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THE ANALYZE OF AN INTERSECTION FROM THE CHEMICAL POINT OF VIEW

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Abstract: The air quality is one of the most important conditions for the life quality of the inhabitants. In Brasov district the air quality is mainly affected by the high and continuously increasing road traffic, by the stationary sources and by the climatic conditions which are specific to a depression with a low atmospheric circulation. For intersection's analysis there were collected data about the road traffic and data about the chemical pollution in the neighborhood of the road (the values of some pollutants resulted from the fuel combustion).

1. THE CURRENT SITUATION OF THE CHEMICAL POLLUTION LEVEL IN URBAN AREAS

The air quality is one of the most important conditions for the life quality of the inhabitants. In Brasov district the air quality is mainly affected by the high and continuously increasing road traffic, by the stationary sources and by the climatic conditions which are specific to a depression with a low atmospheric circulation.

Brasov City, especially in the historical center area, has a "canyon" type structure, from the street network point of view. The urban areas, obviously can not be considered homogenous entities; the highest levels of pollution are measured on "canyon" type streets street canyons, where the dilution of the exhaust gases is substantially limited because of the high buildings which act like a relief for the relatively restricted roads. This thing is very important, because from the architectural point of view, the street canyons represent one of the main geometrical structures of the city's topography.

In Brasov's Center we have a traffic flow close to the saturation limit of the access way. In the central area of the Brasov City can be found the biggest concentration of the carbon monoxide, where the majority in traffic is composed by the vehicles equipped with gasoline engines, where the traffic conditions are admitting their functioning frequently at uneconomical regimes, with partial loads, low engine speeds and uncompleted burnings of the fuel.

The nitrogen oxides, the ozone and the VOC are usually specific to the peripheral urban areas, where it can be noticed a high volume of heavy vehicles, which have diesel engines.

The level of health and comfort of the population:

The following list describes the potential health risks associated with these emissions:

- Carbon Monoxide (CO): An odorless and colorless gas which is highly poisonous. CO can reduce the blood's ability to carry oxygen and can aggravate lung and heart disease. Exposure to high concentrations can cause headaches, fatigue and dizziness.

- Nitrogen Oxides (NO_x) and Nitrogen Dioxide (NO_2): These chemicals form the yellowish-brown haze seen over dirty cities. When combined with oxygen from the atmosphere, NO becomes NO_2, a poisonous gas that can damage lung tissue.

- Hydrocarbons (HC): This is a group of pollutants containing hydrogen and carbon. Hydrocarbons can react to form ozone. Some are carcinogenic and other can irritate mucous membranes. Hydrocarbons include: Volatile organic compounds (VOC); Volatile organic gases (VOG); Reactive organic gases (ROG); Reactive organic compounds (ROC); Non-methane hydrocarbons (NMHC); Non-methane organic gases (NMOG).

- Ozone (O_3): This is the white haze or smog seen over many cities. Ozone is formed in the lower atmosphere when NMOG and NO_x react with heat and sunlight. Ozone can irritate the respiratory system, decrease lung function and aggravate chronic lung disease such as asthma [1],[2].

2. CHARACTERISTICS OF THE STUDIED INTERSECTION

It was chosen an intersection with a high traffic flow. This intersection is passed by a high number of vehicles (most of them having spark ignition engines), a high number of buses (with compression ignition engines) and by a relatively small number of trucks. For this intersection, the level of the chemical pollution was measured in 12 points. The points where the measurements were done are presented in the next figure.

