Air Pollution Levels by Re-suspended and Airborne Dust Due to Traffic Movement at the Main High Traffic Crossroads of Hilla City, Iraq

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Abstract:

This research includes a monitoring and an evaluation of the air pollution levels generated by the re-suspended and airborne dust due to traffic movement at the main busy crossroads of Hilla City, Nader Crossroad and Al-Thowra Crossroad, Iraq. The re-suspended dust is one of the most important contributors towards overall atmospheric pollution, especially when the roads are unpaved or under maintenance with high traffic load such as Nader Crossroad, which was under maintenance to construct a bridge on it. The concentrations of the total suspended particulate matters were determined at the two locations using portable air sampler during traffic rush hour on sunny moderated weekdays for four months, December 2011, February 2012, April 2012, and May 2012. The results have confirmed the contribution of the unpaved roads in air pollution. The results showed that the average *TSP* levels at Nader Crossroad was higher than the average *TSP* levels at Al-Thowra Crossroad during the total period of the study in which the minimum *TSP* level at Nader Crossroad was 5676.67 μg/m^3, which was higher than the maximum *TSP* level at Al-Thowra Crossroad, 4096.41 μg/m^3. In addition, the re-suspended dust concentrations that were measured in this study and ranged from 426.06 to 9348.95 μg/m^3 are much higher than the American Environmental Protection Agency acceptable limits of national ambient air quality standards for the particulate matter.

Keywords: Air pollution, Air quality, Airborne Dust, Crossroads Traffic, Particulate Matter, Reuspended dust, Suspended Particulate Matters

1- Introduction:

Hilla City is one of the most polluted cities in Iraq and only a few studies have been conducted in this area to assess the prevalent pollution levels that are in relation to the increasing roadside automobile traffic. The traffic load reached (3388 Vehicle/h) in peak hour [1]. Therefore, this study was carried out to assess the roadside dust levels at two high traffic intersections in Hilla City.

Many terms are used to categorize particulates depending on their size and phase (liquid or solid). The most general term is aerosol, which is applied to any tiny particles dispersed in the atmosphere (liquid or solid). Also, solid particles are called dust if they are generated by grinding or crushing operations [2]

The airborne dust plays a major part in the overall atmospheric pollution, and the motor vehicle emissions usually constitute the most significant source of ultra-fine particles in the urban environment [3], [4]. The smoke emitted by these vehicles is a mixture of particles and gaseous chemicals of varying physical and chemical properties [4], [5].

Additionally, the re-suspended dust is the major contributor to ambient particulate matter, especially in the coarse particle fraction. According to a European survey, the annual mineral dust load in PM10 varies from 13% to 37% in Europe with an increasing trend moving from rural background sites to sidewalk sites that are heavily influenced by traffic [6],[7]. This load is significantly low compared to the loads found in some arid areas. For example, in Arizona and Nevada US, fugitive dust sources (paved and unpaved roads and construction activities) account for more than 80% of PM10 [8], [9], and [10]. A comprehensive report on fugitive dust emissions and a bibliography of pertinent literature were prepared by Watson and Chow (2000) [11].

Gravel and other unpaved surfaces can provide good, economical roads for low traffic volumes. The produced dust, however, causes air pollution, slows plant growth, and damages the road surface. Although paving is the only permanent solution to dust problems, using effective controls can significantly reduce the dust and can reduce the required maintenance. Unpaved roads are the largest source of particulate air pollution. According to the Environmental Protection Agency, unpaved roads produce almost five times as much particulate matter as construction activities and wind erosion (the next two largest sources) combined. In addition to pollute the air, dust can be a health problem for nearby residents. It also settles on plants up to 500 feet from the road edge, slows their growth and reduces crop yields [12].

A single vehicle traveling on an unpaved road once a day for a year will produce one ton of dust per mile [12]. This translates to losing 100 tons of fine particles a year for each mile of road with an average of 100 vehicles a day. When these fines are lost as dust, it damages the gravel surface and exposes the larger aggregate pieces. These are then scattered by vehicles or washed away. The unstable road surface becomes rough, developing potholes and wash boarding. The water may be held and then maybe infiltrates and damages the base. In addition, the eroded material damages ditches and drainage systems, resulting in a frequent and an expensive required repairing [12].

2- Re-suspended dust problem:

The term re-suspension is commonly used to include both suspension of newly generated particles and re-entrainment of previously deposited particles into the atmosphere [10]. Re-suspension is a complex process that can be initiated by mechanical disturbances such as wind, traffic-induced turbulence and tire stresses, and construction activities. The windblown dust is often called 'natural dust' because of its origin from mostly non-urban areas that are subjected to suspension by wind [9]. In non-arid urban environments, particulate matter (PM) can be made available for re-suspension in a variety of ways, including application of traction sands or de-icing salts, track-out from construction sites and other unpaved areas, vehicle exhaust, tire and brake wear, oil leaks and spills from vehicles, wearing and maintenance of the streets, and atmospheric deposition of anthropogenic PM emissions [10],[13].

Road dust is an agglomeration of contributions from several anthropogenic and biogenic sources of particulate matter [14]. In all road environments, the dust from various sources accumulates on road shoulders, near the curbs and along center dividers [15]. Re-suspension, deposition, washout of materials on and off the road, and generation of new particles constitute a dynamic source and sink relationship in the traffic environment [14], [16]. Paved and unpaved roads are among the largest emitters of particulate matter in many urban areas, and numerous studies have shown that traffic-induced re-suspension is the predominant source of coarse particles and many elements at traffic-influenced sites [10],[17],[18],[19].

Furthermore, a study of traffic-related ambient concentrations of air pollution as a risk factor in the work environment of a group of street-cleaners emphasized that traffic-related air pollution is an occupational health hazard to individuals who perform physical labors close to traffic. Moreover, the public can also be affected in areas of high traffic density [4], [20].

3- The relationship between different types of dust:

Chemical composition of re-suspended dust varies from a location to another location due to the differences in the crystal composition. In addition to natural variation in composition of crystal dust in different regions, the composition of re-suspended dust may also be altered by enrichment of pollution-derived elements in surface soil [14],[19],[21],[22],[23].

Generally, particles from different sources and emission processes are often distinguished by their physical size and as highlighted for total suspended particles (TSP) in Figure (1), which explains the size distribution of several types of dust [11]. For road and soil dust, about 48% of TSP have a size distribution greater than 10 μm, about 42% of TSP have a size distribution from 10 μm to 2.5 μm, about 6% of TSP have a size distribution from 2.5 μm to 1 μm, and about 4% of TSP have a size distribution less than 1 μm [10]. Although there is a lack of data, it is expected that most of the road dust re-suspension particles, which are caused by the movement of vehicles on the street, will be in a size range 3 to some 30 μm [24].

