

COMPARATIVE STUDY IN TERMS OF CARBON MONOXIDE POLLUTION IN A TRAFFIC AREA BEFORE AND AFTER TRAFFIC RECONFIGURATION

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Abstract—This paper presents a comparative study done at an interval of one year, on the carbon monoxide emissions from motor vehicles in circulation on the main roads which were reconfigured, in Sibiu.

Keywords—Air quality monitoring, traffic, pollution, carbon monoxide emission.

I. INTRODUCTION

Development of human society, lead to anthropogenic and techno-genic impact on air quality, resulting a significant adverse effects on human health. Also, it can cause serious damage to flora, fauna and ecosystems in general. Air quality monitoring is the most important environmental factor, which has to be taken into account because this is the fastest way that favors transport pollutants into the environment [1].

The paper is based on analysis of data from air quality monitoring to highlight the actual amount of carbon monoxide emission from vehicles on the roads from Sibiu. To analyze spatial data, the GeoMedia Professional software was used, which is a product of Intergraph Corporation USA and for achieving virtual appliances it was used LabView software, a product of National Instruments Corporation [1].

Air quality monitoring involves a series of actions of observation and measurement of quantitative and qualitative indicators of the air (such as concentrations of components of the air). The monitoring system allows obtaining useful data for rapid identification of polluted areas for strategic and tactical decision making pollution control and prevention [1].

II. MEASUREMENTS AND DATA ANALYSIS

The area chosen for the study research has main car traffic during peak hours, where the traffic is exceeding maximum allowable concentrations of air quality directly affects the health status of the population. In this area (Fig. 1) were performed two measurements at an interval

of 12 months before (30.04.2012) and after reconfiguring intersections (15.04.2013).

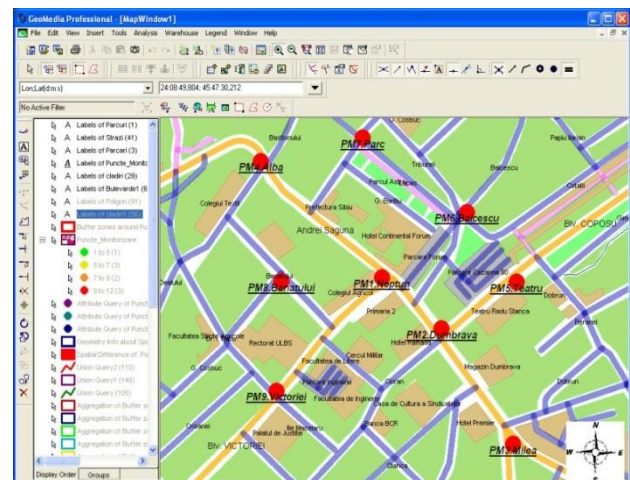


Fig. 1. The monitoring area

The nine locations where measurements were done, have been chosen strategically. Four of them are on the main boulevard in town, and the other five are located quite far from the first four, as the purpose of this study was to highlight as clear as possible the air pollution level in the central area and also the other main roads in to the marginal areas [2].

As can be observed in previous image (Fig. 1), the monitoring locations are placed in the following positions [2]:

- ML1 (Monitoring Location 1) "Neptun"- located at the intersection of Victory Boulevard with Andrei Saguna street, with geographic coordinates: longitude: 24 ° 08'48 "latitude: 45 ° 47'31"
- ML2. "Dumbrava" - located at the intersection of boulevards Vasile Milea with Corneliu Coposu and geographical coordinates: longitude: 24 ° 08'53" latitude: 45 ° 47'28 "
- ML3 "Milea" - located at the intersection of boulevards Vasile Milea with Calea Dumbravii, and

geographical coordinates: longitude: 24°08'59", latitude: 45°47'22"

- ML4 "Alba" - located at the crossroads Alba Iulia Street Hill, with geographic coordinates: longitude: 24 ° 08'38" latitude: 45 ° 47'37"
- ML5 "Theatre" - located near the Radu Stanca National Theatre, Coposu Blvd, with geographic coordinates: longitude: 24 ° 08'59" latitude: 45 ° 47'31"
- ML6 "Balcescu"- located at the intersection of N. Balcescu Tribune (the pedestrian zone), with geographic coordinates: longitude: 24 ° 08'55" latitude: 45 ° 47'35"
- ML7 "Park"- located at the intersection of Metropolitan with Dr. I. Lupas, with geographic coordinates: longitude: 24 ° 08'47" latitude: 45 ° 47'38 "
- ML8 "Banatului" - located at the intersection Coşbuc Banat, with geographic coordinates: longitude: 24 ° 08'40" latitude: 45 ° 47'31"
- ML9 "Victoriei" - located at the intersection of Victoria Blvd with Dr. I. Ratiu with geographic coordinates: longitude: 24 ° 08'40" latitude: 45 ° 47'25".