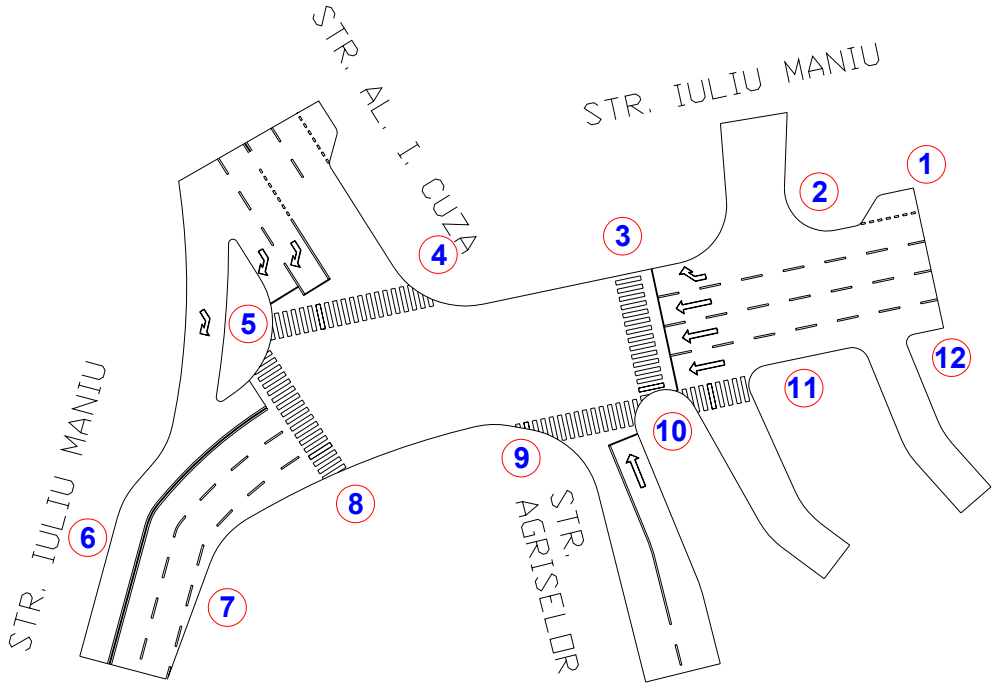

Figure 1. The points where the measurements were done

Alexandru Ioan Cuza Street + Nicolae Iorga Street + Iuliu Maniu Street Intersection is situated between two important residential areas of the Brasov city: the Historic Centre and

Civic Centre (commercial area). This intersection has traffic lights with 2 phases, tree entrances and the traffic flow corresponding to these entrances are different regarding the dimension and the composition from the vehicles' categories point of view. The most loaded entrance is the Iuliu Maniu Street, representing the transit of the vehicles from the Civic Center to the Historical Center of the city.

3. DATA OBTAINED FROM THE MEASUREMENTS

For intersection's analysis there were collected data about the road traffic and data about the chemical pollution in the neighborhood of the road (the values of some pollutants resulted from the fuel combustion).

The most common and handy method is the manual collecting of the road traffic data, with the help of an observer team, each member of this team writing down a specific element of the road traffic.

For a certain input with time variable signals, it is established the following method of data collecting for the intersection's analysis:

- Traffic volume, the number of vehicles which are passing the stop line, for each traffic movement (fore, left, right), but also the vehicles' type for each entrance.

- Total number of the arrivals or more correctly, the arrivals on the green light. These data give the real service request for each entrance of the intersection and a correct image over the progression factor and vehicles' delay. Usually, these kinds of applications are not used on a local plan because they are too laborious.

In order to determine the pollution degree of this area, it was used an OLDHAM MX21 Plus portable multi-gas detector. With this equipment there were measured the values of six main pollutants: NO, CO, VOC, NO_2, H_2S and O_3. The measurement unit for these pollutants is [ppm] – parts per million.

The values obtained during these measurements are shown in the following tables:

Table 1.

Entrance 1 – Iuliu Maniu Street														
Cars			Buses			Trucks			Trolleybuses			Articulated buses and trolleybuses		
Left	Fore	Right	Left	Fore	Right	Left	Fore	Right	Left	Fore	Right	Left	Fore	Right
0	2096	814	0	45	12	0	10	4	0	6	0	0	11	4
Entrance 2 - Agriselor Street														
Cars			Buses			Trucks			Trolleybuses			Articulated buses and trolleybuses		
Left	Fore	Right	Left	Fore	Right	Left	Fore	Right	Left	Fore	Right	Left	Fore	Right
33	259	0	2	3	0	1	0	0	0	0	0	0	0	0
Entrance 3 - Alexandru Ioan Cuza Street														
Cars			Buses			Trucks			Trolleybuses			Articulated buses and trolleybuses		
Left	Fore	Right	Left	Fore	Right	Left	Fore	Right	Left	Fore	Right	Left	Fore	Right
0	0	296	0	0	8	0	0	4	0	0	0	0	0	4

Table 2.

