

THE CONCENTRATION OF AEROSOL PARTICLES IN THE URBAN AREA OF CLUJ-NAPOCA

ANCA SUCIU¹, TIBERIU RUSU¹

¹ Technical University, 103 – 105 Muncii Boulevard,
Cluj –Napoca, Romania,
ank.suciu@yahoo.com; tiberiu.rusu@sim.utcluj.ro

ABSTRACT

In urban environments there are a multitude of sources of pollution. The dominant source of pollution by aerosols is due to traffic and other anthropogenic sources (MERKEL ET AL, 2007). According to epidemiological studies WHO (World Health Organization) and EPA (USA, 2004) as well as some research (WILSON et al, 1966) has been associated with adverse effects on human health of exposure to ambient air laden with particles in suspension. In this way, the pollution with particulate matter (PM) are associated with pulmonary and cardiovascular diseases. The research conducted was heavily traveled areas of the town/city of Cluj-Napoca. Suspended particle measurements were conducted at various distances from the source of pollution, as well as at various time slots depending on the intensity of the traffic. At the end of the work he carried out the link between the level of pollution by aerosols and its effects on human health. The price that we pay for the convenience that it involves modern living is for many of us, their own health.

Keywords: aerosol, urban areas, traffic, the effects on human health..

INTRODUCTION

In urban areas, transport, thermal power plants and other anthropogenic sources constitute a significant contribution to air quality degradation.

Vehicles emit into the atmosphere significant quantities of carbon oxides, sulfur dioxide, nitrogen oxides and particulate matter. Another source of particulate matter is particulate resulting from wear of the braking system, as well as the involvement of the dust on the surface of the roadway (SRIMURUGANANDAM ET AL, 2010). Particulate matter is the most common form of air pollution but at the same time, and most dangerous, both for the environment as well as for the health of the population.

The importance of the study of particle material is due primarily to the adverse effects they have on human health. In this way, particles PM₁₀ are associated with respiratory diseases, and PM_{2.5} particles with cardiovascular disease.

To assess the quality of the air in terms of mass concentration of particulate matter in the atmospheric air has been sampling PM₁₀, PM_{2.5} and total PM in various locations, globally the congested areas of the city (intersections with heavy traffic, children's parks and schools located in the vicinity of major intersections, hospitals located in areas traveled, streets narrow canyons and heavily-used, the streets narrow canyons and heavily-used, streets in excavations in working areas, such as a tram line rehabilitation project amply significantly affecting the air quality during the progress of the work).

Air pollution in the context of civilization based on industrial and urban development, is part of our daily life and remains a major factor, although in recent years there has been significant progress in reducing the effects of direct.

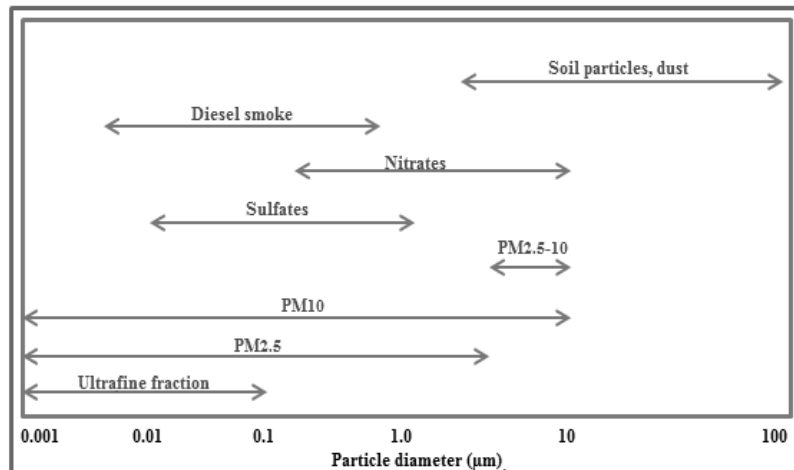


Figure 1. The size of the particles in the air which affect human

METHODOLOGY OF RESEARCH

The study was done in the city of Cluj-Napoca. The city of Cluj-Napoca, is the most important urban center of Transylvania. With an surface of the city is 179.5 km² located in the center of the county, at the intersection of important roads of national and international interest. Defined geographically, its location is the intersection of the parallel of 46 ° 46 ' North latitude to the Meridian 23 ° 35 ' longitude East.

