A Preliminary Study on Pollution of Polycyclic Aromatic Hydrocarbons in Soil around a Thermal Power Plant of Xi'an City

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Abstract. To understand the status and risk of polycyclic aromatic hydrocarbons (PAHs) pollution in industrial areas in China. The total of 4 surface soil samples were collected from a thermal power plant of Xi'an. The concentrations of 16 priority polycyclic aromatic hydrocarbons (PAHs) were analyzed by high performance liquid chromatography (HPLC). In addition, the composition, source, pollution level and risk assessment of PAHs in surface soil of thermal power plant were studied. The results showed that the total concentrations of 16 PAHs ranged from 3.28 to 8.88 $\mu g•g^{-1}$, with a mean of 5.52 $\mu g•g^{-1}$. The concentration of 7 carcinogenic PAHs (Σ_7CPAHs) ranged from 1.52 to 4.82 $\mu g•g^{-1}$, with a mean of 2.60 $\mu g•g^{-1}$. The ∑PAHs in around thermal power plant surface soils of Xi'an belonged to serious pollution level. The PAHs in present study were mainly composed of medium molecular weight PAHs and high molecular weight PAHs, which have strong three effects. The results of source analysis showed that the PAHs in surface soil were mainly originated from the combustion of fossil oil, coal, wood and other biomass. The results of ecological risks of PAHs in the surface soil showed that all samples were polluted generally. The potential ecological risk of PAHs belonged to the serious level in individual PAHs and samples. There are two samples value of TEQ_{Bap} exceed the security value 0.600 $\mu g•g^{-1}$. Therefore, the environment of industrial areas should be attention and controlled.

Keywords: polycyclic aromatic hydrocarbons, pollution, thermal power plant, soil, Xi'an City

Polycyclic aromatic hydrocarbons (PAHs) is a kind of common persistent organic pollutants widely existing in the environment, which are composed of two or more benzene rings[1]. Because of its strong "three effects" (carcinogenic, teratogenic and mutagenic), it is listed as

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the priority control pollutant by the United States Environmental Protection Agency (USEPA). China has also listed seven PAHs in the "blacklist of environmental priority pollutants"[2]. The sources of PAHs include both natural sources and anthropogenic processes. Such as forest fires and volcanic eruptions. Man-made pollution includes incomplete combustion of fossil and biomass fuels, industrial emissions, etc. PAHs enter the soil directly or indirectly through diffusion, sedimentation, adsorption and other processes, and more than 90% of PAHs remain in the soil, making the soil become the main environmental load of PAHs[3]. High concentration of PAHs have been found in soils. PAHs in soil can enter human body through respiratory tract, skin, digestive tract and food chain, which increases the risk of cancer[4].With the rapid development of industrialization and urbanization in China, PAHs pollution in soil is becoming more and more serious, which has a potential negative impact on human health and ecological environment. Therefore, several studies have focused on the PAHs contamination status of soils in different regions.For instance, Tarragona[5], Isfahan[6], Kocaeli[7] and Germany[8],etc. And many cities in China, such as Beijing[9], Shanghai[10], Shenyang[1], Shenzhen[11], Nanjing[12], Tianjin[13], etc.

Xi'an is located in the Midwest of China. It is an important hub city connecting the northwest and southwest of China.

It is inevitable to cause environmental problems by the rapid development of the city. The accumulation and migration of pollutants in the soil medium will inevitably threaten the soil ecological environment. As a special functional area of the city, the industrial zone, as a result of the impact of its energy structure, discharges a large number of pollutants into the soil through various ways, resulting in soil pollution. In order to understand the environmental problems caused by rapid industrialization, this research study takes the surrounding soil of a thermal power plant in Xi'an as the research object, preliminarily determine the contamination level, pollution status and evaluate the health risk of 16 kinds of PAHs in the soil. It can provide theoretical guidance for the environmental management of the surrounding soil in Xi'an industrial Park.

1 Materials and methods

1.1 Sample collection and pretreatment

5-10 sampling sites are respectively set in four directions around the thermal power plant, each sampling point adopts diagonal sampling method to collect 0-20cm topsoil for uniform mixing, and finally uses quartering method to form a mixed sample,a total of 4 soil samples, specific information and numbers are: east(I1), west(I2), south(I3), north(I4), respectively. Sample pretreatment method reference the preliminary study[14].

