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Particulate matter urban air pollution from traffic car

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Abstract. The particulate matters (PM) are very important compounds of urban air pollution. There are a lot of air pollution sources who can generate PM and one of the most important of them it is urban traffic car. Air particulate matters have a major influence on human health so everywhere are looking for PM reducing solutions. It is knows that one of the solution for reduce the PM content from car traffic on ambient urban air is the fluidity of urban traffic car by introduction the roundabout intersections. This paper want to present some particulate matter determinations for PM10 and PM2.5 conducted on the two types of urban intersection respectively traffic light and roundabout intersections in Baia Mare town in the approximate the same work conditions. The determinations were carried out using a portable particulate matter monitor Haz – Dust model EPAM – 5000, who can provide a real time data for PM10, PM 2.5.Determinations put out that there are differences between the two locations regarding the PM content on ambient air. On roundabout intersection the PM content is less than traffic light intersection for both PM10 and PM 2.5 with more than 30%.

1. Introduction

Particulate matters are one of the most important compounds of air pollution. The risks of air pollution with PM are extremely serious for human health and for environment.

The effects of particulates on the environment depend on the particle size and their chemical composition and may occur as follows:

- short and medium influencing environmental factors (air, water, soil) and the condition of fauna and flora at local and regional level;
- long-term effects by climate change globally

Particulate matters negatively influence the development of flora and fauna. Decrease the brightness, the dissolving oxygen in water, so it is a negative influence for plants photosynthesis, disturbing animals breath can be harmful animals' health.

Coarse (bigger) particles, called PM10, can irritate eyes, nose, and throat. Fine (smaller) particles, called PM2.5, are more dangerous they can play a role in causing serious illnesses and death because they are small enough to be inhaled deep into the lungs or even into blood. Once fine particles are in the lungs, they can affect the heart, blood vessels, and lungs, Figure 1 [1].

People exposed to fine particles over a long period of time have more heart and lung problems

Estimates of the health impacts attributable to exposure to air pollution indicate that PM2.5 concentrations in 2012 were responsible for about 432 000 premature deaths originating from long-term exposure in Europe [2].

So it is very important for our health and environment health to maintain a proper concentration for PM on ambient air. The first step for achieving this goal it's to know the origin sources for particles

emission and then to find the best method/technologies for reduce the PM concentration to a limit value.

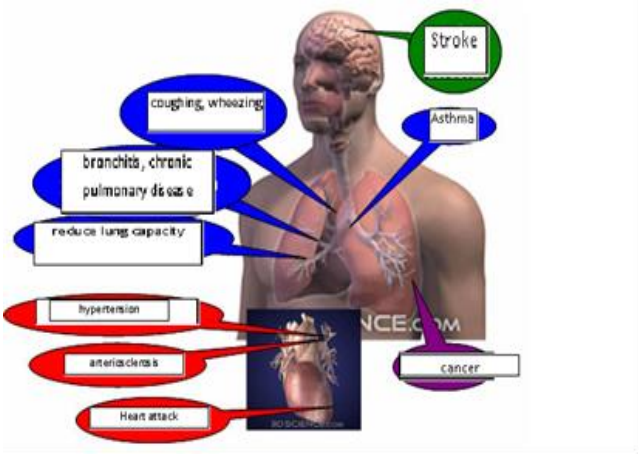

Figure 1. Diseases caused by PM pollution

It is very well known that there are two important sources that can provide PM pollution respectively:

- natural sources such as volcanoes eruptions, forest fires, sandstorms;
- anthropic sources, power plants, factories, cars and trucks, construction sites.

The pollutant emission from both mentioned sources can contain all type of particulate matter, PM10, PM2.5 and PM1.

In the last years the accelerated development of transport and the increasing of car numbers it have change the major balance sources of air pollution and the car traffic became one of the most important source for PM emissions especially in ambient urban air.