Cluj is colinar topography and hilly (more than two-thirds of the land area) which are part of the Someşul Mic River in lane.

The general configuration of the relief exercise a number of constraints on the deployment of anthropogenic activities, in particular in relation to urban development – originally performed mainly along the aisle of the Someşul Mic River.

Climate Cluj Country is characterized by a moderate continental climate, with specific characteristics determined by the position of the city.

The average annual wind speed is 4.3 m/s in the direction of Northwest and 3-8 m/s in the direction of the West. In June the absolute maximum recorded speed of 18 m/s, with higher frequencies at midday. The multiannual average temperature is 8,4 °C.

The multiannual average rainfall are ~ 663 l/m². Relative humidity is highest in December was 88% and minimum in august was 65%.



Figure 2. Overview of Cluj-Napoca

For the urban agglomeration Cluj-Napoca, have chosen a number of locations in order to carry out the measurements of total suspended particulates (PM).

✚ P1: sampling point is located near the roundabout direction of the district Mărăști (*figure 3*), more precisely in the immediate vicinity of the bus station; there is also a children's play area;

✚ P2: point in Lucian Blaga Square; the measurements were conducted in two locations

at this point – in front of the House of Culture of Students (CCS) and in front of the Central University Library (BCU) (*figure 4 - left*);



Figure 3. Representation of the investigated area at the point P1 (Mărăști district)



Figure 4. Representation of the investigated area in point P2 (CCS and BCU) – left; representation of the investigated area in point P3 (Horea Street)-right.

✚ P3: point located on the street in front of the Horea Street, in front of the building Technical College "Ana Aslan", respectively in the school yard of the Tehnical College (*figure 4 - right*);

✚ P4: point located in the railway station area of Cluj-Napoca; it is a point of intersection of roadways, (1) the road to the city centre, (2) the way to exit from the town to the direction of Zalău, (3) road leading to the Muncii Boulevard; therefore the station area is extremely congested and congested/crowded (*figure 5 - left*);

✚ P5: point located in the Muncii Boulevard in front of the building of Technical University; the place has a characteristic measurements in addition, construction work – rehabilitation of the city's tram line (*figure 5 – right*).



Figure 5. Representation of the investigated area in point P4 (The railway station) – left; representation of the investigated area P5 (Muncii Boulevard, in front of the building UTCN) – right.

The calculations were made with a portable tool called DustTrak™ DRX, Aerosol Monitor model 8533. It records more optical and particle sizes calculated mass of more mass fractions measured simultaneously.

RESULTS

Table 1. Concentrations of PM_{2.5} and PM₁₀

MEASURING POINTS	PM _{2.5} [mg/m ³]			PM ₁₀ [mg/m ³]		
	min	max	average	min	max	average
P1 (next to the road)	0.008	0.173	0.052	0.021	0.227	0.088
P1 (10 m)	0.003	0.226	0.041	0.019	0.256	0.083
P1 (20 m)	0.002	2.19	0.017	0.007	3.06	0.042
P2 (CCS)	0.003	0.193	0.003	0.001	0.218	0.019
P2 (BCU)	0.001	0.179	0.005	0.002	0.195	0.009
P3 (next to the road)	0.001	0.226	0.007	0.004	0.736	0.053
P3 (in the schoolyard)	0.001	0.037	0.002	0.001	0.197	0.004
P4 (next to the road)	0.001	0.41	0.005	0.003	0.478	0.036
P5 (next to the road)	0.008	1.51	0.039	0.010	3.68	0.156
P5 (15 m)	0.002	0.31	0.007	0.005	0.49	0.074

In *Figure 6* can be seen to represent the concentrations of PM_{2.5} and PM₁₀ materials in the five points selected in the study. It is noted that concentrations of particles as PM_{2.5} and PM₁₀ are large variations between the minimum and the maximum our values, transcending the daily limit value for the protection of human health - 50 µm/m³ (Directive 2001/81/EC).

The points where the highest values are the point P1 – Mărăști district, and those of the P5 – Muncii Boulevard.

Point P1 in the Mărăști district, is characterised as being located in an area with heavy traffic. The P5, which is in a neighborhood on the outskirts of the city, more specifically a boulevard, is characterised as a liaison between the city and the area of the belt from the city towards the direction of Zalău – Satu Mare; another characteristic of this area is the presence of the construction site for the modernisation of the city's tram line.

