Environmental Investigation and Category Analysis of Solid Wastes in Heavy Metal Pollution Industrial Sites - Taking an industrial contaminated site in a city of Jiangxi Province as an example

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Abstract: Whether certain pollutants would remain after the relocation of heavy metal contaminated industrial sites? It required environmental investigation of the site, determined the scope of investigation of contaminated sites, and conducted site identification. This paper took an industrial contaminated site in a city of Jiangxi Province as an example. After identifying the site, the solid waste was sampled, analyzed and measured, and the solid waste category was determined to determine whether it had potential risks. It was the same type of contaminated site solid waste. It would provide technical ideas for the identification and identification of environmental impacts.

1. Introduction
With the rapid development of China's economy and the upgrading of industrial structure, some polluting enterprises located in the center of the city began to relocate one after another. Some enterprises lacked awareness of environmental protection, resulting in a large number of contaminated sites left behind after the relocation of industrial enterprises. There were a large number of abandoned workshops, industrial raw materials and industrial waste residues. The waste industrial raw materials and industrial waste residues were mixed, without any treatment, the stockpiles were large, the solid waste can not be properly disposed and utilized, and there was also huge heavy metal pollution. The risk would not only pollute the surrounding soil, but also pollute the groundwater through rain and leaching, which was extremely risky to the surrounding environment\[1\-2\].

Relevant national policy documents clearly, soil environmental survey, soil and groundwater monitoring, risk assessment and restoration should be carried out on the sites after the relocation of polluting enterprises. Therefore, the contaminated site in this paper is also in need of on-site environmental investigation. The survey focuses on the environmental investigation of solid waste. Through on-site sampling analysis, it is judged whether the site is contaminated and the potential risk of solid waste in the contaminated site is known. Eco-environmental governance makes decisions\[3\].

2. Site overview
The industrial site is located in a city in Jiangxi Province. Before the site is relocated, the enterprise mainly produces an oxide, which adopts the waste roasting-acid-precipitation-spinning-burning production process. No existing enterprises were produced before the existing site, and there is no historical source of pollution. The land type planned for the site is forest land or green land. The
residential area is scattered around the southeast side of the industrial site. The nearest residential area is 20m from the southeast side of the enterprise. The factory area is connected to the county road by the rural road, about 200m from the east side of the factory, and the east side of the county road is the village. The river is 20m on the side, and the surrounding residents do not drink groundwater. According to the survey data of the industrial site, the location of the site is low hilly landform. The overall height of the site is high and low in the west, and the height difference is about 8m. From the main production workshop to the west until the elevation of the river is gradually reduced, the highest elevation is 107m and the lowest elevation is 99m. The stratum is mainly the Quaternary Holocene and the Jurassic granite weathering layer.

The company covers an area of 1.23hm\(^2\). The survey is based on the boundary of the field. The scope of the survey is shown in Figure 1.

![Figure 1. The industrial site survey evaluation scope map](image)

3. Site pollution identification results
The company is a waste recycling enterprise, the auxiliary materials are chemicals such as hydrochloric acid and sodium carbonate, and the product is an oxide. The raw materials would contain heavy metals. Solid waste was used to remove impurities, wastewater was sedimentation and washing wastewater, and all of them would contain heavy metals. Therefore, the raw material (rare earth waste) storage area and intermediate production process unit (acid solution workshop, sedimentation workshop, Roasting workshop), waste slag yard, wastewater treatment, field production would have run, drip, and leakage conditions. Metals in raw materials and product yards would enter the soil directly, or enter the air during roasting, and naturally settle after entering. The soil, which caused heavy metal pollution, would cause soil pollution in the production process of the site, including the production area and the periphery of the solid waste dump. Leakage of wastewater, leaching of waste slag and accidental discharge would have local effects on the groundwater of the site.
4. Monitoring, sampling and analysis

4.1. Monitoring points
The method of judging the distribution was used to determine the sampling point of the solid waste. The site had a solid waste storage volume of 62 m³ and a storage height of about 0.4-1.2m. The original site was divided into seven sampling areas: waste refractory pile (5 sample piles), raw material yard (1) and waste residue yard (1), of which waste refractory material was mainly on the north side of the roasting workshop and the west side of the open space; the remaining raw materials were mainly piled up in the cement floor yard on the north side of the gate entrance, and the waste slag was mainly piled up in the open space yard on the south side of the workshop.