The measurements were carried out with the device Dragger Pac III, equipped with a sensor for measuring the concentration of carbon monoxide. The values displayed on the device are shown in parts per million (ppm), these values should be multiplied by 1.16 and the resulting value is represented in mg/m³.(Fig. 2) [1]

The first stage of measurements was performed on 30.04.2012, between the hours 6:00 a.m. to 6:00 p.m. On

the day of the measurements, the minimum air temperature was 11° C and maximum 26° C. Wind speed was 2 meters / second (8 km / h). Due to relatively low wind speed dispersion of pollutants was not good.

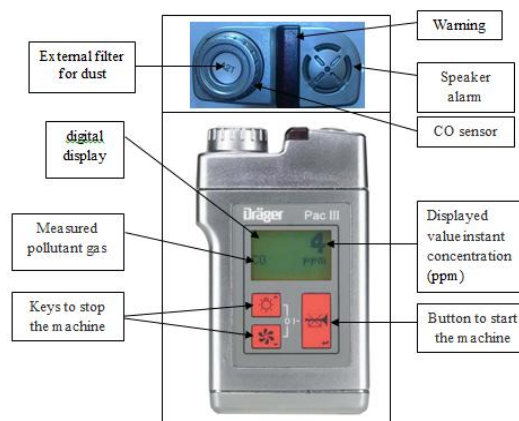


Fig. 2. Dragger Pac III

Measurements were performed in the breathing exclusively pedestrian traffic areas [2].

Measurements were repeated after one year on the same locations and the temperatures were between 3 ° C minimum and 16 ° maximum, with wind speed of 2 meters / second. (table 1 and table 2).

TABLE I
FIRST STAGE OF MEASUREMENTS - 2012

MONITORING LOCATIONS	Hour of monitoring														PM/CO/12h (average) [mg/m³]
	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00		
ML1. Neptun	5,80	8,12	11,60	10,40	9,28	6,96	8,12	5,80	4,64	3,48	4,64	3,48	3,48	6,60	
ML2. Dumbrava	5,80	9,28	10,44	9,28	10,44	5,80	4,64	4,64	4,64	3,48	4,64	3,48	4,64	6,25	
ML3. Milea	6,96	8,12	9,28	8,12	8,12	6,96	5,80	4,64	3,48	3,48	4,64	5,80	5,80	6,25	
ML4. AB	3,48	5,80	6,96	5,80	4,64	3,48	4,64	5,80	4,64	3,48	4,64	3,48	2,32	4,55	
ML5. Teatru	4,64	6,96	8,12	6,96	5,80	4,64	4,64	4,64	4,64	3,48	5,80	4,64	5,80	5,44	
ML6. Balcescu	2,32	3,48	4,64	6,96	5,80	4,64	4,64	4,64	4,64	3,48	3,48	2,32	2,32	4,10	
ML7. Parc	3,48	5,80	6,96	5,80	4,64	3,48	3,48	4,64	4,64	2,32	3,48	2,32	3,48	4,19	
ML8. Banatului	3,48	4,64	6,96	5,80	4,64	3,48	4,64	3,48	3,48	3,48	4,64	3,48	4,64	4,37	
ML9. Victoriei	4,64	6,96	8,12	6,96	4,64	4,64	4,64	4,64	4,64	3,48	5,80	3,48	4,64	5,18	
The average concentrations of CO/hour (mg/m³)	4,51	6,57	8,12	7,34	6,44	4,90	5,03	4,77	4,38	3,35	4,64	3,61	4,12	The average of CO concentrations in the study area/12 hours (5.21 mg/m³) & Maximum allowed concentration (30 min) = 6 mg/m³ STAS 12574/87	

