

# Study on Concentration of Suspended Particles in Different Parts of Tehran City during 2009- 2010

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**Abstract** – Development of technology and increasing population caused environmental pollution, especially air pollution. Since the suspended particles considered as main contaminants of Tehran city, In this study the concentration of air suspended particles available during the years 2009 to 2010 in various parts of Tehran were studied & compared with standard level. Also with using Software SPSS and T-Test paired, Maximum contaminants concentration at each station was compared in 2009 and 2010. The results indicate that Municipality region No. 22 showed the highest level of contamination and Region No. 20 the lowest pollution level among the four stations studied during the years 2009 to 2010.

**Keywords** – Pollution, Suspended Particles, Tehran, Station, PM<sub>10</sub>.

## I. INTRODUCTION

The existence of hazardous materials, in addition to natural compounds in the atmosphere caused by natural phenomena or human activities is called air pollution. The most important factors of air pollution in recent decades, especially in big cities such as Tehran, are population growth and rising living standards. Phenomena such as acid rain, global warming and the thinning of the ozone layer as thick as possible to take into consideration the phenomenon of air pollution have a significant impact on a global scale.

*I.I. The main objectives of research*

*I.I.II. Determine the average annual production of PM<sub>10</sub> particles in Tehran.*

*I.I.III. Compare values of annual PM<sub>10</sub> particles at stations.*

*I.I.IV. Compare the PM<sub>10</sub> particulate in different regions with international standards.*

## II. MATERIAL AND METHOD

*II.I Case Study Data*

In this study, we used concentrations of 4 stations data recorded by Air Quality Control Company of Tehran during the 2009 to 2010 year. The region of each station is given below.

Table 1: Location of air quality monitoring stations in Tehran

Situation In Tehran	Station Name	No. of Air Quality Station
Region 16	Municipal 16	10
Region 22	Rose Park	24
Region 20	Shahre Rey	6
Region 5	Geophysic	4

*II. II Case study region*

Tehran is one of the biggest cities and the capital of Iran and has 7705036 populations with 73 km area. This city lies at south Alborz mountain range in the space of 51 degree geographical length and two minute east till 51 degree and 36 minute with about 15 km length an geographical width 35 degree ,36 minute north till 35 degree and 50 minute north with about 30 km width.

The highest area is 1800 from north and lowest area is about 1050 from sea level. Tehran ends to highland area from north and ends to desert area from south. There is different climate in north and south .It is cold and dry at north and warm and dry at south. Because of relative humidity less than %50 and the temperature between 5 and 10 degree there will be associated with the highest concentration of particular matter, especially during inversion phenomena.

*II. III Methodology*

In this research data about concentration of particles have been measured by Roz Park, Municipal station, Shahre Rey city and geophysics in 2009-2010 and they were taken from Tehran air quality control station. Then it was researched by day changes statistic and also year changes. In next step annual changes were compared in each station with universal standard level. At the end data scales were checked statistically until evaluation of pollution density in each area. These changes of pollutants can help expert in the control and prevention of Tehran air pollution a lot.

## III. RESULTS

The main results of suspended particles concentrations are given in below tables. Maximum and minimum concentrations of these pollutants are presented in these tables in the years 2009 to 2010.

Table No.1 shows the maximum concentration of suspended particles in Shahre Rey station was 630.69 micrograms per cubic meter in the seventh month of 2009. This concentration was more than standard level & is very dangerous. Also the minimum concentration of suspended particles at same station was 11.33 micrograms per cubic meter in tenth month of 2010 that is equal to average global standard. During these two years, an air pollution in 15 month (with an average) was moderate.

Table 2: Average minimum and maximum particle in ShahreRey Station

Date	Max PM <sub>10</sub> (PPM)	Min PM <sub>10</sub> (PPM)	Maximum Concentrations of Contaminants & Compared with Standard
2009/1	78/68	40/42	55<78.68<154 Average
2009/2	94/94	42/58	55<94/95<154 Average
2009/3	136/42	18/99	55<42/136<154 Average
2009/4	234/9	23/6	155<9/234<254 Unhealthy for sensitive groups
2009/5	130/9	26/13	55<9/130<154 Average
2009/6	110/86	68/56	55<86/110<154 Average
2009/7	630/69	68/56	604<69/630 Very dangerous
2009/8	227/26	67/28	255<26/277<354 Unhealthy
2009/9	220/09	27/97	255<09/220<354 Unhealthy
2009/10	122/45	61/46	55<45/122<154 Average
2009/11	97/76	26/34	55<76/97<154 Average
2009/12	110/75	26/34	55<75/110<154 Average
2010/1	112/52	22/27	55<52/112<154 Average
2010/2	216/65	20/98	155<65/216<254 Unhealthy for sensitive groups
2010/3	174/61	12/14	155<61/174<254 Unhealthy for sensitive groups
2010/4	79/7	18/78	55<70/79<154 Average
2010/5	178/05	17/99	155<05/178<254 Unhealthy for sensitive groups
2010/6	131/42	17/3	155<42/131<254 Unhealthy for sensitive groups
2010/7	200/81	17/2	155<81/158<254 Unhealthy for sensitive groups
2010/8	158/66	17/44	55<66/158<154 Average
2010/9	125/65	18/48	55<65/125<154 Average
2010/10	113/36	11/33	55<36/113<154 Average
2010/11	120/38	11/44	55<38/120<154 Average
2010/12	127/48	16/8	55<48/127<154 Average

Table 3: Minimum and maximum particle in Geophysic station.

