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Application of Soil Pollution Status Survey in a Land Engineering

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Abstract: This article points out that due to changes in the nature of the land on a certain plot, a preliminary site environment survey has been conducted on the site. A total of 5 sampling sites were set up in the project area, and a background control site was set up outside the project area. A total of 18 soil samples were collected. The test items were heavy metals (cadmium, lead, copper, nickel, arsenic, mercury, hexavalent chromium), Volatile Organic Compounds, Semi-volatile Organic Compounds, including all the mandatory factors required by the preliminary survey in the "Soil Environmental Quality Construction Land Ten Soil Pollution Risk Control Standards (Trial)" (GB36600-2018). The soil heavy metals, volatile organic compounds, and semi-volatile organic compounds of the plot meet the requirements of the second category land screening value in the "Soil Environmental Quality Construction Land Ten Soil Pollution Risk Control Standards (Trial)" (GB36600-2018). It meets the environmental quality requirements for the development of industrial land, no further detailed investigation work is required. The site investigation work ends at this stage, and the land can be safely used.

1. Introduction

With the acceleration of my country's urbanization process, the main urban areas of various regions continue to expand to the periphery. In this large-scale urbanization process, tens of thousands of companies in the chemical, metallurgy, steel, light industry, machinery manufacturing and other industries have relocated and left behind. These urban industrial land has been transformed into urban greening and public facilities. Even residential land. Due to years of industrial production, the soil and groundwater of these industrial sites may be polluted to varying degrees. If it is directly developed and used, it will cause huge hidden dangers to the health of

people, animals and plants on the ground. Therefore, before changing the nature of the original land, it is necessary to conduct a pollution investigation and analysis on the original land to determine whether the original land is contaminated. If it is contaminated, an environmental risk assessment is required to determine whether the original land needs soil remediation and a reasonable definition the nature of its soil. The investigation of contaminated sites in my country started at the end of the 20th century, and has gradually formed a complete system after years of development. My country promulgated the "Notice on Effectively Doing a Good Job in Environmental Pollution Prevention and Control in the Process of Enterprise Relocation" in 2004, and the "Technical Guidelines for Site Environmental Investigation" (HJ25.1) was promulgated in 2014 and revised in 2019. In May 2016, the State Council issued the "Soil Pollution Prevention and Control Action Plan" (referred to as the "Ten Articles of Soil"). In December 2016, the Ministry of Environmental Protection passed the "Environmental Management Measures for Soil in Contaminated Plots (Trial)", which will be implemented on July 1, 2017. On August 31, 2018, the Fifth Session of the Standing Committee of the 13th National People's Congress passed the "Law of the People's Republic of China on the Prevention and Control of Soil Pollution" unanimously. The promulgation of this series of guidelines, laws and regulations strengthened the protection of the soil environment, improved the quality of the soil environment, strengthened the supervision of pollution sources, and ensured the safety of people's lives and lives. In our country, due to the lack of reasonable planning in the early years, there were situations where multiple companies shared the same site. With the development of urbanization and economic transformation, most of these factories have been relocated. In this paper, based on the historical production situation of a site left over, the site soil will be collected, analyzed and tested for its pollutant content and compared with the threshold specified in the relevant guidelines. Based on the test results, a comprehensive evaluation of the soil environment of the site is made. It aims to serve as a reference for the follow-up development and environmental control of industrial legacy sites where multiple production types coexist.

2. Investigation purpose and principles

2.1 Purpose of Investigation

The purpose of this site environmental investigation and assessment is as follows:

(a) Through data collection, site surveys, and personnel interviews, on the basis of understanding the current status and historical changes of the site and its surrounding sites, identify and analyze whether the site has environmental pollution caused by potential pollutants;

(b) Develop a sampling plan based on the pollution identification conclusion, conduct on-site sampling, conduct experimental testing on the samples, conduct data analysis and evaluation of the test results, and determine whether the soil on the site meets the requirements for industrial land in construction land based on the above work results.

2.2 Investigation principles

(a) The principle of pertinence: According to the characteristics of the plot and the characteristics of potential pollutants, conduct pollutant concentration and spatial distribution surveys to provide a basis for the environmental management of the plot.

(b) Normative principles: use procedural and systematic methods to standardize the investigation process of soil pollution status to ensure the scientificity and objectivity of the investigation process.

