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Research paper

Analysis of the Metal Pollution Bioremediation in the Environment of Water and Soil in Yongding River

Abdul Qahar Massror
Assistant professor and lecturer of Medical school Alberoni University

A R T I C I E I N F O

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**Corresponding Author:*
Abdul Qahar Massror
qaharm@yahoo.com

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A B S T R A C T

The main river in Beijing is the Yongding River. Nevertheless, According to the environmental contamination induced by economic growth, the environment of water, and the shore of the Yongding River are in danger of destruction. The Yongding River ecological repair is crucial. Phytoremediation and microbial remediation have constructed specific accomplishments in the contamination management aspect of river, while both have some advantages and some disadvantages. Using in the best way of the related advantages relies on the collocation and composition of microbes and plants. According to the search domain and past literature, we have presented the procedure of plant microbe-associated bioremediation for restoring the environment of the water and removing heavy metal contamination in the soil of the Yongding River. This study presents novel concepts and procedures for repairing the Yongding River ecologic environment.

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Introduction

Yongding River is the most extensive river in the Haihe river drainage basin, by a zone about 4.7×10^4 km^2. The Yongding River zone that sails through Beijing is approximately 3200 km^2, 6.7 percent of the total watershed zone. The Yongding River's length is 747 km, and the section that floats through Beijing is 170 km long, floating from five sections: Mentougou, Shijingshan, Fengtai, daxing, and Fangshan. By considering the longitudinal slope and part of various features, and the features of the overflow controlling, Yongding River is separated into the Guanting gorge part, a simple city area, with their pasturelands (Wen et al. 2012).

In the current 30 years, since the quick social economy development didn't coordinate nicely by the ecological environment, the water sources of Yongding River basin have been developed highly. furthermore, from the late 1970s, human elements like a considerable amount of sand-excavating, more contamination, generated by the Sanjiadian channel part going out, environmental deterioration, heavy sand blow, and the river had dried up for a long term. Currently, the wide river is surrounded by dense sand; the empty riverbed is surrounded by continuous wild grass, evolving bleak. Particularly in the late 1980s, in the zone Sanjiadian to south loop six, the river way is going out; sands blow repeatedly; the ecologic system evolves excessively weak (Zhu & Deng 2012).

On October 22, 2010, the city is whizzing, since "city environment preservation the first main" eventually settled. Beijing Mentougou court created the first-case judgment, Beijing Huanxingyuan Environment Protection Technology Corporation, which employed harmless sewage treatment plant sludge disposed of Qinghe and Jiuxianqiao, was discovered blameworthy by the court of main environment contamination offense. Formerly, the organization flowed 6500-ton sludge including a combination of heavy metals and a considerable amount of bacteria from Beijing Qinghe, Jiuxianqiao sewage treatment plant to the old bed of Yongding river that connected to Beijing underground water source preservation area, driving the wealth loss that was up to hundreds of millions

of yuan. by facing these strict contamination happenings, the ecologic environment of the Yongding river basin control is critical. As a connection between the south-west area ecology, Beijing significant ecologic passage, and the critical water resource, the development of the Yongding river control could greatly enhance the ecologic environment of Beijing zone. While promoting the constant evolution of the area economy, and has a significant position on performing the strategic plan of constructing a world city, accelerate the Beijing global livable city building, thoroughly executing "Humanistic Beijing, science, and technology Beijing, green Beijing" target.

We have comprehended from the literature that the Beijing government employs the "ecologic water kind" control method for dealing with the Yongding river control. With optimization of the schedule of water sources, improving the river reservoir, constructed lakes and wetlands associated with streams, reforming the rive natural morphology, and forming good perspective river (Li et al. 2006). it related sides of the green land construction organization to achieve mutual fusion among river and city by restore bottomland, close river, and grow grass, and restore vegetation. in the flood land and sand urban riverside area.

By considering the present condition of Yongding river water environment and soil contamination, also the Beijing government for the Yongding river control method, we have acknowledged. That in the procedure of constraining contamination we must spend more awareness for the Yongding river ecologic usefulness, instead of the utilizing the easy method of "having means for resisting" for managing the heavy metal contamination in Yongding river. Combined with the real condition of the Yongding River, we set off to reflect on certain ecological and economical amounts in the procedure of management. Thus, according to the past research, we present utilizing plant microbes' joint restoration technology for restoring the Yongding River ecological environment.