Date	Max PM <sub>10</sub> (PPM)	Min PM <sub>10</sub> (PPM)	Maximum Concentrations of Contaminants & Compared with Standard
2009/1	214/01	8/26	155<01/214<254 Unhealthy for sensitive groups
2009/3	123/9	11/92	55<9/123<154 Average
2009/4	132/58	18/09	55<58/123<154 Average
2009/4	280/91	26/41	255<91/280<354 Unhealthy
2009/5	171/79	42/66	155<79/171<254 Unhealthy for sensitive groups
2009/6	110	31	155<110<254 Unhealthy for sensitive groups
2009/7	731/34	50/94	604<34/731 Very dangerous
2009/8	174/92	44/59	155<92/174<254 Unhealthy for sensitive groups
2009/9	197/91	27/13	155<91/197<254 Unhealthy for sensitive groups
2009/10	86/45	5/32	55<45/86<154 Average
2009/11	97/22	4/3	55<22/92<154 Average
2009/12	116/41	21/32	55<41/116<154 Average
2010/1	150/65	22/54	55<65/150<154 Average
2010/2	79/96	38/09	55<96/79<154 Average
2010/3	109/83	25/87	55<83/109<154 Average
2010/4	146/32	33/67	55<32/146<154 Average
2010/5	220/11	40/15	155<11/220<254 Unhealthy for sensitive groups
2010/6	114/91	31/48	55<91/114<154 Average
2010/7	268/84	38/88	255<84/268<354 Unhealthy
2010/8	72/68	42/53	55<68/72<154 Average
2009/9	93/63	36/33	55<63/93<154 Average
2010/10	96/77	51/21	55<77/96<154 Average

2010/11	179/36	32/07	155<36/179<254 Unhealthy for sensitive groups
2010/12	172/89	52	155<89/172<254 Unhealthy for sensitive groups

According to the table No 3, the maximum concentration of suspended particles is in Geophysics station was 731.34 micrograms per cubic meter in the seventh month of 2009. This concentration was more than the standard level & is very dangerous. Also the minimum concentration of

suspended particles at the same station was 4.3 micrograms per cubic meter in 11<sup>th</sup> month of 2010 that is nearby the average global standard. During these two years, air pollution in 13 months (with an average) was moderate.

Table 4: Minimum and maximum particle in Municipal 16

Date	MAX PM <sub>10</sub> (PPM)	Min PM <sub>10</sub> (PPM)	Maximum Concentrations of Contaminants & Compared with Standard
09/1	111/85	45/61	55<85/111<154 Average
2009/2	100/36	67/17	55<36/100<154 Average
2009/3	108/79	62/56	55<79/108<154 Average
2009/4	111/59	81/71	55<59/111<154 Average
2009/5	144/98	89/64	55<98/144<154 Average
2009/6	177/05	88/89	155<05/177<254 Unhealthy for sensitive groups
2009/7	118/84	55/47	55<84/118<154 Average
2009/8	109/07	70/56	55<07/109<154 Average
2009/9	106/69	49/98	55<69/106<154 Average
2009/10	191/53	56/79	155<53/191<254 Unhealthy for sensitive groups
2009/11	124/75	40/75	55<75/124<154 Average
2009/12	138	53/97	55<138<154 Average
2010/1	143/14	32/19	55<14/143<154 Average
2010/2	425/85	44/96	425<85/425<504 Dangerous border
2010/3	219/97	32/21	155<97/219<254 Unhealthy for sensitive groups
2010/4	228/37	44/47	155<37/228<254 Unhealthy for sensitive groups
2010/5	357/84	58/68	355<84/357<424 Very Unhealthy
2010/6	314/65	40/12	255<65/314<354 Unhealthy
2010/7	305/41	51/67	255<41/305<354 Unhealthy
2010/8	117/28	5/76	55<28/117<154 Average
2010/9	191/97	7/32	155<97/191<254 Unhealthy for sensitive groups
2010/10	233/34	68/28	155<34/233<254 Unhealthy for sensitive groups
2010/11	209/48	34/66	155<48/209<254 Unhealthy for sensitive groups
2010/12	227/67	92/7	155<67/227<254 Unhealthy for sensitive groups

According to the table No 4 the maximum concentration of suspended particles was in Municipal 16 was 425.85 micrograms per cubic meter in the second month of 2009. This concentration was higher than the standard level & is very dangerous. Also the minimum concentration of

suspended particles at the same station was 7.56 micrograms per cubic meter in 8<sup>th</sup> month of 2010, that was nearby to the average global standard. During these two years, 12 months a year (with an average) air pollution was moderate.

