Air pollution generated by road traffic in the city of Zagreb and measures proposed

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Abstract

The objective of this paper is to analyze the impact of road traffic on air pollution in the city of Zagreb and emphasise the measures to establish sustainable traffic in the city of Zagreb. Due to the large number of vehicles, high percentage of defective vehicles and relatively low speeds (below 80 km/h), the highest effect on air pollution in the city of Zagreb is generated by road vehicles. If air pollution in the city is analyzed from 2001 to 2009 it may be concluded that the biggest problem lies in the pollution by nitrogen oxides, airborne particles and ground-level, which means that taking these pollution parameters into consideration the air was of category II, i.e. moderately polluted. The most endangered city areas are the industrial zones and traffic nodes. Some of the suggestions for the decreasing emission of harmful components in exhaust gasses emissions in Zagreb are: reconstruction of road network (emphasis on intersection), introduction of traffic oriented control, usage of intelligent transport system for guiding organization of traffic, "park and ride" system, fuel quality improvement etc. In the city of Zagreb there's a lot of room for improvements in technical, technological and ecological sense. This paper in conclusion offers optimal proposals of measures to establish better air quality and sustainable traffic in the city of Zagreb.
Keywords: air pollution, intersection, monitoring of air pollution, road traffic, city of Zagreb, pollutants, measurements, transport simulation, traffic density.

1 Introduction

The total number of registered road motor vehicles in Croatia in the year 2008 was 2,021,936, out of which 20.5% were registered in the city of Zagreb. Due to unfavorable engine operating conditions, relatively low driving speeds (below

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80 km/h), poor quality of fuel, and high numerical presence of motor vehicles, road motor vehicles represent the primary air polluters in the city of Zagreb. In the Republic of Croatia, based on the Air Quality Act, air quality measurements are performed by the State Network for Continuous Air Quality Monitoring using the local networks. The structure of the measuring network for monitoring of air pollution in a certain urban area is a dynamic process which is changed, harmonized and improved depending on the new scientific knowledge [1]. In the last decade, there has been a substantial increase in the number of vehicles in the city of Zagreb, by more than 60%. Generally, the traffic in the region of the city of Zagreb participates with high share in the total emission of carbon (IV) oxide (CO_2), carbon (II) oxide (CO), nitrogen oxides (NOx), sulfur (IV) oxides (SO_2), volatile organic substances (NMVOC) and particulates. There is an especially high level of nitrogen oxides and NMVOC compounds which interact and cause the creation of ground-level ozone, which is especially expressed during the summer season [1]. The traffic system of the city of Zagreb can be optimized even without constructing new traffic routes, by introducing intelligent traffic control, with the possibility of organizational change at intersections, and by establishing a secondary system for the control and management, which was shown also by the computer simulation. In this way it is possible to achieve energy and ecological efficiency, that is, reduction of HC, CO, VOC, and NOx by 50% [2]. The paper will present an overview and analysis of the condition of studying exhaust gases generated by road vehicles in the city of Zagreb, as well as the proposals of measures for their reduction.

2 Regulations and testing of exhaust gases in the city of Zagreb

Over the last years, an entire series of acts have been brought that need to be implemented and which is, according to past experiences of the transition states, a complex organizational, technical and financial process. The basic documents that define the air quality policy in the Republic of Croatia include:

- Environmental protection strategy with National Plan of acting on the environment,
- Environment protection act and air protection act.

