

# CONCENTRATION OF VOLATILE ORGANIC COMPOUNDS IN URBAN AIR HEAVILY INFLUENCED BY TRAFFIC

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## ABSTRACT

The volatile organic compounds emissions from motor vehicles have noxious effects on human health in cities with high traffic. There are especially benzene with provable carcinogenic effects and 1,3-butadiene with suspicion of carcinogenic effect. The results of benzene, toluene, ethylbenzene, xylenes and 1,3-butadiene concentrations monitoring in urban air in a very heavily used junction with high traffic are presented in this paper. The measures were carried out from February to June of 2004. The obtained data are used as the base for the review of potential exposure of population in the cities near the busy roads.

**KEYWORDS:** VOCs, determination, traffic, urban air

## 1. INTRODUCTION

The volatile organic compounds (VOCs) emissions originated from running motor vehicles have noxious effects on human health especially in cities with high traffic. Especially benzene with its provable carcinogenic effects and 1,3-butadiene with suspicion of carcinogenic effect were in focus. This paper contains the presented results of monitoring of benzene, toluene, xylene, ethyl benzene (BTEX) and 1,3-butadiene concentrations in urban air in locality – a very heavily used junction with high traffic (circa 30,000 cars.day<sup>-1</sup>). The measures were carried out from the February to June of 2004 (15-minute averages). The obtained data are used for evaluation of actual emission situation and as the base for the review of potential exposure of population in the cities near the busy roads.

## 2. METHODOLOGY

The VOC71M-PID Analyser for determination of concentrations VOCs in ambient air was used. (Environment SA, France). Principle of analysis is based on selective accumulation of pollutants into trapping desorption tube, pre-focussing into resorption tube of them, separation on chromatographic column after ballistic thermal desorption of them and detection with selective detector. Retention times of all pollutants were set in according with values RT in Tab. 1 and weekly checked. The unit switches automatic between two desorption tubes so that they permit continual measurement. The measurement was carry out from 26.2.2004 to 30.6.2004 in 15 - minute intervals. The analyser was situated in automatic imission measurement station.

### Characteristics of measurement conditions:

Sampling time of accumulation in one tube = 900 s

Sample volume = 1 litre, sampling air flow rate = 66.4 and 64.2 ml min<sup>-1</sup>

Trapping desorption tubes: Carbotrap

Pre-focussing tube: Carbopack B

Column type EPA 624 temperature regulated, length = 10 m.

Carrier gas: N<sub>2</sub>, flow rate 39.3 ml min<sup>-1</sup>

Temperature range:

Start 34 °C

Rising 20 °C min<sup>-1</sup>

End 150 °C

Refresh 32 °C

Detector: Photoionization detector (P.I.D)

## 3. RESULTS AND DISCUSSION

Seven volatile pollutants content in ambient air - benzene, toluene, m-xylene + p-xylene together, o-xylene, ethyl benzene and 1,3-butadiene – was measured. Weekday and quarter hour mean values from obtained results were calculated. The weekday mean values were calculated as averages of all quarter hours concentrations for each weekday. These values and retention times of all measured pollutants are shown in Tab.1. Weekday averages for benzene and 1,3-butadiene are shown on Fig. 1.

Figure 1. Weekday averages for benzene and 1,3-butadiene content in ambient air, Kotlarska locality, Brno, Czech Republic