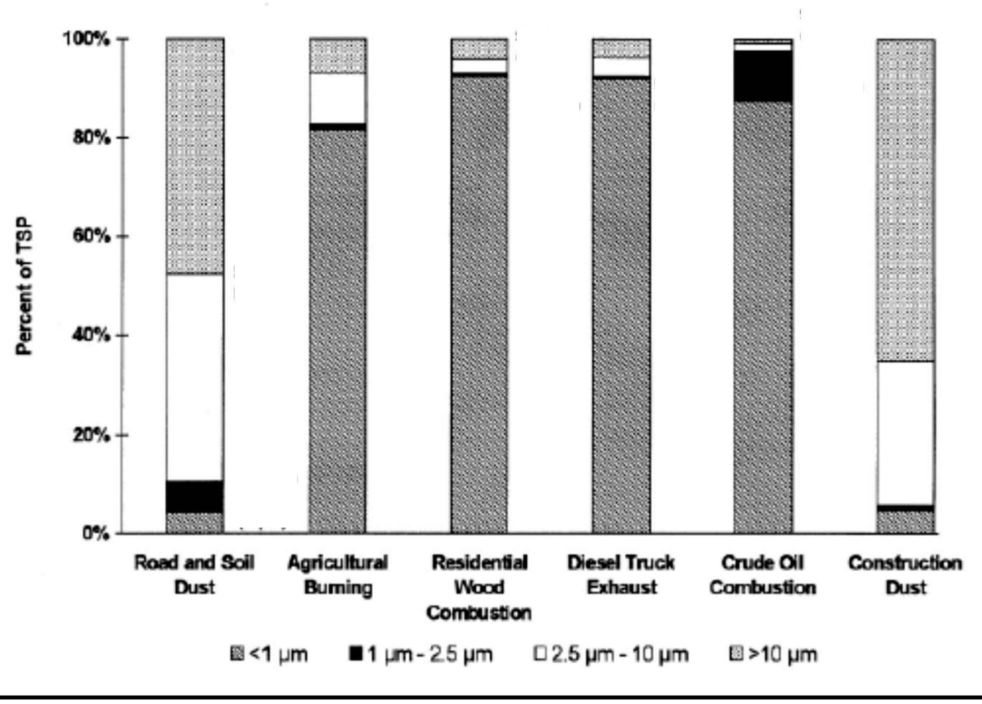

Figure (1): Size distribution of several types of dust [11].

4- The health effects of dust exposure:

The effects of dust exposure are summarized in this study according to exposure period into two parts:

1. Short-term increases (over hours to days) in particle pollution have been linked to:

- Death from respiratory and cardiovascular causes, including strokes [25].

- Increased numbers of heart attacks, especially among the elderly and in people with heart conditions [26].
- Inflammation of lung tissue in young, healthy adults [27].
- Increased hospitalization for cardiovascular disease, including strokes [28].
- Hospitalization for asthma among children [29].
- Aggravated asthma attacks in children [30].

2. Year-round exposure to particle pollution has also been linked to:

- Increased hospitalization for asthma attacks in children living near roads with heavy truck or trailer traffic [31].
- Stunted lung function growth in children and teenagers [32].
- Significant damage to the small airways of the lungs [33].
- Increased risk of heart attacks and strokes in older women [34].
- Increased risk of dying from lung cancer [35].
- Greater risk of death from cardiovascular disease [36].

5- Particulate matter (PM) standards:

The Clean Air Act, which was last amended in 1990, requires Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (40 CFR part 50) for pollutants considered harmful to public health and the environment. The Clean Air Act identifies two types of national ambient air quality standards. **Primary standards** provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. **Secondary standards** provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. The history of the National Ambient Air Quality Standards for particulate matter during the period 1971-2006 are listed in Table (1) [37], [38].

Table (1): History **of PM national ambient air quality standards [37], [38].**

Final Rule	Primary/ Secondary	Indicator	Averaging Time	Level μg/m^3	Form
1971	Primary	TSP	24-hour	260	Not to be exceeded more than once per year
			Annual	75	Annual Average
	Secondary	TSP	24-hour	150	Not to be exceeded more than once per year
1987	Primary and Secondary	PM_{10}	24-hour	150	Not to be exceeded more than once per year on average over a 3-year period
			Annual	50	Annual arithmetic mean, averaged over 3 years
1997	Primary and Secondary	$PM_{2.5}$	24-hour	65	98th percentile, averaged over 3 years
			Annual	15.0	Annual arithmetic mean, averaged over 3 years
		PM_{10}	24-hour	150	Initially promulgated 99th percentile, averaged over 3 years; when 1997 standards for PM10 were vacated, the form of 1987 standards remained in place (not to be exceeded more than once per

					year on average over a 3-year period)
			Annual	50	Annual arithmetic mean, averaged over 3 years
2006 71 FR 61144 Oct 17, 2006	Primary and Secondary	$PM_{2.5}$	24-hour	35	98th percentile, averaged over 3 years
			Annual	15.0	Annual arithmetic mean, averaged over 3 years
		PM_{10}	24-hour	150	Not to be exceeded more than once per year on average over a 3-year period

6- Methodology:

Study area and sampling locations:

Airborne dust was calculated at the two different sites in Hilla City. The first site was at Nader Crossroad which was unpaved road and the second site was at Al-Thowra Crossroad which is paved road already. The two crossroads are connected by a strategic street, which is 60 street. The locations of sampling on the study area are as shown in figure (2). The reason that leads to select these locations is the important location of 60 street roadway which has a different traffic situations:

As a highway: Most health and air quality studies implicating roadways as a public health concern have generally focused on highways supporting large volumes of traffic. These transportation facilities typically support a large number of passenger cars and large trucks operating at higher speeds during most times of the day. However, most urban highways experience regular periods of congestion during morning and afternoon rush hours at which time vehicles tend to operate at low speeds and/or even idle. On these high-speed highways, motor vehicle emissions occur primarily from fuel combustion, fluid evaporation, brake and tire wear, and re-suspended road dust [39].

As arterial road: Most urban areas also contain arterial roadways with large volumes of both passenger cars and large trucks, although these roads typically support much lower traffic volumes than highways. Some health studies suggested that residential proximity to arterial traffic emissions may relate to a higher public health risk than highway traffic emissions [39].

