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合肥市典型交通干道大气苯系物的特征分析

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摘要:为研究合肥市交通干道大气苯系物污染状况,采用自主研制的差分吸收光谱(DOAS)系统,于2016年3月期间对合肥市交通主干道大气苯系物(苯、甲苯、间二甲苯和邻二甲苯)以及常规污染物 NO₂、SO₂等进行了连续观测.观测结果显示,观测期间苯、甲苯、间二甲苯和邻二甲苯的平均浓度分别为:21.7、63.6、33.9 和 98.7 μg·m⁻³.与国内外其它城市比较显示,合肥市交通干道大气苯和甲苯的污染处于中等水平,二甲苯的污染较为严重.结合观测期的间风速风向、T/B 特征比值以及与 CO 等污染物的相关性,对上述苯系物来源进行了分析,结果显示观测期间 T/B 值为 0.8~4.5,苯、甲苯与 CO 的相关性系数 R 分别为 0.55 和 0.34.表明机动车尾气排放是观测区域苯和甲苯的主要排放源之一,同时也受到周边工业园区排放的影响,二甲苯的主要排放源为观测地点北偏东方向的涂料行业工业园区.苯和甲苯的夜间高浓度峰值分析结果表明,夜间的高浓度苯和甲苯可能主要来源于观测地点周边工业园区的排放.观测区域苯系物的臭氧生成潜势(OFP)表现为邻二甲苯>间二甲苯>甲苯>苯,其中二甲苯的 OFP 占总 OFP 的 85%,表明周边工业园区的排放对该地区臭氧生成的贡献较大.

关键词:差分吸收光谱; 苯系物(BTX); 交通排放; 工业园区; 臭氧生成潜势

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Characteristics of Atmospheric BTX near a Main Road in Hefei City

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Abstract: In order to study levels of BTX near a main road in Hefei in March 2016, benzene, toluene, *m*-xylene, and *o*-xylene (BTX) and conventional pollutants (such as NO₂ and SO₂) in the atmosphere were monitored through a home-made differential optical absorption spectroscopy (DOAS) system. Results showed that average concentrations of benzene, toluene, *m*-xylene, and *o*-xylene were 21.7, 63.6, 33.9, and 98.7 µg·m⁻³, respectively. Compared with other cities both in China and elsewhere, benzene and toluene pollution can be considered to be of medium level, while xylene pollution is serious. Wind direction, T/B ratio, and correlation with CO were also analyzed, together with BTX sources. Result showed that the T/B ratio was 0.8-4.5, with correlation coefficients of benzene, toluene, and CO of 0.55 and 0.34, respectively. These values indicate that benzene and toluene are mainly derived from automotive emissions, also affected by surrounding industrial parks. Xylene is mainly derived from a coating industrial park north of the observation site. It was shown that high night-time concentrations of benzene and toulene could be due to industrial emissions from the industrial parks around the observation site. The ozone formation potential is in the order of o-xylene > m-xylene > toulene > benzene at the observation site. The ozone formation potential of xylene accounted for 85% of total ozone formation potential, indicating that emissions from surrounding industrial parks contribute greatly to ozone formation in the area.

Key words: differential optical absorption spectroscopy; benzene, toluene, *m*-xylene, and *o*-xylene (BTX); traffic emissions; industrial park; ozone formation potential

随着工业化的加速和城市人口的激增,大量挥发性有机化合物(volatile organic compounds, VOCs)被排放到城市大气环境中. 机动车保有量的持续增加,使机动车尾气排放成为城市大气环境的主要污染源之一. 此外各类装修材料的大量使用、洗涤剂和工业溶剂等的广泛应用,导致了城市大气污染状况的日益加剧.

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VOCs 作为重要的大气污染物,在臭氧(O₃)、光化学烟雾^[1]和二次有机气溶胶的形成过程中扮演着重要角色^[2~6]. 苯系物是苯及其衍生物的总称(BTEX),是 VOCs 中的重要一类,包括苯、甲苯、乙苯、二甲苯、硝基苯、苯乙烯等. 作为城市大气中重要的污染物种类之一,BTEX 具有较高的光化学反应活性,同时也存在一定的毒性. 如苯具有致癌性^[7],甲苯会对人体神经系统产生强烈的刺激作用,长期接触会对人体健康造成危害等^[8,9]. 因此,苯系物受到了各国研究学者的广泛关注,并在国内外开展了相关测量分析工作^[10~13].