4.2. Sampling
The sampling plan was formulated based on 《the Technical Specifications for Sampling and Sample Preparation of Industrial Solid Waste》 (HJ/T 20-1998) and 《the Technical Specifications for Identification of Hazardous Waste》 (HJ/T 298-2007). The sampling position was located at the upper, middle and lower parts of the yard. Each area determined the number of sampling points according to the degree of environmental hazard of possible pollutants. A total of 20 points were randomly arranged in each area, and 60 samples were taken. Among them, 30 samples of waste refractory piles, 15 samples of raw material yard, 15 samples of waste residue yard, and the distribution map of solid waste sampling points were shown in Figure 2.

Figure 2. Distribution map of solid waste sampling points

4.3. Monitoring project screening and sample analysis
The monitoring factors determined the indicators for the analysis and detection of hazardous wastes and solid wastes based on the different characteristics of the raw materials and products used in each region and the hazardous properties of the pollutants. Hazardous waste monitoring factors were pH, hexavalent chromium, total copper, total zinc, total lead, total cadmium, total chromium, total mercury, total nickel, and total arsenic. According to pH requirements of 《the Hazardous Waste Identification Standard Corrosion Identification》 (GB5085.1-2007), the first-class standard allows for the analysis of sampled samples with the highest allowable emission concentration requirements of 《Dangerous Waste Identification Standard Leaching Toxicity Identification》 (GB5085.3-2007) and 《Sewage Integrated
Emission Standards》(GB8978-1996). The indicators were tested according to the standard analysis method of GB/T 15555.1~15555.12-1995.

4.4. Analysis of results
The results of this solid waste test were shown in Tables 1 to 4.

Table 1. Identification of waste refractory properties of the industrial site of the enterprise

| Numble | Test projects | Maximum value | Minimum value | GB5085.3-2007 | GB8978-1996 |
|--------|---------------|---------------|---------------|---------------|-------------|
|        |               |               |               | Standard value | Excess number | Standard value | Excess number |
| 1      | pH            | 7.56          | 7.01          | ≥12.5 or≤2.0  | 0            | 6-9          | 0             |
| 2      | Cr<sup>6+</sup> | <0.004        | <0.004        | 5             | 0            | 0.5          | 0             |
| 3      | Cu            | 0.107         | <1x10<sup>-3</sup> | 100          | 0            | 0.5          | 0             |
| 4      | Zn            | 0.091         | 0.055         | 100          | 0            | 2            | 0             |
| 5      | Pb            | 0.105         | <1x10<sup>-3</sup> | 5             | 0            | 1            | 0             |
| 6      | Cd            | 7x10<sup>-4</sup> | 3x10<sup>-4</sup> | 1            | 0            | 0.1          | 0             |
| 7      | Cr            | <0.01         | <0.01         | 15           | 0            | 1.5          | 0             |
| 8      | Hg            | <2x10<sup>-4</sup> | <2x10<sup>-4</sup> | 0.1          | 0            | 0.05         | 0             |
| 9      | Ni            | <0.01         | <0.01         | 5            | 0            | 1            | 0             |
| 10     | As            | <1x10<sup>-4</sup> | <1x10<sup>-4</sup> | 5            | 0            | 0.5          | 0             |

According to Table 1, the waste refractory materials did not exceed the 《Dangerous Waste Identification Standard Leaching Toxicity Identification》(GB 5085.3-2007), and were not classified as hazardous wastes. It also did not exceed first-level emission standards of 《the Sewage Integrated Emission Standard》(GB8978-1996). Therefore it identified by the property as Class I general industrial solid waste.

Table 2. Identification of the legacy materials of the industrial site of the enterprise

| Numble | Test projects | Maximum value | Minimum value | GB5085.3-2007 | GB8978-1996 |
|--------|---------------|---------------|---------------|---------------|-------------|
|        |               |               |               | Standard value | Excess number | Standard value | Excess number |
| 1      | pH            | 7.57          | 7.21          | ≥12.5 or≤2.0  | 0            | 6-9          | 0             |
| 2      | Cr<sup>6+</sup> | <0.004        | <0.004        | 5             | 0            | 0.5          | 0             |
| 3      | Cu            | 0.065         | <1x10<sup>-3</sup> | 100          | 0            | 0.5          | 0             |
| 4      | Zn            | 0.954         | <6x10<sup>-3</sup> | 100          | 0            | 2            | 0             |
| 5      | Pb            | 0.022         | <1x10<sup>-3</sup> | 5            | 0            | 1            | 0             |
| 6      | Cd            | 0.080         | 3x10<sup>-4</sup> | 1            | 0            | 0.1          | 0             |
| 7      | Cr            | <0.01         | <0.01         | 15           | 0            | 1.5          | 0             |
| 8      | Hg            | <2x10<sup>-4</sup> | <2x10<sup>-4</sup> | 0.1          | 0            | 0.05         | 0             |
| 9      | Ni            | 0.13          | <0.01         | 5            | 0            | 1            | 0             |
| 10     | As            | 2.4x10<sup>-3</sup> | <1x10<sup>-4</sup> | 5            | 0            | 0.5          | 0             |