7- Sampling program:

During the survey, the samples took from a height 1.5 m above the curb. The intensive sampling program was conducted during traffic rush hour on sunny moderated weekdays for four months, December 2011, February 2012, April 2012, and May 2012 at the two locations. The sampling was repeating three times each month. These months, which are the study period, represent the cold weather condition in December and in February to moderately weather condition in April until the starting of the hot weather condition in May. These weather conditions represent the most moderately weather conditions in Iraq.

8-Materials and methods:

The sampling of airborne dust was done according to U.S. EPA / 435 ATMOSPHERIC SAMPLING [40] by using ‘PORTABLE AIR SAMPLER TYPE L60 MKIII 240V’ directly at the sampling locations with an inlet perpendicular to the roadway. This device depends on withdrawing air through the filter holder. Glass fiber filtration discs 6.0 Cm diameter were used as a filter and were heated under (105c°) for (15 minutes) to get rid of the moisture content in the filtration discs that prevents the particles from holding on the surface of the filtration discs. The filtration discs must stand on the 6cm filter holder.

The dragged air passes through a filtration membrane or filtration paper, and then the particulate matters (dust) gather on the filter. The membrane weight must be calculated before and after the measurement, and the difference between them is the weight of the gathered particulate matters on the membrane. Knowing the air flow rate and the withdrawing time, the volume of flowing air through the device can be calculated. By dividing the weight of gathered particulate matters on the volume of passed air we get the concentration of the particulate matters and as the following equation [40]:

$$TSP(\mu g/m^3) = \frac{w2 - w1}{V} \times 10^6$$

Where : *TSP* is the total suspended particulate matters.

w2 is the filter weight after the withdrawing in gram.

*w*1 is the filter weight before the withdrawing in gram.

V is the volume of the withdrawing air in cubic meter.

w2, and *w*1 were determined for each sample in the lab of the Department of Environmental Engineering / University of Babylon, after sampling directly so that the physical and chemical characteristics of samples did not change during transporting or saving from the river to the lab. After applying the above equation, *TSP* was calculated for each sample and summarized in Table (2) as an average daily concentrations of *TSP*.

Table (2): Average daily concentrations of *TSP*.

Sampling locations	Sampling date		*TSP* (μg/m³)	Average *TSP* (μg/m³)
	Month	Day		
Nader Crossroad	December / 2011	15	3305.32	6529.31
		22	7142.85	
		29	9139.78	
	February / 2012	9	9348.95	6737.51
		16	5385.56	
		23	5478.03	
	April / 2012	1	5215.36	5676.67
		15	5472.52	
		29	6342.15	
	May / 2012	12	7332.25	6306.01
		19	3252.45	
		26	8333.33	
Al-Thowra Crossroad	December / 2011	15	634.92	4096.41
		22	3876.54	
		29	7777.77	
	February / 2012	9	2756.89	1860.64
		16	2398.98	
		23	426.06	
	April / 2012	1	2147.63	2533.63
		15	2273.52	
		29	3179.76	
	May / 2012	12	2641.97	1823.85
		19	1328.32	
		26	1501.27	

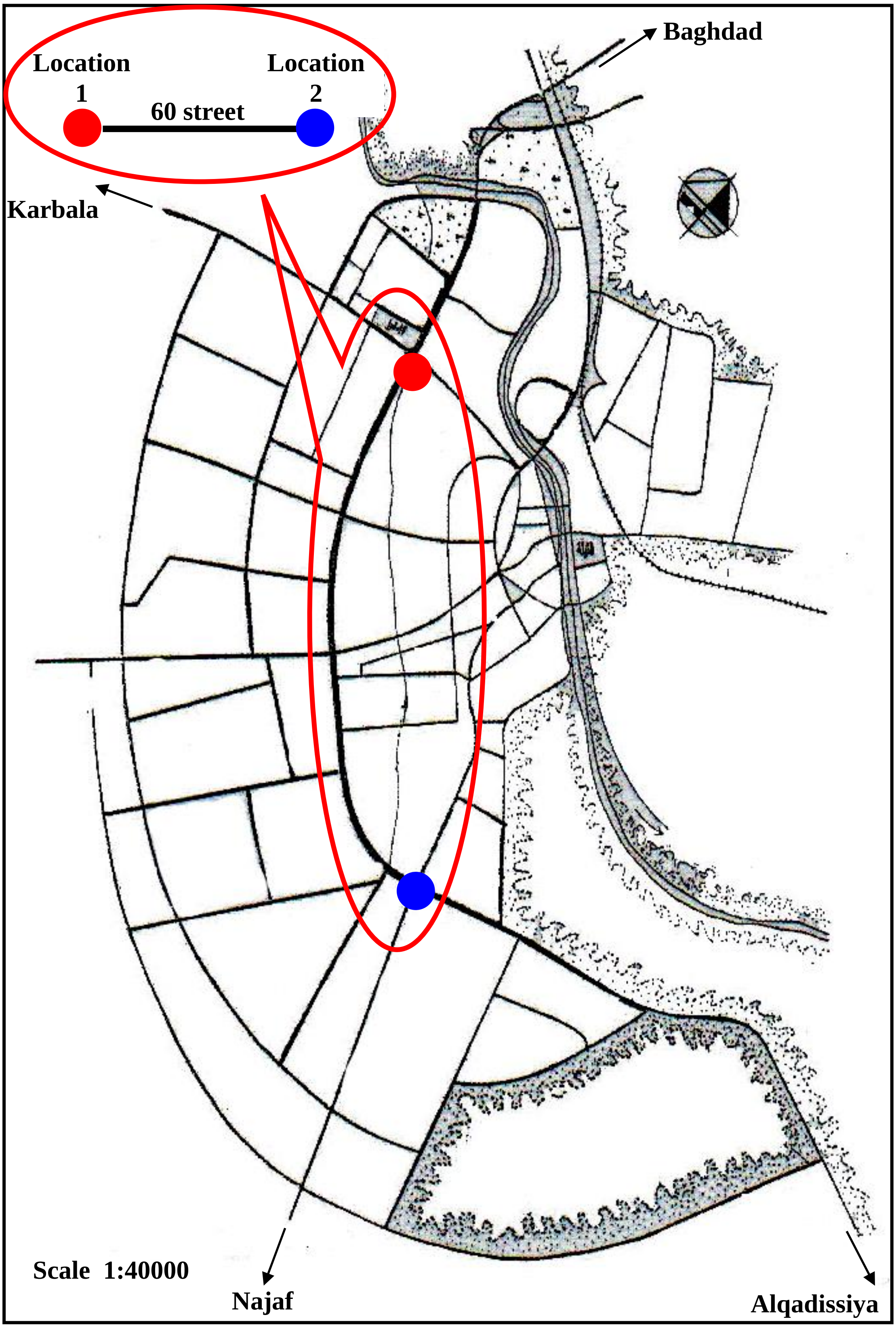

Figure (2): Sampling locations and the study area, Hilla City.

