The pollution and sources of PAHs in the Capital Circle of China

J.J. Fei, Y.Y. Wan*, Y. Zhang, Z.H. Zhang*

State Key Laboratory of Petroleum Resources and Prospecting, China University of Petroleum, Beijng 102249, China

Introduction

Environments in the Capital Circle of China (CCC) mainly including Beijing, Tian Jin and Hei Bei province is worsening because of high-density population and numerous polluting companies. As one kind of persistent organic pollutants, polycyclic aromatic hydrocarbons (PAHs) released from various anthropogenic activities were investigated in this paper.

The pressurized liquid extraction (PLE) was applied for the recoveries of PAHs from the 11 topsoils sampled from the CCC region (Figure 1), involving different functional areas, such as mountain area, orchard, cropland, public garden and city center, combining with GC-MS to determine the content, distribution and source recognition of PAHs .

Results

The percent recoveries of PAHs were from 76.64% to 125.93% by PLE. In all the sampling sites, 16 USEPA priority PAHs were detected (Figure 1) with the minimum content 1.74μg/kg and the maximal content 353.05μg/kg. Among 16 priority PAHs, the contents of acenaphthene (Aen), acenaphthylene (Acy), anthracene (An), benzo[k]fluoranthene (BkF), dibenzo[a,h]anthracene (DahA) were relatively lower than the others. According to the management and evaluation standard of PAHs in soil of Holland[1], the excessive rate of the lowest and most pollutants An and fluoranthene (Fla) was zero and 24 times respectively, and in turn both benzo[a]anthracene (BaA) and chrysene (Chy) 10 times, all benzo[a]pyrene (BaP) and indeno[1,2,3-cd]pyrene (IcdP) and benzo[ghi]perylene (BghiP) 7 times, naphthalene (Nap) 5 times, BkF 4, and phenanthrene (Phe) 3. The total amount of 16 PAHs ranged from 141.00 μg/kg as the lowest one in Daxingfeng cropland, Beijing to 2300.8 μg/kg as the highest one in the Central Park, Tianjin. On the basis of the pollution classification standard of soil PAHs[2], sampling sites that heavy contamination accounted for 18.1%, contamination 9.1%, weak contamination 36.4% and non-contamination 36.4%.

Conclusion

According to the results, the range of the pollution in the CCC region distributed widely, which mostly occurred in the city center, and was relatively less in other sites that are far away from the urban area. The pollution sources evaluation of PAHs in 11 samples sites have been showed in Table 1. The PAHs pollution in the CCC region can be divided into diesel combustion, fuel combustion, coal combustion, industrial coal, wood combustion and coking source accordingly.
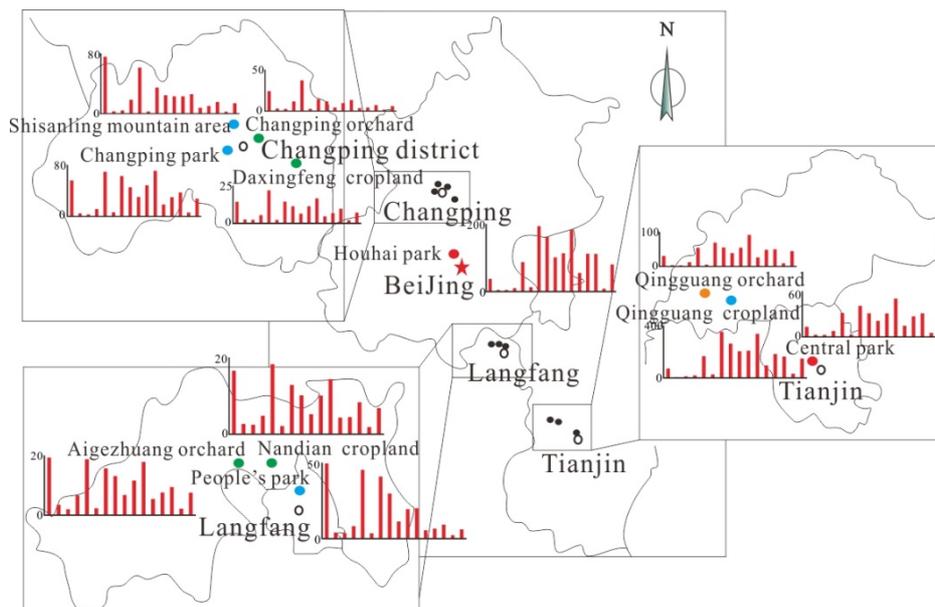
Figure 1. Distribution and contents of 16 priority PAHs in CCC

Note: in the bar chart, horizontal axis represents PAHs of Nap, Aen, Acy, fluorine (F), Phe, An, Fla, pyrene (Pyr), BaA, Chy, benzo[b]fluoranthene (BbF), BkF, BaP, IcdP, DahA and BghiP in turn from left to right. The vertical axis represents the content of PAHs, μg/kg.

Table 1 The qualitative evaluation for pollution source of PAHs in research area

Sample sites	Volatilization source	Combustion source
Shisanling mountain area	kerosene	wood, coal tar
Changping park	diesel oil	coal tar, diesel oil, grass and wood
Changping orchard	crude oil 、diesel oil	hard coal ball, coal
Daxingfeng cropland	diesel oil	gasoline, grass and wood
Houhai park	—	grass and wood, bituminous coal, diesel oil, kerosene
People's park	crude oil	gasoline, kerosene, coal tar, wood
Aigezhuang orchard	—	gasoline, diesel oil, kerosene, coal
Nandian cropland	—	gasoline, grass and wood
Central park	—	grass, kerosene, hard coal ball
Qingguang orchard	diesel oil	coal, grass, coal tar
Qingguang cropland	diesel oil	wood, grass, hard coal ball

References

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[2] Barbara M. Polycyclic aromatic hydrocarbons in agricultural soils in Poland: preliminary proposals for criteria to evaluate the level of soil contamination[J]. Applied Geochemistry. 1996, 11: 121-127.