TABLE II
LAST STAGE OF MEASUREMENTS -2013

MONITORING LOCATIONS	Hour of monitoring														PM/CO/12h (average) [mg/m³]
	06:00	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00		
ML1. Neptun	6,83	12,20	15,71	14,53	13,00	8,81	10,68	8,50	6,56	4,89	6,07	4,51	4,83	9,01	
ML2. Dumbrava	6,95	10,85	12,16	11,36	12,20	6,24	5,53	5,28	5,62	4,34	5,83	4,38	4,72	7,34	
ML3. Milea	8,56	10,94	13,27	11,63	10,03	7,70	6,35	5,83	4,89	4,94	5,80	7,46	7,80	8,09	
ML4. AB	4,10	8,71	9,43	8,10	6,50	4,41	6,10	8,50	6,56	4,89	6,07	4,51	3,22	6,24	
ML5. Teatru	5,56	8,14	9,46	8,52	6,78	4,99	5,53	5,28	5,62	4,34	7,28	5,83	5,90	6,40	
ML6. Balcescu	2,78	4,07	5,41	8,52	6,78	4,99	5,53	5,28	5,62	4,34	4,37	2,92	2,36	4,84	
ML7. Parc	4,34	7,34	9,77	7,57	5,29	3,91	8,56	7,29	5,80	2,69	3,92	2,80	4,45	5,67	
ML8. Banatului	3,92	5,75	7,84	7,19	5,52	4,45	5,50	4,47	4,89	5,83	7,29	5,61	5,27	5,66	
ML9. Victoriei	5,13	8,82	12,22	10,94	7,34	6,51	5,80	5,59	5,76	5,16	5,14	3,90	4,86	6,71	
The average concentrations of CO/hour (mg/m³)	5,35	8,54	10,59	9,82	8,16	5,78	6,62	6,22	5,70	4,60	5,75	4,66	4,82	The average of CO concentrations in the study area/12 hours (6.66 mg/m³) & Maximum allowed concentration (30 min) = 6 mg/m³ STAS 12574/87	

A. Analysis of measurements

The evolution of carbon monoxide pollution in the study area was performed graphically (Figure 3 for the first stage & figure 4 for the last stage of measurements) as follows:

- for each of the monitoring points to draw a line which varies depending on the concentration of CO and the hour at which the measurements were made;

- to highlight average CO concentrations for each of the monitored times a yellow line was drawn, which varies depending on the level of pollution;
- average CO concentrations for 12 hours in the study area was highlighted by drawing a blue line;
- to highlight the maximum permissible concentration of CO for 30 minutes (6 mg/m^3) STAS 12574/87 a red line was drawn [3].