Table 5: Minimum and maximum particle in Park Roz Station

Date	Max PM <sub>10</sub> (PPM)	Min PM <sub>10</sub> (PPM)	Maximum Concentration of Contaminants & Compared with Standard
2009/1	118/95	29/21	55<95/118<154 Average
2009/2	166/52	26/75	155<52/166<254 Unhealthy for sensitive groups
2009/3	181/67	22/77	155<67/181<254 Unhealthy for sensitive groups
2009/4	272/96	26/25	255<96/272<354 Unhealthy
2009/5	171/78	32/52	155<78/171<254 Unhealthy for sensitive groups
2009/6	108/64	25/36	55<65/108<154 Average
2009/7	754/59	54/11	604<59/754 Very dangerous
2009/8	171/44	46/37	155<44/171<254 Unhealthy for sensitive groups
2009/9	206/33	33/48	155<33/206<254 Unhealthy for sensitive groups
2009/10	101/86	27/89	55<86/101<154 Average

2009/11	100/93	23/48	55<93/100<154Average
2009/12	145/01	22/7	55<01/145<154Average
2010/1	175/42	20/11	155<42/175<254Unhealthy for sensitive groups
2010/2	260/46	43/09	255<46/260<354Unhealthy
2010/3	182/2	17/98	155<2/182<254Unhealthy for sensitive groups
2010/4	166/95	17/23	155<95/166<254Unhealthy for sensitive groups
2010/5	388/81	30/17	355<81/388<424Very Unhealthy
2010/6	305/88	24/28	355<88/305<424Very Unhealthy
2010/7	322/27	28/02	255<27/322<354Unhealthy
2010/8	415/1	64/77	355<1/415<424Very Unhealthy
2010/9	268/84	25/8	255<84/268<354Unhealthy
2010/10	202/04	52/61	155<04/202<254Unhealthy for sensitive groups
2010/11	209/59	40/79	155<59/209<254Unhealthy for sensitive groups
2010/12	341/71	25/8	255<71/341<354Unhealthy

According to the table No 5, the maximum concentration of suspended particles is in Park Roz station was 754.59 micrograms per cubic meter in the 7<sup>th</sup> month of 2009. This concentration is higher than the standard level & is very dangerous. Also the minimum concentration of suspended particles at the same station was 17.23 micrograms per cubic meter in 10<sup>th</sup> month of 2010, that this is the Unhealthy for sensitive groups. During these two years, 5 months, air pollution (with an average) was moderate.

Using the software SPSS and T test paired, we were compared maximum concentrations of PM<sub>10</sub> for 2009 and 2010 at each station.

Table 6 outcomes this test, also the Table 6 displays the mean maximum concentration of PM<sub>10</sub> for each station in the years 2009 and 2010.

Table 6: The results of the t-test paired to compare the maximum concentrations of PM<sub>10</sub> in 2009 and 2010

The Significant Number of T-Test Paired	Station Name
0.378	ShahreRey
0.170	Geophysic
0.001	Municipal 16
0.272	Rose Park

Table 7: The average maximum concentrations of PM<sub>10</sub> for each station in 2009 and 2010

Average Maximum PM <sub>10</sub> Concentrations (in 2010), PPM	Average Maximum PM <sub>10</sub> Concentrations (in 2009), PPM	Station Name
145	183	ShahreRey
142	203	Geophysic
248	129	Municipal 16
270	208	Rose Park

As Table 6 show, the number of significant in 16 station is smaller than 0/05. Therefore we can conclude that 16 station, has maximum concentration of the pollutant PM<sub>10</sub> in both of 2009 and 2010 with significant differences. Table 6 shows that the concentration of these pollutants in 16 stations for 2010 is much higher.

#### IV. DISCUSSION AND CONCLUSION

In this study concentration of dusts checked at 4 points of Tehran city at 2009 and 2010. For this study information about particles was received from air quality control Tehran city. Result showed that the maximum concentration of dusts at Park Roz station at 22<sup>th</sup> region at seventh month of 2009 was 754.59. Also the minimum concentration of dusts at Geophysic station at 16<sup>th</sup> region at eleventh month of 2009 showed different fluctuation with using T-Test paired test & Software SPSS observed that 16 stations were different maximum concentrations at 2009 and 2010. Reason can be increasing traffic of region at these two years. Also Park Roz station with maximum concentration of dusts is at western part of Tehran city and nearby the main roads that contain high level of contaminants. Also region No. 22 has normal dusts concentration and region No. 20 has most healthy air. Hope this study can help related organization to control of air pollution in Tehran city.

#### V. THE OVERALL RESULTS AND RECOMMENDATIONS

In this study concentration of dusts at Tehran city was measured. Traffic city and passing west dusts are most the important factor of pollution at Iran's cities. In this study we tried to check the dust concentrations at different areas at Tehran city until explaining the reason of pollution.

For decreasing traffic pollution we should reduce using vehicles. We should research about demand and origin, destination and type of trip. Also we can encourage Tehran citizen to using public transport. In other cases create traffic culture, learning and public notification in order to control of air pollution, encourage using public transport that has little dusts, create landscape and use suitable trees that help decrease pollution and bring out old vehicles.

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