These documents regulate the bringing of a series of bylaws which, among other things, determine: the method of assessing air quality, the method of monitoring air quality, the limit values of airborne pollutants, requirements for technical appliances and fuel, control of implementation, requirements for the quality of data and measurements. By coming into force of the Regulations on modifications and amendments of the Regulations on technical inspections of vehicles in the Republic of Croatia on 18 April 2001 as part of regular technical inspection the exhaust gases on petrol engines started to be tested, and on 28 April 2002 the tests started to be applied to Diesel engine vehicles. The EKO-test is performed during the regular technical inspection and it is a condition that has to be fulfilled for a vehicle to be considered roadworthy at a technical inspection station. One of the reasons why road vehicles are primary air polluters in the city is also partial failure at the EKO-test of 4.25% since Zagreb citizens perform 37% of their trips by passenger cars [3]. The reason for worry is also the growing trend in the number of passenger cars, and the reduction in the volume of public urban transport, and relative old age of vehicles. Thus, the number of passenger vehicles per 1000 citizens increased from 233 in 1981 to 517.9 vehicles per 1000 citizens in 2008 [10]. In Zagreb monitoring the concentrations this is dealt with by the Institute for Medical Research that performs measurements at 13 measuring stations in the wider region of the city, out of which six are urban, and three state stations, and four measuring stations for special purposes. In order to harmonize the measuring network for air pollution monitoring in Zagreb, one measuring station each has been located in the city centre, and in its northern, eastern, southern and two in the western part, which is a total of six measuring stations. Regarding the level of air pollution, the regions, including the area of the City of Zagreb, can be classified into three categories: (i) Category I – pure or slightly polluted air; (ii) Category II – moderately polluted air; and (iii) Category III – excessively polluted air. Analyzing air pollution in Zagreb from 2001 to 2011, one can come to the conclusion that the biggest problem of pollution is from nitrogen oxides, airborne particulates and ground-level ozone, which means that air in relation to these pollution parameters was of Category II, i.e. moderately polluted. The tolerant values have been exceeded, for the third year in a row, for PM parameter, so that the air in the western part of the city was of Category III i.e. excessively polluted. This refers to the orientation assessment performed on the basis of the number of registered vehicles (Table 1). The assumption was used that an average vehicle in the urban area travels about 5000 km annually. With the data on the vehicle emission factors, the final assessment of pollution from mobile emission sources was found. The table shows that in the city the emissions are mostly from carbon (IV) oxides. An increasing use of passenger vehicles has become the dominant problem regarding air quality in the city area. Regardless of this referring to newer generation of vehicles with reduced emissions and vehicles that use higher quality fuels, the increase is continuing and causing an increase in the total emissions especially in the peak traffic and on congested traffic routes. Table 2 presents a summary of the emissions for the city of Zagreb for the period from 2001 to 2011 [4].

Table 1: Orientation assessment of emissions from the traffic sector of the city of Zagreb.

Parameters of pollution	Quantity of emission (t)
CO	7890
NO_x	2474
NMVOC	2217
PM	276,2
CO_2	641193
SO_2	426

Table 2: Summary presentation of pollutant emissions (t per year) for the city of Zagreb.

Emission from sources/	TE-TO EL-TO	Nonenergy sources	Process technology	Heating, steam	Households and institutions	Transport	Total
CO	482,97	2,54	13,74	25,11	-	7890	8414,36
CO2	1192344	1441,21	89215,45	221564	-	641193	2145757
SO2	4086,66	9,32	22,81	309,78	3612	426	8466,57
NOX	1119	0,48	95,89	613,93	1051	2474	5354,3
Overall particles	44,15	13,73	44,06	45,91	1375	276,2	1799