We have chosen points P1 and P5 due to the fact that the measurements for the determination of concentrations of total suspended particulates were conducted at the edge of the roadway surface.

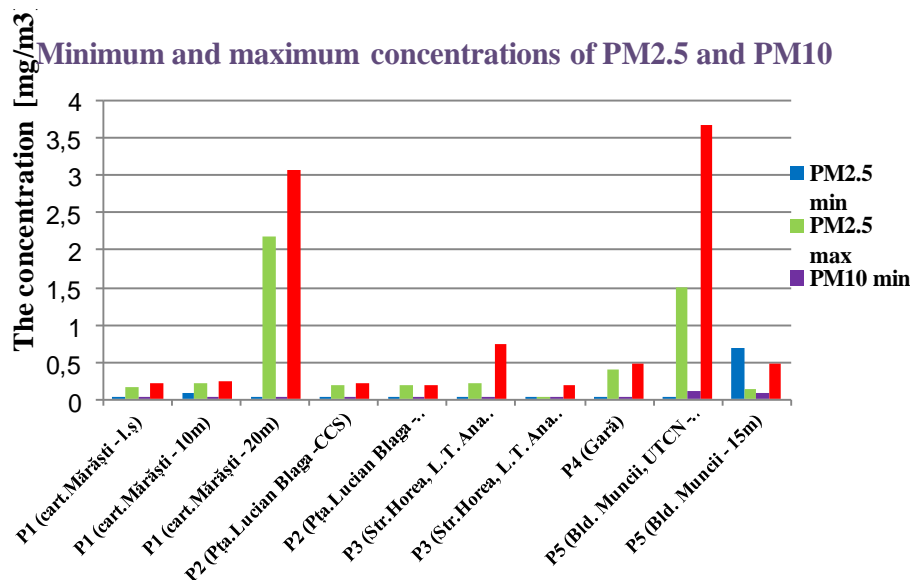


Figure 6. Represent the minimum and maximum values of PM_{2.5} and PM₁₀

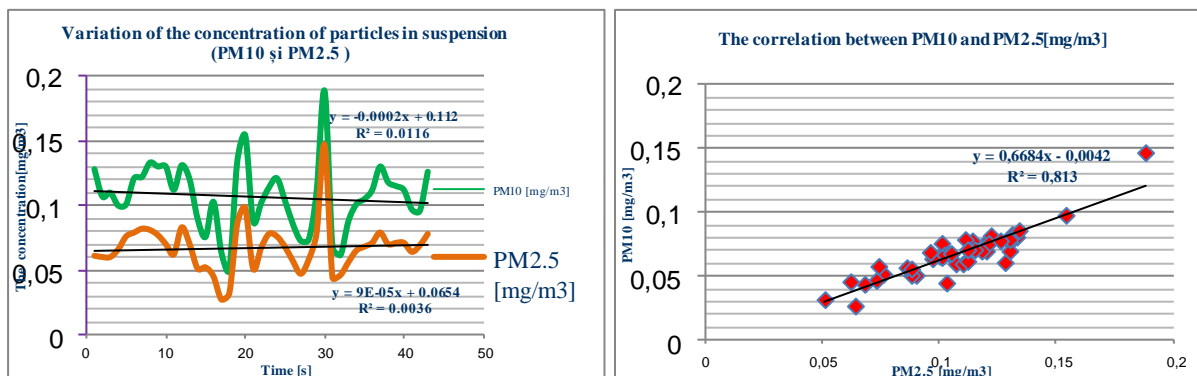


Figure 7. Variation (first graph) and correlation (second diagram) of the concentrations of PM₁₀ and PM_{2.5} in the P1 (Mărăști district) near the road

As can be seen in *figure 7 (first diagram)* and *figure 8 (first diagram)* are represented changes in concentrations of PM₁₀ and PM_{2.5}. In both cases the variations in the concentrations of PM₁₀, PM_{2.5} levels are much higher and the point P1 variation – Mărăști district, against the P5. High levels can be correlated with road traffic (being the only source of anthropogenic area) and the presence of round buildings, which prevent the dispersion of pollutants, resulting their accumulation in the area.