(c) The principle of operability: Comprehensive consideration of factors such as survey methods, time, and funding, combined with current technological development and professional skills, makes

the survey process feasible.

According to the relevant technical process requirements of the "Technical Guidelines for the Investigation of the Soil Pollution Status of Construction Land" (HJ 25.1-2019), in order to fully investigate the pollution status of the project plot, the following work needs to be carried out:

The first stage of soil pollution investigation: the pollution identification stage is based on data collection, on-site surveys and personnel interviews. In principle, on-site sampling and analysis are not performed. The second stage of soil pollution investigation: the stage of pollution verification based on sampling and analysis. If the first phase of the soil pollution investigation shows that there are possible sources of pollution in or around the plot, such as chemical plants, pesticide plants, smelters, gas stations, chemical storage tanks, solid waste treatment and other facilities or facilities that may produce toxic and hazardous substances Activities; and when the pollution sources inside and outside the plot cannot be ruled out due to lack of information, conduct the second-stage soil pollution survey to determine the type, concentration (degree) and spatial distribution of pollutants. The third phase of soil pollution investigation is mainly based on supplementary sampling and testing, to obtain the parameters required for risk assessment and soil and groundwater remediation.

3. Site pollution identification

3.1 The main work content of pollution identification

The main purpose of pollution identification is to initially determine the types of existing pollutants on the site and the polluted area. The main task is to understand the hydrogeological data of the plot and surrounding areas through data collection and analysis, personnel interviews and site surveys, and to understand the life and production activities carried out in the history of the survey site, combined with site surveys, visual inspections, and smells. Sensory analysis, preliminary confirmation of site pollution, determine the types of related pollutants that may be generated, and the distribution of polluted areas. At the same time, understand the location of major pollution sources, pollutant migration pathways, receptors and exposure pathways, etc., to provide a basis for subsequent sampling work.

3.2 Data collection, site survey and personnel interviews

Project staff went to work on site. Obtain basic information such as site layout, site hydrogeological characteristics, and historical changes of site utilization through on-site surveys, personnel interviews, and data surveys, etc., to identify and judge whether the site is polluted, and if so, identify the types of potential pollutants and the ways of pollution, Contaminated media and contaminated areas.

4. Investigation of the current soil environment of the site

4.1 Arrangement basis

According to "Technical Guidelines for the Investigation of Soil Pollution Status of Construction Land" (HJ25.1-2019), "Technical Guidelines for Soil Pollution Risk Control and Remediation Monitoring of Construction Land" (HJ 25.2-2019), "Technical Guidelines for Soil Environmental Investigation and Assessment of Construction Land" "(2017.12.24), based on the site pollution identification results of this project, set up sampling points. Based on data analysis and site surveys, this survey adopted a combination of grid points to arrange sampling points on the site.

4.2 Distribution principle

The project will be deployed in the main suspected polluted areas in the site, and the principles are as follows:

(a) Comply with "Technical Guidelines for the Investigation of Soil Pollution Status of Construction Land" (HJ 25.1-2019), "Technical Guidelines for Soil Pollution Risk Control and Remediation Monitoring of Construction Land" (HJ 25.2-2019), "Technical Guidelines for Soil Environmental Investigation and Assessment of Construction Land" And other relevant technical guidelines;

(b) The arrangement of sampling points can meet the requirements for judging the contaminated area in the site;

(c) The monitoring point of each plot should be the most potentially polluted area of the plot. If the sampling point does not meet the sampling conditions, it can be appropriately shifted.

4.3 Sampling point design

According to "Technical Guidelines for the Control and Remediation of Soil Pollution Risk Management and Remediation Monitoring of Construction Land" (HJ 25.2-2019) 6.1.1.1, "For areas with similar soil characteristics and the same land use functions in the site, a systematic random arrangement method can be used to monitor points. Location layout. The systematic random location method divides the monitoring area into several plots of equal area, randomly selects a certain number of plots from them, and arranges a monitoring point in each plot. The number of samples drawn should be based on the area of the site, the purpose of monitoring and site usage are determined." The survey plots of this project have similar soil characteristics and the same land use functions. In this survey, a systematic random placement method was used for sampling within the plots.

The total area of the survey plots is 6,500 square meters. The plot area is divided into 4 plots of about 40m×40m. Two plots are randomly selected within the plot range, and 1 sampling point is arranged in each plot. Outside the project area, 1 background control point and 3 soil columnar sampling points are arranged. In terms of sampling depth, the drilling depth of each of the two soil monitoring points was 0.5m and 1.0m to collect soil samples for testing.