1.2 PAHs experimental analysis

The 16 USEPA priority PAHs measured in samples were as follows: naphthalene (Nap), acenaphthylene (Acy), acenaphthene (Ace),fluorene (Flu),phenanthrene (Phe), anthracene (Ant), fluoranthene (Fla), pyrene (Pyr), benz[a]anthracene (BaA), chrysene (Chy), benzo[b]fluoranthene (BbF), benzo[k]fluoranthene (BkF), benzo[a]pyrene (BaP), dibenz[a,h] anthracene (DBahA), benzo[g,h,i]perylene (BghiP) and Indeno[1,2,3-cd]pyrene (IcdP).The extraction, purification, sample determination method, quality control and assurance of PAHs in soil are detailed in the previous study[14].

1.3 PAHs evaluation method

1.3.1 Pollution classification standard

The PAHs pollution degree of soil around the thermal power plant in Xi'an was classified according to the standards of PAHs pollution grade proposed by maliszewska kordybach [15]. Pollution classification standards of PAHs are given in Table 1.

Table 1 Pollution classification of PAHs in soil

∑PAHs(ug·g $^{-1}$)	<0.2	0.2~0.6	0.6~1.0	>1.0
Pollution degree	Unpolluted	Mild pollution	contaminated	Severe pollution

1.3.2 Ecological risk assessment

There is no unified PAHs ecological risk assessment method at home and abroad. Most of the studies use the quality standard method and quality standard method. In this study, the quality standard method and quality standard method are used to evaluate the soil PAHs ecological risk. The two commonly used in quality benchmark method are effects range low (ERL) and effects range (ERM), ERL and ERM indexes divide the ecological risk of PAHs into three levels: if the concentration of pollutants is less than ERL, there is little negative ecological effect and the probability of ecological risk is low (less than 10%); if ERL ≤ the concentration of pollutants≤ ERM, there will be occasional negative ecological effect on the surrounding ecological environment; if the concentration of pollutants is greater than ERM, there will be often negative ecological effect and ecological riskThe probability of birth is higher (more than 50%)[16]. The specific reference values of ERL and ERM see Table 2.

Table 2 Standard values of ERL and ERM by quality guidelines method (μg·g^{-1})

PAHs	ERL	ERM	PAHs	ERL	ERM
Nap	0.160	2.100	BaA	0.261	1.600
Acy	0.044	0.640	Chy	0.384	2.800
Ace	0.016	0.500	BbF	0.320	0.880
Flu	0.019	0.540	BkF	0.280	1.620
Phe	0.240	1.500	BaP	0.430	1.600
Ant	0.085	1.100	DBahA	0.063	0.260
Fla	0.600	5.100	BghiP	0.430	1.600
Pyr	0.665	2.600	IcdP	-	-

Table 3 Evaluation standard of PAHs quality in Quebec of Canada (μg·kg^{-1})

PAHs	REL	TEL	OEL	PEL	FEL
Nap	17	35	120	390	1200
Acy	3.7	6.7	21	89	940
Ace	3.3	5.9	30	130	340
Flu	10	21	61	140	1200
Phe	25	42	130	520	1100
Ant	16	47	110	240	1100
Fla	47	110	450	2400	4900
Pyr	29	53	230	880	1500
BaA	14	32	120	390	760
Chy	26	57	240	860	1600
BaP	11	32	150	780	3200
DBahA	3.3	6.2	43	140	200

Generally, the quality standard method adopts the method issued by Quebec in 2006, which sets five evaluation indexes to evaluate the pollution degree and ecological risk of PAHs. They are rare effect concentration (REL), critical effect concentration (TEL), accidental effect concentration (OEL), possible effect concentration (PEL) and frequent effect concentration (FEL) [17].See Table 3 for specific reference values.

