Site Pollution Remediation and Its Technology

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Abstract This paper summarized the connotation of contaminated site remediation, the differences between contaminated site and brownfield, the differences between contaminated site and soil pollution and land pollution, clarified the relationship between the concepts, and introduced the remediation technology of contaminated site.

Key words Contaminated sites, Brownfield, Soil pollution, Contaminated site remediation technology

1 Connotation of remediation of contaminated sites

Contaminated site remediation refers to the process of transferring, absorbing, degrading and transforming contaminants in soil to an acceptable level by physical, chemical or biological methods, or the process of converting toxic and harmful pollutants into harmless substances.

Contaminated site remediation can be distinguished from remediation objects, mainly including soil remediation and groundwater remediation. With reference to *Technical Guideline for Contaminated Sites Remediation Plan* (DB11/T 1280-2015)[1], the soil restoration refers to using the physical, chemical or biological transformation and degradation methods, absorbing, transferring, fixing or cutting off site contaminants in the soil, the poisonous and harmful pollutants into harmless substances, or its content is reduced to an acceptable level, or reducing the dissolution and migration capacity of pollutants, or blocking their exposure pathway, to meet the corresponding soil environmental function or use function process; groundwater repair refers to using the physical, chemical or biological transformation and degradation method, absorbing, transferring or cutting off site of pollutants in the groundwater, the poisonous and harmful pollutants into harmless substances, or the concentration is reduced to an acceptable level, or blocking the exposure pathways, to satisfy the corresponding groundwater environmental function or use of the process.

Contaminated site remediation can be divided by means of remediation, and it mainly includes *in situ* remediation and ectopic remediation. According to the *Technical Specification for Acceptance of Contaminated Site Restoration* (DB11/T 783-2011)[2], the *in-situ* remediation refers to the remediation method that does not move the spatial location of contaminated soil and groundwater, but only takes certain engineering measures at the original contaminated site. Commonly used *in-situ* remediation technologies include biological ventilation, soil leaching, gas phase extraction, air injection, *etc.* Ectopic remediation refers to the remediation method of moving contaminated soil and groundwater to nearby sites or other sites to take engineering measures, including *in-situ* heterotopic remediation and off-site heterotopic remediation. The commonly used heterotopic remediation technologies include bioreactor, mud reactor, thermal desorption, *etc.*

2 Differences between polluted site and brownfield

Brownfield is the abbreviation of brown land. Initially put forward in the United States, it specifically refers to "those abandoned, idle, or underutilized industrial and commercial land, which has been polluted or has been recognized to have the possibility of pollution, so it will be very difficult to redevelop it"[3]. From the perspective of "polluted site" and "brown land", although both emphasize the pollution of land by human industrial activities, there are still some differences. (i) The sources of land are different. The land of the polluted site comes from the land left over by human industrial activities and is the product of human industrial activities, while the land of the brown site comes from the abandoned and idle land or the land that has not been abandoned and idle but has not been fully utilized. (ii) The emphasis is different. The polluted site emphasizes the negative impact of the polluted land on residents and the environment, so it is in urgent need of restoration and treatment, while the brown site emphasizes the weakening of the use performance of the land caused by pollution and the obstruction of redevelopment, so it is necessary to solve the problem of land pollution faced by redevelopment. However, it should be pointed out that, with the development of the concept of "brownfield", the concept of polluted site and brown land has gradually become similar. For example, the international environmental science community defines "brownfield" as "the general term of the land left by the relocation of enterprises with high pollution and high energy consumption in the city"[4]. Yang Yong believes that with the acceleration of urbanization in China,

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many polluting enterprises originally located in urban areas have moved out from the city center, resulting in a large number of polluted sites (also known as "brown land")[5], and the concept of polluted sites and brownfield tends to assimilate.

3 Differences between polluted site and soil pollution and land pollution

Contaminated site and soil pollution, land pollution is a group of concepts with very similar meanings. Making clearing their meanings is helpful for understanding the concept of pollution. The differences between polluted site and soil pollution and land pollution are as follows.

(i) The emphasis is different. The polluted site emphasizes "site", while the soil pollution and land pollution emphasize "pollution". Because the emphasis is different, the purpose of eliminating pollution is different. The purpose of decontamination of contaminated sites is to enable the site to be restored to the standard required for redevelopment and use, and its ultimate purpose is to use the land safely. The purpose of eliminating soil pollution and land pollution is to make the soil or land restore to the national standard of environmental elements, and its ultimate goal is to achieve environmental governance.

(ii) The causes of pollution are different. Because polluted site refers to the land that is polluted by human industrial activities, and the polluted land has negative effects on residents and the environment, the pollution of polluted site comes from human industrial activities. However, soil pollution and land pollution do not require the causes of pollution formation. Soil and land pollution may be caused by industrial activities or non-industrial activities, such as excessive use of fertilizers and pesticides in agriculture.

(iii) The scope of site, land and soil is different. Soil refers to the unconsolidated layer on the surface of land that is composed of minerals, organic matter, water, air and living things, and has fertility and can grow plants. Land refers to a certain section of the surface, including geology, geomorphology, climate, hydrology, soil, vegetation and other natural elements of the natural complex. The "site" of polluted site refers to the land polluted by human industrial activities[6].

Therefore, contaminated site and soil belong to the sub-concept of contaminated land.

4 Contaminated site remediation technology

4.1 Treatment of heavy metals by physical methods There are three common physical methods. (i) Electric soil remediation method, mainly suitable for the treatment of heavy metal pollutants, under the action of the electric field through electroseepage or electrophoresis and other ways to make the heavy metal in the soil is brought to both ends of the electrode so as to clean the contaminated soil. (ii) Heat treatment method, that is, the soil is heated and heated, so that the volatile harmful heavy metals or volatile organic compounds are volatilized from the soil and collected for concentrated treatment. (iii) Mechanical cleaning method, this method is a relatively new oil pollution remediation technology, using pure mechanical method heterotopic cleaning of soil.

4.2 Degradation of pollutants by chemical methods It is divided into three kinds: chemical gate method, chemical oxidation method and bioremediation technology.

(i) Chemical gate method. In this method, a solid material which is permeable to water and has a strong capacity to precipitate pollutants is placed in the aquifer of the bottom or subsurface layer of the pollution accumulation, so that the organic pollutants can be retained in the solid material, so as to control the diffusion of pollutants and purify the pollution sources.

(ii) Chemical oxidation method. The method is to spray or inject chemical oxidants into the soil contaminated by petroleum hydrocarbons, through the occurrence of REDOX reaction between the pollutants, so that the pollutants are removed by the way of degradation, evaporation and precipitation, and finally achieve the purpose of purification.

(iii) Bioremediation technology. As early as 1983, the idea of using super-enriched plants to remove heavy metal pollution in soil, namely bioremediation technology, was put forward in the UK. It is the first time to put forward remediation of soil polluted by heavy metals caused by long-term application of sludge with plants of Cyanophora genus, and the feasibility of this technology is confirmed. At present, a variety of heavy-metal-resistant herbaceous plants have been developed in the UK for the treatment of heavy metals and other pollutants in contaminated soil, and these developed herbaceous plants have been pushed to the commercialization process, and the super-enriched plant material bank has been established.

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