

Soil Screening Study of Soil Pollution Risk of Closed Enterprises in Mentougou District, Beijing

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Abstract: In order to grasp the soil environmental pollution risk of closed enterprises in Mentougou District, this study targeted 32 industrial enterprises in Mentougou for soil environmental pollution risk screening. Through pollution identification, field investigations, personnel interviews, drilling sampling, and analytical testing, 19 closed enterprises that met the sampling conditions were sampled and analysed, collecting a total of 132 soil samples (including 17 parallel samples). The survey results show that the pH values of the soil from various enterprises ranged between 7.10 and 8.45. Heavy metal detection indicators (arsenic, cadmium, copper, lead, mercury, nickel) in soil samples and petroleum hydrocarbons measured in individual plots did not exceed the screening value standards for the first category of land in the "Soil Environmental Quality Risk Control Standard for Construction Land Soil Pollution (Trial)" (GB 36600-2018). Overall, the soil environmental pollution risk faced by closed enterprises in Mentougou District is controllable.

Keywords: Mentougou; Closed Enterprises; Soil Environmental Pollution; Risk Screening

1. Introduction

With the rapid development of China's socio-economic landscape and the accelerating pace of industrial transformation, many industrial enterprises historically located in urban areas have been shut down or relocated. Due to the weak environmental awareness in the early stages, pollutants that escaped during the production process may have polluted the soil and groundwater in and around the enterprises [1-3]. There might be certain risks

and hazards when the closed or relocated plots are redeveloped and utilized [4-7]. To effectively strengthen the work of soil pollution prevention and control, both the state and Beijing have issued documents such as "Notice of the State Council on Issuing the Action Plan for Soil Pollution Prevention and Control" (Guo Fa [2016] No. 31), "Beijing's Action Plan to Deepen the Battle against Pollution Prevention and Control in 2022" (Jing Zheng Ban Fa [2022] No. 6), and "Mentougou District Action Plan to Deepen the Battle against Pollution Prevention and Control in 2022" (Men Zheng Ban Fa [2022] No. 1). These documents have put forward requirements such as "strictly screening enterprise lands, completing the screening of the original sites of closed enterprises, incorporating them into the management ledger, and grasping the spatial information of high-risk plots"[8].

Mentougou District has a variety of industries included among its closed enterprises. In addition to industries that might be polluted and are under particular scrutiny, such as oil processing, chemical, and leather-making mentioned in the "Management Measures for Polluted Plots Soil Environment (Trial)" (Environmental Protection Order No. 42) issued by the Ministry of Ecology and Environment, it also includes printing, stone processing, garment manufacturing, and petroleum processing. To further understand the land conditions and environmental risks of the closed enterprises in Mentougou District and establish a more complete and accurate ledger of closed enterprises, environmental investigations were conducted on 32 closed enterprise plots.

2. Overview of the Research Area

2.1 Regional Overview

Mentougou District is located to the southwest of downtown Beijing. It borders Haidian District and Shijingshan District to the east, Fangshan District and Fengtai District to the south, Zhuolu County and Lai Shui County of Hebei Province to the west, and Changping District and Huailai County of Hebei Province to the north. Mentougou District covers an area of 1,447.85 square kilometers, comprising 4 sub-districts and 9 towns. According to the enterprise list compiled by

the Mentougou District Ecological and Environmental Bureau, screening of closed enterprises was conducted, encompassing 32 enterprises (Figure 1). They are distributed across 10 towns and sub-districts: Dayu Sub-district (1), Dongxinfang Sub-district (2), Chengzi Sub-district (3), Yongding Town (1), Longquan Town (5), Miaofeng Mountain Town (5), Junzhuang Town (4), Shilong Economic Development Zone (7), Tanzhesi (3), and Zhaitang Town (1).