No.	NO [PPM]	CO [PPM]	VOC [PPM]	NO_2 [PPM]	H_2S [PPM]	O_3 [PPM]
1	2	5	7	0.1	2	0.02
2	2	4	7	0.1	2	0.04
3	2	4	4	0.1	2	0.04
4	2	4	15	0.1	2	0.02
5	2	4	3	0	2	0.01
6	2	5	8	0.1	2	0.05
7	2	6	9	0.1	1	0.03
8	2	2	3	0	1	0.01
9	2	4	6	0.1	1	0.04
10	2	4	3	0.1	1	0.05
11	2	4	5	0	0	0.02
12	2	5	9	0.1	1	0.02

The meteorological conditions of the area where the measurements were done:

- weather: good (Atmospheric temperature, T_{atm} = 30-31 °C; Humidity, H = 57%, Wind speed, w = 11-14 km/h (Wind direction - N, NV), Atmospheric pressure, P_{atm} = 1.015 KPa);

The traffic chemical pollution measurement conditions:

- Type of source: line source;
- Distance from source = 1 meter to 5 meters;
- Measurement interval = 60 seconds.

The volume of the traffic flow was determined by counting the total number of the vehicles, which passed through the intersection during one hour (15.00-16.00) in all ways.

4. USED EQUIPMENT

The MX21 Plus is a portable multi-gas monitor which can detect up to four gasses simultaneously and includes features such as: data logging, interchangeable pre-calibrated sensor blocks, instantaneous, STEL and TWA alarms. The unit is programmable via serial link from a PC or via a user-friendly menu interface and is approved for use in hazardous areas. By the use of intelligent plug-in sensor modules the device has one of the largest range of toxic sensors (20 plus) including CO_2, CO, H_2S, SO_2, CL_2, NO, NO_2, HCN, HF, PH_3, O_3, H_2, solvents etc.

Another unique feature of the MX21 Plus is the ability to measure CH_4 in percentage volume as well percentage LEL with a library of 32 pre-programmed flammable gasses to allow for more accurate monitoring of specific flammable gasses by simply selecting the target gas CH_4, H_2, butane, petrol vapors etc., from a menu.

Advantages:

- Simple to use. The MX 21 PLUS incorporates a self-diagnostic function, which indicates any irregularities in its operation thereby providing complete confidence measurement.
- Clear messages. Without having to calibrate the MX 21 PLUS, you can select the gas you wish to measure from any of the 16 preprogrammed flammable gases or vapors from its

international library, thereby ensuring a direct reading in % LEL. If the concentration exceeds the LEL range, the instrument will display over range in compliance with "non-ambiguity readout"

- Reliable oxygen measurement. The oxygen sensor manufactured in OLDHAM's modern laboratories provides accurate and reliable measurement [6].

Figure 2. The OLDHAM MX21 Plus portable multi-gas detector

5. CONCLUSIONS

Regarding the road traffic composition, as total hour traffic flow that transits the intersection, we have the following data: 3498 cars, 70 buses, 6 trolleys, 19 articulated buses and trolleys, 19 trucks (about 3900 standard vehicles).

About the chemical pollution measured in intersection's area, the following conclusions can be made:

NO – The level of nitrogen monoxide is constant in all the points where the measurements were done, the value being 2 [ppm].

CO – The level of carbon monoxide is situated around the value 4 [ppm]. In some points the value is bigger with one or two units, but in general, the CO concentration level in the measured area is constant.

VOC – The measured values of the volatile organic compounds are different for most of the measurement points. The highest values were measured in the points were the column of vehicles is forming at the traffic lights and in the exit area of the intersection, were we have a canyon type street.

NO_2 – The level of nitrogen dioxide is also constant, the values being approximately equal and low.

H_2S – The values of sulphur hydrogen are bigger in the area where the buses are, in the right side of the road, where the special lanes for the common transportation vehicles are.

O_3 – The values of ozone varies in function of the points where the measurement was made. The highest values were measured in the area where the column of vehicles is forming at the traffic lights.

From the 12 measurement points' pollution level point of view, it was determined:

- The biggest values were recorded in measurement points: 1, 12, 6 and 7. These are the points where the vehicles' line is formed on the main access of the intersection, and where the vehicles enter in the so-called street canyon area, at the evacuation of the intersection.

In conclusion, it is necessary to make more measurements in all kind of meteorological conditions and in all seasons of the year.

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