BIOREMEDIATION OF URANIUM VIA GEOBACTER SPP

Seyedeh Golchereh Mirlahiji 1, Khosro Eisazadeh2*

1,2 Department of Microbiology, Faculty of Basic Sciences, Islamic Azad University – Lahijan Branch, Iran

Abstract
The in situ stimulated of Fe (III) oxide reduction by Geobacter bacteria tend towards the pollutant acceleration of U (VI) from groundwater. The biological mechanism behind this reaction has abided evasive approximately for two decades, in the face of its guarantee for the treatment (bioremediation) of uranium pollutants. Because reducing Fe (III) Oxide by Geobacter needs the expression of their conductive pili. Considerably pile expression increased the value and expansion of uranium deduction for each cell and concludes in the fixation of dissolvable hexa valent uranium, U (VI) beside the pili as mononuclear tetravalent uranium U (IV) that is completed by carbon that is involved ligands and arranging steady with a biological mechanism. Although there was a straight agreement between pilation levels, the cell blanket breathing activities and the cell applicability. Dissimilarly, the deficiency of pili strains, superiorly decrease the uranium in the periplasm and had lowered aerobic activities and applicability which the conductive pili operate as the first mechanism for Uranium reducing and cellular protection in it.

1. Introduction
At the time of cold war, many areas that uranium was drown out and processed for nuclear fighting have polluted with uranium which, in potential is a problem for groundwater pollution. Oxidized uranium intensely is poisonous for the environment and dissolved in groundwater. This brings out the polluted area increases because at this case the dissolvable uranium is portable. The experts have researched and developed on how the problem of ground water pollution is solvable. Using the bio-stimulation is one technique that they believed it as the most valuable and forcible technique. In order to adopt the oxidized uranium and changes it to a non- soluble precipitate, this technique arrange for the metal-reducing microbiology of the polluted area. In order to remove the uranium pollution problem, they could adopt the polluted areas natural bacterial flora (Bond et al,2003, Giammar et al,2010).The way bio-stimulation, by using acetate, was efficacious that providing them with the electrons required increased the number of metal reducing bacteria. The conclusion supported the primary hypothesis that explained stimulating the in situ activity of metal reducing to bio remediates polluted areas. Although the test succeeded but there was a problem: uranium centralization started to enhance in some of the wells after lowering. This problem would be solved if there was long term maintenance to promote the growth of Geobacter species.

* corresponding Author
2. Geobacter specie

Geobacter species are well known because their metal reducing ability and they can accelerate the bioremediation of radioactive oxidation of organic subsurface environments with responsibility (Barlett et al, 2012, Bond et al, 2003). With reducing pollution of metals such Fe (III) and other pollution such uranium, they can do anaerobic oxidation of organic and subsequently are serious for groundwater bioremediation (Cologgi et al, 2012, Giammar et al, 2010). Additionally Geobacter kinds can directly transfer electron to an electrode motivating their use in microbial fuel cells (Liang et al, 2012). The Geobacter sulfurreducens model from Geobacteraceae view is unmixed culture and has been broadly studied for the reason that it characterizes its physiology to distinguish the mechanism accompanied with the transferring by extra – cellular electron. Currently , some genome – wide studies have described the metabolic factors of Geobacteraceae as single in kind that have included development of a genome- scale metabolic model of Geobacter sulfurreducens , the chemotaxis towards iron and the synthesis of conductive pili. the model that is based on genome shows that global proton balance was considerably different from Geobacter species which lean on transferring extra- cellular electron to in soluble substrates comparing to aerobic organism which decrease oxygen to water(Petrie et al,2003; Wilkins et al,2009).Additionally recovered understanding of the global proton balance in Geobacter species make available perspicacy on the physiology of other ability of kinds in order to transferring extra- cellular electron like erhodoferax ,shewanella in spite of electron transferring mechanism because the protons are not used at the last electron that is admitted in all terms. Changes such as PH, temperature, osmolality and electron donor accessibility in environmental conditions can changes the trans- membrane PH gradient total proton motive force and impress the internal PH of the cells as well as the energetic(Wilkins et al,2009).Therefore, cells should to compose energetically the internal PH by secreting or using protons to keep energy homeostasis. The cultivation environment act as a source for protons leaning on the secondary layer that is present. The characterization of replacing proton can supply additional understandings about the metabolism and physiology of organisms that have studied lesser such as Geobacteraceae that use transferring of extra- cellular electron for energy generation. Many in silicon- models hav been built in order to describe and foretell the intracellular metabolism at the genome – scale for many organisms including E. coli, S. cerevisiae and B. subtilis(Liang et al,2012, Cologgi et al,2012).

