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Monitoring of PM10 concentrations on Babylon province, Iraq

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Abstract

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 during 2012 year.

The results showed that most of monthly average concentrations of PM10 were more than 150 μg/m^3. Whereas the great concentrations of PM10 was at station of Hillah water project within April (576.25 μg/m^3) and station of Babylon university within July (467.40 μg/m^3). There are positive correlation between concentrations of PM10 with wind speed and air temperature, and negative correlation with relative humidity.

Keyword: PM10, Air, Monitoring, Pollution, Babylon

Introduction

Air pollution occurs when gases, fumes (or smoke), dust particles or odour are introduced into the atmosphere in a way that results it harmful to plant, animals and humans. The air pollutants sources may be divided into natural and anthropogenic. However, as activity of human disturbs natural systems, the distinction may become blurred [1]. Particle pollution is a mixture of liquid droplets suspended and microscopic solids 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 decreasing road dust loads was found by acting periodic samplings on both the untreated areas and the treated [2].

Many studies have confirmed a close relationship between deterioration in human health and particulate matter (PM10) pollution. PM10 is one of the air contaminants that can be harmful to health of human [3]. Generally, only dust fine particles are of health concern. Dust particles PM10 or/and less in size are likely to have

the greatest health impacts because they may be gone deep into the lungs. Particles larger than PM10 tend to be hold in the nose, mouth, throat or major bronchi and are typically sent down from the body. There was a positive correlation between concentrations of PM10 and number of children complaining about cough [4]. Therefore, in Europe the short-term limit value for PM10 concentrations (i.e. not more than 35 days per year with a concentration of daily mean exceeding 50 $\mu g/m^3$) is the limit value most often exceeded in urban areas and European cities [5]. Levy et al [6] mentioned that the effects PM10 effects were greater in cities where PM2.5 included a higher percentage of PM10. The PM10 range of the imparting is a 0.5-1.6% increase in mortality per 10 $\mu g/m^3$ excess of PM10. However, when longer exposure averaging time are tested, using distributed delays several days or collective exposures of up to several months, the measured effects may be about a 2% rise in mortality per 10 $\mu g/m^3$ excess of PM10 [7].

The particles of dust originating from desert regions and transmigration around the globe are a subject of increasing interest of scientific due to their affects climate, air quality and biogeochemistry [8]. Along with meteorological elements, the effect of the warming season and weekdays on the pollution of air was considered [9]. Moreover, Hussein et al. [10] suggests that traffic emissions are one of the main sources in the urban/suburban atmosphere.

Graz and Brno, the second biggest cities of Czech Republic, show in each season of winter PM10 concentrations of everyday means, which regularly across the limit value of 50 $\mu g/m^3$, this is mostly affected by unfavorable dissemination circumstances of the environment air [11]. Air pollution consists of particles or chemicals in the air that can hurt the human health, animals, and plants. PM10 levels of the metals components Fe, Al, Si, Mg, Ca and some trace elements were determined at three various sites in the urban region of Vienna (Austria). Showed concentrations of trace metals differed between less than approximately 200 ngm^{-3} (Zn) and 0.1 ngm^{-3} (Cd) [12]. Moreover, the visibility reduction and the precipitation of trace metals, the direct affect health of human via inhalation is an imperative subject [13].

Main Notability, these evaluates of particulate air pollution have been employed in numerous researches of epidemiological from about the countries, of both morbidity and mortality of air pollution. PM levels has been related to severe impacts on health after exposure of short-term and more prolonged exposure (mounts and years). Ambient PM10 pollution was investigated in Korea from 1996 to 2010, the utmost average value for period within study is seen from Seoul (capital city) 63.2±17.9 $\mu g\ m^{-3}$, while the lowermost is from Ulsan 46.7±14.8 $\mu g\ m^{-3}$ [14]. Padre et al [15] were concluded that knowing the air quality history was not sufficient enough for estimate since the meteorological circumstances also occupied an important act in the PM10 removal or accumulation on the day of estimation. Quality of the air is one of the essential indicators of the overall the environment quality [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 parameters.

Materials and Methods

Study Area

The study was conducted in two air-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).

