

## **Application of Environmental Geophysical Method in Pollutant Investigation of Soil and Groundwater**

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**Abstract:** In recent years, a new method of environmental science, environmental geophysical method, has been innovated, which is mainly used in the investigation of site pollution. The pollution of soil and groundwater is a major global environmental problem, which has a serious impact on the quality of soil, the health of human beings, the safety of food and the security of ecology. Therefore, it is necessary to assist the environmental geophysical method to investigate the pollution of soil and groundwater, which can further optimize the geological environment and enable people to live in a healthy environment.

### **Introduction**

With the rapid development of environmental science and environmental geophysics, the scope of using the knowledge of environmental geophysics in the field of environmental science is also expanding. Environmental geophysical method has been widely used to study the chemical or physical properties of site materials in the investigation of site pollution, as well as monitoring environmental pollution and predicting the change of ecological environment. This paper takes the Xidian 19-36-1 plot project in the city of Ningbo as the monitoring scope of the survey of site environment, and its monitoring area is 37850m<sup>2</sup>. The pollution of soil and groundwater is investigated, and the effect of environmental geophysical method in the investigation is analyzed.

### **1. Advantages of environmental geophysical method**

#### **1.1 Large detection depth, high accuracy and large coverage**

In the traditional methods of pollutant investigation of soil and groundwater, the coverage area is small, there is no strong pertinence to the design of sampling points, and the investigation cost is too high, which makes the use of useless samples in the survey wasteful. In addition, it can only analyze the specific situation of the point or the line, and such investigation results lack accuracy, and it takes too long. At the same time, it can not detect the pollution status of deep soil and groundwater caused by pollution diffusion in time. The detection is easy to cause the omission of the investigation, so it is impossible to effectively analyze the migration law of the polluted site through the investigation data. Besides, geophysical exploration technology can be used to explore the whole three-dimensional space in the exploration area, which has the characteristics of high precision and deep measurement. It can delineate both the designated pollution area and the site, including the structure of stratum, depth of groundwater and flow direction of groundwater<sup>[1]</sup>.

#### **1.2 Suitable for measurement of various polluted sites**

In the process of detecting soil and groundwater pollution, environmental geophysical method can remotely measure three-dimensional changes in the characteristics of underground media from

the ground without the need for a large number of trenches or drilling. The environmental geophysical method and other environmental monitoring methods have a common field of use, but it also has a strong advantage in the research of the North and South Pole and offshore environments<sup>[2]</sup>. In addition, geophysical exploration technology has its unique advantages that it is fast, economic, and non-destructive. It is more suitable for factories, dams, and nuclear waste depots where drilling and sampling cannot be performed. In such environments, geophysical detection method is able to investigate the environmental pollution situation when drilling sampling is not available. Therefore, the environmental geophysical method can measure and investigate various sites without being destructive, and is more suitable for the investigation of soil and groundwater pollution.

### **1.3 Able to delineate the polluted area of the site, divide the structure of stratum, and accurately judge the depth and flow direction of groundwater**

In the process of detecting soil and groundwater pollution, environmental geophysical method can be used to conduct effective surveys of pollutants and other surrounding media, and analyze their fundamental differences in chemical and physical properties, and the distribution of the contaminated physical field in the contaminated site is obtained with the use of self-developed professional instruments. In addition, the range of pollutants at a certain depth in the ground is effectively inferred through the analysis and exploration of the change law of the pollution field and in combination with hydrological and geological data, and its distribution characteristics are explained effectively<sup>[3]</sup>. And environmental geophysical method can further detect the nature of groundwater pollution channels, the permeability of polluted water, and the characteristics of overlay structures. At the same time, it can also dynamically monitor the polluted sites to grasp the scope and speed of pollution.