Heavy Metal Contamination Condition

Considering the environmental contamination, heavy metals refer to mercury, cadmium, lead, arsenic, chromium, and metals, which have important biological toxicity. Heavy metal contamination mostly contains water contamination and soil pollution. The wastewater consisting of heavy metals that are created by current industrial points would generate severe contamination for the environment, actually endangering life of humans.

The water including heavy metals mostly is from the drainage of the mine pit, electroplate manufacturer plated regions washing water, drainage concentrator tailings, trash rock field rain flooding, non-ferrous metals processing manufacturer, steel pickling water drainage, also paint, electrolysis, pesticide, pigment, and other industrial sewage. Since heavy metals include enrichment and couldn't be biodegraded, for reducing their damage for the environment, we could transmit the location or vary their physical and chemical structure in the functional control (Wang& Jiang 1993).

There existed mostly two types of heavy metal wastewater treatment technologies in the world formerly. The first one is changing the liquefied form of heavy metal to insoluble metal depositions, therefore we could get rid of the heavy metal from wastewater via showers and flotation. Like frustration showers, sulfide showers, the float, electrolysis, and showers. The second one is concentrating and separating the heavy metals in wastewater by not varying the chemical arrangements, like inverse osmosis, electro dialysis, ion exchange processes. By considering the effluent water quality, water quantity, and additional elements, these techniques could be utilized independently or in composition (Hu 2008). Nevertheless, the impact of the two types of process procedures is unitary by restricted ecological advantages. Recently the technology of plants combined with microbes to improve the contaminant environment evolves so prevalently, and it forms a new condition to control water contamination.

Last search Bioremediation Status

Heavy metals pollution Repair by utilization of plants

The technology of Phytoremediation is an approach, which could improve, absorption, transition, conversation, and reduce contaminants by green plants, ultimately changing them to safe substances for the environment (Tang 2006). By considering the plant removal method of heavy metal contaminants, phytoremediation technology mostly includes plant extractive, plant repaired, and plant volatile. Its procedure is according to Table 1 (Luo et al. 2007). The root's store of Cu^{2+} is largely high in comparison to leaf section store. According to examination outcomes, Pistia stratiotes enrich the capability of Cu^{2+} has the thing for doing with Cu^{2+} water mass concentration and ph. Tang et al. 2010 studied duckweeds' potential in the utilization of heavy metal contamination of water body repair and discovered that duckweeds have a fine restoring and absorbing impact on Zn. Dai et al 1998 analysis indicates that the Lolium multiflorum treatment impact for wastewater including Au is so clear, and the root of Lolium multiflorum (dry weight) contains Au which clarity would be about 784 g/t. Thlapi carulescens is a typical subject to investigation phytoremediation of soil heavy metal contamination currently.

Table.1. the kind and concept of heavy metal pollution phytoremediation.

Phytoremediation type	Phytoextraction	Phytostabilzation	Phytovolatilization
The concept	Utilizing hyperactive store plants absorb heavy metals in the soil, by harvest for achieving the purpose of clearing.	Plants by modifying the soil's chemical, biological, and physical situation for making the heavy metals showers.	Absorption of Plants happens simply by volatile components, like Hg, Se, changing them to a gaseous essence that was discharged to the environment by transpiration of the leaf; So, eliminate the contamination of soil and water.

By considering some kind of heavy metal contamination phytoremediation, by conferring related literature, we have discovered some types of plants that could restore heavy metal contamination excellently. Barite is appropriate for growing in a moist environment. It can cause a lot of heavy metals enrichment like Cr, Cu, Ni, etc. Barite is the first chromium hyperactive store plant discovered in China (Zhang et al. 2006). Hyperactive accumulators are related to plants, which could collect heavy metals extremely. Brooks first nominate the conception of the hyperactive accumulator (Liu 2010) in 1977. It is a metal hyperactive store plant (Xue et al. 2004), that could take and gather heavy metals from the growing medium, and wouldn't generate any harm. Zhang et al. (2008) discovered that barite has a powerful capacity for toleration of Cr, Cu, and Ni. In harvest root of barite, leaves, and stem, the amount of Cr, Cu, and Ni have been more. The heavy metal amount in the root has been extremely high in comparison with 2 other sections. The climate of Beijing relates to the moderate zone monsoon conditions, where rain is more. Barite is appropriate to rise in the Yongding River basin.