例如, Khoder 等[14] 采用气相色谱法测量了 2007年埃及首都开罗地区的 BTEX, 通过计算 BTEX 之间的比值和相关性, 分析了该地区 BTEX 的主要排放源. Pandit 等[15]同样采用气相色谱法测 量了2011年印度孟买地区6个城市的BTEX浓度, 研究了该区域不同排放源对 BTEX 浓度的贡献. Buczynska 等[16]采用气相色谱和质谱联用的方法, 分析了比利时莫尔特赛尔地区的 BTEX 变化. 分析 结果表明, 该地区 BTEX 主要来源于交通排放, 其 浓度变化与交通密度相关. 与此同时, 我国研究学 者也开展了一系列针对中国城市 BTEX 浓度的研究 分析工作. 如叶丛雷等[17] 采用差分吸收光谱法 (differental optical absorption spectroscopy, DOAS), 于2010年在广州市开展了交通干道大气苯系物 (BTX, 苯、甲苯和二甲苯的总称)的测量, 观测期 间苯和甲苯的平均浓度分别为 15.9 µg·m⁻³和 61.3 μg·m⁻³, 相关性分析结果表明, 机动车尾气排放是 苯和甲苯的主要排放源. Hsieh 等[18] 于 2004 年在 台湾南部地区开展了隧道观测实验, 测量了5个不 同隧道内的甲基叔丁基醚 (methyl tertiary butyl ether, MTBE)和 BTEX浓度,结果显示5个测量隧 道内 MTBE、甲苯和邻、间二甲苯的浓度最高,不 同隧道内的车流量和车辆类型存在差异,其 T/B 特 征比值也不同. 霍霄玮等[19]采用气相色谱法, 测量 了2015~2016年冬、夏两季西安市交通干道大气 苯系物的浓度变化,观测结果显示西安市冬、夏两 季 BTEX 的日变化趋势不同, 冬季出现早中晚 3 个 高峰, 而夏季仅有早晚两个高峰. 分析结果表明, 该地区的主要污染物为苯和甲苯. 上述开展的城市 大气 BTEX 研究工作, 对评估城市 BTEX 污染水平 和确定城市 BTEX 排放源具有重要意义.

本文介绍了2016年3月期间合肥市交通干道 交汇口开展的大气BTX观测结果,结合观测期间 的风速风向、T/B 特征比值以及与 CO 等污染物的相关性,分析了观测区域 BTX 的污染水平和来源分布,并计算了该地区 BTX 的臭氧生成潜势.

1 材料与方法

本研究的目的是为了评估合肥市典型交通干道 大气苯系物的污染水平,并探究其来源,为合肥市 大气苯系物的污染控制提供数据支持.实验观测周 期为2016年3月4~28日,观测数据可以作为合 肥市春季交通主干道大气苯系物排放状况的参考.

1.1 监测地点

本研究观测地点位于合肥市黄山路与天智路交汇口(31°55′N,117°22′E),黄山路是合肥市东西交通干道,全长9.08 km,是合肥市主要交通干道之一,车流量较大.观测地点北面为工业园区,南面为企业办公区,东面约300 m为合肥市西二环路,如图1所示.



图1 监测地点示意

Fig. 1 Measurement site

1.2 监测仪器

苯系物测量采用自主研制的 DOAS 系统,系统望远镜安装在某写字楼 3 楼,距地面约 12 m. 角反射镜安装在望远镜北偏西方向的四层建筑顶楼,系统总光程为 566 m. 该系统主要由 150 W 的氙灯光源,发射接收一体的 Cassegrain 式望远镜,角反射镜阵列,传输光纤,紫外波段光谱仪(QE65000 光谱仪)和计算机数据采集系统等组成(图 2),其详细描述可参考文献[20,21].由于单一光谱仪的光谱测量范围有限,DOAS 系统采用分支光纤连接双光谱仪的方法扩展光谱测量范围,两台光谱仪的光谱测量范围分别为 200~300 nm 和 300~400 nm,除对苯(benzene)、甲苯(toluene)、间二

甲苯(m-xylene) 和邻二甲苯(o-xylene) 等苯系物进行测量外还可同时获取 NO_2 、HCHO 和 SO_2 等多种污染物的浓度信息. 系统对苯、甲苯、间二甲苯和邻二甲苯的探测灵敏度为 $0.5 \times 10^{-9} \sim 2 \times 10^{-9}$ (566 m),时间分辨率为 $1 \sim 3$ min,反演总误差约为 11.4%.