According to Table 2, the remaining raw materials did not exceed the 《Dangerous Waste Identification Standard Leaching Toxicity Identification》(GB 5085.3-2007), and were not classified as hazardous wastes. It also did not exceed first-level emission standards of 《the Sewage Integrated
Emission Standard》(GB8978-1996). Therefore it identified by the property as Class I general industrial solid waste.

Table 3. Identification of the slag attribute of the industrial site of the enterprise

| Numble | Test projects | Maximum value | Minimum value | GB5085.3-2007 Standard value | Excess number | GB8978-1996 Standard value | Excess number |
|--------|---------------|---------------|---------------|-----------------------------|---------------|----------------------------|---------------|
| 1      | pH            | 7.39          | 7.11          | ≥12.5 or ≤2.0               | 0             | 6~9                        | 0             |
| 2      | Cr^{6+}       | <0.004        | <0.004        | 5                           | 0             | 0.5                        | 0             |
| 3      | Cu            | 0.219         | <1×10^{-3}    | 100                         | 0             | 0.5                        | 0             |
| 4      | Zn            | 0.099         | <6×10^{-3}    | 100                         | 0             | 2                          | 0             |
| 5      | Pb            | 7×10^{-3}     | <1×10^{-3}    | 5                           | 0             | 1                          | 0             |
| 6      | Cd            | 1.7×10^{-3}   | 3×10^{-4}     | 1                           | 0             | 0.1                        | 0             |
| 7      | Cr            | <0.01         | <0.01         | 15                          | 0             | 1.5                        | 0             |
| 8      | Hg            | <2×10^{-4}    | <2×10^{-4}    | 0.1                         | 0             | 0.05                       | 0             |
| 9      | Ni            | 0.17          | <0.01         | 5                           | 0             | 1                          | 0             |
| 10     | As            | 3.9×10^{-3}   | <1×10^{-4}    | 5                           | 0             | 0.5                        | 0             |

According to Table 3, the waste residue did not exceed the 《Dangerous Waste Identification Standard Leaching Toxicity Identification》 (GB 5085.3-2007), and were not classified as hazardous wastes. It also did not exceed first-level emission standards of 《the Sewage Integrated Emission Standard》 (GB8978-1996). Therefore it identified by the property as Class I general industrial solid waste.

The solid waste quantity, attributes and major over-standard factors were summarized in Table 4.

According to the identification results of solid waste attributes, the solid waste classification of the plant area would be treated and disposed. It was recommended that the waste refractory materials, residual raw materials and waste slag of the waste refractory piles in the plant area would be used as filling materials.

Table 4. solid waste quantity, attributes and major over-standard factors of site solid waste

| Solid Waste          | Solid waste quantity (m³) | property                                      | Over-standard factor | Recommended action |
|----------------------|---------------------------|-----------------------------------------------|----------------------|--------------------|
| Waste refractory     | 43.34                     | Class I general industrial solid waste        | No                   |                    |
| Legacy raw materials | 15                        | Class I general industrial solid waste        | No                   | Filling process    |
| Waste residue        | 4                         | Class I general industrial solid waste        | No                   |                    |

5. Conclusions

1) The industrial field is surrounded by a wall, separated from the outside by the road. The terrain of the site is high in the east and low in the west. The overall layout is divided into three levels. The width of the platform is large, the height difference of the three-level platform is small, and the workshop is along the third-level platform. However, the greening in the site is better, and the pollution may only be partially polluted; there are residual solid materials, waste refractory materials,
waste slag and other solid wastes in the site, and solid waste may contain heavy metals and radioactivity;

2) The industrial site has 7 solid waste storage points, including waste refractory materials, residual raw materials, waste residue, and the amount of solid waste is 62.34m$^3$. 60 samples of waste refractory materials, residual raw materials and waste slag were tested for leaching toxicity. The results showed that waste refractory materials, residual raw materials and waste slag belonged to Class I general industrial solid waste, and the main treatment measures were the use of filling.

References
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