3 Road traffic as source of air pollution in the city of Zagreb

In the city of Zagreb the highest impact on air pollution is from road vehicles due to unfavorable conditions of engine operation, relatively low driving speed, insufficient fuel quality and large number of vehicles, because of the high percentage of defective vehicles (in 2008 there were 21.4% defective vehicles in a total of 1,775,354 inspected vehicles according to data of the Croatian Centre for Vehicles). In Croatia the total number of road vehicles from 1999 to 2008 increased by 53%, whereas the number of passenger cars increased by 4–5% [5]. Although the share of passenger cars in the total number of vehicles is decreasing, it is still at the high 76%, which is why it represents the main problem from the aspect of air pollution by exhaust gases. In the same period there was a significant increase in the emission of particulates because of the increase in the number of Diesel vehicles. Since in the overall number of registered vehicles in the Republic of Croatia the city of Zagreb accounts for about 20%, i.e. one fifth, it may be concluded that road vehicles are the largest source of air pollution especially by carbon (II) oxide, nitrogen oxides, particulates and metals in the overall sedimentary substance. In the situation of such high increase in the number of motor vehicles such as the one in Zagreb, there comes inevitably to significant difficulties in the traffic system flow, particularly in the historical centre whose streets, primarily constructed for pedestrians, fail to withstand this pressure, and a lot is said by the data from the European Green Paper about the urban traffic that due to traffic congestions and diseases caused by exhaust gases from traffic, almost 100 billion euro, i.e. 1% GDP are lost annually [6]. The regulation and organization of traffic flows in road traffic network of the city of Zagreb, which, except for the smaller rail system, accepts all transport means, is extremely unfavorable. Because of the restrictive regulation, numerous unnecessary bans and obligations, i.e. unfavorably directed street network, the intersection capacities have been reduced by more than 20%. This reflects negatively both on the expenditures and on environmental pollution.

4 Methodology

In Zagreb in 2011 a seven-day pilot measurement of air pollution levels at seven city intersections was carried out [7]. The measurement included intersections in the strict city centre as well as open intersections at the entries into the city centre. The traffic count provided data on the number of vehicles, vehicle structures and traffic congestions at intersections and the surrounding traffic routes. One of these intersections is also the intersection of the Slavonska avenija – Radnička cesta and Heinzelova ulica. With the traffic count the data have been obtained on the number of vehicles, structure of vehicles and traffic load of the intersection and the surrounding roads. By analyzing the traffic flows at the respective intersections one should consider the road routes and approaches designated by numbers from 1 to 4 (Tables 3 and 4). Route 1 designates the arrival of vehicles from the South, Route 2 the arrival of vehicles from the East, Route 3 the arrival of vehicles from the North, Route 4 the arrival of vehicles from the West. During the traffic count, i.e. recording of traffic flows, the traffic routes have been defined as well in accordance with the numerical codes: 1 > 2, 1 > 3, 1 > 4, codes for the vehicle flow from the South towards the East, North and West; 2 > 1, 2 > 3, 2 > 4, codes for the vehicle flow from the East towards the South, North and West; 3 > 1, 3 > 2, 3 > 4, codes for the vehicle flow from the North towards the South, East and West; 4 > 1, 4 > 2, 4 > 3, codes for the vehicle flow from the West towards the South, East and North. The vehicles have been classified in the following groups of vehicles: passenger cars, motorcycles, bicycles, vans, two-axle vehicles, three-axle vehicles, a set of vehicles and bus. According to their number we can conclude through which intersections the dominant transport is only by passenger vehicles, through which intersections the delivery segment is also present, and which intersections also accommodates freight traffic, as well as the public passenger traffic through the share of buses in the traffic flows.

The application of Trafficware-Synchro 4 software, Traffic Signal Coordination Software, was used to make the computer image of the current condition of traffic routes and intersections and traffic flows, from which the data have been taken for the days with the heaviest traffic flows. The software processed the actual traffic situations in the current moment without trying to influence by means of software parameters. In this way the image of fuel consumption and the image of exhaust gas emissions (NOx, CO and VOC) are obtained. Table 5 Shows the values obtained in this way as the basic situation. The emissions of the main pollutants (CO, NMOC, NOx, SOx and PM) generated by road transport have been evaluated, i.e. calculated by using the EMEP/CORINAIR methodology which is implemented for the EU countries. For the calculation needs COPERT III method has been used (Road Transport Emission Factors Calculator). The assessment of the main pollutant emissions from the traffic sector of the city of Zagreb is presented in Table 1 [8]. The Traffic-SimTraffic, Traffic Signal Simulation Software, have been used to make computer-controlled simulation of the traffic situation in the duration of 10 minutes, and new values of the mentioned parameters are presented in Table 5 as

Table 3: Intersection: Slavonska avenija – Radnička cesta – Heinzelova ulica, total number of vehicles and hourly distribution.