观测期间 CO 的浓度采用开放式可调谐半导体 激光 吸 收光 谱(tunable diode laser absorption spectroscopy, TDLAS) 气体分析仪进行测量, 仪器安装位置与 DOAS 系统基本相同, 系统总光程为 566 m. 仪器检测限为 0.07 × 10 ⁻⁶, 时间分辨率优于 1 min, 其详细描述可见文献[22,23]. 观测期间的车流量数据由摄像机记录, 摄像机安装高度大于 7 m, 俯角为 30°~35°, 监测道路长度大于 80 m. 采集图像采用图像处理的方式获取车流量数据, 统计每日车流量变化情况.

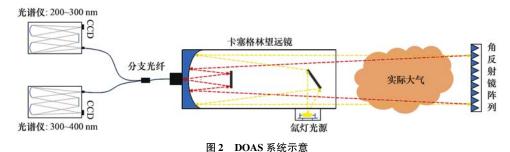


Fig. 2 Scheme of the DOAS system

1.3 质量控制和数据分析

观测期间为保证仪器的正常运行和监测数据的有效性,对实验期间的监测数据进行质量控制.每日对 DOAS 和 TDLAS 仪器进行光路校准,保证测量光谱的信噪比;定期对 DOAS 仪器进行氙灯谱和汞灯标准光谱的测量,减少温度、光源光强变化等因素引起的光谱漂移及仪器函数变化对监测数据的影响.观测期间采用开放式 TDLAS 仪器测量 CO,部分夜间数据的缺失是由于昼夜温差变化导致仪器光路偏移,数据信噪比较低所致.

DOAS 系统苯系物测量的时间分辨率为 1~3 min, 开放式 TDLAS 仪器 CO 测量的时间分辨率优于 1 min. 为便于数据分析讨论, 对苯系物、NO₂ 和 CO 等监测数据进行 5 min 数据平均处理并剔除奇异值, 在此基础上进行小时平均和日平均处理. 同时对气象参数、车流量等辅助数据进行相同处理, 保证数据的一致性.

2 结果与讨论

2.1 风速风向和污染物浓度时间序列

图 3 为观测期间的风速风向玫瑰图. 玫瑰图显示,观测期间的主导风向为北风和东北风,风速以中低风速为主. 图 4 为观测期间苯、甲苯、间二甲苯、邻二甲苯以及 NO₂、HCHO 和 SO₂ 的浓度时间序列,观测期间苯、甲苯、间二甲苯和邻二甲苯的平均浓度(时均值平均)分别为: 21.7、63.6、33.9 和 98.7 μg·m⁻³. 由图 4 可知,间二甲苯和邻二甲

苯存在较明显的目变化,表现出目间高浓度,夜间低浓度的变化趋势.观测期间,苯和甲苯出现了明显的高浓度峰值,特别是 3 月的 16 日、18 日和 19 日夜间,二者同时出现了高浓度峰值,该期间苯和甲苯的浓度峰值分别达到 102.5 μg·m⁻³ 和 244.0 μg·m⁻³,远高于观测期间苯和甲苯的平均浓度,表明该区域可能存在较强的夜间污染物排放源.

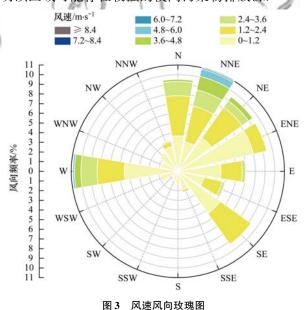


Fig. 3 Rose plots of wind speed and wind direction

为评估合肥市交通干道大气苯系物污染水平, 对国内外相关测量结果进行了比较. 表 1 中列举了 国内外城市交通干道大气苯系物的浓度, 为与国内 外其它城市比较,采用二甲苯浓度表示间二甲苯和

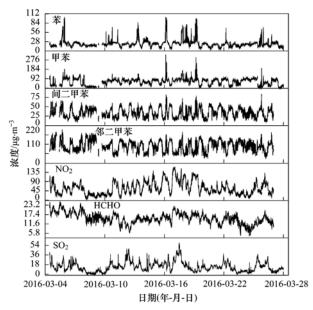


图 4 污染物浓度时间序列

Fig. 4 Time series of pollutant concentrations

邻二甲苯的总浓度.相比于国内外其它城市,合肥市交通干道大气苯和甲苯的污染处于中等水平.二甲苯浓度除那不勒斯市外,合肥市交通干道大气二甲苯浓度显著高于国内外其它城市.总体而言,合肥市交通干道大气苯系物的污染水平较为严重,因而制定相应的苯系物排放限制措施显得尤为重要.

