

Occurrence of benzene and its alkylated derivatives in the atmospheric air in urban areas – considerations particularly concerning the neighborhood of communication arteries

Summary

Growing from year to year number of motor vehicles enhances the problem of air pollution and confirms a conviction on the traffic being a great environmental problem to big cities. Organic compounds emitted by cars to the atmospheric air have become a subject of growing social concern in recent years. That concern results from changes in the hitherto existing perception of the vehicular emission as emission of exclusively inorganic substances.

Such organic compounds as benzene and its alkylated derivatives: toluene, m,p,o-xylenes, ethylbenzene, isopropylbenzene, 1,2,4- and 1,3,5-trimethylbenzene are of special significance among substances emitted in exhaust gases. Affecting living organisms directly or indirectly, those hydrocarbons cause serious health hazard. The hazard follows from great toxicity of some compounds, e.g. benzene, possessing carcinogenic, mutagenic, teratogenic and embryotoxic properties.

Homologues of benzene are much less dangerous in their direct impact on living organisms than benzene itself. They are harmful because they contribute to formation of ozone and photochemical smog much more significantly than benzene, what is confirmed by high values of their maximum incremental reactivity (MIR) factors and photochemical ozone creation potentials (POCP).

The mentioned aromatic hydrocarbons belong to the group of volatile organic compounds (VOCs).

Being the main high-octane components of gasoline's, emitted benzene and its alkylated derivatives come from spark-ignition (SI) engines almost in total. Those hydrocarbons are present in the car exhaust as unburned components of fuel, but also as products of dealkylation proceeding during combustion in an engine. In that process, mainly benzene, but also its lower homologues arise from higher benzene alkyl derivatives.

Contamination of atmospheric air with benzene and its alkylated derivatives coming from vehicular sources is an important problem to all big cities. So, measurements of concentrations of benzene and its homologues in car exhaust and atmospheric air have been performed for many years in the whole world. In Poland, this problem was weakly recognized till now. This is why the Authors attempted research concerning the emission of benzene and its homologues from vehicular sources and the air contamination with these hydrocarbons. The 3 year investigations allowed assessment of air contamination with benzene and its homologues in direct vicinity of communication arteries of Silesian cities. Also areas where air quality was additionally affected by municipal and industrial sources were investigated. In this case, the urban background concentrations within densely populated areas were examined. Obtained results allowed determination of concentration profiles for benzene and its derivatives in the ambient air affected simultaneously by vehicular and other sources.

Methods of chromatography accompanied by automatic and passive air sampling were used in investigations of the levels of short and long term concentrations. In the continuous measurements an automatic BTX analyzer was applied.

Also determination of levels of emission from vehicular sources of benzene and its homologues by estimating emission factors for the most popular in Poland types of cars, both with spark- and compression-ignition engines, taking under consideration catalytic converters, was the goal of this work. This attempt yielded

emission profiles of benzene and its alkylated derivatives in the car exhaust gases.

Comparison of the profiles of concentrations of benzene and its homologues in car exhaust and in ambient air in the neighborhood of communication arteries proved cars to be the main source of those pollutants in the vicinity of roads.

Results of quality determinations of commercial fuels in respect of their benzene and its homologues content are also presented in the paper.