Estimation of major source of organic compounds in the ambient aerosols over Seoul

S.H. Han[1], J.Y. Lee[2] and Y.P. Kim[1,3]

[1]*Department of Environmental Engineering and Science, Ewha Womans University, Seoul, Korea*
[2] *Department of Renewable Energy Convergence, Chosun University, Gwangju, Korea*
[3]*Department of Chemical Engineering and Materials Science, Ewha Womans University, Seoul. Korea*
Keywords: PMF, Seoul, Organic components, PAHs.
Presenting author email: sangheeh@ewha.ac.kr

In this study, major contributors of air pollution over Seoul were estimated for 5 separated periods using the Positive Matrix Factorization (PMF) model. By understanding major emission sources in each period, change of major sources between 2002 and 2014 can be identified.

Information on the sampling is given in Table 1.

Table 1. Sample information for each period.

Period	Site	Size	No. of samples	Species*
Aug.2002-Dec.2003	A	TSP	68	PAHs
Aug.2006-Aug.2007	B	PM_{10}	73	PAHs, oxy-PAHs, DCAs, Levoglucosan
Apr.2011-Apr.2012	B	PM_{10}	52	PAHs, Alkane, n-Alkanoic acid, DCAs, sugars
Oct.2012-Sep.2013	C	$PM_{2.5}$	114	n-Alkane, PAHs, Fatty acids, DCAs, sugars
Aug.2013, Jan.2014, Feb.2014	A	$PM_{2.5}$	68	PAHs

A: Ewha Womans University, Seoul, Korea.
B: Seoul National University, Seoul, Korea.
C: Korea Institute of Science and Technology, Seoul, Korea.
*PAHs: Polycyclic Aromatic Hydrocarbons
DCAs: Dicarboxylic Acids

PMF ver. 5.0 provided by the US Environmental Protection Agency (US EPA, 2014) was used. Number of factors were decided by estimation error parameters of PMF relation to the suggested by Paatero *et al* (2014). Displacement (DISP) and Bootstrap (BS) and Q value. Displacement analysis obtains uncertainty estimates for individual variable by repeatedly fitting the model such that each variable in turn is perturbed from its fitted value (Table 2). Bootstrap analysis perturbs the original data set by resampling. Q value is goodness of fit parameters and an assessment of how well the model fits the input data.

It was decided that four or five factors were appropriate for the major sources of PAHs for the periods. It is consistent with the Chemical Mass Balance (CMB) modelling results for PAHs in Aug. 2002-Dec. 2003 (Lee and Kim, 2007) and Aug. 2006-Aug. 2007 (Jung *et al.*, 2015). Two factors were identified as common factors in all periods. Low molecular PAHs (e.g. Phenanthrene, Fluoranthene, Pyrene) have high portion in first common factor and PAHs with five rings (Benzo[a]pyrene, Bezo[b]pyrene, Dibenzo[ghi]perylene) have high portion in second common factor. According to the Simcik *et al* (1999), low molecular weight PAHs have been described as coal combustion source markers. Second common factor can be considered as diesel vehicle (Sofowote *et al*., 2008; Lee *et al*., 2004) or light oil burning (Bari *et al*., 2009).

Further modelling will be carried out using other species. Variation in major factors and profiles including other organic compounds of PMF modelling from 2002 to 2014 will be shown and reviewed.

Table 2. Error estimation parameters and number of factors for the PMF modeling to the PAHs data.

Period	No. of factors	Q (robust)	%dQ (DISP)	BS (%)
2002-2003	5	507.546	0.008	92.4
2006-2007	4	908.3	0.007	85.0
2010-2011	4	493.5	0.007	94.0
2012-2013	5	2784.9	0	78.8
2013-2014	5	627.34	0	83.8

Jung, D. B., Cho, Y. S., Kim, I. S., Lee, J. Y., and Kim, Y. P. (2015). *Aerosol Air Qual. Res.,* 15, 2190-2199

Lee, J.Y. and Kim, Y.P. (2007). *Atmos. Chem. Phys*., 7, 3587-3596.

Lee, J.H., Gigliotti, CL, Offenberg, J.H., Eisenreich, S.J., Turpin, B.J. (2004). *Atmos. Environ.*, 38, 5971-5981

Paatero, P., Eberly, S., Brown, S.G., and Norris, G.A. (2014) *Atmos. Meas. Tech.*, **7**, 781-797.

Sofowote, U. N., Hung, H., Rastogi, A. K., Westgate, J. N., Deluca, P. F., Su, Y., and McCarry, B.E. (2011). *Atmos. Environ.*, 45, 967-976.

Simcik, M. F., Eisenreich, S. J., and Lioy, P. J. (1999). *Atmos. Environ.*, 33, 5071–5079.

US EPA. (2014). EPA Positive Matrix Factorization (PMF) 5.0 Fundamentals and User Guide.