days in a week	Manday 24.10.2011.		Tuesday 25.10.2011.		Wednesdey 26.10.2011.		Thursday 27.10.2011.		Friday 28.10.2011.		Saturday 29.10.2011.	
quantity / direction	average of hourly distribution	total number of vehicles	average of hourly distribution	total number of vehicles	average of hourly distribution	total number of vehicles	average of hourly distribution	total number of vehicles	average of hourly distribution	total number of vehicles	average of hourly distribution	total number of vehicles
1>2	102	1525	107	1605	87	1310	27	405	98	1470	92	1375
1>3	241	3620	234	3505	131	1965	75	1130	247	3710	254	3805
1>4	241	3610	265	3975	164	2465	109	1640	270	4055	257	3855
2>3	357	5350	355	3520	269	4030	171	2560	263	3940	385	5780
2>4	1546	23190	1689	25340	1259	18880	1125	16870	1744	26160	1469	22040
2>1	121	1820	122	1830	79	1180	68	1020	125	1880	119	1780
3>4	843	12640	945	14170	821	12320	743	11140	1057	15850	855	12830
3>1	390	5850	395	5920	240	3600	193	2890	378	5670	390	5850
3>2	336	5040	333	4990	265	3970	161	2410	393	5890	385	5780
4>1	158	2370	143	2150	161	2420	137	2050	147	2200	143	2150
4>2	1251	18760	1151	17270	1286	19290	1238	18570	1109	16630	1025	15370
4>3	809	12140	744	11160	1039	15580	801	12020	795	11930	642	9630
total number of vehicles	6394	95915	6482	97235	5801	87010	4847	72705	6626	99385	6016	90245

Table 4: Intersection: Slavonska avenija – Radnička cesta – Heinzelova ulica, day – Monday.

Intersection Slavonska avenija - Radnička cesta - Heinzelova ulica											
Date	24.10.2011.	Week day	Monday								
		period	period	period	period						
vehicle type	route	6.00-11.00	11.00-16.00	16.00-21.00	6.00-21.00						
pass.car	1>2	600	360	295	1255	two-axle vehicles	1>2	30	40	15	85
	1>3	1205	895	840	2940		1>3	105	65	0	170
	1>4	1220	885	505	2610		1>4	135	80	0	215
	2>3	1100	2200	810	4110		2>3	120	120	0	240
	2>4	5210	8780	4570	18560		2>4	500	600	0	1100
	2>1	270	820	260	1350		2>1	20	110	0	130
	3>4	2400	2580	5780	10760		3>4	150	150	170	470
	3>1	1380	1420	1830	4630		3>1	130	130	0	260
	3>2	860	1080	2110	4050		3>2	50	30	40	120
	4>1	540	610	420	1570		4>1	70	60	0	130
	4>2	4008	5292	5370	14670		4>2	460	300	0	760
	4>3	2940	3360	3780	10080		4>3	30	170	0	470
motorcycle	1>2	0	0	0	0	three-axle vehicles	1>2	15	10	0	25
	1>3	0	5	0	5		1>3	25	5	10	40
	1>4	0	0	5	5		1>4	65	35	25	125
	2>3	0	0	0	0		2>3	20	10	20	50
	2>4	0	10	10	20		2>4	80	180	170	430
	2>1	0	0	0	0		2>1	10	0	30	40
	3>4	0	0	20	20		3>4	0	50	20	70
	3>1	0	0	20	20		3>1	0	10	70	80
	3>2	0	0	0	0		3>2	10	10	50	70
	4>1	0	0	0	0		4>1	70	40	80	190
	4>2	0	0	0	0		4>2	90	90	630	810
	4>3	0	0	40	40		4>3	0	30	120	150
bicycle	1>2	0	0	0	0	set of vehicles	1>2	0	0	0	0
	1>3	0	0	0	0		1>3	5	0	0	5
	1>4	0	0	0	0		1>4	35	35	0	70
	2>3	0	0	0	0		2>3	0	60	10	70
	2>4	0	0	0	0		2>4	30	280	0	310
	2>1	0	0	0	0		2>1	10	20	0	30
	3>4	0	0	0	0		3>4	0	50	30	80
	3>1	0	0	10	10		3>1	0	0	0	0
	3>2	0	100	0	100		3>2	20	10	0	30
	4>1	0	0	0	0		4>1	0	10	0	10
	4>2	0	0	0	0		4>2	70	240	0	310
	4>3	0	0	0	0		4>3	50	0	0	50
van	1>2	65	70	20	155	bus	1>2	0	5	0	5
	1>3	170	160	60	390		1>3	35	15	20	70
	1>4	270	185	105	560		1>4	15	0	10	25
	2>3	280	370	50	700		2>3	70	80	30	180
	2>4	990	1300	360	2650		2>4	10	50	60	120
	2>1	10	150	110	270		2>1	0	0	0	0
	3>4	280	450	480	1210		3>4	30	0	0	30
	3>1	230	380	160	770		3>1	20	20	40	80
	3>2	160	170	260	590		3>2	40	10	30	80
	4>1	160	190	90	440		4>1	10	20	0	30
	4>2	720	730	660	2110		4>2	0	70	30	100
	4>3	510	500	280	1290		4>3	0	20	40	60
						SUM		28483	36372	31060	95915