Measurements

Particulate matter pollution investigated monthly during 2012 year at two different sites within the province of Babylon. In each station there is a system of meteorological measuring, the system of temperature air by Metone (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 measures (automatically) and records concentration levels of airborne particulate using beta ray principle attenuation. This technique supplies a simple concentration measuring of particulate on the air in units of micrograms or milligrams per cubic meter. A small Carbon 14 element emits high-energy electrons from constant source (beta particles). An external pump pulls a determined quantity of dust-laden air within a tape of filter. After the tape of filter is loaded with dust, it is automatically employed between the source and the detector thus result an attenuation of the signal of beta particle.

The mass of particulate matter on volumetric concentration in air determine by the attenuation degree of the beta signal of particle.

Result and Discussion

Air pollution is became of one contaminants that can reason harmful to health of human, animal life and plant. Indeed, Particulate matter (PM) is one of the most important pollutants as it enters into sensitive zones of the respiratory system and can cause health problems and early mortality. There are many sources of PM in the air and is a composite heterogeneous mélange whose size and chemical structure change in time and space, depending on weather conditions, atmospheric and emission sources [5]. Notable, PM10 a mass fraction of air borne particles with an aerodynamic diameter of 10μm (microns) or less matter of particulate comes from both natural sources and human made.

The result showed that high monthly average of PM10 concentrations found in two stations at all months (figure 2 and 3). Especially, levels of PM10 concentrations were very higher at station 1 during April (576.25 $\mu g/m^3$) than other months, whereas the great concentrations of PM10 was within station 2 within July (467.40 $\mu g/m^3$), but their most levels of PM10 are exceed than Iraqi suggestion limited concentrations150 $\mu g/m^3$ [16]. Also, the data exhibited that the concentrations of PM10 at two stations monthly variations with the highest concentration occurring in April and July. Probably due to high temperature increases the activity of particles. It is important to evaluate whether the decreases that have occurred in the emissions of PM10 into air and are reflected in the measured of concentrations. 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 great depletion accomplished for local deposited dust motivated a reduction of 7–10% of PM10 ambient concentrations, being the assessed of remaining

non-exhaust particles released from the surrounding streets and/or the untreated stretch [2]. Accordingly, higher sources could be expected more concentrations belong to unsurfaced of roads and land desertification. In addition, increasing of demolition and construction activities, urbanization transformation and vehicle emission has associated to high quantities of PM10 concentrations at Hillah atmospheric. Mitigation measures attempt instead to eliminate or predicament those PM10 emissions can get up from a amount of sources, not only deconstruction actions require to be considered, but also emissions from on the further practice exhaust filtration measures and road vehicles will decrease the remaining emissions of particulate by a more 85 % [17]. The study in Sweden exposure that PM10 produced by road erosion pavement by studded tyres motivated a responses of inflammatory in cells as potent as the comeback affected by particles of diesel [18].

Statistical analysis indicate that positive correlation was between PM10 with wind speed and temperature of air, while negative correlation with relative humidity (Tables 1 and 2). The conditions of meteorological that effect on distribution of PM10, the higher PM10 concentrations distribution was observed when humidity reduced. Generally, the humidity differs inversely proportional with heating. Therefore, higher PM10 concentration showed when temperature is increase. Hrdlickova et al [9] reported that influence of the heating season and weekdays on the air pollution was considered. Furthermore, high concentrations of PM10 also showed when the speed of wind is increasing. Seasonal difference of mixing elevations, winds and rainfall, temperatures, accounts for the inter-annual variability of PM10 concentrations [19].

When compare the concentration of PM10 on Hillah city with other cities are remarkably higher PM10. The annual average concentration of PM10 in 2012 year were 320.03 and 274.18 $\mu g/m^3$ on station 1 and station 2 respectively, while the PM10 annual average concentrations for the triennium 2004 in Rome and Naples 42.7 and42.7$\mu g/m^3$ respectively. The World Health Organization reported the limiting value of PM10 are 20 $\mu g/m^3$ for annual mean and 50 $\mu g/m^3$ for 24 hour mean [20].

