah atmospheric. Mitigation measures attempt instead to remove or bind those particles PM10 emissions can arise from a number of sources, not only deconstruction activities need to be considered, but also emissions from on road vehicles and the additional use of exhaust filtration measures for high risk sites will reduce the remaining particulate emissions by a further 85 per cent [17].A study in Sweden, found that PM10 generated by erosion of road pavement by studded tires provoked an inflammatory responses in cells as potent as the response caused by diesel particles [18].

The results of statistical analysis indicate that positive correlation betweenPM10 with wind speed and air temperature, and negative correlation with relative humidity (Table 1 and 2).Meteorological conditions that effect on PM10 distribution, the higher PM10 concentrations distribution was observed when lower of humidity. Generally, the humidity varies inversely proportional with temperature. Therefore, higher PM10 concentration observed when temperature is high. Hrdlickova et al [9] reported that influence of the heating season and weekdays on the air pollution was considered. Furthermore, increasing concentrations of PM10 also showed when the speed of wind is higher. Seasonal variation of mixing heights, temperatures, winds and rainfall, accounts for the inter-annual variability of PM10 concentrations [19].

**Table (1)** Data of wind Speed, wind direction, air temperature, relative humidity and correlation factor with PM10 concentrations on station 1 during 2012.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Month/2012** | **W/Speed[m/s]** | **W/Dir. [°]** | **Air Temp. [°C]** | **R/Hum [%]** |
| January | 4.81 | 255.39 | 13.69 | 49.85 |
| February | 6.12 | 172.62 | 15.03 | 42.87 |
| March | 4.92 | 217.48 | 20.46 | 27.83 |
| April | 6.24 | 168.68 | 30.16 | 23.71 |
| May | 5.03 | 165.20 | 34.71 | 18.64 |
| June | 6.47 | 158.27 | 37.75 | 20.35 |
| July | 5.75 | 132.93 | 40.35 | 18.64 |
| August | 6.08 | 153.88 | 39.13 | 22.94 |
| September | 5.72 | 193.49 | 36.43 | 20.03 |
| October | 4.87 | 140.14 | 32.31 | 28.34 |
| November | 4.60 | 205.49 | 23.73 | 47.55 |
| December | 5.45 | 182.55 | 17.29 | 54.02 |
| Correlation Factor | 0.655 | -0.620 | 0.795 | -0.766 |

**Table (2)** Data of wind speed, wind direction, air temperature, relative humidity and correlation factor with PM10 concentrations on station2 during 2012.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Month/2012** | **W/Speed[m/s]** | **W/Dir. [°]** | **Air Temp. [°C]** | **R/Hum [%]** |
| January | 4.53 | 220.94 | 12.87 | 54.00 |
| February | 5.15 | 234.57 | 14.36 | 40.17 |
| March | 5.55 | 238.89 | 18.10 | 28.13 |
| April | 5.34 | 227.09 | 29.90 | 22.03 |
| May | 6.98 | 184.74 | 34.30 | 22.30 |
| June | 7.19 | 286.49 | 36.75 | 21.86 |
| July | 5.26 | 279.97 | 40.69 | 18.62 |
| August | 7.11 | 290.75 | 38.01 | 23.70 |
| September | 4.53 | 177.52 | 32.28 | 27.56 |
| October | 4.53 | 167.60 | 32.14 | 27.62 |
| November | 4.55 | 202.43 | 19.83 | 60.29 |
| December | 4.47 | 219.03 | 15.55 | 55.68 |
| Correlation Factor | 0.737 | 0.003 | 0.577 | -0.706 |

When compare the concentration of PM10 on Hillah city with other cities are remarkably higher PM10. The annual average concentration of PM10 at 2012 year were 320.03 and 274.18 μg/m3 on station 1 and station 2 respectively, while the annual mean concentrations of PM10 for the triennium 2004 in the cities Rome and Naples 42.7 and42.7μg/m3 respectively. The World Health Organization reported the limiting value of PM10 are20 μg/m3 annual mean and50 μg/m3 24-hour mean[20].

Particulate matter was a major contributor to these health effects and led to very poor visibility conditions. The European Directive for Ambient Air Quality and Cleaner Air for Europe set the limit values for various different pollutants, i.e., the maximum concentrations of pollutants in the air to avoid, prevent or reduce harmful effects on human health and/or the environment as a whole[21]. When the air pollutants enter the human body, they may cause adverse health effects. The assessment indicates that existing PM10 concentrations are associated with around 40–70 deaths per year and around 75–100 hospitalizations [22]. As well as the effects on mortality, respiratory and cardiovascular hospital admissions and other health variables have been observed at levels well below 100 μg/m3, expressed as a daily average PM10 concentration [23].Furthermore, the health impact of air pollution in Italian cities is large: 8220 deaths a year, on average, are attributable to PM10 concentrations above 20 μg/m3. This is 9% of the mortality for all causes (excluding accidents) in the population over 30 years of age; the impact on short-term mortality, again for PM10 above 20 μg/m3, is 1372 deaths, which is 1.5% of the total mortality in the whole population [24].

The health impacts associated with concentrations of suspended particles include effects such as coughs, asthma symptoms, bronchitis, respiratory illness and mortality. Currently, most epidemiological evidence and data on air quality that could be used for such estimates comes from developed countries. Many of epidemiological studies of different designs have reported the occurrence of a variety of adverse effects on health due to PM10 consistently. The current levels of PM exposure experienced by most urban and rural populations have harmful effects on human health. Chronic exposure to PM contributes to the risk of developing cardiovascular and respiratory diseases, as well as lung cancer [5]. Particulate matter (PM) in ambient air is considered one of the most hazardous pollutants to human health [20]. Highest PM levels were obtained on airborne particulate matter (PM 10) and its public health risks when exposures to populations of Hillah city.

For a targeted reduction of PM10 levels, detailed knowledge of concentrations and their respective contribution to increase the PM levels is required. Appropriate measures and applications for reduction of ambient PM10 levels should therefore consider the elements that caused air pollution with particulate matter. It necessitates the development of the air quality since accurate air quality forecast can help people to reduce/cancel outdoor activities on the days of high pollutant concentrations and avoid exceeding of the limiting value.

**Conclusions**

The data of PM10 concentrations that investigated monthly in two air quality monitoring stations in Hillah city are exhibited high level concentration and exposure to these levels of particulate matter is environmentalist concern because it is associated with various health effects. Many studies are emphasis that short- and long-term exposure to PM10 cause respiratory and cardiovascular diseases and even death. In order to reduce PM10 concentrations either preventive or mitigation strategies can be adopted such as paved roads, increase vegetation cover, speed controls on vehicle movements, regular cleaning of paved surfaces and using a mobile vacuum sweeper. However, the severing effects on health are caused by exposure to PM10 their concentrations in different seasons are importance in policy making decisions thereupon aiming to improve the air quality in Hillah city.

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