The environment scientists have found that one of the solutions for reduce the PM content from car traffic on ambient urban air is the fluidity of urban traffic car by introduction the roundabout intersections instead of traffic light. Modern roundabouts can improve traffic flow as well as cut down vehicular emissions and fuel consumption by reducing the vehicle idle time at intersections and thereby creating a positive impact on the environment [3].

This paper presents some particulate matter determinations for PM10 and PM2.5 conducted on the two types of urban intersection respectively traffic light and roundabout intersections in Baia Mare town, Romania. Through these determinations we wanted to see if and how much PM concentration on ambient air decreases.

2. Method

2.1. The status of fleet car from Baia Mare town. Consideration about the air pollution sources on Baia Mare

Baia Mare is a municipality the capital of Maramures County in NV Romania with a population about 150000. The city is located along the Săsar River and it is encircled by hills. The economic activity has been based on the mining and metallurgical activity but for about 8 years ago almost all industrial activity has ceased but behind this activity it remained a big tailings pond at a 15 km distance from Baia Mare [4].

So the most important air pollution sources are Bozânta tailing pond (PM), the heating fuel systems (PM and combustion gas) and car traffic.

The reports from Environmental Protection Agency Maramures emerges that one of the most important source for PM10 pollution in Baia Mare for the last two years is road traffic. For the last year there were a total of 32 exceedances of the daily PM10 limit value.

Whereas that one of the causes of increase the amount of air pollutants generated by motor vehicles is car fleet age and the type of use fuel so we have identified the following characteristics of the car fleet of Baia Mare:

- for the moment of our experiment the vehicles number it was more than 80000;
- average cars age has dropped from 9 years in 2007 to 5 years in 2014;
- out of total vehicles number, 75% they are cars and 60% of which operate on gasoline.

2.2. Experiment method

The determinations show in this paper were conducted for the two type of urban intersection respectively traffic light and roundabout intersections in Baia Mare.

Determinations were conducted identically for both traffic intersections. During the experiment we determined the content of PM10 and PM2.5 in ambient air in this area. They were made in the early summer during 5 days in a row (from Monday to Friday).

The used monitoring system it was the ***EPAM-5000*** portable environmental PM monitor a highly sensitive and accurate portable monitor for ambient and environmental monitoring with interchangeable size-selective sampling heads for PM10, PM2.5.

Working conditions were as follows:

1. determinations were carried out at rush hour car traffic respectively in the afternoon between 3 pm and 5 pm;
2. monitoring time it was 30 minutes for each traffic intersection;
3. weather conditions were almost the same throughout the experiment period respectively sunny day with little wind.

We must mention that there are certain important factors that we could not control them, which are the numbers of cars, the cars model, the used fuel, the technical condition of cars. Considering this we can say that the results presented in the paper are not very accurate.

3. Results

3.1. PM determinations for light traffic car intersection

For our determinations we choose one of the biggest light traffic cars intersection in Baia Mare city between two large avenues and we placed the monitoring system according to Figure 2 at about 6 m from the center of the intersection**.**

Figure 2. Monitoring system location on light traffic car intersection

The content for PM10 and PM2.5 average values on ambient air are presented in Table 1.
In the air quality directive (2008/EC/50) [5], the EU has these limit values for particulate matter:

- the PM10 daily mean value may not exceed 50µg/m^3 more than 35 times in a year;
- the PM2.5 may not exceed 25µg/m^3.

Table 1 PM10 and PM2.5 average values - for light traffic car intersection

Day	PM10 average value, µg/m^3	EU reference value	PM2.5 average value, µg/m^3	EU reference value
1	55	50 µg/m^3	32	25µg/m^3
2	47		39	
3	61		42	
4	53		37	
5	69		43	

It can see that for all 5 days the average value for PM10 and PM2.5 exceed EU reference value.

3.2. PM determinations for roundabout traffic car intersection
The location for monitoring system EPAM5000 on roundabout intersection is showed in Figure 3.

Figure 3. Monitoring system location on roundabout traffic car intersection

The contents for PM10 and PM2.5 average values on ambient air on roundabout traffic car intersection are presented in Table 2.