PM10 was a main contributor to these effects of health and cause very reduced visibility conditions. The European directive for quality of ambient air and cleaner air for Europe put on the limit values for numerous different pollutants, i.e., the maximum of pollutants concentrations in the air to avoid, prevent or decrease harmful effects on health of human or / and the environment as a whole [21]. The evaluation indicates that present concentrations of PM10 are contributed with around 40–70 deaths / year and about 75–100 hospitalizations [22]. As well as the affects cardiovascular hospital admissions and respiratory, mortality and other health variables have been showed at levels well below 100 $\mu g/m^3$, expressed as a daily main concentration of PM10 [23]. Furthermore, the health effect of air pollution in Italian cities is great (8220 deaths a year on average), are attributable to concentrations of PM10 over 20 $\mu g/m^3$. The mortality is 9% for all causes in the population (excluding accidents) over 30 years of age; the affect short-term mortality (for PM10 over 20 $\mu g/m^3$) is 1372 deaths, which is 1.5% of the total mortality [24]. The health effects contributed with concentrations of suspended particles contain effects such as asthma symptoms, coughs, respiratory illness, bronchitis and mortality. Presently, most evidence of epidemiological and data on quality of air that could be utilized for such determines comes from developed countries. Many of epidemiological researches of different projects have reported the amount of a variety affects health due to exposure into PM10 regularly. Chronic exposure to PM associated to the hazard of emerging respiratory and cardiovascular diseases, as well as cancer of lung [5]. PM in ambient air is regarded one of the

most dangerous pollutants to health of human [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 purpose, decrease of PM10 levels, comprehensive information of concentrations and their respective involvement to increase the levels of PM is required. Appropriate measures and applications for decreasing of PM10 levels in ambient air should therefore regarded the activities that caused air pollution with particulate matter. It requires the improvement of the quality of air since can advantage people to cancel / reduce outdoor activities and avoid exceeding of the limiting value.

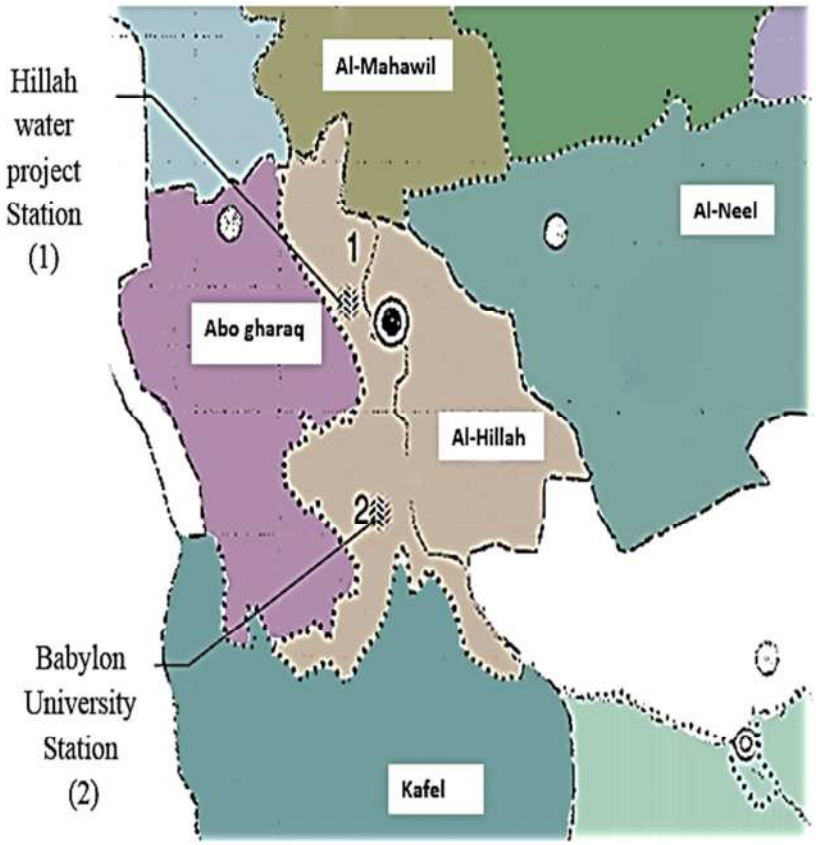

Figure 1: The study sites located on Babylon province, Air monitoring station (1) and Air monitoring station (2)

