$PM_{2.5}$ AND PM_{10} LEVELS IN SOME CLUJ-NAPOCA`S CROSSROADS

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ABSTRACT. - $PM_{2.5}$ and PM_{10} levels in some Cluj-Napoca`s crossroads. **P**articulate matter (PM) is the term used for a mixture of solid particles and liquid droplets suspended in the air. These particles originate from a variety of sources, such as power plants, industrial processes, and diesel trucks, and they are formed in the atmosphere because of the transformation of gaseous emissions. For these two classes of PM are taken into account: PM_{10} to describe particles of 10 micrometers or less and $PM_{2.5}$ represents particles less than 2.5 micrometers in aerodynamic diameter. Due to their significant health problems, United States Environmental Protection Agency (USEPA) has introduced some standards that regard to the maximum values accepted in the outdoor air. These standards include values for 24 hour and one year time. The variation of PM_{10} and $PM_{2.5}$ levels in some crossroads from Cluj-Napoca is presented in this study. According to our data for PM_{10} the main values of short determination (15 minutes) varied between 18 and 164 μg/m^3 air depending to the point of determination and to the meteorological parameters. Regarding to $PM_{2.5}$ the main values of short determination (15 minutes) varied between 0,081 and 64 μg/m^3 air.

Key words: PM, sources, urban areas

1. Introduction

Particulate matter (PM) is the term used for a mixture of solid particles and liquid droplets suspended in the air. These particles originate from a variety of sources, such as power plants, industrial processes, and diesel trucks, and they are formed in the atmosphere because of the transformation of gaseous emissions [1]. Generally, the most common classification of particulates mater is those witch respect the size and aerodynamic diameter of particles. There are two classes of PM: PM_{10} to describe particles of 10 micrometers or less and $PM_{2.5}$ represents particles less than 2.5 micrometers in aerodynamic diameter [2].

PM_{10} is composed of aluminosilicate and other oxides of crystal elements, and major sources including fugitive dust from roads, industry, agriculture, construction and demolition, and fly ash from fossil fuel combustion [3].

$PM_{2.5}$ are formed from gas and condensation of high-temperature vapours during combustion, and they are composed of various combinations of sulphate compounds, nitrate compounds, carbon compounds, ammonium, hydrogen ion, organic compounds, metals (Pb, Cd, V, Ni, Cu, Zn, Mn, and Fe) etc. and the major sources are fossil fuel combustion, vegetation burning, and the smelting and processing of metals [4].

Several epidemiological studies [5, 6] have linked both PM_{10} and especially $PM_{2.5}$ with significant health problems, including: premature mortality, chronic respiratory disease, aggravated asthma, acute respiratory symptoms, and decreased lung function. Fine particulate ($PM_{2.5}$), is of great concern because it contains a high proportion of various toxic metals and acids, and aerodynamically it can penetrate deeper into the respiratory tract [7].

Taking into account the human health effects of PM, the United States Environmental Protection Agency (USEPA) has been established standards regarding to the limit value set for the protection of human. These limits are 150 $\mu g/m^3$ air as the 24 hour and 50 $\mu g/m^3$ air as the annual standard for PM_{10} and 65 $\mu g/m^3$ air as the 24 hour and 15 $\mu g/m^3$ air as the annual standard for $PM_{2.5}$ [8].

Romania such as European Union has established limits only for PM_{10} and these are 100 $\mu g/m^3$ air for 24 hour and 50 $\mu g/m^3$ air as the annual standard [9][11].

2. Material and method

For the evaluation of the level of particulates matter (PM_{10} and $PM_{2.5}$), we have chosen six point [Păcii Square (1), Primărie (2), Mihai Viteazu Square (3), Matei Corvin Square (4), Avram Iancu Square (5) and Ştefan cel Mare Square (6)] and for the determination, we have chosen some crossroads with intense traffic, from Cluj-Napoca city. The determination points chosen for this study are represented in figure 1.

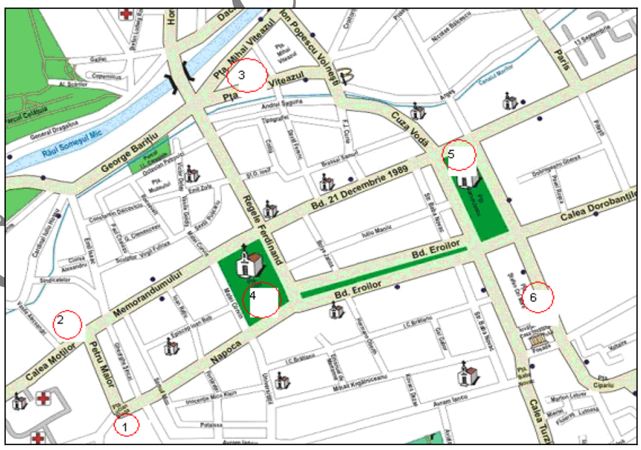

Fig.1. The determination points chosen in Cluj-Napoca city.