Table 2 PM10 and PM2.5 average values - for roundabout traffic car intersection

Day	PM10 average value, µg/m^3	EU reference value	PM2.5 average value, µg/m^3	EU reference value
1	35	50 µg/m^3	15	25µg/m^3
2	41		24	
3	33		17	
4	43		23	
5	37		18	

The determined values for PM10 and PM2.5 on roundabout traffic car intersection are below the allowed EU reference value.

3.3. Comparative results

The average PM values for the experiment period are given on Table 3.

Table 3 Comparative PM emissions results

Location /Emission	Light intersection	Roundabout intersection	Difference
PM10 average value,µg/m^3	57	37	20
PM2.5 average value,µg/m^3	38,6	19,4	17,6

The comparative results for PM contents determinations in those two intersections types are shown in the graphic form in Figure 4 for PM10 contents determinations and Figure 5 for PM2.5 contents determinations, It can see that the PM contents on air decrese for both PM10 and PM2.5 for the roundabout intersection traffic.

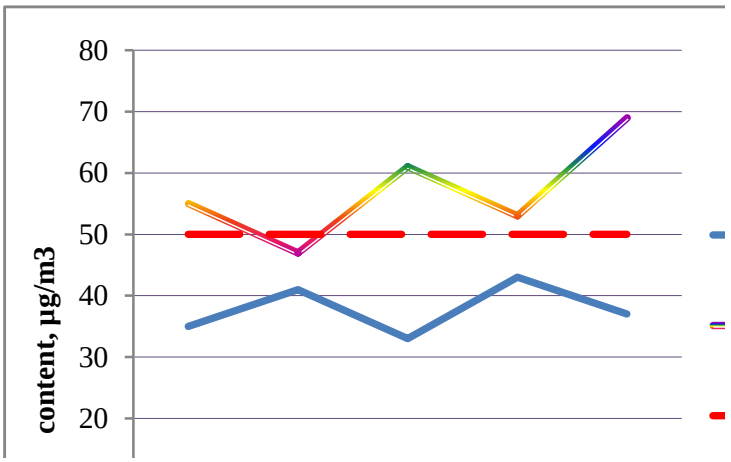

Figure 4. PM10 content on traffic intersections

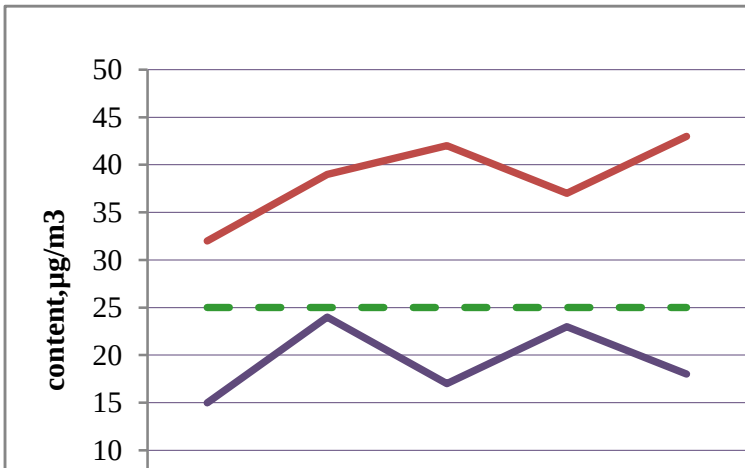

Figure 5. PM2.5 content on traffic intersections

4. Conclusion

Considering the above summary the roundabout intersection is very effectively in reducing PM cars emissions.

Thus it is noted that PM10 content on ambient air decreases with 33,68% and PM2.5 content decreases with 49,74% compared with light traffic intersection.

All the values for PM10 and PM2.5 on roundabout intersection for all 5 days experiment are below the allowed EU reference value.

As mentioned before the results shown are not very accurate but they may give a signal as regards the importance of the traffic cars organization in the cities in such a way as to reduce the ambient air pollution

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