9- Results and discussion:

After the experimental works and tests had been done for the two crossroads, Nader Crossroad and Al-Thowra Crossroad, for a period of time of four months, the concentration and the average of the roadside dust (*TSP*) were obtained for each location as shown in Table (2).

Figures (3, and 4) show the variation of the average total suspended particulate matters with time at the two crossroads. The *TSP* levels at Nader Crossroad were higher than the *TSP* levels at Al-Thowra Crossroad during the total period of the study. The results refer to that, at Nader Crossroad, the maximum average value of *TSP* concentration is 6737.51 $\mu g/m^3$ which occurred during February and the minimum average value of *TSP* concentration is 5676.67 $\mu g/m^3$ which occurred during April ;while at Al-Thowra Crossroad, the maximum average value of *TSP* concentration is 4096.41 $\mu g/m^3$ which occurred during December and the minimum average value of *TSP* concentration is 1823.85 $\mu g/m^3$ which occurred during May. We can see clearly that the minimum *TSP* level at Nader Crossroad was higher than the maximum *TSP* level at Al-Thowra Crossroad. The large difference in *TSP* levels between the two crossroads can be attributed to the paved surface at Al-Thowra Crossroad and unpaved surface at Nader Crossroad. This confirms that "the unpaved roads are the largest source of particulate air pollution in the country" (Chunhua Han, 1997). The minimum average level of *TSP* concentrations for each location through the period of investigating is much higher than the acceptable limits of national ambient air quality standards for particulate matter in its two types, 260 $\mu g/m^3$ for the primary standards and 150 $\mu g/m^3$ for the secondary standards (U.S. Environmental Protection Agency, 2006, 2011).

Figures (5 to 8) show a comparison in total suspended particulate matters levels between Nader Crossroad and Al-Thowra Crossroad during the same day in the period of investigation (December, February, April, and May); as well as, the acceptable limits of national ambient air quality standards for particulate matter (primary standards, 260 $\mu g/m^3$). Based on these figures, *TSP* levels at Nader Crossroad are much higher than *TSP* levels at Al-Thowra crossroad during the total investigation period. The re-suspended dust concentrations that were measured in this study ranged from (426.06 - 9348.95) $\mu g/m^3$. These concentrations are dangerous on human health as we showed previously in the effects of dust exposure where different studies provide further evidence that long-term exposure to air pollution of rather low levels are associated with higher prevalence of respiratory symptoms in adults. Although Al-Thowra Crossroad, which is paved, has low levels, it is still much higher than the acceptable limits. This is a reflection to Iraqi weather conditions that is courage us to increase the vegetation and afforestation around the towns and roads to decrease the effect of traffic on the generation of re-suspended dust.

10- Conclusions:

Hilla city suffers from high levels of air pollution. Among the sources that contribute significantly to the air pollution problem in Iraq are the re-suspended dust as a result of traffic movement as well as roads surface (paved, or unpaved), where the paved surface decreases the amount of re-suspended dust. The results of the present study have shown that high levels of air pollution by re-suspended dust ranged from (426.06 - 9348.95) $\mu g/m^3$, and exceeded the permissible limits of primary and secondary national ambient air quality standards for particulate matter.

Therefore, it is necessary to analysis each sample and knowing its size distribution to know the re-suspended dust components and its main sources. In addition, increasing the vegetation and afforestation around the towns and roads in Hilla City and paving its roads can reduce the amount of re-suspended dust. Also, it is necessary to proper cleaning, widening and maintenance of the roads, removal of encroachments, making pavements of sidewalks and effective sewerage system for smooth traffic flow.

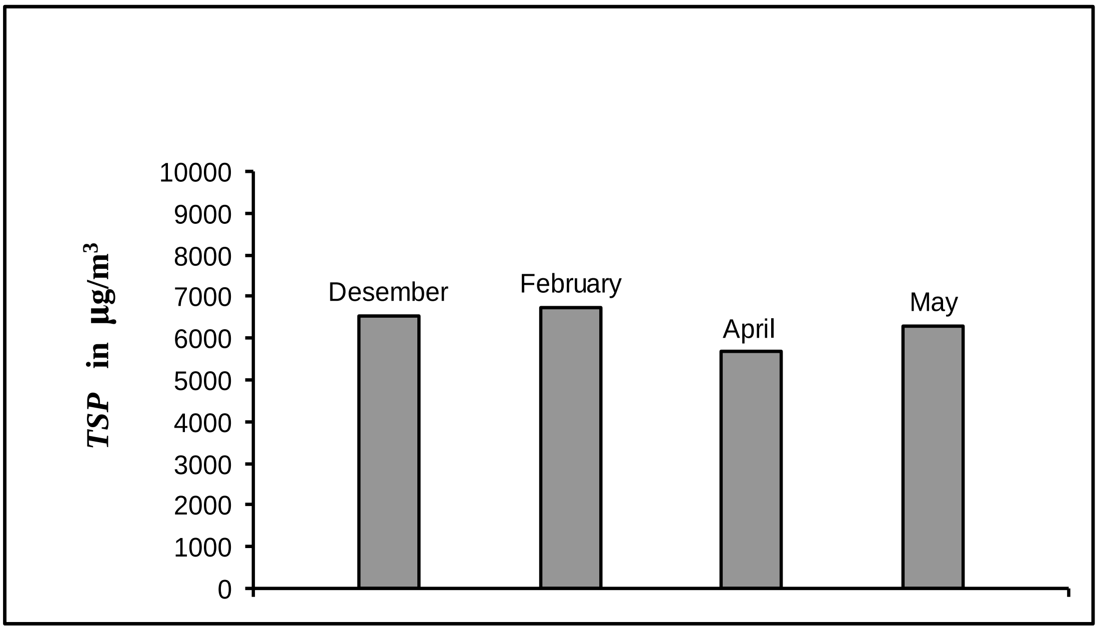

Figure (3): Average *TSP* levels at Nader Crossroad.