2.2 苯系物日变化趋势

图 5 为观测期间的污染物日变化趋势,阴影部分显示,CO 浓度的日变化趋势与车流量日变化趋势一致,在交通早高峰和晚高峰期间达到浓度峰值. 苯和甲苯的日变化趋势与车流量日变化趋势存在一定相似性,表明机动车尾气排放对观测区域苯和甲苯浓度有影响. 观察苯和甲苯的日变化趋势图发现,观测期间苯和甲苯的夜间浓度值较高,而夜间车流量明显减少,表明夜间高浓度苯和甲苯主要来源于非交通排放源,可能是观测地点周边污染源

表 1 国内外城市交通干道大气苯系物污染水平比较

Table 1 Comparison of atmospheric BTX in urban traffic artery in China and elsewhere

测量日期(年-月)	城市	苯/μg⋅m ⁻³	甲苯/µg·m ⁻³	二甲苯/μg·m ⁻³	文献
2016-03	合肥	21.7	63. 6	132. 6	本研究
2010-11	广州	15.9	61.3	23. 4	[17]
2011	北京	50.2	79. 8	77.4	[24]
2004-12	上海	14. 4	55. 6	24. 4	[25]
2006-04 ~ 2007-01	南京	9.5	29.4	4. 8	[26]
1999-09	香港 //	4. 85	28. 81	6. 83	[27]
2008-04	巴里//	1.4	2. 5	3. 8	[28]
2009-10 ~ 2009-12	胡志明市	56. 0	121.0	87. 0	[29]
2005-05 ~ 2005-10	那不勒斯	14.2	180. 6	208. 9	[30]
2013 ~ 2014	德里	26. 2 ± 11. 9	92. $7 \pm 43. 7$	37.4 ± 23.5	[31]

的排放所致. 同时考虑到夜间边界层稳定且高度较低, 易造成污染物浓度的累积, 从而导致观测区域夜间高浓度苯和甲苯值的出现.

图 5 中间二甲苯和邻二甲苯的日变化趋势显示,二者的日变化趋势相同,都表现出日间高浓度,夜间低浓度的变化特征.且其日变化趋势与交通排放日变化趋势存在显著差异,表明机动车尾气排放不是观测区域二甲苯的主要排放源,其可能主要来源于观测地点周边污染源的排放.

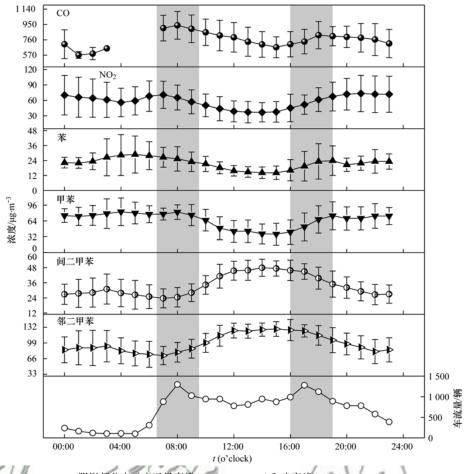
2.3 苯系物来源分析

2.3.1 二甲苯排放源分析

苯系物日变化趋势分析结果表明,观测地点周边可能存在其它污染源.因此对观测地点周边污染源进行了调查:①北偏东方向300m:塑料行业工业园区;②北偏东方向250m:涂料行业工业园区;③西北方向40m:烟草行业工业园区;④东方向

300 m:西二环路. 上述企业生产加工过程中会使用 苯系物溶剂或产生苯系物废气,可能会影响观测区 域苯系物的浓度.