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Table 5: Energy and ecological efficiency at the Slavonska avenija – Radnička cesta – Heinzlova ulica intersection [9].

Intersection Slavonska avenija - Radnička cesta - Heinzlova ulica		
Indicators:	Basic situation	Improved situation
Total period of travelling (hours)	153	91
Total travelled transit (km)	2611	2611
Average speed (km h-1)	17	29
Consumption of fuel (liter)	889	483
Efficiency of fuel consumption (km lit-1)	29	54
Emission CO (g)	16530	8990
Emission NOX (g)	3190	1730
Emission VOC (g)	3810	2070
Stopping of vehicle (total all/one average)	6095/1,01	3853/0,64
Indicators for simulation of 10 min		
Total travelled time (hour)	40	38,8
Total travelled transit (km)	765,3	771,1
Average speed (km h-1)	20	21
Consumption of fuel (liter)	305,8	250,6
Efficiency of fuel consumption (km lit-1)	2,5	3,1
Emission CO (g)	9960	6133
Emission NOX (g)	725	503
Emission VOC (g)	203	154
Stopping of vehicle	1569	1327

improved situation. The data were processed according to the following criteria: all the current traffic flows have been kept according to values and directions; the directions, number and size of traffic lanes at intersections have been kept; the same traffic light cycle has been kept; all other infrastructure factors have been kept; detector coordinated automatic signal-safety devices control has been introduced into the traffic light operation, automatic traffic flow management has been regulated by means of intersection passing speed.

5 Results obtained by computer simulation

Under the title of basic situation and improved situation, the data about the emission of harmful substances, about the fuel consumption, fuel consumption efficiency, lost time necessary to pass an intersection, speed and volume of traffic flows, etc. have changed. In the computer processing the software uses data and calculation methods, which have been applied and verified by the US organization "Federal Highway Administration Research" and the data processing procedure under the title "CORSIM". Table 5 shows the essential indicators for energy efficiency and environmental protection, through their reduction or increase. Computer simulation indicates significant possible reductions in environmental pollution (lower emissions) from road traffic by using telematic systems to control traffic as well as improved throughput capacity of traffic flows, even without their reconstruction. The analysed Slavonska avenija – Radnička cesta – Heinzlova ulica intersection was grade separated in 2011, and the seven-day measurement was repeated after the reconstruction in October. Figures 1 and 2 show the levels of concentrations of NO2 and PM10 before and after the reconstruction.

During the seven-day measurement in 2011 (February), higher values of NO2 concentrations were recorded in comparison to concentrations from 2011 (October). Lower NO2 concentrations after the construction of the overpass in spite of the assumed traffic density indicate the justification of constructing the overpass. Its construction has prevented the formation of long queues of vehicles at traffic lights.