The variation of PM_{10} and $PM_{2.5}$ has been done with a MicroDust pro instrument equipped with a pump for air aspiration and PUF filters for PM_{10} and $PM_{2.5}$ (figure 2). These techniques measure the concentration of PM basing on the dispersion of infra red radiation and give the possibility to measure the concentration in real time.

The measurements (short time, 15 minutes) have been made in two different days: the 6`Th and 11`Th of June 2008. The values of meteorological parameters in the measurement days of were: 18ºC, 89% RH and 0-2m/s wind speed for the 6`th of June and 26ºC, 75% RH and 0-2m/s wind speed for 11`th of June. It is important that the measurements from 6`Th of June have been preceded by two raining days with a high relative humidity (over 90%).

Fig. 2. MicroDust pro instrument used for PM monitoring.

3. Result and discussions

The results showed that the PM values depend on the point of determination and the meteorological parameters. As can be see in figure 3 and 4 the lowest values both for PM_{10} and $PM_{2.5}$ was registered in 6`th of June when the measurement was preceded by two raining days with a high air humidity (over 90% RH). Since 6`Th of June to 11`Th of June there have been no raining days and the concentration of PM increased strongly and this is the results of PM accumulation in the urban air.

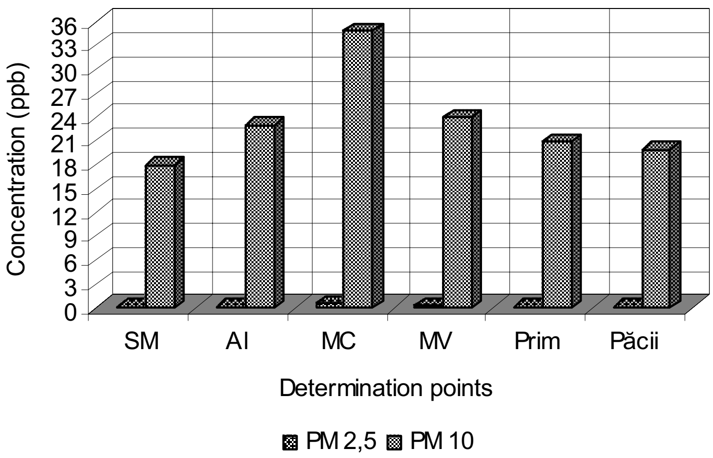

Fig. 3. Main values (15 minutes) $PM_{2.5}$ and PM_{10} registered in 06.06.2008 in Cluj-Napoca

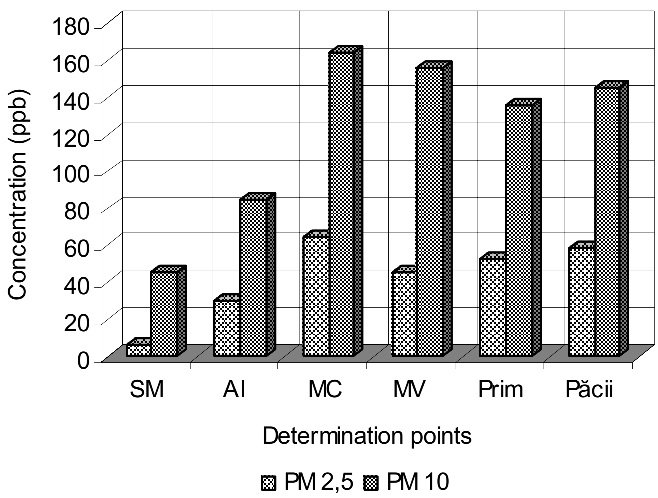

Fig. 4. Main values (15 minutes) $PM_{2.5}$ and PM_{10} registered in 11.06.2008 in Cluj-Napoca

Regarding to the PM levels registered in measurement points one can notice that the highest concentration was registered in Matei Corvin Square both in 6`th and 11`th of June. This can be explained by the intensity of urban traffic as well as to the building restoration activity present in this area. The lowest concentration of PM_{10} and $PM_{2.5}$ was registered in Stefan cel Mare Square and this can be explained by the presence of the tries in that point of determination. For Mihai Viteazu Square, Avram Iancu Square and Pacii Square the concentration of PM_{10} and $PM_{2.5}$ were very similar both for $PM_{2.5}$ and PM_{10}. The variation of $PM_{2.5}$ and $PM_{10,}$ in Mihai Viteazu Square, in 11.06.2008, for 15 minutes is presented in figure 5 and 6.