1.3.3 Risk assessment of toxic equivalent

According to the Netherlands soil quality standard, the over standard rate of the site was judged.In order to further determine the ecological risk of PAHs, the toxicity risk assessment proposed by Nisbet was used. BaP was used as the toxicity standard substance. The toxicity equivalent concentration (BEQ_i,$ug\cdot g^{-1}$) and total toxicity equivalent concentration (TEQ,$ug\cdot g^{-1}$) of each PAHs monomer were calculated by comparing other PAHs with BaP[15].The calculation formulas are as follows.

$$BEQ_{\mathrm{i}} = c_i \times TEF_i$$

$$TEQ = \sum BEQ_i$$

The C_i refers to the concentration of components, and TEF_i refers to the toxic equivalent factor of components. The TEF_i specific values are given in Table 4.

Table 4 The TEF value of 16 PAHs

PAHs	TEF	PAHs	TEF	PAHs	TEF	PAHs	TEF
Nap	0.001	Phe	0.001	BaA	0.1	BaP	1
Acy	0.001	Ant	0.01	Chy	0.01	DBahA	1
Ace	0.001	Fla	0.001	BbF	0.1	BghiP	0.01
Flu	0.001	Pyr	0.001	BkF	0.1	IcdP	0.1

2 Results and analysis

2.1 PAHs content in soil

Except acenaphthene (Ace), the detection rate of other monomer PAHs in four surface soil samples was 100%, which indicated that PAHs pollution existed in the surface soil around the thermal power plant.The statistical results of PAHs content of 16 monomers in four surface soil samples of the thermal power plant are shown in Table 5.It can be seen from table 5 that the total concentration of 16 PAHs in the soil around the thermal power plant ranged from 3.28 to 8.88 $\mu g\cdot g^{-1}$, with an average value of 5.52 $\mu g\cdot g^{-1}$, and the pollution degree of PAHs in the soil reaches the serious pollution level. The content of seven carcinogenic polycyclic aromatic hydrocarbons (Σ_7CPAHs,including BaA, Chy, BbF, BkF, BaP, DBahA and IcdP) is 1.52 - 4.82 $\mu g\cdot g^{-1}$, with an average value is 2.60 $\mu g\cdot g^{-1}$. The content of specific combustion compounds (ΣCOMB, including Fla, Pyr, BaA, Chy, BbF, BkF, BaP, IcdP, BghiP) is from 2.14 to 7.15 $\mu g\cdot g^{-1}$, the mean value is 2.28 $\mu g\cdot g^{-1}$.The most serious point of PAHs pollution occurred in the West (I2) direction of the thermal power plant, which may be related to the layout of the park.According to the classification standard of PAHs pollution in maliszewska [15], the surrounding soil of thermal power plant has reached the serious pollution level, which indicates that the surrounding soil has been generally polluted by

PAHs. Therefore, the relevant departments should attach great importance to the pollution prevention and control. And adjust the energy structure and the treatment of relevant environmental pollution prevention and control equipment in the plant.

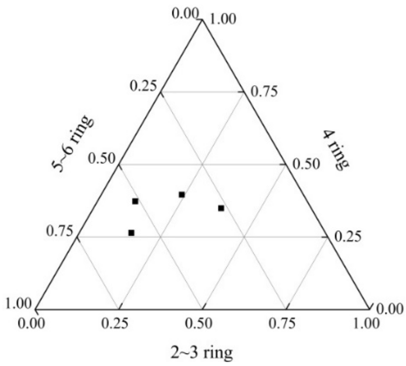
Table 5 Statistics of PAHs contents in soil samples ($\mu g \cdot g^{-1}$)

PAHs	Min /$\mu g \cdot g^{-1}$	Max /$\mu g \cdot g^{-1}$	Mean /$\mu g \cdot g^{-1}$	SD	Maximum point	Minimum point
Nap	0.188	0.338	0.265	0.071	I4	I1
Acy	0.070	0.624	0.221	0.269	I4	I3
Ace	ND	0.552	0.182	0.250	I4	I3
Flu	0.034	0.139	0.085	0.045	I4	I3
Phe	0.180	0.745	0.416	0.237	I4	I3
Ant	0.007	0.063	0.032	0.024	I2	I3
Fla	0.299	1.470	0.894	0.508	I2	I3
Pyr	0.064	0.653	0.354	0.255	I2	I3
BaA	0.104	0.504	0.219	0.191	I2	I3
Chy	0.358	0.687	0.486	0.147	I2	I1
BbF	0.308	0.872	0.510	0.261	I2	I1
BkF	0.143	0.389	0.223	0.112	I2	I1
BaP	0.180	0.881	0.367	0.343	I2	I3
DBahA	0.164	0.733	0.428	0.297	I2	I1
BghiP	0.243	0.933	0.470	0.313	I2	I1
IcdP	0.225	0.757	0.371	0.258	I2	I3
Σ_{16}PAHs	3.277	8.882	5.523	2.643	I2	I3
Σ COMB	2.135	7.145	3.893	2.276	I2	I3
Σ_7CPAHs	1.516	4.822	2.604	1.499	I2	I1