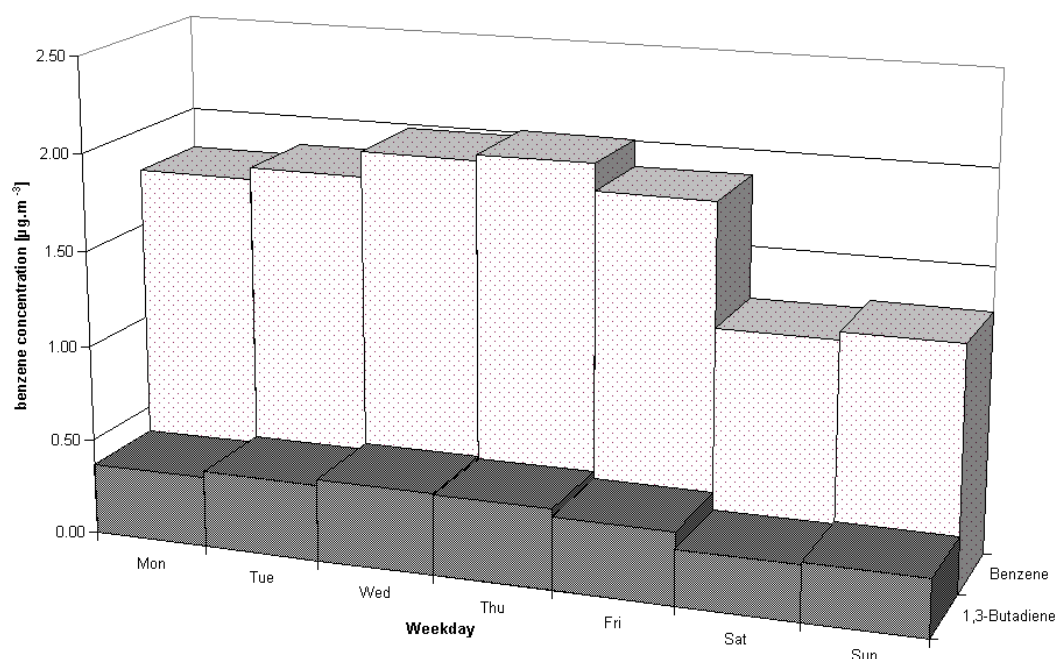


Table 1 Weekday averages of measured pollutants content in ambient air, Kotlarska locality, Brno, Czech Republic

Weekday	Mon	Tue	Wed	Thu	Fri	Sat	Sun	RT sec
Benzene µg m <sup>-3</sup>	1.79	1.85	1.97	2.01	1.88	1.3	1.27	114.6±1.5
Toluene µg m <sup>-3</sup>	4.10	4.07	4.21	4.33	3.0	2.0	2.40	170.5±1.5
Ethylbenzene µg m <sup>-3</sup>	1.76	1.86	2.60	2.03	1.8	1.2	1.13	222.6±1.5
m-+p-Xylene µg m <sup>-3</sup>	2.99	3.13	3.23	3.35	3.6	1.8	1.78	227.2±1.5
o-Xylene µg m <sup>-3</sup>	1.44	1.53	1.60	1.62	1.8	0.92	0.96	241.8±1.5
1,3-Butadiene µg m <sup>-3</sup>	0.37	0.40	0.43	0.42	0.9	0.29	0.30	38.1±0.8

Mean values for each quarter hour were calculated in according with Horn method for small statistical samples (4 to 20). The quarter hour sliding averages of these values (each for 4 values) of every weekday for benzene content in ambient air are shown on Fig. 2.

Quarter hours concentrations of benzene, toluene, ethylbenzene, o-, m- xylene + p-xylene and 1,3-butadiene was correlated statistical significantly each to other (Tab. 2). Thus, the contents of other pollutants were similar as is shown on Fig. 2. Two mean maxims in workdays were registered. In the morning were about 8:30 and afternoon about 17:00. On Saturday were maxims very smaller and in morning hours about 10:30, afternoon about 20:00. On Sunday was maximal concentration VOCs about 21:00 (Fig. 2)

Table 2. Correlation coefficients among benzene, toluene, m-xylene + p-xylene together, o-xylene, ethyl benzene and 1,3-butadiene content in ambient air, Kotlarska locality, Brno, Czech Republic

	Benzene	Toluene	Ethylbenzene	m-+p-Xylene	o-Xylene	1,3-Butadiene
Benzene	1.000	0.953	0.733	0.960	0.961	0.818
Toluene	0.953	1.000	0.677	0.989	0.977	0.810
Ethyl	0.733	0.677	1.000	0.681	0.682	0.808
m-+p-Xylene	0.960	0.989	0.681	1.000	0.985	0.810
o-Xylene	0.961	0.977	0.682	0.985	1.000	0.801
1,3-Butadiene	0.818	0.810	0.808	0.810	0.801	1.000

Figure 2. Quarter hour sliding averages of every weekday for benzene content in ambient air, Kotlarska locality, Brno, Czech Republic