图 5 中间二甲苯和邻二甲苯的日变化趋势表明,二者为同源污染物,且机动车尾气排放对其贡献可能并不占主导,其可能主要来源于观测地点周边污染源的排放.根据污染源调查结果显示,观测地点北偏东方向 250 m 为涂料行业工业园区,其生产过程会产生二甲苯污染[32].为探究观测区域二甲苯的主要排放源,以间二甲苯为例,绘制了观测期间间二甲苯浓度分布,如图 6 所示.浓度分布显示,观测期间高浓度的间二甲苯主要集中在观测地点北偏东方向.且在较高风速(7.0 m·s⁻¹)情况下,北偏东方向仍存在高浓度的间二甲苯,表明该方向存在二甲苯的排放源.该结果与污染源调查结果一致,表明观测区域二甲苯的主要排放源为观测地点



阴影部分表示交通早高峰(07:00~09:30)和晚高峰(16:00~19:00) 图 5 污染物日变化趋势

Fig. 5 Diurnal variations in pollutants

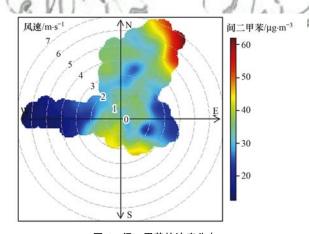


图 6 间二甲苯的浓度分布

Fig. 6 Concentration distribution of m-xylene

北偏东方向的涂料行业工业园区.

2.3.2 苯系物和交通排放的关系

大气 CO 浓度可以作为机动车尾气排放的示踪物,分析苯、甲苯与 CO 的相关性,分析其与交通排放的关系. 图 7 为观测期间苯和甲苯的相关性,二者的相关性系数 R 为 0.64. 图 8 分别为苯、甲苯

与 CO 的相关性, 其中苯与 CO 的相关性系数 R 为 0.55, 甲苯与 CO 的相关性系数 R 为 0.34, 表明观测区域苯、甲苯与交通排放源的相关性较弱, 可能是受观测地点周边污染源苯系物排放的影响.

甲苯/苯(T/B)的浓度比值可以作为鉴别交通

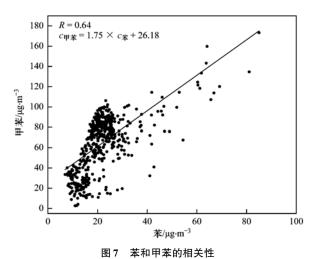


Fig. 7 Correlation of benzene and toluene

排放源的标识^[33~35].有研究表明,当 T/B 的比值为 1.5~3.0 时城市机动车尾气排放是苯和甲苯的主要排放源. Barletta 等^[36]在中国东莞地区的观测结果表明, T/B 值大于 5 时,观测区域苯系物浓度受到工业排放的较大影响. Hsieh 等^[37]在台湾南部工业园区附近和 Lee 等^[38]在香港地区的研究结果表明, T/B 值与交通流量的增加、工业排放和其它城市污染源相关. 本次观测的 T/B 值为 0.8~4.5,表明观测区域的苯和甲苯主要来源于机动车尾气排放,同时也受到周边工业园区排放的影响. 根据污染源调查结果显示,观测地点周边存在涂料、塑料行业工业园区^[32,39],其会产生苯系物废气和溶剂挥发,影响观测区域苯和甲苯的浓度.

图 4 污染物浓度时间序列显示,观测期间 3 月 7~10 日甲苯出现连续浓度低值,而其它苯系物浓度无明显变化.为探究该期间苯和甲苯的浓度变化,绘制了该期间苯、甲苯和 CO 的浓度时间序列(时均值平均),如图 9 所示.图 10 为该期间苯和甲苯的相关性,二者的相关性系数 R 为 0.84,表明该期间的苯和甲苯可能来自于同一排放源.计算该

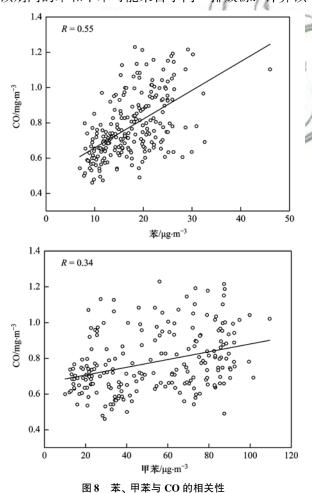
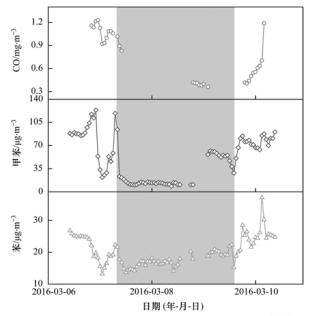