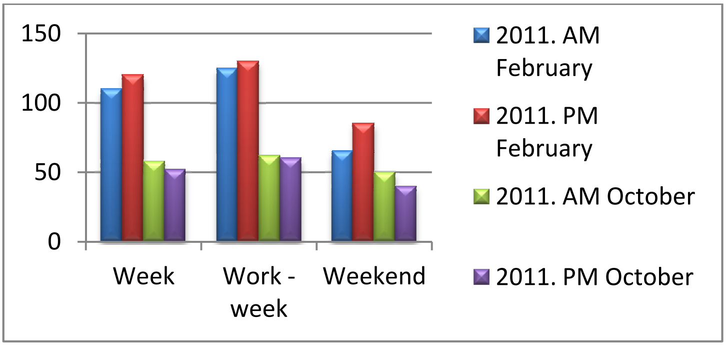

Figure 1: Levels of concentration of NO_2 at Slavonska avenija – Radnička cesta – Heinzlova ulica intersection during the measuring periods in 2011 [9].

Also, the year 2011 (February) marked higher values of concentrations during the morning hours as consequence of accumulation of pollution during the formation of long queues. This effect was not marked during 2011 (October) because of the construction of the overpass and higher traffic throughput capacity. For the reduction of exhaust gases emissions at intersections it is of primary importance to increase the throughput capacity, thus avoiding the delay of vehicles and increasing the speed of passing through the intersection.

Using the example of this intersection we can see that the grade separation of the intersection achieves the effects of greater throughput capacity of the intersection, better connection of the intersections in the network, which results in lower congestion at the intersection, smaller waiting queues for left turns, and consequently also lower emission of harmful substances.

By considering the network of surrounding traffic routes and intersections we can see that some intersections, which until the leveling had no congestions, now start to receive greater flow of vehicles that may result in congestions i.e. shifting of the congestion to the adjacent intersections. The given examples show that this can be achieved in two ways: by reconstruction and adaptive traffic light management. A partial solution (only reconstruction or only a new telematic system) would not give the desired results.

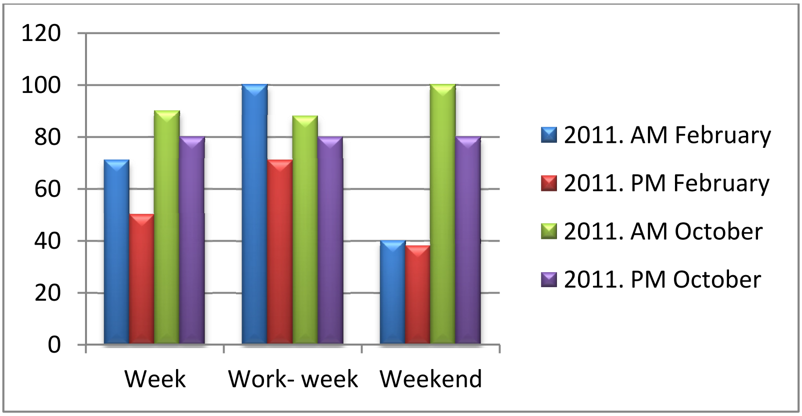

Figure 2: Levels of concentration of PM10 at Slavonska avenija – Radnička cesta – Heinzlova ulica intersection during the measuring periods in 2011 [9].

6 Proposals of measures for establishing the air quality in the city of Zagreb

6.1 Increase of capacity by using ITS

The introduction of ITS in the city of Zagreb can be observed through five basic criteria [10]: increase of throughput capacity, increase of the efficiency of public urban transport, increase of traffic safety level, increase of environmental protection, increase of economic efficiency.

Since the public urban traffic in Zagreb mostly shares the traffic area with the motorized traffic, it has been estimated that the starting criterion, the criterion which should be given priority, is the increase of the efficiency of public urban traffic, which inevitably includes also the increase of all the other parameters. Modernization of the traffic lights (new devices, sensors, special sensors for public traffic, etc.) and the construction of the main traffic centre represent the base for the development of the system for automatic traffic management in the City of Zagreb, and should therefore be given priority in relation to other ITS subsystems.