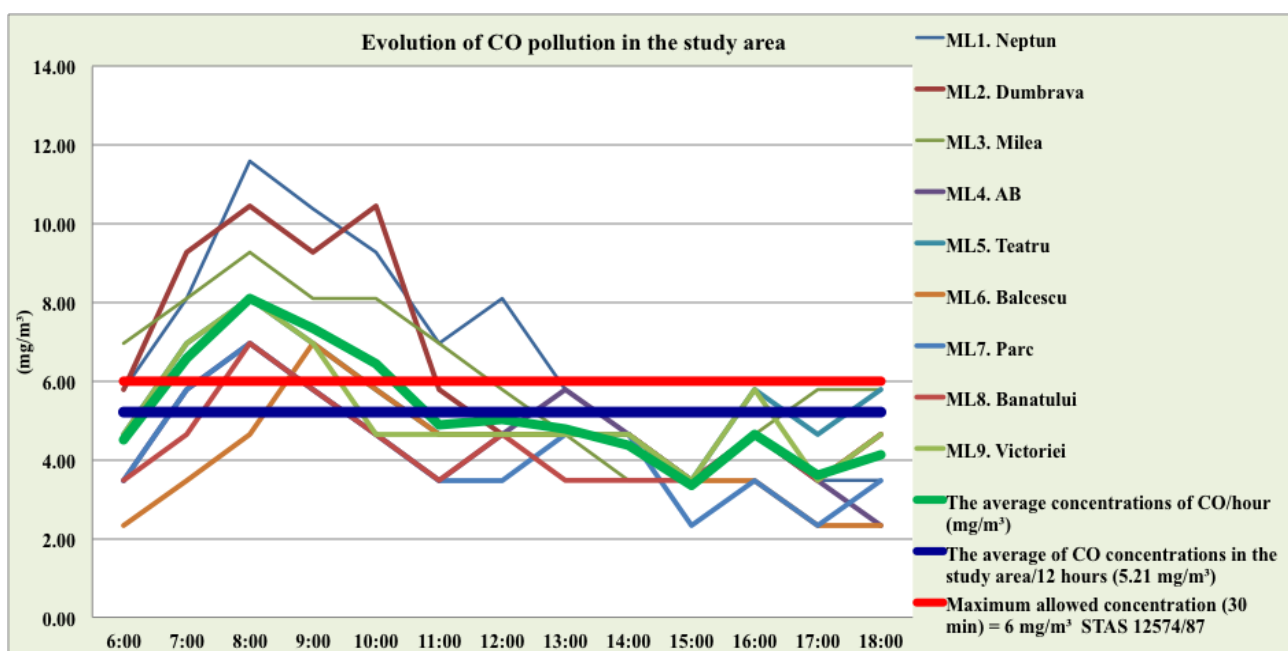


Fig. 3. The evolution of carbon monoxide pollution in the first stage of measurements

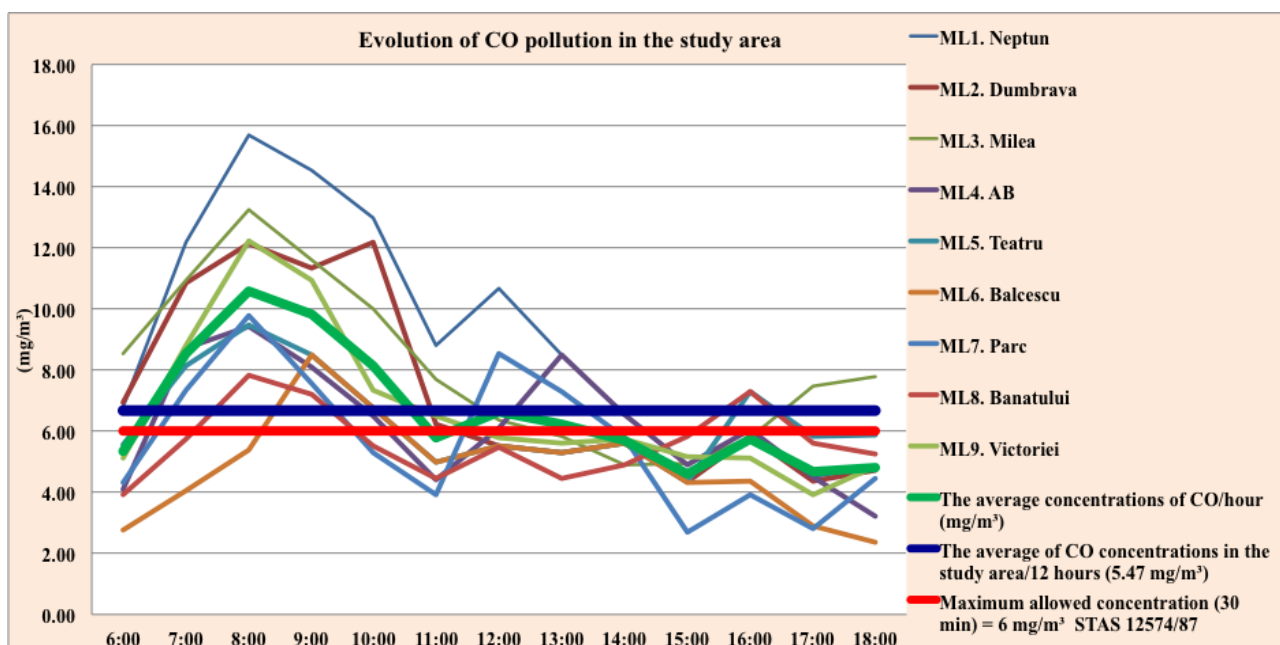


Fig. 4. The evolution of carbon monoxide pollution in the first stage of measurements

After analyzing the graphs presented in Figures 3 and 4 results that at a distance of one year, in similar conditions data sampling are increasing in an average

value from 5.21 to 6.66 mg/m^3 CO. The most significant increase were registered in ML 1 and ML 9 between the hourly interval 7.00-10.00 (figures 5 and 6).