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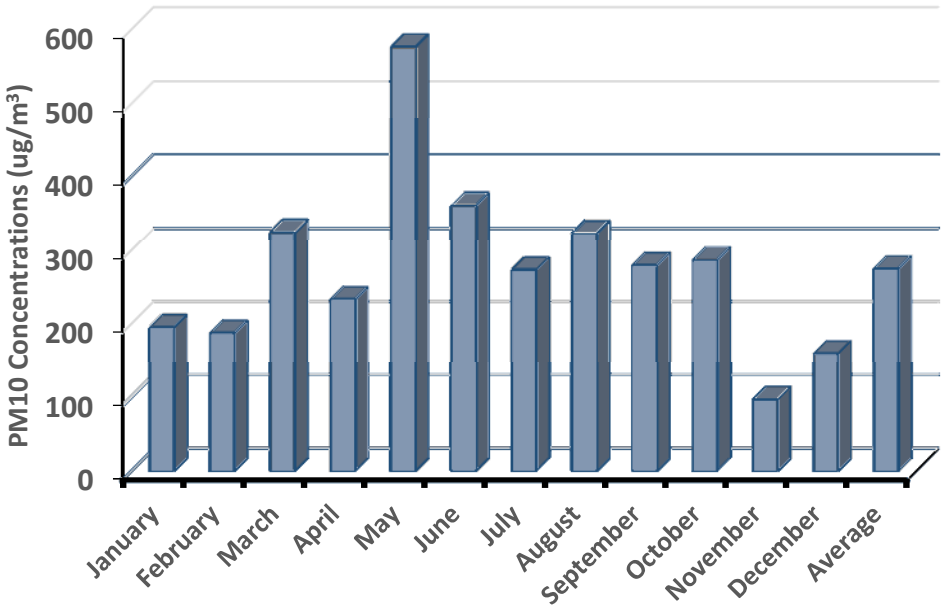

Figure 2: PM10 concentrations on station (1) of Hillah water project during 2012 year

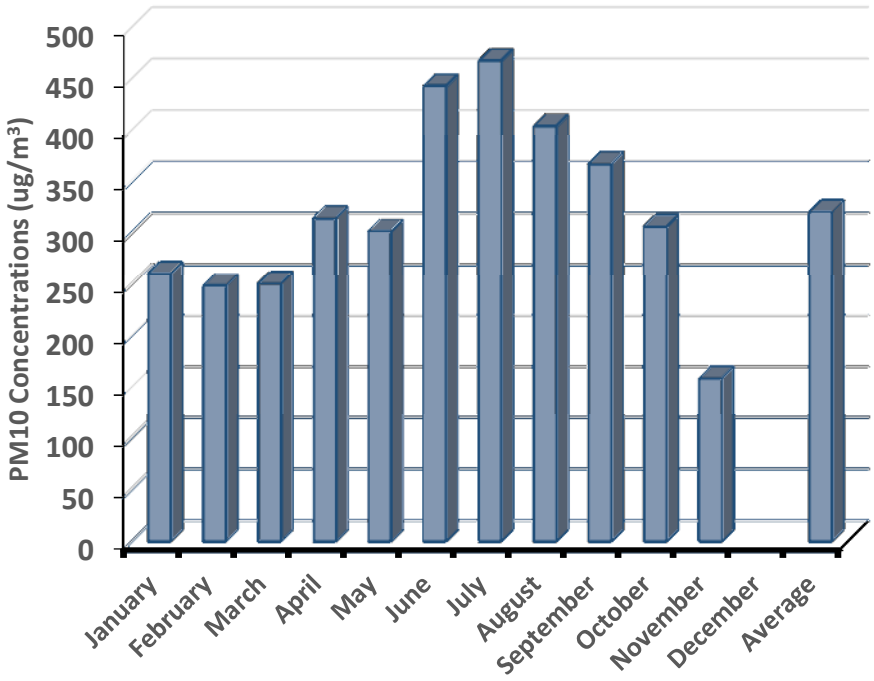

Figure 3: PM10 concentrations on station (2) of Babylon University during 2012 year

Table 1: Data of wind speed, wind direction, temperature of air, 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, temperature of air, 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

Conclusion

PM10 concentrations that investigated monthly in two air quality-monitoring stations in Hillah city are exhibited high concentration level and exposure to these levels of particulate matter is environmentalist concern because it is associated with various health effects. 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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