4.4 Investigation of detection factors

In accordance with the requirements of "Soil Environmental Quality Construction Land Soil Pollution Risk Control Standards (Trial)" (GB36600-2018), the required test items for soil pollution risk screening of construction land during the preliminary investigation stage, including soil heavy metals (cadmium, lead, copper, nickel) , Arsenic, mercury, hexavalent chromium), volatile organic compound VOC, semi-volatile organic compound SVOC, a total of 45 items. Therefore, the survey and monitoring factors of this project are finally determined as the 45 mandatory factors stipulated in the "Soil Environmental Quality Construction Land Soil Pollution Risk Control Standard (Trial)" (GB36600-2018).

5. Analysis and evaluation of preliminary investigation results

5.1 Analysis of soil heavy metal detection results

The detection results are statistically analyzed, and the detection factors are 7 heavy metals such as cadmium, lead, copper, nickel, arsenic, mercury, and hexavalent chromium. The soil heavy metal

detection status is shown in Table 1 below, and the soil heavy metal detection result statistics table is shown in Table 2.

Table 1 Summary of soil heavy metal detection

Sample properties	Factor category	Excess factor	Not exceeded
soil	Heavy metal	None	Cd, Pb, Cu, Ni, As, Hg, Cr^{6+}

Table 2 Statistics of soil heavy metal detection results

category	Detection factor	Screening value (mg/kg)	Number of samples	Content range (mg/kg)	The detection rate (%)	Detection limit (mg/kg)	Average (mg/kg)	Over-standard rate (%)
Heavy metal	Cu	18000	5	22~23	100	1	22	0
	Cd	65	5	0.10~0.12	100	0.01	0.11	0
	Ni	900	5	26~29	100	3	28	0
	Pb	800	5	18.2~19.9	100	0.1	19.4	0
	As	60	5	10.1~11.6	100	0.4	10.7	0
	Hg	38	5	0.009~0.015	100	0.002	0.013	0
	Cr^{6+}	5.7	5	1.1~1.7	100	0.5	1.5	0

It can be seen from the above table that the 7 heavy metals tested, including cadmium, lead, copper, nickel, arsenic, mercury, and hexavalent chromium, do not exceed the standard, and meet the "Soil Environmental Quality Construction Land Soil Pollution Risk Control Standard (Trial)" (GB36600-2018) the second category of land screening value requirements.

5.2. Analysis of volatile organic compounds test results

The test results are statistically analyzed. The test factors are 27 volatile organic compounds. See Table 3 for the summary of soil volatile organic compounds test results and Table 4 for the statistical table of soil volatile organic compounds test results.

Table 3 List of soil volatile organic compounds testing

Sample properties	Factor category	Excess factor	Not exceeded
soil	VOCs	None	Carbon tetrachloride, chloroform, methyl chloride, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethylene, cis-1,2-dichloroethylene, trans-1, 2-Dichloroethylene, methylene chloride, 1,2-dichloropropane, 1,1,1,2,2-tetrachloroethane, 1,1,2,2-tetrachloroethane, tetrachloroethylene, 1, 1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethylene, 1,2,3-trichloropropane, vinyl chloride, benzene, chlorobenzene, 1,2-dichlorobenzene, 1,4-Dichlorobenzene, ethylbenzene, styrene, toluene, m,p-xylene, o-xylene

Table 4 Statistical Table of Testing Results of Volatile Organic Compounds in Soil