Fig. 8 Correlation of benzene, toluene, and CO



阴影部分为甲苯连续浓度低值变化区间

图9 3月7~10日苯、甲苯、CO的变化趋势

Fig. 9 Variations in benzene, toluene, and CO from March 7 to March 10

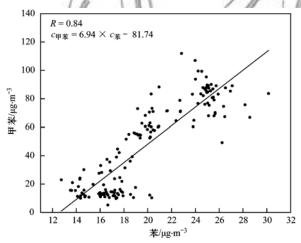


图 10 3月7~10日苯和甲苯的相关性

Fig. 10 Correlation of benzene and toluene from March 7 to March 10

期间苯、甲苯的 T/B 值为 6.9,表明观测地点周边工业园区的排放对该区域苯和甲苯的浓度有较大影响.为探究该期间苯和甲苯的排放源分布,绘制了苯和甲苯的浓度分布,如图 11 所示. 苯的浓度分布显示,3 月 7~10 日期间观测区域中心、北偏西方向和北偏东方向,苯浓度值较高. 该方向分别为黄山路和天智路交汇口、涂料、塑料行业工业园区和烟草行业工业园区,其均会产生苯的排放. 该期间苯的排放源分布较广,其来源较为复杂.

甲苯的浓度分布显示, 3 月 7~10 日期间观测 地点北方向存在高浓度甲苯, 其浓度值达到 120.0 μg·m⁻³,表明该区域可能存在甲苯的排放源.根据周边污染源的调查结果显示,观测地点北偏东方向为涂料、塑料行业工业园区,且该期间的主导风向为东南风,观测地点北方向的高浓度甲苯可能主要来源于北偏东方向的涂料、塑料行业工业园区的排放扩散.同时甲苯的浓度分布显示,低风速(小于1.0 m·s⁻¹)情况下,观测区域中心的甲苯浓度值较低,表明该期间机动车尾气排放对该区域甲苯的浓度贡献较小,可能是导致3月7~10日期间甲苯出现连续浓度低值的原因.

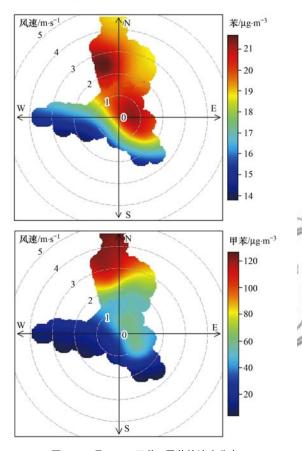


图 11 3月7~10日苯、甲苯的浓度分布 Fig. 11 Concentration distribution of benzene and toluene from March 7 to March 10

2.3.3 苯、甲苯的夜间高浓度峰值

图 4 污染物浓度时间序列图显示,观测期间的 苯和甲苯出现了夜间高浓度峰值. 特别是在 3 月的 16 日、18 日和 19 日夜间,苯和甲苯同时出现了高浓度峰值,且二者的变化趋势一致,如图 12 所示.该期间苯和甲苯的相关性系数 R 为 0.93,如图 13 所示,表明该期间的苯和甲苯可能来自于同一排放源.图 12 苯和甲苯的浓度时间序列显示,3 月的 16日、18 日和 19 日夜间的苯和甲苯浓度峰值分别达到 102.5 µg·m⁻³和 244.0 µg·m⁻³,显著高于观测

期间的平均浓度. 而根据车流量日变化趋势显示, 夜间机动车数量显著降低, 表明夜间的高浓度苯和甲苯主要来源于非交通排放源, 其可能主要来源于观测地点周边污染源的排放. 为探究该期间苯和甲苯的主要排放源, 以苯为例, 绘制了苯的浓度分布, 如图 14 所示. 浓度分布显示, 观测地点北偏东方向的苯浓度值较高, 该方向为涂料、塑料行业工业园区,夜间的高浓度苯和甲苯可能主要来源于上述工业园区的排放, 表明观测地点周边涂料、塑料行业工业园区可能存在夜间排放行为, 导致观测区域苯和甲苯夜间高浓度峰值的出现. 该期间的 T/B值为1.4, 反映了观测地点周边污染源的排放状况,表明周边污染源排放的甲苯浓度较高, 苯浓度较低.