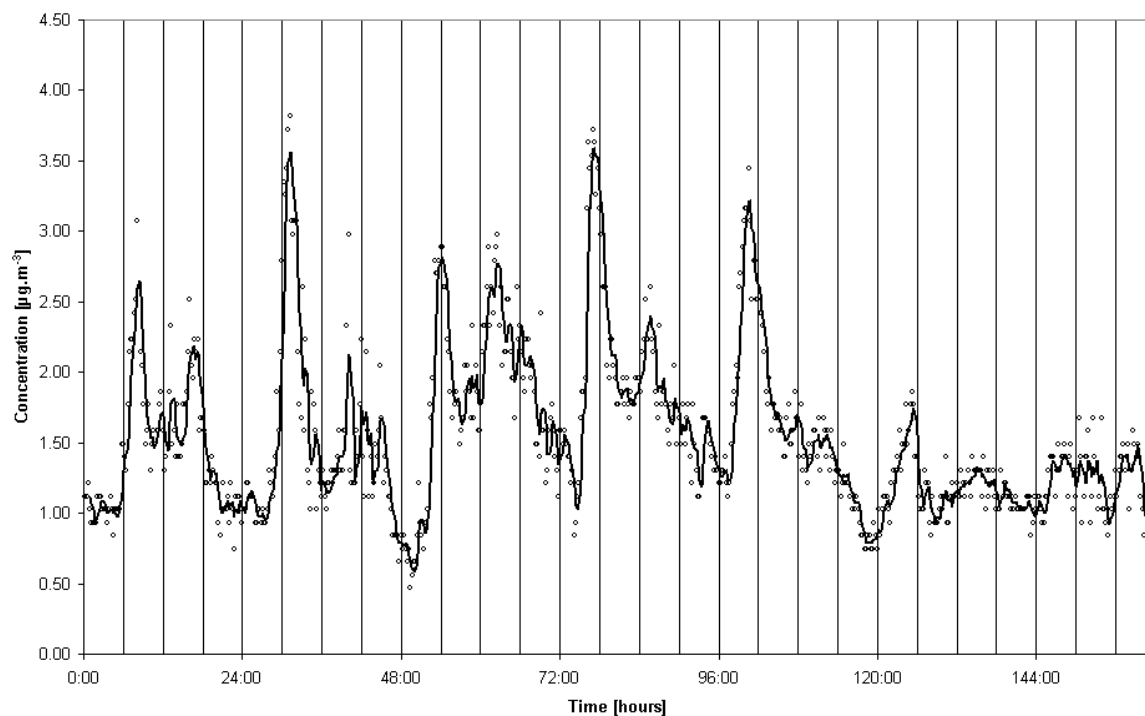
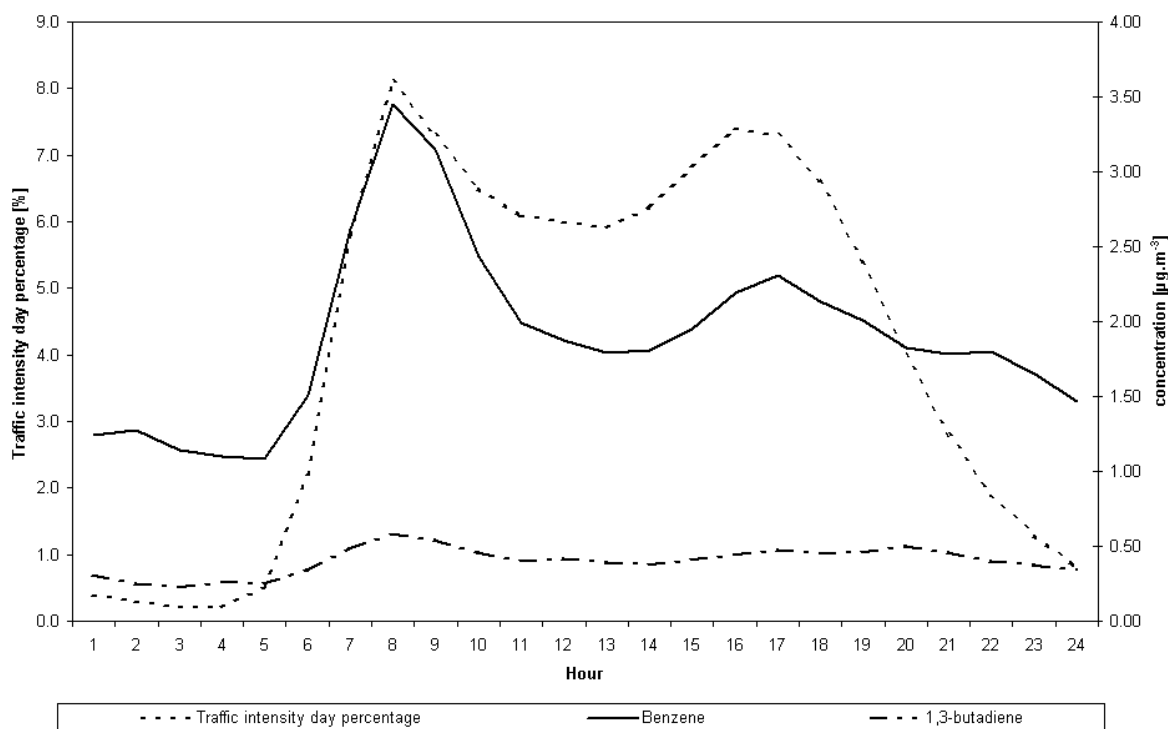


Figure 3. Day variation of traffic intensity, benzene and 1,3-butadiene concentration hour average, Kotlarska locality, Brno, Czech Republic



Results of measurement show, that BTEX and 1,3-butadiene content in ambient air is in good accordance with day variation of traffic intensity in Brno (Fig. 3). Day average concentrations of benzene didn't exceed Czech regulatory limits ( $8.75 \mu\text{g m}^{-3}$  for year 2004).

#### **4. CONCLUSIONS**

- The highest content of measured pollutants in Brno was in the middle of week, especially on Thursday
- The content of measured pollutants had two of day maxims according with maxims of traffic intensity
- All contents of measured pollutants was correlated statistically significant each to other
- Average concentration for benzene didn't exceed Czech regulatory limits for year 2004 ( $8.75\mu\text{g m}^{-3}$ )

#### **5. ACKNOWLEDGEMENTS**

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#### **REFERENCES**

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