2.2 PAHs composition in soil

According to the properties and molecular weight of PAHs, 16 kinds of monomer PAHs are generally divided into three types: small molecule 2 -3 ring (Nap, Acy, Ace, Flu, Phe, Ant) low molecular weight PAHs (LMW PAHs), 4 ring (Fla, Pyr, BaA, Chy) medium molecular weight PAHs (MMW PAHs) and high molecular weight PAHs (HMW PAHs) of 5-6 rings (BbF, BkF, BaP, DbahA, BghiP,IcdP).The toxicity and carcinogenicity of PAHs are also different due to their different nature and environmental behavior[17].Among them, low ring PAHs are volatile and toxic to aquatic organisms, while PAHs with high ring have "three effects"[18], so it is of great significance to study the composition characteristics of PAHs in soil.

See Fig.1 for the relative abundance of PAHs in the surface soil around the thermal power plant.It can be seen from the figure that PAHs in the surrounding soil of thermal power plant are mainly composed of PAHs in the middle ring and PAHs in the high ring, and the distribution of PAHs in the whole shows the law of PAHs in the high ring (43.16%) > PAHs in the middle ring (35.54%) > PAHs in the low ring (22.29%), which is consistent with the characteristics of PAHs pollution in typical industrial areas studied by Ran Zongxin [18]. The content of PAHs in low ring is 11.31% - 38.17%, that in middle ring is 26.41% - 39.58%, and that in high ring is 26.93% - 57.99%. However, the relative abundance of PAHs with different ring numbers can reflect the status of pollution sources. The proportion of 4 rings and above PAHs in the soil around the thermal power plant is 61.83% - 88.69%, significantly higher than the PAHs content in the low ring, indicating that PAHs in the surrounding soil of the study area may have a strong "three effects", which should be highly valued by the surrounding residents and relevant departments. Most of the pollution sources come from the combustion of various fossil fuels.



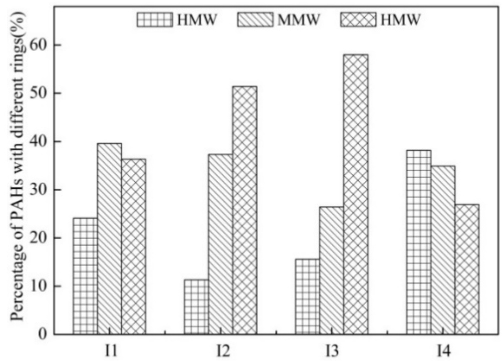


Fig. 1 Composition characteristics of PAHs in soils around a Thermal Power Plant

2.3 PAHs source analysis

Characteristic compound ratio method: Based on a large number of previous studies, a variety of characteristic ratio methods can reflect the source of PAHs to a certain extent.The most common are LMW (2-3 ring) / HMW (4-6 ring), Icdp/(Icdp+BghiP) , BaA/(BaA+Chy), Ant/(Ant + Phe) , Fla/(Pyr+ Fla),etc.Research shows that when LMW/HMW>1, BaA/(BaA+Chy) < 0.2, Ant/(Ant+Phe) < 0.1, Icdp/(Icdp+BghiP) < 0.2 and Fla/(Pyr+ Fla) < 0.4, it is petroleum pollution. When LMW/HMW< 1, 0.2 < Icdp/(Icdp+BghiP)< 0.5, 0.2 < BaA/(BaA+Chy) < 0.35 and 0.4 < Fla/(Pyr+ Fla) < 0.5, which are incomplete combustion of petroleum products. Ant/(Ant+Phe)> 0.1, representing a mixed combustion source. When Icdp/(Icdp+BghiP) > 0.5, BaA/(BaA+Chy) > 0.35 and Fla/(Pyr+ Fla) > 0.5, the main sources are incomplete combustion of wood, coal and other biomass [19, 20].