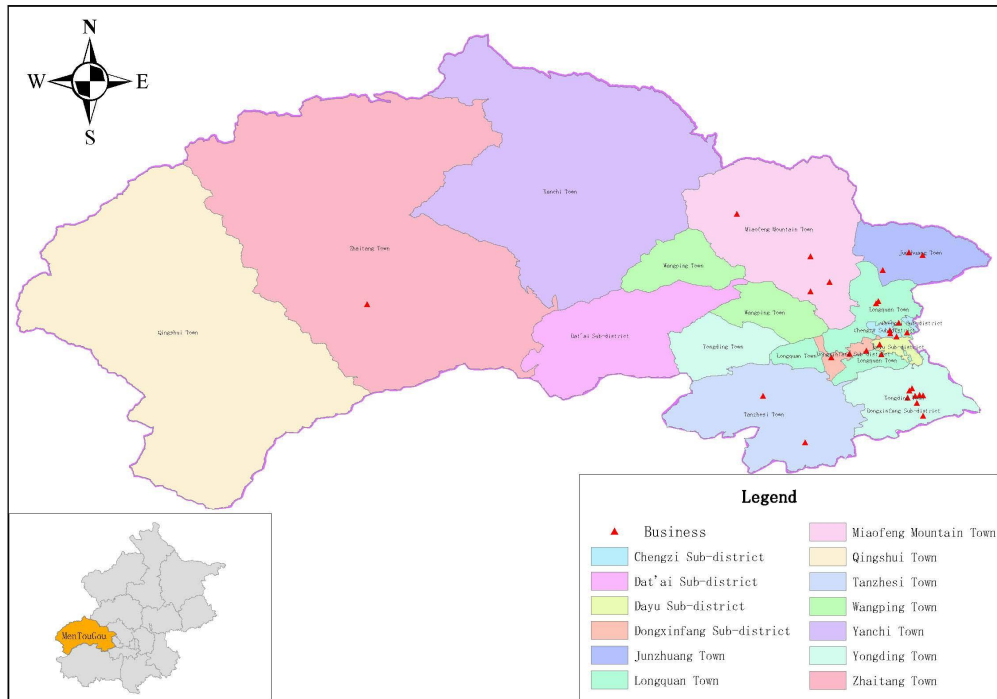


Figure 1. Geographical Distribution of the Closed Enterprises in Mentougou

2.2 Overview of the Surveyed Enterprises

Based on preliminary field inspections and interviews, the current status of 32 closed enterprises was collated (among them, three enterprises each have two factories, totaling 35 plots).

The closed enterprises in this district mainly fall into the following categories: completely or partially demolished and idle, completely or partially demolished with personal residences, afforestation on plains, in operation, registered or rented for offices, demolished and rebuilt, and others (sensitive units, undetermined, etc.).

Referring to the “Technical Regulations for Risk Screening and Grading of Closed and Relocated Enterprise Sites (Trial)”, the “Guideline for Potential Soil Pollution Risk Screening of Key Supervised Units (Trial)”,

and the “Technical Guideline for Self-Monitoring of Soil and Groundwater by Industrial Enterprises (Trial)” (HJ 1209—2021), combined with enterprise survey results and the current status, sampling was not conducted for enterprises that were rebuilt as residential communities, roads, and sports facilities (with all ground paved and no exposed soil), office rental enterprises, registration-only enterprises, normally operating enterprises, and undetermined enterprises. Eventually, 19 closed enterprises that met the sampling criteria were selected, mainly concentrated in the Shilong Economic Development Zone, Junzhuang Town, Longquan Town, and other towns.

3. Risk Screening Methods

3.1 Identification of Pollution

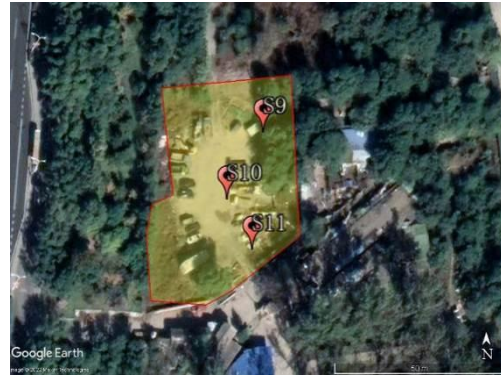
The industries mainly involved in this study area include petroleum, coal and other fuel processing industries, chemical manufacturing, non-metallic mineral products, alcoholic beverages and refined tea manufacturing, specialized equipment manufacturing, metal products, paper and paper products, warehousing, transportation, etc. Possible pollutants mainly include heavy metals such as lead, chromium, nickel, petroleum hydrocarbons, and other organic pollutants [9-12].

3.2 Sampling Point Layout

Referring to the “Technical Regulations for Investigative Sampling Point Layout of Suspected Contaminated Sites in Key Industries (Trial)” and the “Technical Guideline for Soil Pollution Status Investigation for Construction Land” (HJ 25.1-2019), at least two soil sampling points are set for each layout area. For closed and relocated enterprises, soil sampling points are preferably chosen in the layout area's production facilities, tanks, pollution leakage points, and other potential sources of pollution. They are determined without causing safety hazards or secondary pollution (e.g., explosions, collapses, drilling through pipelines or anti-seepage layers during drilling). A total of 62 sampling points were set up in this study area (Figure 2), with 115 samples collected, including 17 parallel samples.



a. Layout Diagram for Beijing Rongdong Mobile Housing Co., Ltd.