3. A General Overview of Bioremediation:

A process of bioremediation uses microorganisms to detoxify decrease or remove environmental contaminants. Microorganisms may be added to the polluted area in a direct way and addition of nutrients can instigate their growth. Carbon introducing that source into the ground is sometimes efficient to instigate the growth of bacteria that can reduce U (VI) (Cologgi et al, 2012).As a general rule; uranium bioremediation is on the basis of deduction of dissolvable U (VI) to dissolvable U (IV) slightly or based on bio sorption of U (VI) indeed biomass. This process fixes the half – life of metal but helps to fix uranium and prohibits it from doing filtration a polluting ground water. In environments that are , as a general rule, poor in nutrients with a variety of chemical and physical properties, the bio sorption of U(VI) and the development of many bacterial communities are difficult to instigate. Additionally, it is important to impede its reoxidation or desorption when the uranium is fixed. So, a correct bioremediation strategy always will rely on a right knowledge of microbiological, geochemical and geological features of the area to decontaminate.
The word bioremediation means a process that uses biological agents to remedy poisonous waste from environment. Bioremediation is the most efficacious equipment management to manage the polluted environment and recover polluted soil. One of the successful cleaning strategies for polluted environment is bioremediation. It has been used in many areas in global level like Europe that the degree of success is varied. Also, it has derived a benefit from strong scientific growth both in situ and ex situ because the use of natural weakness has increased since most natural weakened is because of biodegradation. They are considered as a way for solving the pollutant problem that became visible e.g. endocrine interrupters, landfill fixation, compound waste bio treatment, and biological carbon seclusion (Bond et al, 2003). Microorganism are very helpful to remove the polluted environment. These microorganism are including aerobes, anaerobes, fungi are involved. in bioremediation process uranium may be remediated biologically by 3 fixation – based process in minimum;1-dissimilatory from the view point of enzymology metal bio reduction of dissolvable U (VI) in slightly soluble V (IV)2-Chemical reduction by microbial – generated by – products and3- bio sorption on cell surface, biopolymers or dead organisms. These processes happen on a pollutant and dependent manner (Cologgi et al, 2012).

3.1 Type of Bioremediation
There are two methods that are based on removal and transportation of wastes for treatment:
1-In situ bioremediation
2-ex situ bioremediation

3.1.1. In situ bioremediation
It means that it's not necessary to excavate or remedy soils or water due to accomplish remediation. It is captured to make oxygen and nutrients available by spreading aqueous solution along pollution soils to instigate which is happened for bacterial in natural to degrade organic pollutant. We can use it for soil and ground water. It includes situations such as the water infiltration including nutrients and oxygen or other electron acceptors for ground water treatment in general. Most of the time it is used to the degradation pollutants in impregnated soils and ground water. It is a preferable method in order to cleaning polluted environments because of being cheap and it uses inoffensive microbial organism to degrade the chemicals. Studying chemo taxis is important because organisms that are microbial can move into an area that is polluted. In conclusion when the cells chemotactic abilities increase, In situ bioremediation will be a method with high safety in degrading noxious mixtures (Findlay et al, 2008).

3.1.2. Advantage and Disadvantage of in situ bioremediation:
This method has many potential advantages. It doesn’t need excavate polluted soil and so the value of proving is effective. There is minimal interruption therefore the creating dust measure is less and contemporaneous behavior of soil and ground water may be happen. It causes some disadvantages. The methods is time wasting in comparison to other remedial method. Microbial activity varies seasonal because direct opening changes in environmental features that are uncontrollable and problematic application of treatment additives. Microorganisms just when the waste material present let them producing nutrients and energy for the expanding of more cell, work well. Their capacity is decreased when these conditions are not desirable. In such cases, although stimulating natural microorganisms is offered, engineered microorganism has to be used on the basis of genetic (Cologgi et al, 2012; Giammar et al, 2010).
Bioremediation is a natural process and so the public perceive it as a desirable waste treatment process for polluted material like soil. When the pollutant is available, microbes can degrade the pollutant increase in number (Wilkins et al, 2009). The bioremediation population decrease, when the pollutant is degraded. The remainder for the treatment is harmless products as usual and contains carbon dioxide, water and cell biomass. Bio remediation on the basis of theory is useful for the perfect desolation of a wide variation of pollutants. Many mixtures are statutory seem dangerous. Their form can change to injurious products. This omits the opportunity of future liability connected with treatment and available polluted material (Cologgi et al, 2012, Gianmar et al, 2010). The perfect destroying of target pollutant is possible instead of transferring pollutants from one area of environment to another like from land to water or air. Bioremediation can be accomplishing site most of the time without reasoning in a major interruption of normal activities. Also this omits the requirement of transporting quantities of waste of site and the potential treats to human health and environment that can increase at the time of transferring (Esteve-Núñez et al, 2005).