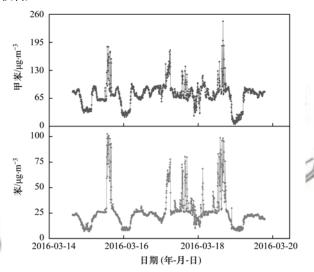


图 12 3 月的 16 日、18 日和 19 日夜间苯和甲苯浓度时间序列

Fig. 12 Time series of night-time benzene and toluene on March 16, 18, and 19

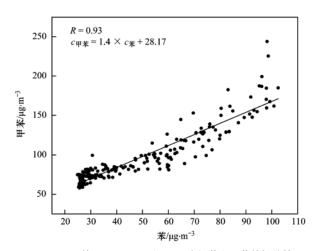


图 13 3月的 16日、18日和 19日夜间苯和甲苯的相关性

Fig. 13 Correlation of night-time benzene and toluene on March 16, 18, and 19

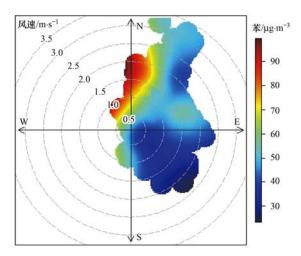


图 14 3 月的 16 日、18 日和 19 日夜间苯的浓度分布

Fig. 14 Concentration distribution of night-time benzene on March 16, 18, and 19

2.4 苯系物臭氧生成潜势

作为光化学反应的重要产物, 臭氧在大气污染物的转化过程中扮演着重要角色. VOCs 作为前体物与氮氧化物(NO_x)反应生成臭氧, 是城市臭氧污染的重要来源之一. 过高浓度的臭氧还会对人体健康和植物生长造成危害^[40], 因此针对苯系物臭氧生成潜势的研究具有重要意义.

苯系物臭氧生成潜势(ozone formation potential, OFP)的研究,通常采用卡特的最大增量反应活性(MIR)法^[41,42]评估其臭氧生成潜势,计算公式为:

$$OFP_i = MIR_i \times [VOC_i]$$
 (1)

式中, OFP_i 为臭氧生成潜势(μ g·m⁻³); [VOC_i]为某 VOCs 的实际大气浓度(μ g·m⁻³); MIR_i 为最大增量反应活性系数. 表 2 列举了观测期间各苯系物的臭氧生成潜势.

表 2 苯系物臭氧生成潜势

Table 2 Ozone formation potential of BTX

化合物	浓度/µg·m ⁻³	MIR	OFP/μg·m ⁻³
苯	21. 7	0. 42	9. 1
甲苯	63. 6	2. 70	171. 7
邻二甲苯	98. 7	8. 20	809. 3
间二甲苯	33. 9	6. 50	220. 4

由表 2 可知,观测区域邻二甲苯的臭氧生成潜势最大,其次为间二甲苯和甲苯,苯的臭氧生成潜势很小. 计算结果表明,观测区域二甲苯的 OFP 占总 OFP 的 85%,对臭氧生成的贡献较大,表明观测地点周边工业园区的排放对该地区臭氧生成的影响较大.

3 结论

(1)观测期间测量地点的大气苯、甲苯、间二

- 甲苯和邻二甲苯的平均浓度分别为:21.7、63.6、33.9 和98.7 μg·m⁻³. 污染物日变化趋势和周边污染源调查结果显示, 观测地点周边存在其它污染源.
- (2)观测区域的间二甲苯和邻二甲苯为同源污染物,且机动车尾气排放对其贡献可能并不占主导,其主要排放源为观测地点北偏东方向的涂料行业工业园区.
- (3)分析观测期间苯、甲苯与 CO 的相关性,计算 T/B 值为 0.8~4.5,表明观测区域的苯和甲苯主要来源于机动车尾气排放,同时也受到周边工业园区排放的影响.观测区域的苯主要受到周边涂料、塑料行业工业园区和烟草行业工业园区排放的影响.甲苯主要受到周边涂料、塑料行业工业园区排放的影响.
- (4)夜间的高浓度苯和甲苯主要来源于观测地点周边涂料、塑料行业工业园区的排放,表明观测地点周边涂料、塑料行业工业园区可能存在夜间排放行为.
- (5)观测区域苯系物的臭氧生成潜势表现为邻二甲苯>间二甲苯>甲苯>苯,其中二甲苯的 OFP 占总 OFP 的 85%,表明观测地点周边工业园区的排放对该地区臭氧生成的贡献较大,潜在影响该地区的光化学反应活性.

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