Computer simulations have also shown that significant reduction of environmental pollution caused by road traffic can be achieved by the usage of telematic systems for traffic management, as well as better throughput of the traffic flows even without reconstruction. Having in mind the benefits of ITS confirmed in practice in the cities of Europe, for the city of Zagreb, the following results can be expected [11]: shorter travel time up to 25%, lower exhaust emissions up to 22%, lower fuel consumption up to 10%, lower losses by 15–20%.

6.2 Traffic redirection – “park-and-ride” system

It is an indisputable fact that there is a shortage of parking spaces in Zagreb, and they need to be constructed best in the frame of the public garages, at the City periphery, immediately next to the public transport stops [12]. From the ecological aspect this is the only acceptable solution. In order to reduce the entry of passenger cars from the peripheral urban districts to the narrow city area, including the quantity of pollutants, it is necessary to introduce the park-and-ride system, i.e. construct parking lots (garages) along tram and bus terminals and bigger peripheral railway stops.

6.3 Public urban and non-motorized traffic improvement

Regardless of the planned improvements of railway, tram and bus transport it has been estimated that due to the size and spatial organization of the City this would be insufficient, so that it was concluded that the optimal choice for Zagreb is the construction of light rail. Since the 1970s in Zagreb the concepts of constructing a new system of fast rail transport have been present, different regarding the spatial span of such a system and its traffic and technological characteristics. The prognostic model has simulated the future traffic demand and several versions of the traffic system, from the existing one to the construction of a metro and light urban rail [13].

6.4 Improved air quality control

Due to excessive air pollution by the PM10 particulates in the western part of the city and the moderate pollution by ozone, nitrogen oxides and particulates on the majority of monitoring stations of local network, the introduction of pre-fabricated monitoring stations of small dimensions is recommended which would allow precise measurements of the traffic-generated pollutants [14]. The plan is to move three such monitoring stations within certain time intervals (1–3 years) to extremely loaded traffic routes, and the planned measuring parameters are the particulates, benzene, nitrogen oxides, sulphur (IV) oxides and ozone. Also, at the existing monitoring stations of local network (where this is not the case) it is recommended to upgrade the measuring system by introducing PM2, 5 particulates and BTX parameters in compliance with the Regulation on Emission Limit Values for Air Pollutants.

7 Conclusions

The results of air quality monitoring in the city of Zagreb undoubtedly indicate increased air pollution caused by traffic, i.e. mobile pollution sources. By analyzing the air pollution in the city of Zagreb from 2001 to 2011, it may be concluded that in the city the biggest problem was the pollution by nitrogen oxides, airborne particulates and ozone (ground-level ozone), which means that the air in relation to these parameters of pollution was of category II, that is, moderately polluted. The tolerant values were exceeded for PM10 parameter, so that the air in the western part of the city was of category III, that is, excessively polluted. The traffic system of the city of Zagreb can be optimized without constructing new traffic routes, but rather by introducing intelligent transport management, with possible organizational changes at intersections, and by establishing the accompanying supervision and control system which has been shown also by the computer simulation. Reduction of HC, CO, NOx and VOC even up to 50% can be seen at the analyzed intersection. The current situation in the city requires measures that will alleviate the load on the traffic routes, reduce the growing number of passenger cars, increase the usage of public urban transport, and thus also improve the air quality, within a very short period of time. Having in mind these facts, the proposed measures include:

- introduction of adaptive control of traffic lights and giving priority to the vehicles of public urban transport through active access model. In order to achieve this, it is necessary to change all the traffic lights since the existing ones are obsolete and cannot be managed intelligently;
- to found the main traffic centre which would control and supervise the traffic lights;
- unify and time-coordinate all the forms of public urban traffic;
- stop the construction of parking spaces in the central parts of the city, and direct the money intended for these purposes to the construction of the park-and-ride parking lots;
- better air quality control.

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