Bioremediation can fix cheaply in comparison to other technologies that are used for unpolluted useless and dangerous efforts. also bioremediation is considered as an advantage in the middle of present day environmental situations and considered as a problem because when essences are added in order to increase the acting of one special bacterium fungi or and other microorganisms, it may be interruptive to other organisms dwelling that same environment when done in situ. Even if microorganisms that are modified on the basis of genetic, are dropped into the environment after a particular point of time removing them is difficult (Wilkins et al, 2009).

As a rule, bioremediation is very valuable, intensively labor and can last several months for the remediation to acquire adequate levels. Another problem with regard to the use of in situ and ex situ process is ability of reasoning for more injury that the real contamination itself. Bioremediation is limited to those mixtures that are biodegradable. But all compounds are not disposed to fast and complete degradation. The product of bio degradation may be more persistent or toxic than the parent compound. Biological processes are often considerably special the presence of metabolically ability of microbial populations suitable environmental growth conditions, and proper levels of nutrient and pollutant are vital site factors that are needed for success (Burgard et al, 2008). Bioremediation often lasts longer than other treatment options such as excavation and relocation of soil or burning. By increasing the natural biodegradation process, bioremediation provides a method for polluting contamination. Therefore these chances prefer potential for important progresses by important of a perception of microbial communities and their feed back to the natural environment and contaminant spreading the learning of the genetics of the microbes in order to enhance abilities to degrade contaminants. Conducting field trials of new bioremediation methods which are forcible valuably and dedicating areas where are set aside research purpose that takes long term (Esteve-Núñez et al, 2005).

This technology prefers a skilled and valuably forcible way to remove polluted ground water and soil in spite of which aspect of bio remediation that is used. Its advantages are important than the disadvantages as a general rule which are evidence for come area’s that choose to use this technology and its increasing popularity (Cologgi et al,2012, Bond et al,2003).

We appreciate from the bioremediation technology to polluting the contaminated environment and so it may be used as management equipment. It is essential to know the physiological needs of most important bacteria at these area to keep a careful check on their metabolic condition in situ and connecting this metabolic state to features controlling the rate and the degree of bioremediation processes in order to become better bioremediation strategies for polluted subsurface environments. Transcript levels for genes connected to most important metabolism or nutrient envelopment may be useful for monitoring the in situ
metabolic state of key microorganisms during bioremediation (Esteve-Núñez et al, 2005). Although there are many other environmental conditions that are probably to affect the metabolic states of bacteria at the time of bioremediation. Techniques for taking away uranium from ground water depend on unskilled pump- and – treat technologies or simple ground water cleaning and lowering in situ metal concentrations to below desirable limits. Projected manner of treating time (or natural weakness) of several decades or longer are common and have spurred investigation of more- skilled remediation technique in situ fixation of uranium, which takes advantage of redox character of uranium has been suggested as a possible strategy to take away uranium from ground water. U (VI) is able to move capacity state of uranium especially in carbonate containing groundwater while decreased uranium, U (IV) IS Dissolvable us uraninite. Deduction of U (VI) to U (IV) within aquifer could accelerate uranium prohibiting further down gradient expand of grand water pollution. Studies that done in laboratory, have offered that a pure strategy for advocating U(VI) deduction in polluted aquifers is to add acetate as an electron benefactor to animate the activity of concealment metal-reduction microorganisms(Petrie et al,2003).