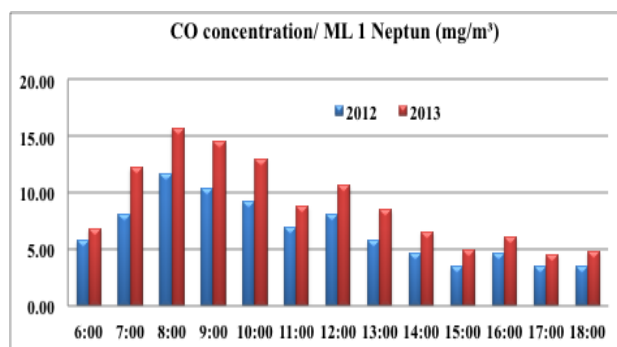


Fig. 5. CO concentration in ML 1 in 2012 and 2013

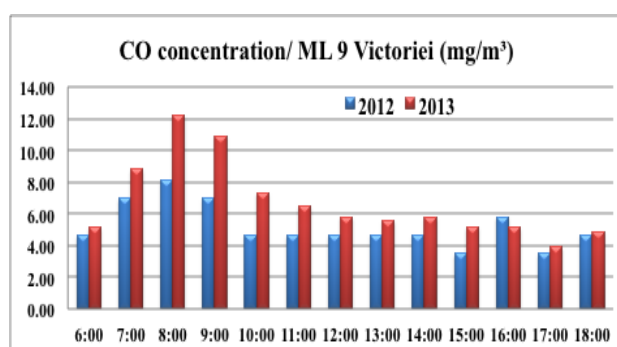


Fig. 6. CO concentration in ML 9 in 2012 and 2013

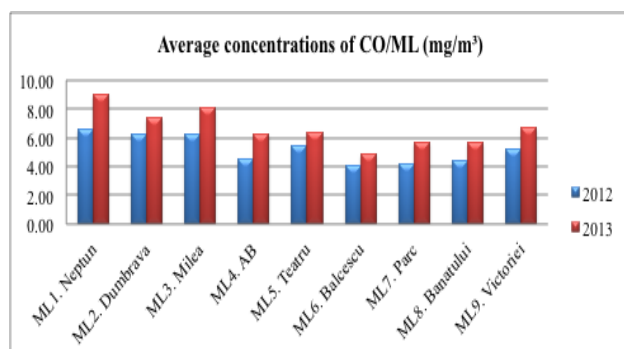


Fig. 7. Average concentration of CO in studied area in 2012 and 2013

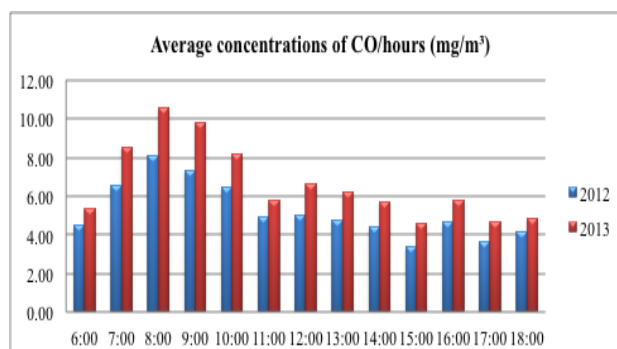


Fig. 8. Average concentration of CO in studied area/hours in 2012 and 2013

The locations where were registered the highest differences are those situated on the main town boulevards, on which the traffic was reconfigured in the second year.

One way roads, imposed by the new reconfiguration that were meant to ease congestion did have as a direct consequence, as results from the measurements a significant increase of CO.

The study of the average values in the monitoring area, in both stages are presented in Figures 7 and 8.

III. CONCLUSION

In Sibiu city, the tendency of traffic congestion during the rush hours is not caused by undisciplined road users (motorists and pedestrians), but by achieving maximum carrying traffic capacity of the analyzed arteries, in addition with the reconfiguration.

The main purpose of the reconfiguration of traffic in Sibiu's roads was for easing the traffic flow, but in some areas it caused a significant increase of pollution.

In the absence of an extensive monitoring during a whole year, the interpretation of the measurements made during just one day, represents only a case study of the traffic pollution in the area.

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