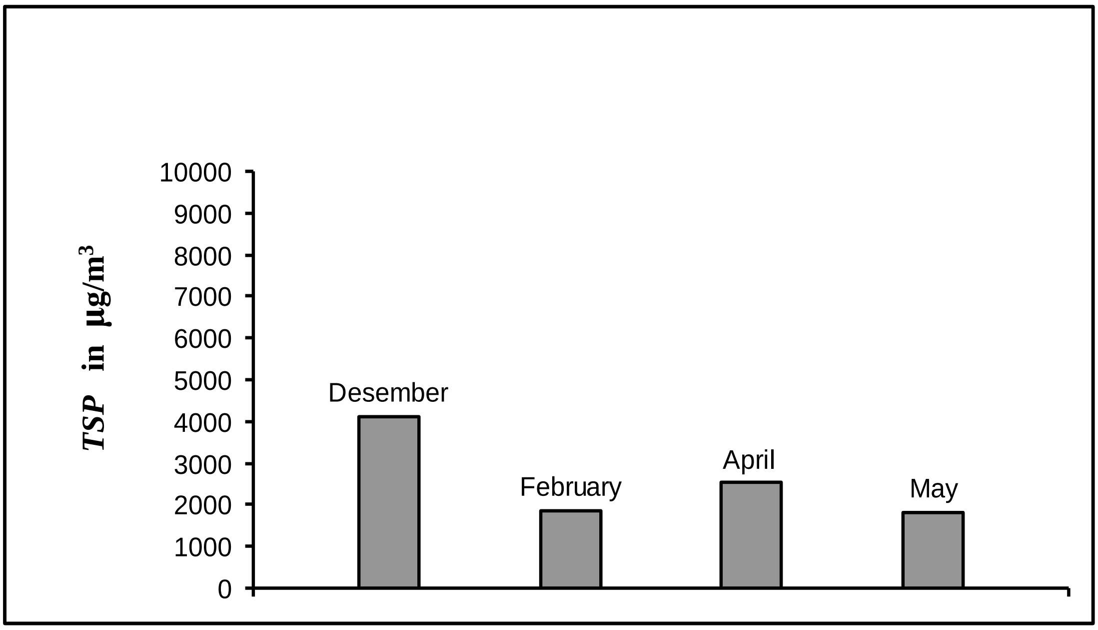

Figure (4): Average *TSP* level at Thowra Crossroad.

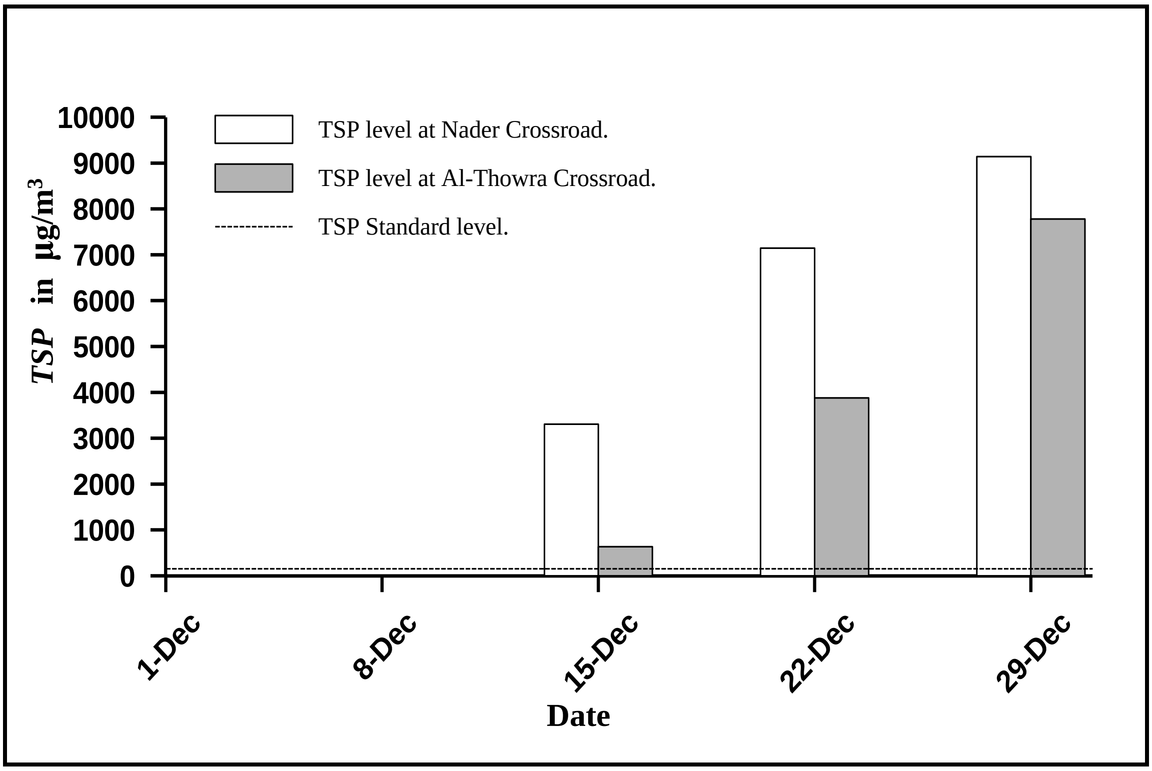

Figure (5): Comparison in *TSP* levels between Nader Crossroad and Al-Thowra Crossroad during December.