## **2. Application of environmental geophysical methods in pollutant investigation of soil and groundwater**

### **2.1 Investigation of groundwater pollution by nuclear magnetic resonance method**

The nuclear magnetic resonance method (NMR method) is performed by NMR technology and further investigates and explores the change law of NMR signals generated by the detection target based on the characteristic differences of proton fluids in water or matter to obtain the characteristic parameters of the response to the NMR signal, that is, the relaxation characteristic parameters. The relaxation characteristic parameters can give certain detection targets to the chemical and logistics environment, and can further determine the extent and scope of groundwater pollution, and detect the movement state of groundwater to obtain information about hydraulics. The use of NMR method to investigate water pollution is monitor the changes of pollutants within the delimited range dynamically through the delineation of the possible movement direction of the contaminated liquid. At the same time, the anti-fouling device is inspected and monitored to prevent the leakage of the device in time<sup>[4]</sup>. In the environmental investigation and monitoring of the project site of Xidian 19-36-1, according to the monitoring purpose, the type of aquifer and its burial depth and relative thickness, the depth of the monitoring well is effectively analyzed to ensure that it will not penetrate the shallow groundwater floor<sup>[5]</sup>. Therefore, according to the plan and production process of the original plant, 10 groundwater monitoring points and 10 soil monitoring points are selected in the site, including the assembly workshop of the original plant, the original injection molding second workshop, the original refrigerator production workshop, and the original factory, refrigerator production workshop, original finished product warehouse, original east peripheral, original injection molding workshop, original refrigerator workshop, original plastic raw material warehouse, southeast corner outside the original factory. Among these 10 soil and groundwater monitoring points, 45 samples of pollution factors are found in the soil samples through exploration, of which (HM) contains seven heavy metals such as lead, mercury, and copper; 27 volatile organic compounds (VOCs) such as 1,1,1,2-tetrachloroethane, carbon tetrachloride, styrene and toluene; 11

kinds of semi-volatile organic compounds (SVOCs) such as nitrobenzene, aniline, naphthalene. The sample of groundwater contains 14 conventional items such as chloride, sulfide, and ammonia, as well as other characteristic factors determined by the production process.

## **2.2 Investigation of geological structure with the use of seismic exploration method**

Seismic exploration method is a geophysical method for the purpose of underground geological structure exploration. According to the difference of elastic mechanical properties in different underground materials, the seismic wave is caused by artificial source, so that the seismic wave can be transmitted from the stratum, and then the geophone is used to receive the transmitted seismic wave. After receiving the seismic wave, we can further study the propagation law of the seismic wave in the stratum, and obtain various information in the stratum according to its law. In this paper, the Xidian 19-36-1 plot project is taken as the site of environmental investigation and monitoring, and 10 soil monitoring points and 10 groundwater monitoring points are set up, and two samples are taken from each soil monitoring point for investigation<sup>[6]</sup>. In order to select the monitoring area for soil pollutant identification, we should start from the pollution characteristics and use functions of the original site, and select some areas that may be seriously polluted as the monitoring points according to the investigation of the area. In addition, when selecting the monitoring point, the central part of the site or the seriously polluted part should be selected, including sewage pipeline, production workshop and waste stacking area. Through seismic exploration method, it is found that the samples of soil and groundwater extracted from some boreholes have high concentration of volatile organic compounds trichloroethylene. When the seismic wave passes through the soil layer and rock fracture or the heavy non-aqueous phase liquid in the fault, it will absorb or weaken the action of the seismic wave, so we can carry on the quantitative analysis of the process of these actions by using the attributes of the seismic wave to directly detect the position of the heavy non-aqueous phase liquid with the help of the seismic profile, and further analyze its purpose. Therefore, through the use of seismic exploration method and the analysis of seismic attribute, we can effectively detect heavy non-aqueous phase liquid and analyze its function.

## **2.3 Investigation of soil and groundwater pollution by resistivity method**

The resistivity method is carried out based on the conductivity difference between rock media. It is a method to study and detect the distribution law of the underground stable current field manually to prospect ore and solve some geological problems<sup>[7-8]</sup>. It is the most basic method in electrical exploration, which can meet the different requirements of geological profile and depth measurement according to different electrode arrangement. The high-density electrical method is developed from resistivity method, which is widely used in geological exploration. It is one of the most common electrical exploration methods. It has a strong intuitiveness, which makes the characteristics of geoelectric structure more vividly displayed. During the site pollutant investigation of Xidian 19-36-1 plot project, it is found that there are different degrees of pollution to the soil and groundwater in the original plastic raw material warehouse, and there are semi volatile organic compounds in the soil column samples, including nitrobenzene, aniline, benzo [k] fluoranthene, and benzo [ $\alpha$ , h] anthracene. However, conventional pollutants, such as chloride, volatile phenols, sulfide, ammonia, and nitrogen, are detected in samples of groundwater. According to the relevant data, the high-density resistivity method has a significant effect on the investigation and detection of soil and groundwater pollution<sup>[9-11]</sup>.

## **Conclusion**

It can be learned from above that the environmental geophysical method used in the pollutant investigation of soil and groundwater has its own characteristics. Compared with the traditional methods, it is faster and have more samples, lower costs, non-destructive and continuous information. The focus of conducting pollutant investigation of soil and groundwater should be shifted from monitoring to prevention. The investigation measures should be taken to prevent the occurrence of pollution effectively to reduce its pollution hazards. Only by closely combining

monitoring, prevention, and treatment, can environmental geophysical method fully play its role in the investigation of soil and groundwater pollution.

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