These characteristic ratios are used to analyze the PAHs source in the soil around the thermal power plant, and the results are shown in Figure 2.The ratio of LMW / HMW is in the range of 0.1-0.7, which is less than one, indicating that PAHs in the soil around the thermal power plant mainly comes from incomplete combustion process.It can be seen from Figure 2 that the ratios of BaA/(BaA+Chy) and Icdp/(Icdp+BghiP) indicate that PAHs in the soil around the thermal power plant are mainly from petroleum combustion, the ratio of Fla / (Pyr + FLA) indicates that PAHs in the soil are from biomass combustion sources such as coal and wood, and Ant/(Ant+Phe) indicates that PAHs in the soil are from mixed sources, with fossil fuel combustion and petroleum pollution. Based on the results of the above five common characteristic ratio methods, it can be concluded that PAHs in the soil around the thermal power plant comes from the combustion process of biomass such as oil, coal and wood, accompanied by the mixed sources of oil pollution, among which fossil fuel is the main combustion source. The source of soil PAHs in this study is consistent with the source of soil PAHs around Shanxi Iron and Steel Industrial Park studied by Bai Xinyue [21] and the source of soil PAHs in a coal-fired power plant in southwest China studied by Zou Yiping [2]. This is consistent with the energy structure of industrial zones and cities in China.

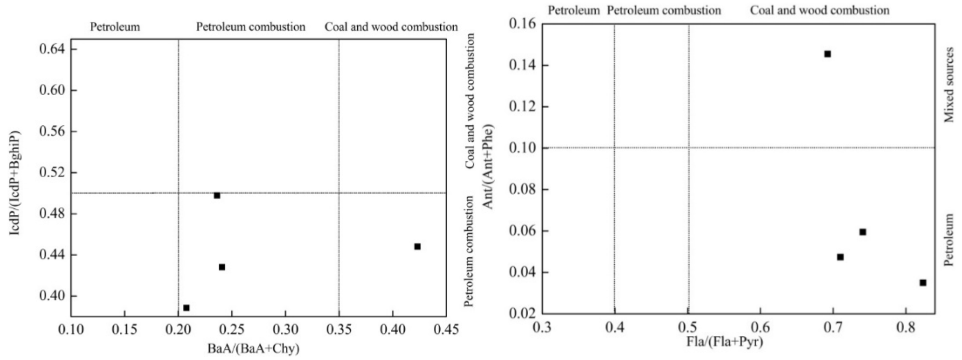


Fig.2 Source identification with composition analysis of PAHs in soils around a Thermal Power Plant

Multivariate statistical analysis: Considering that the ratio method is easy to be affected by environmental factors and the ratio may be unstable, this study further carried out principal component analysis on the surrounding soil of a thermal power plant in Xi 'an, and extracts two factors (PC1 and PC2) with characteristic values greater than 1, with cumulative variance contribution rate of 96.05%, with specific results aare shown in Table 6.The variance contribution rate of PC1 is 64.23%, which is mainly composed of PAHs with 3-6 rings. The PAHs with higher load are Ant, Fla, Pyr, BaA, Chy, BbF, BkF, BaP, BghiP and IcdP. Which Ant, Fla, Pyr, BaA, BbF, BkF and BaP are generally regarded as indicators of coal combustion [3].In addition, Fla and Pyr are also the main polycyclic aromatic hydrocarbons emitted during wood combustion [22].Bghip and IcdP are considered to be the main pollutants emitted by automobile engines [22].Therefore, the definition factor 1 represents the combustion mixture source, mainly including PAHs generated by coal, gasoline, wood and other combustion. Factor 2 accounted for 31.82% of the total variance, among which, Nap, Acy, Ace, Flu and Phe were heavily loaded on PC2.And Nap, Acy and Ace indicated the leakage of petrochemical products or the low-temperature transformation of organic matters.Therefore, it is further confirmed that the PAHs source of the soil around the thermal power plant is a mixed source, in which the combustion mixed source is dominant.