Since the heavy metals, absorption of the plant is rather more, and it wouldn't impact the surrounding biological environment, therefore we could attempt for using the store of the plant for achieving the impact of the initial treatment of Yongding River heavy metal contamination. We require a valid test for validating its possibility. Liang et al. 2008 selected Pistia stratiotes L. for testing material, utilizing hydroponic approach, analyzed the Pistia stratiotes' restoring impacts on copper contaminated water. The examination outcomes demonstrated that the Pistia stratiotes had reasonable restoring impacts on low copper contaminated water. repairment of Pistia stratiotes for copper depends mostly on the absorbing and accumulating in roots. One of the wild herbs isThlapi carulescens. It possesses excellent possibility to absorb Zn and Cd, Liu et al. 2003. Pteris vittata is found in arsenic hyper-store plants, As the content is about 5070 mg/ kg, Liu et al. 2003. Furthermore, there exists a type of generally utilized plant as sources-Brassica juncea. Brassica juncea could endure and usually rise in the environment including Zn, Pn, Cu, and Cd, Jiang et al. 2000, and has a good restoration impact on Zn, Pn, Cu, and Cd contamination.

The aforementioned items are some that could be associated with the utilization of phytoremediation of heavy metal contamination. From the removal techniques of heavy metal contamination, we have some understanding. Firstly, there exist local facts about heavy metal contamination. Various locations may have various resources of heavy metal contamination, mining, ore clearing dust, ore dressing, smelting, steel rolling, and electroplating industries would generate heavy metal contamination. Thus, the focus is on finding out contamination resources while managing heavy metal contamination, for suiting the treatment of the issue. The objective the contamination by the plants' choice; there must exist systematic experimentations. We could select selected protection "contamination protector" via exact empirical information. However, plant restoration in the heavy metal contamination treatment has a significant possibility for developing, though there are some weaknesses, such as plant restoration is very slow, restoration cycle is extended, and plants' toleration is restricted.

Heavy metal pollution repair by microorganisms:

Techniques of microbial technology used for controlling the soil heavy metal contamination mostly include 2 types: the first one is the modification of heavy metals by microbes, the second one is the absorbing the heavy metals via them. Microbial modification of heavy metals related to its metabolites utilizing microbial or some decrease cells themselves by microbial oxidation and decrease, and methylation or demethylation influence would convert toxic metal ions into non-toxic or lower toxic rain. through anaerobic requirements, S^{2}- created by the hydrolysis of sulfate decreasing bacteria (SRB) create H_2S, and metal ions Zn^{2+}, Cd^{2+}, Pb^{2+}, Cu^{2+} form their sulfides and get deceased by rain response, Tao et al. 2003. Absorbing the heavy metals by microbes mostly includes 2 types: active absorbing and absorbing, which is granted importance to passive absorbing. Passive absorbing is all kinds of microbes on the

active group surface, like extracellular polysaccharides, and chemical genes, respond with heavy metal ions by complex, chelation, ion interchange, Tao et al. 2003. Zhou et al. 2006 analyzed utilizing dead bacteria of Bacillus licheniformis for adsorbing Cr^{6+} in water. The examination outcomes demonstrated that dead bacteria of Bacillus licheniformis have a suitable absorbing impact for Cr^{6+} under optimized situations. The temperature of about 50°C, velocity table of about 140 r/min, resolution ph. of 2.5, absorbing time of two hours, bacteria concentration of 1 g/ L, Cr^{6+} initial concentration of 300mg/L, the bacteria of Cr^{6+} had the highest adsorbing capability of 60.5 mg/g. Bacillus licheniformis R08 dead bacteria Pd^{2+} absorb. In addition, adsorbing capability could get 224.8mg Pd^{2+} per gram mycelium, Tang et al. 2008.

There have been considerable analyses about the heavy metals microbial treatment, affected in genetic engineering and immobilized microorganism technology. Like γ-glutamine cysteine is synthesized by glutamic acid and cysteine by the catalysis product of glutamine cysteine synthetize, and GSH is the other synthesis. These combinations include -SH, and they could be integrated by Cd (II), Pb (II), and As (III), decreasing the toxin in the plant and promoting their absorbs and collection. The term of g-ECS genes in arabidopsis and Indian mustard GSH and γ-glutamine cysteine range is extremely high in comparison with the reference of Li et al. 2010. We could collect purpose genes or produce usage of the mutational gene that handles a specific characteristic of the human body, for making the microbe adjust to the water flow velocity, temperature, metal ions concentration, pH, more useful and enhance the impact of treatment for heavy metal contamination, meantime expand the action time. collected microorganisms technology is a method, which could restrict free microbes for a special area by chemical or physical procedures. It could preserve microbes active, and we could utilize the microbes frequently with this recent technology. Iqbal et al 2004 utilized a novel style of permeable lower-cost carrier-Phanerochaete chysosporium, and investigated the absorption of Pb^{2+}, Cu^{2+}, and Zn^{2+}. Ultimately, outcomes demonstrated the collected bacteria release Pb^{2+}, Cu^{2+}, Zn^{2+} in water nicely, getting levels of 14.6%, 12.8%, and 16.1%.