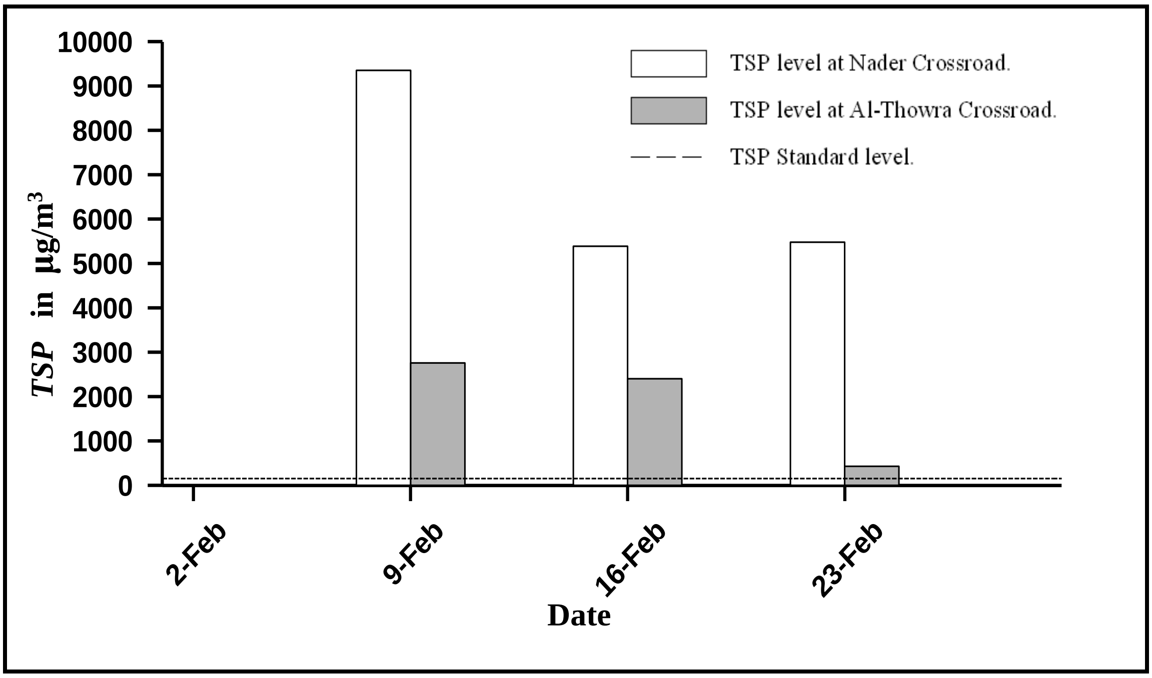

Figure (6): Comparison in *TSP* levels between Nader Crossroad and Al-Thowra Crossroad during February.

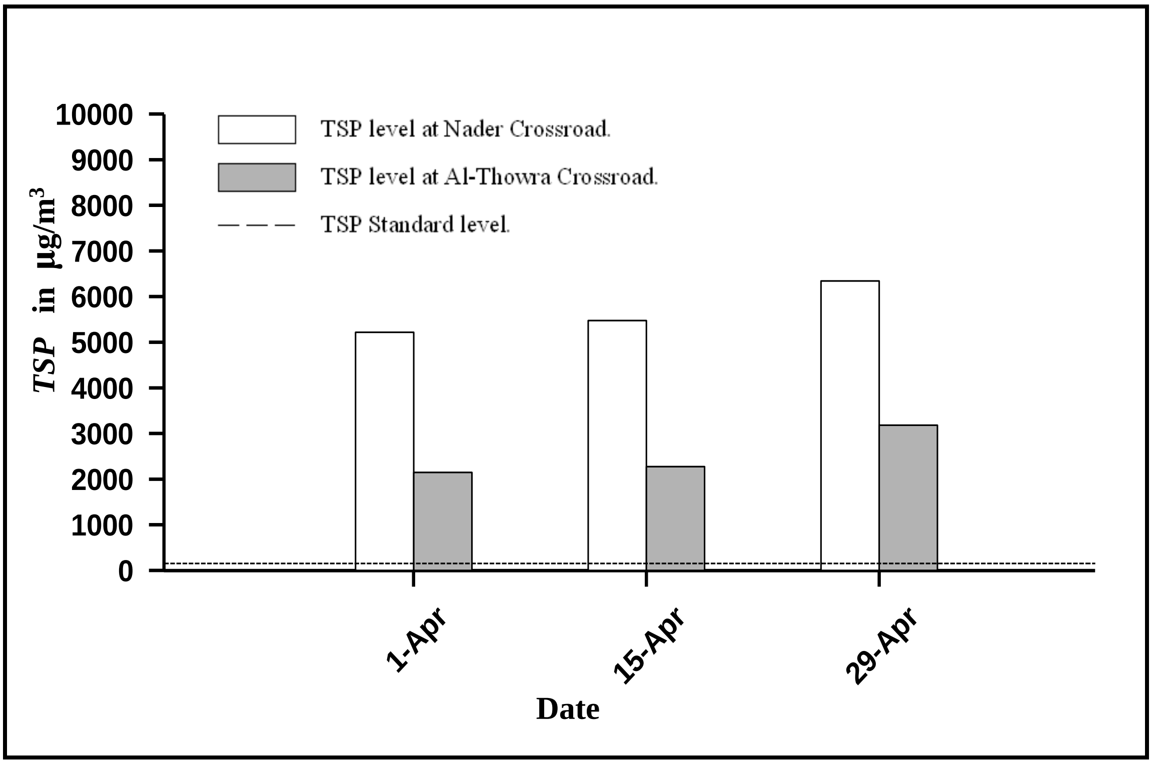

Figure (7): Comparison in *TSP* levels between Nader Crossroad and Al-Thowra Crossroad during April.

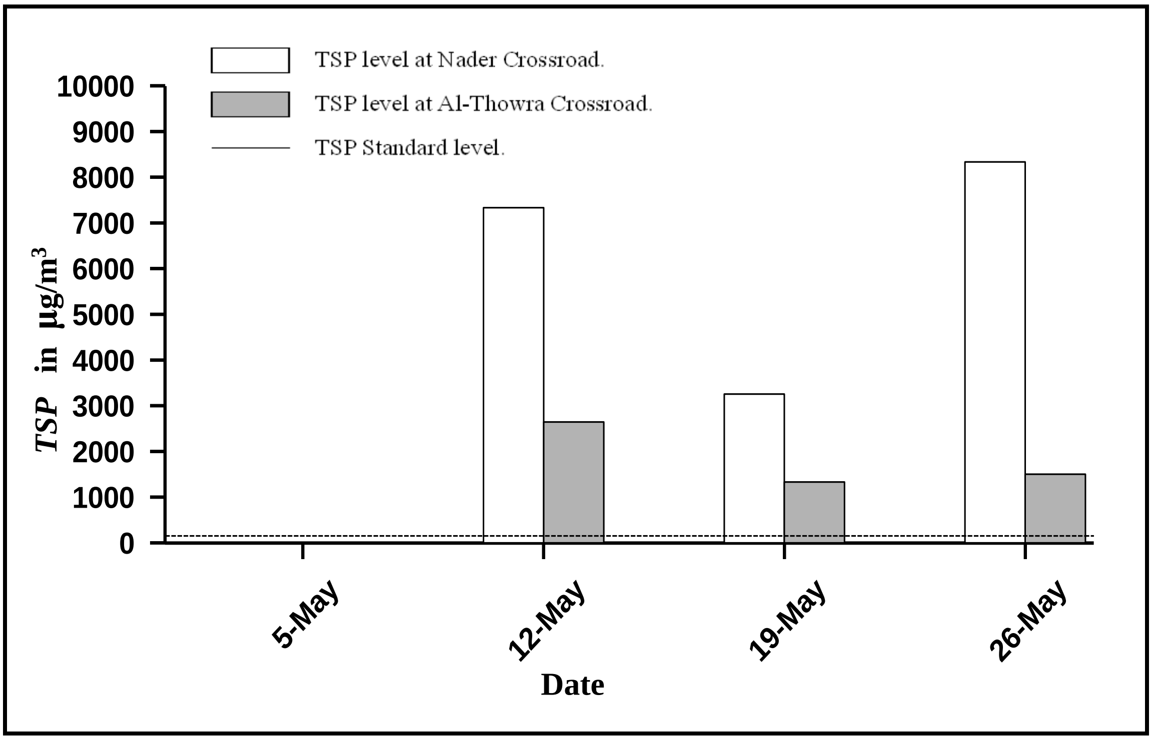

Figure (8): Comparison in *TSP* levels between Nader Crossroad and Al-Thowra Crossroad during May.