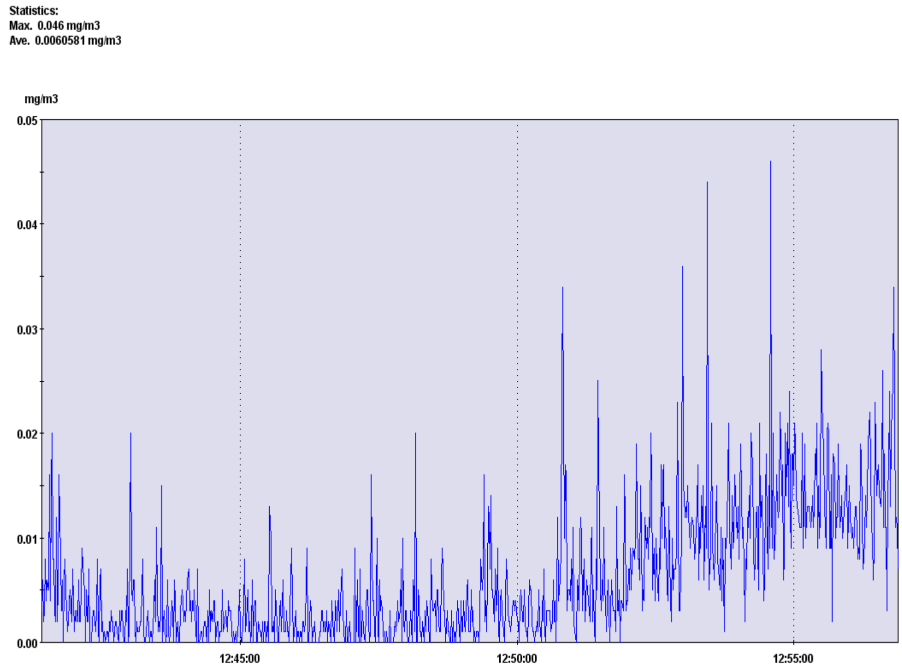

Fig. 5. Variation of $PM_{2.5}$ Mihai Viteazu Square, 11.06.2008 (15 minutes)

From figure 5 and 6 one can notice that the concentration of PM fluctuate during on measurement interval and the instrumentation used for these measurements is able to provide the information regarding to the intensity of these fluctuations.

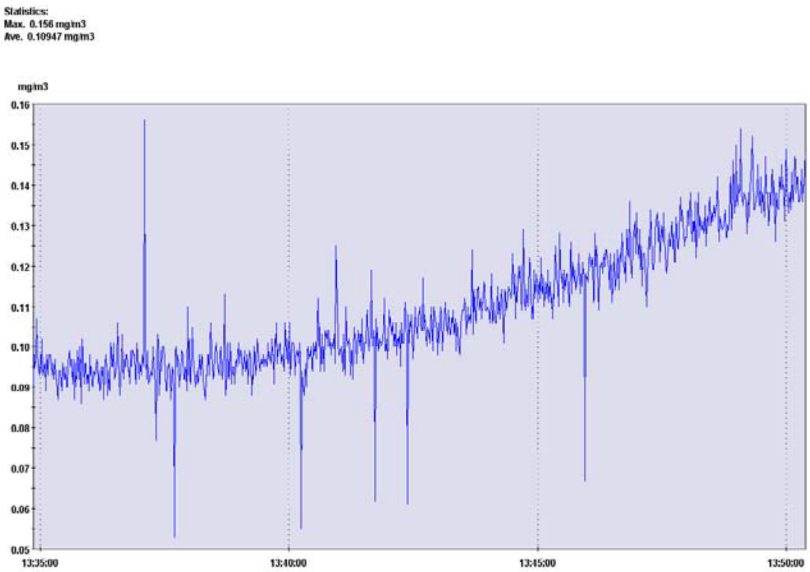

Fig. 6. Variation of PM_{10} Mihai Viteazu Square, 11.06.2008 (15 minutes)

4.Conclusions

Tacking into account the last European Union Report [10] witch stipulate that in the period between 1997-2006, 18-50% of the urban population was potentially exposed to ambient air concentrations of particulate matter (PM_{10}) in excess of the EU limit value set for the protection of human health (50 μg/m^3 daily main per a calendar year), monitoring of particulates matter is important do to their significant human health problems linked with them.

Knowledge of the concentration as well as the distribution and the sources of particulates matter can contribute to the establishment of some rules for reduction of particulates matter level in urban atmosphere.

From data presented this study can notice that in the meteorological parameters (wind speed, rainfall, relative humidity etc) as well as the antropic activity (urban traffic, industrial activity) play an important role in the distribution and levels of PM from urban air.

Taking into account that from presented data the $PM_{2.5}$ found in the urban air represents more then 30% form PM_{10} we can conclude that the Romanian authorities as well as the European Union should introduce limit value set for $PM_{2.5}$ like in the United States.

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