The Yongding River Ecological Environment Repair Condition Currently

Improvement of Yongding River ecological repair:

Currently, the "4 lakes-one line" engineering in the south-west 5 areas has produced several accomplishments in the control of Yongding River. Upstream, i,e, Sanjiadian's storage has created the water source when the downstream Lugouqiao in Fengtai has repaired the perspective called Lugouxiaoyue. The Yongding River in the Shijingshan area that is about13.8 km extended, creating green land and wet land by no bare level. It has varied significantly by comparing it with before. The green ecological development area is named "4 lakes-one line" project that combines Mentougou's Mencheng lake, Shijingshan's Lianshi lake, Fengtai's Xiaoyue lake, and Wanping lake, is a critical accomplishment of the western ecologic preservation area building of Beijing. It has evolved a new mechanism for promoting the growth of the south-west 5 zones economic society. By building Mencheng lake, the Mentougou region has produced significant assistance for ecological control of the surrounding zone and the higher five tributaries, particularly in the domain of building the ecological pure little watershed. The making has organized the Yongding River's gorge area and its principal branches ecologically, and the influence is impressive. The Shijingshan region via the existent Shekwu building upgraded the Shougang destruction and reconstruction and materializing industry base building, simultaneously focusing on mining along the Yongding River historical banks and cultural sources, specific tourism brand cultivation, for developing "water bank" cause the of industrial system modification regulation and developing unique economic development point. Fengtai via the construction of an ecological area, combination of Lugou bridge, Wanping city, Xiaoyue island, Changxindian old town, Fair park, 3 lakes, Fair Park lake, Xiaoyue lake, and Xiao Wan Ping lake and additional sources, suitable organization of 50 km2 industry growth zone, and combined the Yongding River ecological region. Additionally upgrading the industry assembled themselves, and increasing the throughout the industry power.

Restoration of the plant-microbial joint in Yongding River management stays a blank:

We have researched and examined the current contamination and restoration condition of Yongding River, getting the decision, which there is no government that involves the technology on soil heavy metal contamination of Rivers. by considering the appropriate information, we have known that utilizing plant microbial joint restoration, could improve the soil heavy metal contamination, whereas could even have a specific decay and repair on the organic contamination. The various process has a substantial impact on the decay of soil whole hydrocarbon amount that creates the influence of bioremediation and application content additionally enhanced (Ma et al. 2005). However, there are related weaknesses by plant and microbial modification like phytoremediation has a more extended term, toleration is restricted the additional strict conditions on the living

circumstances and microbes in the restoration procedure, and simple disruption by native microorganisms handled by the surrounding environment. The joint restoration of plants and microbes, particularly the plant roots combined action and rhizosphere microorganisms, has gained fine impact in little restoration (Chen et al. 2002). Plants and microorganisms' joint restoration is especially displayed in the subsequent parts: 1. Plants supply a special survivorship environment to microbes that improves microbial probabilities for living, and is helping for repairing the microbial action. 2. Rhizosphere microbial societies could switch raised plants for absorbing nutrients. Therefore, enhancing the survivability of the plants in the environment. 3. By microbial nitrogen stabilization and elements minimization, the fertility of the soil has grown. Restoration of the plant-microbial joint is an influential bioremediation method. We must investigate the joint restoration performance among them. The way for plant-microbial joint restoration in polluted soil is finding a proper correspondent composition of plants and microbes by considering the real condition of soil contamination.

Conclusion

By having the comparison with the current literature, we could understand that the plant-microbes joint restoration approach integrates the benefits of 2 single approaches to make a stronger impact on heavy metal contamination management. The selected plants and microbes have comprehensive resources and increased selectivity. The technology is simple for empirical research and argumentation, and its techniques are easy and helpful. Meantime, it is easy and at a lower cost, and wouldn't get secondary contamination. In addition, we could modify the balance of the selected plants and microbes flexibly in the procedure of government, for applying the technology in various regions of the River. By considering the features and the real condition of every part of the river, we could select different plants and microorganisms for working together, therefore, attaining the purpose of appropriate control of water contamination. We expect that plant microbe's joint restoration procedure could present relation to ecological environment restoration of Yongding River, and deliver new concepts and techniques for ecological passage construction of Yongding River.

Conflict of interest

The authors declare that they have no conflict of interest.

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