CONFLICT OF INTERESTS.

- There are no conflicts of interest.

References:

[1] Al-Khalidy, Khalid Safa'a "Estimation of Carbon Monoxide (CO) Concentration in Crowded Streets at Hilla City" Journal of Babylon university, Vol.17, No.3, 2009.

[2] Masters, Gilbert M. "Introduction to Environmental Engineering and Science" Stanford University, 2005.

[3] Zhu Y, Hinds WC; and Kim S, Sioutas C., "Concentration and size distribution of ultrafine particles near a major highway" J Air Waste Manag Assoc 2002; 52(9):1032-42.

[4] Jafary, Zafar Altaf ; Faridi, Ilyas Ahmed; and Qureshi, Hamid Javaid "Effects of Airborn dust on Lung Function of The Exposed Subjects" Pak J Physiol 2007;3(1), PP. 31.

[5] Hill IR., "Reaction to particles in smoke" Toxicology 1996; 115(1-3):119-22.

[6] Putaud J; Raes F; Van Dingenen R; Brüggemann E; Facchini M-; Decesari S; Fuzzi S; Gehrig R; Hüglin C; Laj P; and et al. "A European aerosol phenomenology 2: chemical characteristics of particulate matter at kerbside, urban, rural and background sites in Europe" Atmos Environ 38: 2579-2595, 2004.

[7] Van Dingenen R; Raes F; Putaud J; Baltensperger U; Charron A; Facchini M-; Decesari S; Fuzzi S; Gehrig R; and Hansson H., "A European aerosol phenomenology 1: physical characteristics of particulate matter at kerbside, urban, rural and background sites in Europe" Atmos Environ 38: 2561-2577, 2004.

[8] Gertler AW; Lowenthal DA; and Coulombe WG. "PM10 Source Apportionment Study in Bullhead City, Arizona" J Air Waste Manage Assoc 45: 75-82, 1995.

[9] Chow JC; Watson JG; Green MC; Lowenthal DH; DuBois DW; Kohl SD; Egami RT; Gillies J; Rogers CF; Frazier CA; and Cates W., "Middle- and neighborhood-scale variations of PM10 source contributions in Las Vegas, Nevada" J Air Waste Manage Assoc 49: 641-654, 1999.

[10] Vallius, Marko "Characteristics and sources of fine particulate matter in urban air" Publications of the National Public Health Institute A6 / 2005. 79 pages.

[11] Watson JG; and Chow JC. "Reconciling Urban Fugitive Dust Emissions Inventory and Ambient Source Contribution Estimates" Summary of Current Knowledge and Needed Research. DRI Document No. 6110.4F, 2000.

[12] Chunhua Han, "Dust Control on Unpaved Roads" Wisconsin Transportation Bulletin NO.13, and Available through National Technical Information Services, Springfield, VA 22161, 1997.

[13] Claiborn C; Mitra A; Adams G; Bamesberger L; Allwine G; Kantamaneni R; Lamb B; and Westberg H., "Evaluation of PM10 emission rates from paved and unpaved roads using tracer techniques" Atmos Environ 29: 1075-1089, 1995.

[14] Rogge WF; Hildemann LM; Mazurek MA; Cass GR; and Simoneit BRT "Sources of Fine Organic Aerosol .3. Road Dust, Tire Debris, and Organometallic Brake Lining Dust – Roads as Sources and Sinks" Environ Sci Technol 27: 1892-1904, 1993.

[15] Etyemezian V; Kuhns H; Gillies J; Chow J; Hendrickson K; McGown M; and Pitchford M "Vehicle-based road dust emission measurement (III):: effect of speed, traffic volume, location, and season on PM10 road dust emissions in the Treasure Valley, ID". Atmos Environ 37: 4583-4593, 2003.

[16] Kuhns H; Etyemezian V; Green M; Hendrickson K; McGown M; Barton K; and Pitchford M "Vehicle-based road dust emission measurement - Part II: Effect of precipitation, wintertime road sanding, and street sweepers on inferred PM10 emission potentials from paved and unpaved roads" Atmos Environ 37: 4573-4582, 2003.

[17] Ruellan S; and Cachier H, "Characterisation of fresh particulate vehicular exhausts near a Paris high flow road" Atmos Environ 35: 453-468, 2001.

[18] Manoli E; Voutsa D; and Samara C, "Chemical characterization and source identification/apportionment of fine and coarse air particles in Thessaloniki, Greece" Atmos Environ 36: 949-961, 2002.

[19] Sternbeck J; Sjödin A; and Andreasson K "Metal emissions from road traffic and the influence of resuspension - results from two tunnel studies" Atmos Environ 36: 4735-4744, 2002.

[20] Nielsen OR; Nielsen ML; and Gehl J "Traffic-related air pollution: Exposure and health effects in Copenhagen street cleaners and cemetery workers" Arch Environ Health 1995; 50(3):207-13, 1995.

[21] Yatin M; Tuncel S; Aras NK; Olmez I; Aygun S; and Tuncel G, "Atmospheric trace elements in Ankara, Turkey: 1. Factors affecting chemical composition of fine particles" Atmos Environ 34: 1305-1318, 2000.

[22] Begum BA; Kim E; Biswas SK; and Hopke PK "Investigation of sources of atmospheric aerosol at urban and semi-urban areas in Bangladesh" Atmos Environ 38: 3025-3038, 2004.

[23] Conko KM; Rice KC; and Kennedy MM "Atmospheric wet deposition of trace elements to a suburban environment, Reston, Virginia, USA" Atmos Environ 38: 4025-4033, 2004.

