Application of Microbial Technology in Contaminated Soil Remediation

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Abstract: Microbial technology has a strong ability to remediate soil. It also has diversity, and generally does not cause secondary pollution. So in recent years, it has begun to appear more and more in the work of pollution control. Its application is of great significance to the treatment of soil pollution. In this paper, the application principle, application method and application technology of microbial remediation of re-polluted soil were introduced. It is hoped that the reading of this article can provide some help and inspiration to the researchers in the field of contaminated soil treatment.

Introduction

As a result of the worldwide economic progress and the development of science and technology, the industrial production and agricultural production will pollute the soil to a certain extent, and then affect the soil-based surface ecological environment. With the enhancement of people's awareness of environmental protection and the proposal of sustainable development strategy, it is urgent to control the soil pollution. Compared with chemical and physical methods, microbial technology has some advantages in the treatment and remediation of contaminated soil, which will not cause secondary pollution, and it has low cost with high efficiency and few restrictions.

1. The Principle of Bioremediation of Contaminated Soil

1.1 Self-purification of soil environment

The soil itself has a certain degree of self-purification ability. When the soil is polluted and the degree of pollution is within the limit, it generally has a self-purification function. Within a certain time, the soil can automatically reduce the concentration and toxicity of pollution even when it returns to normal. But if the pollution is very serious, and it is beyond the soil's ability to restore, then it will lead to the difficulty in application of soil self-purification.

1.2 Processes of soil pollution

The soil absorbs foreign matter and supplies it with various substances. In general, the soil can achieve a dynamic equilibrium without external interference. However, the pollution of various wastes, garbage and pollutants produced in people's life and production exceeds the self-purification ability of soil, which will lead to the decline of soil quality. What is more, because the migration of materials has not stopped, the pollution accumulated in the soil may be transferred to animals, plants, water bodies and the atmosphere, which will lead to serious regional ecological collapse and cause very far-reaching effects.

1.3 Factors affecting soil microbial remediation

In general, the physical and chemical properties of soil have the greatest influence on the bioremediation of microorganisms. In order to make the microorganisms have an effect, they need to reproduce under certain conditions of relatively suitable temperature, humidity and Ph value, and different microorganisms have different requirements for the environment. The soil contains not only solid soil, liquid water and air, but also some oxides and inorganic salts. The proportion of

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these elements directly affects the physical and chemical properties of soil. Thus it affects the reproduction of microorganisms and the decomposition of pollutants.

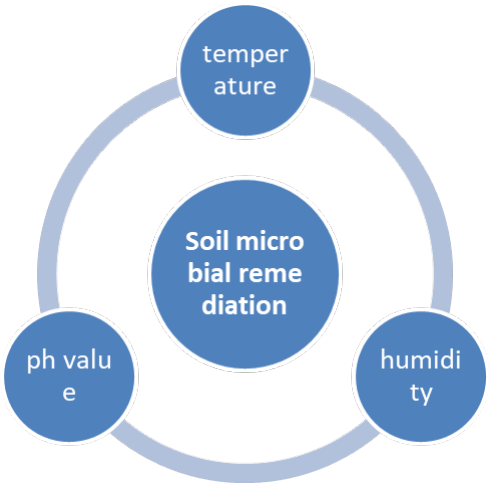

Fig 1. Factors affecting soil microbial remediation

As natural decomposers in nature, microorganisms are born with the mission of decomposing putrid bodies, garbage and other substances that may be the source of pollution into water and harmless gases. However, different microorganisms have a preference for different pollutants, which directly affects the efficiency of decomposition.

1.4 Principles of soil microbial remediation

In the work of soil self-purification, microorganisms play a huge role, that is to say, in fact, soil self-purification is mainly achieved through soil containing microorganisms. However, when the physical and chemical characteristics of the soil change or the pollution situation is serious, the inherent microorganisms in the soil may die. Then it is necessary to use foreign microorganisms to inoculate. It is the essential method to ensure the native microorganism to breed, select and inoculate the foreign and targeted microorganisms.

2. Microbial Soil Remediation Technology

2.1 Inoculation with microorganisms

2.1.1 Indigenous microorganisms

The indigenous microorganism is the original microbial community in the soil. After the soil is polluted, the physical and chemical properties of the soil will change to some extent, and some maladjusted microorganisms will gradually die off. In this process, some of the microbes that can adapt to the environment survive, and these microbes can produce enzymes that can break down the pollutants, so they gradually gain the advantageous position in the soil environment. This process is a bit like evolution, but it happens much faster, and we call it domestication. The domesticated microbes take advantage of the ability to break down and repair certain pollutants. We can directly domesticate indigenous microbes, inoculate them to ensure their numbers and activity, speed up the decomposition of pollutants and allow the soil to be repaired more quickly.

2.1.2 Alien microorganisms

Although soil has self-purification function and some microorganisms can be acclimated, in the actual remediation of contaminated soil, the acclimated microorganisms have certain

uncontrollability. This is because soil pollutants are often complex, and the domesticated microbes have a certain diversity and specificity. In this context, some microbes are domesticated. However, it still has the characteristics of poor reproduction ability, low decomposition efficiency or low activity and low quantity, which is not conducive to the realization of soil remediation. In view of this situation, we can introduce foreign microorganisms to accelerate the domestication process and increase its activity.

2.1.3 Engineered bacteria

Genetically engineered bacteria, as its name suggests, is to use genetic engineering means to artificially cultivate microbial colonies, so they produce various microbial populations that have pertinency, high activity, rapid propagation.

2.2 Add nutrients

Some of the microbes in the contaminated soil have been domesticated, and the organic matter itself, which is a pollutant, can provide a stable carbon source. But because of a lack of essential nutrients, it may also lead to a decrease in microbial activity or even a large-scale death. Therefore, in order to ensure microbial activity and reproductive capacity, it is necessary to add targeted nutrients to the soil, and common nutrients are yeast paste, yeast waste liquid and so on.

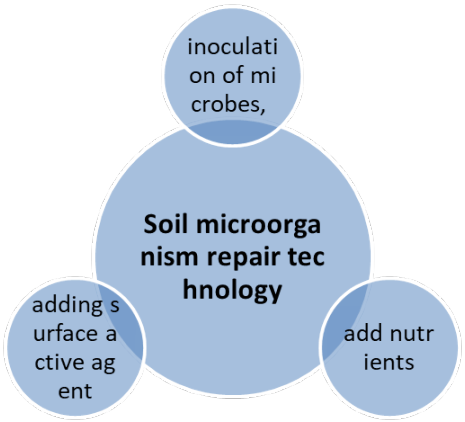

Fig 2. Add nutrients

2.3 Adding surfactant

Microbes break down pollutants by producing specific enzymes, but most of the enzymes are intracellular, that is, they are produced inside a microbe's biological cells and not secreted outside. Such enzymes act only on contaminants to which microbes are exposed, and in order to increase the efficiency of decomposition, surfactant can be added to the soil, which greatly increases the contact between microbes and contaminants in that area. So that pollutants can be used at the same time by more microorganisms. This is to greatly improve the efficiency of microbial decomposition and accelerate the rate of remediation of contaminated soil.

Conclusion

In a word, the remediation technology of contaminated soil is still at the exploratory stage. The relevant researchers are trying to use physical, chemical and biological methods to remediate contaminated soil. During the research and application process, we have found that microbial technology has high advantages because the cost of input is not only low, but also more efficient. In addition, it will not cause secondary pollution, precisely because of such remarkable advantages. It is worthy of further research and extensive application of microbial remediation technology.

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