Table 6 Factor loading variance and variance contribution value of individual PAHs in soil around thermal power

PAHs	Factor 1 (PC1)	Factor 2 (PC2)	Common degree
Nap	0.734	0.554	0.846
Acy	0.075	0.968	0.942
Ace	0.106	0.987	0.986
Flu	0.592	0.804	0.997
Phe	0.256	0.965	0.998
Ant	0.963	0.140	0.947
Fla	0.930	0.301	0.956
Pyr	0.945	0.268	0.965
BaA	0.961	-0.268	0.996
Chy	0.990	-0.039	0.982
BbF	0.998	-0.029	0.996
BkF	0.936	-0.344	0.995
BaP	0.935	-0.345	0.993
DBahA	0.475	-0.748	0.784
BghiP	0.930	-0.358	0.994
IcdP	0.937	-0.335	0.991
Initial eigenvalue	10.276	5.091	
Variance contribution rate (%)	64.23	31.82	
Cumulative variance contribution rate (%)	64.23	96.05	

2.4 PAHs ecological risk assessment

Ecological risk assessment of PAHs in soil around thermal power plants was carried out by using quality benchmark methods (ERL and ERM). From the average concentrations of the four sites, only the average concentrations of Ant, Pyr, BaA, BkF and BaP did not exceed the ERL limit, indicating that these five PAHs have low ecological risk level and low probability of ecological risk (10%). The average value of DBahA is greater than ERM limit, which indicates that the probability of ecological risk is extremely high and there will be frequent negative ecological effects. The average concentrations of the remaining PAHs are between ERL and ERM, indicating that ecological risks will occasionally occur to the surrounding ecological environment. The maximum concentration of Ant and Pyr did not exceed ERL, which indicated that the probability of ecological risk of Ant and Pyr in surrounding soil was extremely low. The maximum concentrations of Ace and DBahA exceed ERM values, resulting in extremely high probability of ecological risks. The maximum concentrations of the remaining PAHs exceeded ERL and were located between ERL and ERM, indicating that the PAHs in the surrounding soil will generate occasional ecological risk.

The ecological risk assessment of PAHs in the surrounding soil of thermal power plant was carried out by using the quality standard method. The reference criteria are: there is high ecological risk if it is greater than FEL. Between PEL and FEL, the potential risk probability is higher. There is medium potential risk if it is between OEL and PEL. Between TEL and OEL, the potential risk probability is low; Between REL and TEL, the potential risk probability is the lowest. Less than REL, no potential risk. Therefore, it can be seen that the concentrations of Nap and Chy is between OEL and PEL, with moderate potential risk. Acy, Phe and Bap concentrations are between OEL and FEL, with potential risks ranging from medium to high. Flu, Fla and Pyr concentrations are between TEL and PEL, with potential risks ranging from low to medium. The concentration of Ant is low and the probability of potential risks is low. Ace, BaA and DBahA concentrations are distributed, so the potential risks are also different. Generally speaking, PAHs in the soil around the thermal power plant has certain potential ecological risks at individual points, and relevant departments should take measures to actively control and control the emission of pollutants.

2.5 PAHs health risk assessment

See Table 7 for the calculation results of total toxic equivalent concentration (TEQ_{Bap}) of BaP in the study area.The results showed that the total TEQ_{Bap} of 16 PAHs was between 0.443-1.886 $\mu g \cdot g^{-1}$, and the average value was 0.939 $\mu g \cdot g^{-1}$.It is much higher than the TEQ_{Bap} (0.138 $\mu g \cdot g^{-1}$) of the surface soil in Jinan[23], the TEQ_{Bap} of the wetland soil in the Pearl River Delta[15], the TEQ_{Bap} (0.428 $\mu g \cdot g^{-1}$) of the urban soil in Shanghai[24] and the TEQ_{Bap} (0.013$\mu g \cdot g^{-1}$) of the surface soil in the Middle East of the Qinghai Tibet Plateau[20]. The TEQ_{Bap} of 7 kinds of carcinogenic PAHs (Σ_7CPAHs) ranged from 0.438 to 1.873 $\mu g \cdot g^{-1}$, with an average value of 0.939 $\mu g \cdot g^{-1}$. The TEQ_{Bap} of Σ_7CPAHs accounted for 99.3% of the total TEQ_{Bap} of ΣPAHs, indicating that 7 kinds of carcinogenic PAHs were the main contributors of the total TEQ_{Bap}. According to the Canadian standard for the protection of human health on risk-based soil (CC-ME, 2010) [15], there are two sample sites in the region with TEQ_{Bap} greater than 0.600 $\mu g \cdot g^{-1}$, indicating that the soil around the thermal power plant has a high risk and potential carcinogenicity, which should be focused on management and control, especially the TEQ_{Bap} of PAHs at I2 site is as high as 1.886$\mu g \cdot g^{-1}$ should be paid special attention to and controlled by the surrounding residents and relevant departments.