Coefficient of correlation between the values of the PM₁₀ and PM_{2.5} in the point P1-Mărăști district (*figure 7 – right diagram*), it has moderate values $R = 0.813$. For the point P5- Muncii Boulevard, coefficient of correlation is $R = 0.4385$ (*figure 8 – right diagram*).

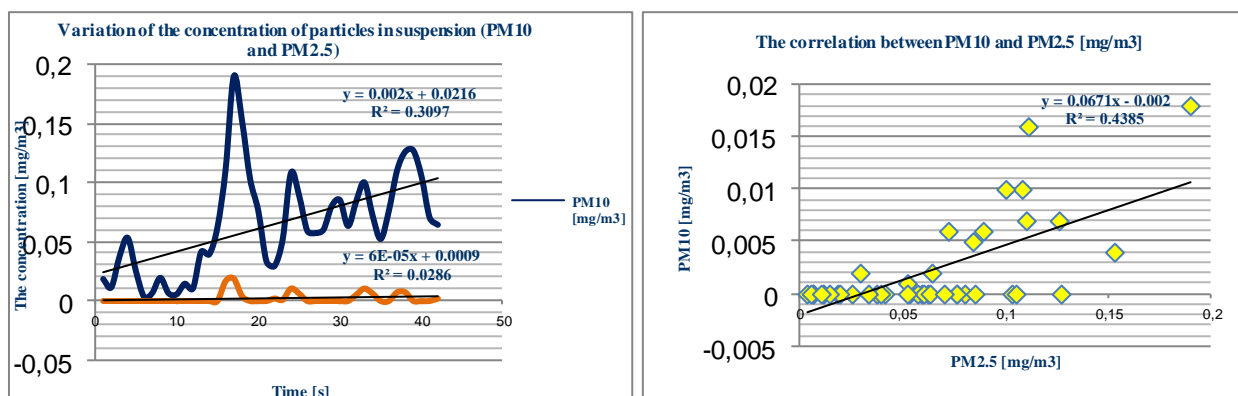


Figure 8. Variation (first graph) and correlation (second diagram) of the concentrations of PM10 and PM2.5 in the P5 (boulevard) near the road

CONCLUSIONS

As final conclusions can be say that high levels of total suspended particulates in the sampling points chosen for study, due to heavy traffic, the involvement of coarse dust deposited on the surface of the roadway due to turbulence induced by the circulation of vehicles (COLBEK ET AL, 2011), in the areas with industrial sources of pollution. The study focused on the interpretation of the material particles PM₁₀ and PM_{2.5} because according to research at the international level, as well as the World Health Organisation studies, these powders have negative effects on the health of the population. Material particles, PM₁₀ and PM_{2.5} presents a higher risk to penetrate the alveoli and cause inflammation and intoxications.

ACKNOWLEDGMENT

This paper was supported by the project "Improvement of the doctoral studies quality in engineering science for development of the knowledge based society-QDOC" contract no. POSDRU/107/1.5/S/78534, project co-funded by the European Social Fund through the Sectorial Operational Program Human Resources 2007-2013.

REFERENCES

- COLBECK, I., NASIR, Z.A., SHAKIL, A., ZULFIQAR, A., (2011): *Exposure to PM₁₀, PM_{2.5}, PM₁ and carbon monoxid on road in Lahore, Pakistan*, Department of Biological Sciences, University of Essex, Colchester, CO4 3SQ, UK, Aerosol and Quality Research.
- MERKEL, M., BIRMILI, W., WIEDENSOHLER, A., HINNEBURG, D., KNOTH, O., TUCH, T., FRANCK, U., (2007): *Microscale variations of atmospheric particle number size distributions in a densely built-up city area*, Leibniz Institute for Tropospheric Research, Germany.
- SRIMURUGANANDAM BATHMANABHAN, SHIVA NAGENDRA SARAGUR MADANAYAK, (2010): *Analysis and interpretation of particulate matter – PM₁₀, PM_{2.5} and PM₁ emissions from the heterogeneous traffic near an urban roadway*, Department of Engineering, Environmental and Water Resources Engineering Division, Indian Institute of Technology Madras, Chennai -36, India.
- WILSON, R., SPENGLER, J., (1966): *Particles in Our Air: Exposures & Health Effects*, Cambridge, MA: Harvard University Press.