[24] European Commission "Ambient Air Quality by particulate matter" Position Paper. Experts from Denmark, France, Germany (co-chair), the Netherlands, Spain, the United Kingdom (cochair), the Commission (DGXI Environment and DGXII Research), UNICE (Union of Industrial and Employers Confederations of Europe), the European Environment Bureau, the European Environment Agency, the Joint Research Centre (Ispra) and the World Health Organization, 1997.

[25] Dominici F; McDermott A; Zeger SL; and Samet JM , "On the Use of Generalized Additive Models in Time-Series Studies of Air Pollution and Health" Am. J. Epidemiol ;156:193-203, 2002.

[26] D'Ippoliti D; Forastiere F; Ancona C; Agabity N; Fusco D; Michelozzi P; and Perucci CA, "Air Pollution and Myocardial Infarction in Rome: a case-crossover analysis" Epidemiology;14:528-535, 2003.

[27] Ghio AJ; Kim C; and Devlin RB "Concentrated Ambient Air Particles Induce Mild Pulmonary Inflammation in Healthy Human Volunteers" Am J Respir Crit Care Med 2000;162:981-988.

[28] Dominci F; Peng RD; Bell ML; Pham L; McDermott A; Zeger SL; and Samet JM "Fine Particulate Air Pollution and Hospital Admission for Cardiovascular and Respiratory Diseases" JAMA;295:1127-1134, 2006.

[29] Norris G; YoungPong SN; Koenig JQ; Larson TV; Sheppard L; and Stout JW, "An Association Between Fine Particles and Asthma Emergency Department Visits for Children in Seattle" Environ Health Perspect;107:489-493.

[30] Slaughter JC; Lumley T; Sheppard L; Koenig JQ; and Shapiro GG (2003) "Effects of Ambient Air Pollution on Symptom Severity and Medication Use in Children with Asthma"Ann Allergy Asthma Immunol; 91:346-53, 1999.

[31] Lin S; Munsie JP; Hwang SA; Fitzgerald E; and Cayo MR, "Childhood Asthma Hospitalization and Residential Exposure to State Route Traffic" Environ Res;88:73-81, 2002.

[32] Gauderman WJ; Avol E; Gilliland F; Vora H; Thomas D; Berhane K; McConnell R; Kuenzli N; Lurmann F; Rappaport E; Margolis H; Bates D; and Peters J , "The Effect of Air Pollution on Lung Development from 10 to 18 Years of Age" NEJM 2004;351:1057-1067, 2004.

[33] Churg; A Brauer; M; Avila-Casado; MdC; Fortoul TI; and Wright JL, "Chronic Exposure to High Levels of Particulate Air Pollution and Small Airway Remodeling" Environ Health Perspect 2003; 111: 714-718, 2003.

[34] Miller KA; Siscovick DS; Sheppard L; Shepherd K; Sullivan JH; Anderson GL; and Kaufman JD "Long-Term Exposure to Air Pollution and Incidence of Cardiovascular Events in Women" N Engl J Med 2007; 56:447-458, 2007.

[35] Pope CA; Burnett RT; Thun MJ; Calle EE; Krewski D; Ito K; and Thurston GD "Lung Cancer, Cardiopulmonary Mortality, and Long-Term Exposure to Fine Particulate Air Pollution"JAMA 2002;1132-1141, 2002.

[36] Pope CA III; Burnett RT; Thurston GD; Thun MJ; Calle EE; Krewski D; and Godleski JJ "Cardiovascular Mortality and Year-round Exposure to Particulate Air Pollution: epidemiological evidence of general pathophysiological pathways of disease" Circulation. 2004;109:71-77.

[37] U.S. Environmental Protection Agency "National Ambient Air Quality Standards for Particulate Matter"; Final Rule. Federal Register Volume 71, Number 200,Pages : 61144-61233, 2006.

[38] U.S. Environmental Protection Agency, "Particulate Matter (PM) Standards - Table of Historical PM NAAQS" http://www.epa.gov, 2011.

[39] Baldauf, R.; Watkins N.; Heist, D.; Bailey, C.; Rowley, R.; and Shores, R. "Near-road air quality monitoring: Factors affecting network design and interpretation of data"Air Qual Atmos Health , 2009, 2:1–9.

[40] U.S. Environmental Protection Agency "435 Atmospheric Sampling" Air Pollution Training Institute APTI 435, 1983.

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مستويات تلوث الهواء الناتج عن الغبار المتصاعد والمحمول بالهواء بسبب حركه المرور في تقاطعات الطرق ألرئيسيه الأكثر ازدحاما في مدينه ألحله، العراق

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ألخلاصه

يتضمن هذا البحث عمليه مراقبه وتقييم لمستويات تلوث الهواء الناتج عن الغبار المتصاعد والمحمول بالهواء بسبب حركه المرور في تقاطعات الطرق الأكثر ازدحاما في مدينه ألحله وهي تقاطع نادر وتقاطع ألثوره. إن الغبار المتصاعد هو واحد من أكثر مصادر تلوث الهواء المساهم في التلوث الجوي الكلي وخصوصا عندما تكون الطرق غير مبلطه أو تحت الصيانة وبحمل مروري عالي مثل مايحصل ألان في تقاطع نادر الذي هو تقاطع رئيسي غير مبلط حاليا كونه تحت عمليه صيانة لأقامه مجسر عليه. تم إيجاد تراكير الدقائق العالقة الكلية للموقعين بواسطة جهاز اخذ العينات المحمول خلال ساعة الازدحام المروري وفي جو مشمس ومعتدل ولأربعه شهور(كانون الأول 2011، شباط 2012، نيسان 2012، أيار 2012). قد أكدت النتائج مساهمه الطرق غير ألمبلطه في تلوث الهواء. بينت النتائج أن معدل مستويات الدقائق العالقة في تقاطع نادر أعلى من معدلاتها في تقاطع ألثوره طوال فتره الدراسة حيث كان اقل مستوى للدقائق العالقة في تقاطع نادر(5676,67 مايكرو غرام/م^3) هو أعلى من أعلى مستوى للدقائق العالقة في تقاطع ألثوره (4096,41 مايكرو غرام/م^3). كما بينت النتائج أن تركيز الغبار المتصاعد ألمقاسه في هذه الدراسة (9348.95-426.06) مايكرو غرام/م^3 هي أعلى بكثير من الحدود المسموحه في المواصفات ألقياسيه لوكالة حماية البيئة الامريكيه.

الكلمات الدالة: تلوث الهواء، نوعيه الهواء، الغبار المحول بالهواء، الازدحام في تقاطعات الطرق، الدقائق، الغبار المتطاير، المواد العالقه.