b. Layout Diagram for Beijing Shuangyi New Building Material Factory



c. Layout Diagram for Vila Huasheng Lubricant Product Factory



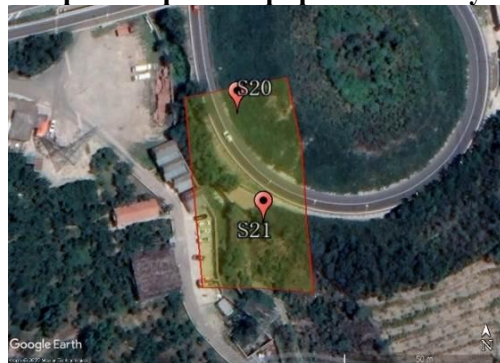
d. Layout Diagram for Wenzhi Superhard Material Product Factory



e. Layout Diagram for Mentougou Baoli Home Paint Factory



f. Layout Diagram for Jingsi Huamei Explosion-proof Equipment Factory



g. Layout diagram for Beijing Zhengbo Trade Co., Ltd.



h. Layout Diagram for Longwangda Machinery Manufacturing Co., Ltd.



i. Layout Diagram for the United Development Test Field



j. Layout Diagram for Rong An Zhiyuan Trade Co., Ltd.



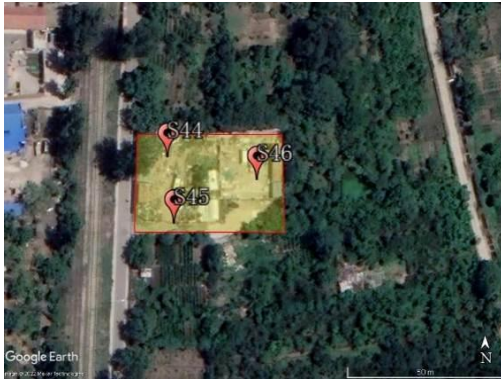
k. Layout Diagram for Zhongtong Expansion Logistics Co., Ltd.



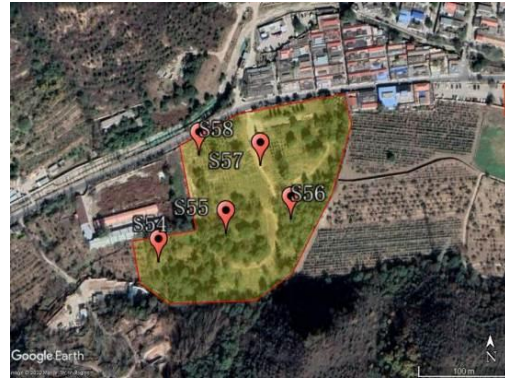
l. Layout Diagram for Yuehai Hengyuan Logistics Co., Ltd.



m. Layout Diagram for Mentougou Huawei Chemical Factory



n. Layout Diagram for Yanxi Machinery Processing Factory



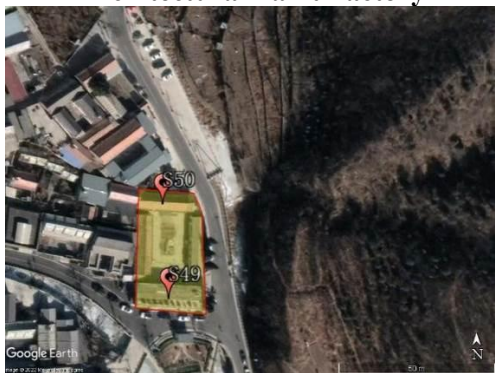
r. Layout Diagram for Hongdu Liquor Co., Ltd.



o. Layout Diagram for Xinying Architectural Paint Factory



s. Layout Diagram for Mentougou Rolling Plastic Product Factory



p. Layout Diagram for Luhe Antai Leather Products Co., Ltd.



q. Layout Diagram for Shilong Hongda Machinery Factory

Figure 2. Layout of Enterprise Plot Points

3.3 Sample Collection

For soil samples intended for VOCs detection, they should be collected separately. After obtaining a soil column using drilling equipment, the top 1cm~2cm layer of soil is scraped off. At the new soil cut surface, at least 5g of soil is collected and pushed into a 40ml amber sample bottle containing 10ml of methanol preservative. For soil samples used for the detection of heavy metals, SVOCs, and other indicators, a sample shovel should be used to collect the soil into a wide-mouth sample bottle and ensure it's packed tightly. After soil sampling, the sample bottles should be wrapped in foam plastic bags and immediately placed in an on-site sample box with blue ice for temporary storage. For this work, 62 sampling points were set up, with a total of 115 samples collected (including 17 parallel samples).

3.4 Screening Methods

3.4.1 Screening Standards

The soil screening standards primarily refer to the "Soil Environmental Quality – Risk

Control Standards for Soil Pollution on Construction Land (Trial)" (GB 36600-2018) for type I land.