category	Detection factor	Screening value (mg/kg)	Number of samples	The detection rate (%)	Detection limit (mg/kg)	Test results (mg/kg)	Over-standard rate (%)
VOCs	Carbon tetrachloride	2.8	5	0	0.0013	<0.0013	0
	chloroform	0.9	5	0	0.0011	<0.0011	0
	methyl chloride	37	5	0	0.0010	<0.0010	0
	1,1-dichloroethane	9	5	0	0.0012	<0.0012	0
	1,2-dichloroethane	5	5	0	0.0013	<0.0013	0
	1,1-dichloroethylene	66	5	0	0.0010	<0.0010	0
	cis-1,2-dichloroethylene	596	5	0	0.0013	<0.0013	0
	trans-1,2-Dichloroethylene	54	5	0	0.0014	<0.0014	0
	methylene chloride	616	5	0	0.0015	<0.0015	0
	1,2-dichloropropane	5	5	0	0.0011	<0.0011	0
	1,1,1,2,2-tetrachloroethane	10	5	0	0.0012	<0.0012	0
	1,1,2,2-tetrachloroethane	6.8	5	0	0.0012	<0.0012	0
	tetrachloroethylene,	53	5	0	0.0014	<0.0014	0
	1, 1,1-trichloroethane	840	5	0	0.0013	<0.0013	0
	1,1,2-trichloroethane	2.8	5	0	0.0012	<0.0012	0
	trichloroethylene	2.8	5	0	0.0012	<0.0012	0
	1,2,3-trichloropropane	0.5	5	0	0.0012	<0.0012	0
	vinyl chloride	0.43	5	0	0.0010	<0.0010	0
	benzene	4	5	0	0.0019	<0.0019	0
	chlorobenzene	270	5	0	0.0012	<0.0012	0
	1,2-dichlorobenzene	560	5	0	0.0015	<0.0015	0
	1,4-Dichlorobenzene	20	5	0	0.0015	<0.0015	0
	ethylbenzene	28	5	0	0.0012	<0.0012	0
	styrene	1290	5	0	0.0011	<0.0011	0
	toluene	1200	5	0	0.0013	<0.0013	0
	m,p-xylene	570	5	0	0.0012	<0.0012	0
	o-xylene	640	5	0	0.0012	<0.0012	0

In this preliminary investigation of the site environment, the test results of volatile organic compounds in the above 27 soil samples showed that the test results of the volatile organic compounds in the test samples were not detected. Therefore, none of the volatile organic compounds in the surveyed plots exceeded the standard.

5.3. Analysis of semi-volatile organic compounds test results

The test results are statistically analyzed. A total of 11 semi-volatile organic compounds were detected in the soil of this site environmental survey. The semi-volatile organic compounds test results in the soil are listed in Table 5, and the statistical table of test results is shown in Table 6.

Table 5 List of semi-volatile organic compounds test results

Sample properties	Factor category	Excess factor	Not exceeded
soil	SVOCs	None	Benzo [a] anthracene, benzo[a]pyrene, benzo [b] fluoranthene, benzo[k] fluoranthene,chrysene, dibenzo [a,h] anthracene, indeno [1,2,3 -cd] pyrene,

			naphthalene, 2-chlorophenol, nitrobenzene, aniline

Table 6 Statistical table of semi-volatile organic compounds in soil

category	Detection factor	Screening value (mg/kg)	Number of samples	The detection rate (%)	Detection limit (mg/kg)	Test results (mg/kg)	Over-standard rate (%)
SVOCs	Benzo[a]anthracene,	15	5	0	0.1	<0.1	0
	benzo[a]pyrene,	1.5	5	0	0.1	<0.1	0
	benzo[b]fluoranthene,	15	5	0	0.2	<0.2	0
	benzo[k]fluoranthene,	151	5	0	0.1	<0.1	0
	Chrysene,	1293	5	0	0.1	<0.1	0
	dibenzo[a,h]anthracene,	1.5	5	0	0.1	<0.1	0
	indeno[1,2,3 -cd] pyrene,	15	5	0	0.1	<0.1	0
	naphthalene,	70	5	0	0.09	<0.09	0
	2-chlorophenol,	2256	5	0	0.06	<0.06	0
	nitrobenzene,	76	5	0	0.09	<0.09	0
	aniline	260	5	0	0.04	<0.04	0

In this preliminary investigation of the site environment, the test results of 11 semi-volatile organic compounds in the soil samples of the survey site showed that the test results of all the detection factors were not detected. Therefore, the semi-volatile organic compounds in the surveyed plots do not have excessive soil environmental pollution, and meet the requirements of the second type of land use screening value in the "Soil Environmental Quality Construction Land Soil Pollution Risk Control Standard (Trial)" (GB36600-2018).

6. Investigation conclusion

In summary, the soil heavy metals, volatile organic compounds, and semi-volatile organic compounds in this plot meet the screening values of the second type of land use in the "Soil Environmental Quality Construction Land Ten Soil Pollution Risk Control Standards (Trial)" (GB36600-2018) It is required that the plot meets the environmental quality requirements for development as a substation, and there is no need to conduct further detailed investigations. The site investigation work ends at this stage and the plot can be safely used.

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