Table 7 Toxic equivalent concentration of PAHs in soils around thermal power from Xi'an City($\mu g \cdot g^{-1}$)

PAHs	TEQ_{Bap}				Mean TEQ_{Bap}
	I1	I2	I3	I4	
Nap	1.88×10^{-4}	3.10×10^{-4}	2.22×10^{-4}	3.38×10^{-4}	2.65×10^{-4}
Acy	1.00×10^{-4}	8.95×10^{-5}	6.95×10^{-5}	6.24×10^{-4}	2.21×10^{-4}
Ace	1.05×10^{-4}	7.22×10^{-5}	0.00	5.52×10^{-4}	1.82×10^{-4}
Flu	6.73×10^{-5}	1.02×10^{-4}	3.36×10^{-5}	1.39×10^{-4}	8.55×10^{-5}
Phe	3.71×10^{-4}	3.69×10^{-4}	1.80×10^{-4}	7.45×10^{-4}	4.16×10^{-4}
Ant	2.35×10^{-4}	6.28×10^{-4}	6.51×10^{-5}	3.71×10^{-4}	3.25×10^{-4}
Fla	6.93×10^{-4}	1.47×10^{-3}	2.99×10^{-4}	1.11×10^{-3}	8.94×10^{-4}
Pyr	2.42×10^{-4}	6.53×10^{-4}	6.41×10^{-5}	4.55×10^{-4}	3.54×10^{-4}
BaA	1.11×10^{-2}	5.04×10^{-2}	1.04×10^{-2}	1.59×10^{-2}	2.10×10^{-2}
Chy	3.58×10^{-3}	6.87×10^{-3}	3.98×10^{-3}	5.00×10^{-3}	4.86×10^{-3}
BbF	3.08×10^{-2}	8.72×10^{-2}	3.30×10^{-2}	5.32×10^{-2}	5.10×10^{-2}
BkF	1.43×10^{-2}	3.89×10^{-2}	1.80×10^{-2}	1.82×10^{-2}	2.23×10^{-2}
BaP	1.90×10^{-1}	8.81×10^{-1}	1.80×10^{-1}	2.15×10^{-1}	3.67×10^{-1}
DBahA	1.64×10^{-1}	7.33×10^{-1}	6.31×10^{-1}	1.83×10^{-1}	4.28×10^{-1}
BghiP	2.43×10^{-3}	9.33×10^{-3}	3.55×10^{-3}	3.47×10^{-3}	4.70×10^{-3}
IcdP	2.41×10^{-2}	7.57×10^{-2}	2.25×10^{-2}	2.60×10^{-2}	3.71×10^{-2}
Σ_{16}PAHs	0.443	1.886	0.903	0.524	0.939
Σ_7CPAHs	0.438	1.873	0.899	0.516	0.932

3 Conclusion

1) The content of soil around the thermal power plant is 3.28-8.88 $\mu g \cdot g^{-1}$, which is polluted by PAHs and reaches the level of serious pollution. The PAHs content of 4 ring and above is the main advantage, which indicates that PAHs in the surrounding soil may have strong "three effects".

2) Two kinds of source analysis methods show that PAHs in the soil around the thermal power plant comes from the combustion process of biomass such as oil, coal and wood, accompanied by the mixed source of oil pollution, in which fossil fuel combustion is the main source.

3) The risk assessment shows that PAHs at individual points and individual PAHs are at risk, and there are two sample points with teqbap greater than 0.600 $\mu g \cdot g^{-1}$ safety level, indicating that the soil around the thermal power plant is at high risk and has potential carcinogenicity, so it is necessary to carry out key control.

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