The test items for soil samples are based on the evaluation indicators (45 items) and pH in Table 1 of the "Soil Environmental Quality –

Risk Control Standards for Soil Pollution on Construction Land (Trial)" (GB 36600-2018), with additional tests for petroleum hydrocarbons (Table 1). The tests are conducted following the methods specified in relevant national standards.

Table 1. Soil Testing Indicators

No.	Category	Analysis Items
1	Metals	Arsenic, Cadmium, Hexavalent Chromium, Copper, Lead, Mercury, Nickel
2	VOCs	Carbon Tetrachloride, Chloroform, Methyl Chloride, 1,1-Dichloroethane, 1,2-Dichloroethane, 1,1-Dichloroethylene, Trans-1,2-Dichloroethylene, Cis-1,2-Dichloroethylene, Dichloromethane, 1,2-Dichloropropane, 1,1,1,2-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
3	SVOCs	Nitrobenzene, Aniline, 2-Chlorophenol, Benzo[a]pyrene, Benzo[a]fluoranthene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Dibenzo[a,h]anthracene, Indeno[1,2,3-cd]pyrene, Naphthalene
4	Petroleum Hydrocarbons	Petroleum Hydrocarbons (C10-C40)

Soil inorganic indicators include 8 items, namely Arsenic, Cadmium, Hexavalent Chromium, Copper, Lead, Mercury, Nickel, and pH. There are 27 VOCs indicators, 11 SVOCs indicators, and 1 total petroleum hydrocarbon indicator.

3.4.2 Screening Methods

The detection results of the pollutants are compared with the screening values. If the detection result of a pollutant is below the screening value, it indicates the soil sample is not polluted. If the concentration of the pollutant exceeds the screening value, the single pollution index method is used to calculate the times of excess. The smaller the single pollution index, the lighter the pollution, and vice versa. The evaluation of the soil single pollution index is in accordance with the "Soil Environmental Monitoring Technical Specifications" (HJ/T 166-2004).

$$Pi = Ci/Si \quad (1)$$

Where: Pi is the single pollution index; Ci is

the measured concentration of a particular indicator in the soil (if the result is below the detection limit of the analysis method, it is counted as half of the lowest detection limit); Si is the standard or reference value for the indicator.

3.5 Screening Results

In this study, 132 soil samples were collected from 19 companies (including 17 parallel samples). The test results show that hexavalent chromium, VOCs, and SVOCs were not detected in any of the soil samples. Heavy metals (Arsenic, Cadmium, Copper, Lead, Mercury, Nickel) were detected but did not exceed the screening values for type I land. For the 3 companies involved in petroleum processing, petroleum hydrocarbons were additionally tested in the soil samples, and their detection values did not exceed the screening values for type I land (Table 2).

Table 2. Soil Detection Results Statistics

Tested Items	Unit	Screening Value	Sample Number	Detection Rate	Minimum Value	Maximum Value	Median Value	Average Value	Exceedance Rate
pH	Dimensionless	—	115	100%	7.10	8.45	7.63	7.65	0.00%
As	mg/kg	20	115	100%	1.46	11.20	6.31	6.21	0.00%
Cd	mg/kg	20	115	100%	0.01	0.16	0.05	0.06	0.00%
Cu	mg/kg	2000	115	100%	11.00	37.00	20.00	20.85	0.00%
Pb	mg/kg	400	115	100%	10.40	52.20	18.20	19.86	0.00%
Hg	mg/kg	8	115	100%	0.00	0.76	0.11	0.15	0.00%
Ni	mg/kg	150	115	100%	11.00	110.00	22.00	26.55	0.00%
Total Petroleum Hydrocarbons (C ₁₀ -C ₄₀)	mg/kg	826	115	6.96%	15.00	53.00	18.00	24.25	0.00%

4. Conclusions

This study focused on 32 industrial companies in Mentougou, conducting soil environmental pollution risk screening. Through pollution identification, on-site reconnaissance, interviews, drilling sampling, and analysis, we obtained soil environmental quality data for shut-down companies and assessed the soil environmental risks of the plots.

19 shut-down companies with suitable sampling conditions were selected, collecting 132 soil samples (including 17 parallel samples). The test indicators for the soil samples were based on the "Soil Environmental Quality – Construction Land Soil Pollution Risk Control Standard (Trial)" (GB36600-2018) Table 1, covering 45 basic items, pH, and total petroleum hydrocarbons.

According to the soil sample test results, all tested indicators did not exceed their respective screening values. Overall, the soil environmental risks faced by the shut-down companies in the Mentougou district are controllable.

This survey does not replace the survey of soil pollution conditions for construction land. According to the "People's Republic of China Soil Pollution Prevention and Control Law", when the use of industrial land is changed to residential, public management, and public service land, a soil pollution status survey should be conducted in accordance with regulations before the change.

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