Dissolvable (VI) emphasizes on subsurface environments because it supply electron benefactor deficiently in order to use soluble oxygen and promote active anaerobic breathing. Acetate efficaciously instigates U(VI) reducing in subsurface sediments, reasoning in cleaning of uranium from polluted ground water (VI) is decreased simultaneously with Fe(III) and before decreased simultaneously with Fe (III) and before reducing of sulfate(Barlett et al,2012; Findlay et al,2008, Liang et al,2012 and Petrie et al,2003). Reducing of U (VI) and Fe (III) have increased. That is connected with increasing the number of Geobacteraceae by several orders of magnitude. In addition, Geobacteraceae account for Ca 40% of the total microbial community as determined from 16s ribosomal DNA(r DNA) – based clone libraries at the time of active period of Fe (III) and U (VI) reducing. Geobacter species that are found were overruling Geobacteraceae in ground waters with salty fresh water while desulfuromonas species overruled in ground waters with salty marine. Most of the Geobacteraceae growing could be applied to electron transfer to Fe (III) because Fe (III) was available in the sediment at mill mole- per-kilogram quantities while only micro mole per-kilogram amount of melted U (VI) were accessible. Geobacter species are known for the bioremediation of radioactive and poison metals in polluted sublevel environments and changing organic mixture to electricity in microbial fuel cells, are among the most influential microorganism. Geobacter species capable to transfer their novel electron, can transfer electrons outside the cell and transport these electron upper distances on the way of conductive line that is considered as microbial nanowires and because of the abilities are of interest. Geobacter kinds have role in environmental revitalization and because of their role are of interest. For example by oxidizing the mixtures of eliminating petroleum pollutants in polluted groundwater to inoffensive carbon dioxide and Geobacter species can remove radioactive metal pollutants from ground water. It has been possible to use this information to change environmental conditions to advance the value of bio remediation when understanding of the way of acting of Geobacter species has improved. Geobacter kinds play an important role in some anaerobic west water promoting declining organic pollutants by transferring Electron to microorganisms that produce an important biofuel know as methane. Current conclusions suggest that this electron transfer continue through Geobacter conductive microbial nano wires. Geobacter species can oxidize organic mixtures by transferring electron to electrodes that shows capability of a strategy for producing bioelectricity especially in improbable environments (Barlett et al, 2012).

Geobacter kinds have novel electronic characteristics that may have workable applications for example the can form highly adhesive conductive films that have conductivities that compete with synthetic conductive polymers. The conductivity of the Geobacter films
conclude from a network of microbial nanowires thin (ca.3nm) protein lines that make electrons along their length with conductivity like metallic. So, Geobacter bids that making electronic sensors and other devices that work under water is possible and can easily link biological and a biological interfaces from cheap feedstock like acetic acid. Geobacter species have analyzed to be an excellent model for development of genome-scale analysis of natural environment, bioremediation and bioenergy applications. This approach has included complicate diagnosis of the physiological status of sublevel microbial community at the time of bioremediation to lead bioremediation additions and predictive computer modeling of ground water bioremediation liking genome-scale metabolic model with geohydrological ones. The biological mechanism behind this reaction has abided evasive for almost two decades in the face of its guarantee for bioremediation of uranium pollutants. The contribution of the pili to uranium reduction was inspected in strains of Geobacter sulfurreducens with different levels of palliation and in pili-defective strains because Fe (III) oxide reduction needs the demonstration of their conductive pili while the pili as a mononuclear tetravalent uranium U (IV) mixes by carbon including ligands and firm adaptation with a biological mechanism, pili demonstration increased significantly the rate and extent of uranium reduction per call and conclude in the fixation of dissolvable hexavalent uranium U (VI) (Giammar et al, 2010). Despite of the pili-defective strains superiorly decreased the uranium in the periplasm and had reduced aerobic activities and viability; we can see a direct correlation between the levels of the palliation, the cell skin activity and the cell viability. Additionally, there is an agreeable correlation between the degrees of priplasmic mineralization in the pili-deficient strains with their outer membrane of c-cytochrome capacity (Burgard et al, 2008, Liang et al, 2012). The outer membrane released cytochrome that seems improbable could have linked with the pili and contributed to reductive precipitation of uranium because direct probing of the pilus lines didn’t show any electronic features concluding in the contribution of cytochrome hem groups by scanning tunneling microscopy. More often they show topographic and electronic characteristics intrinsic to the pilus shaft. In addition the amount of uranium reduction didn’t correlate with the cytochrome capacity of strain tested (Barlett et al, 2012).

4. Conclusion
The polymerization of the micrometer-long conductive pili on the cell skin increases the redox-active surface area available for restraining and decreasing uranium that is outside the cell. So by preserving the vital aerobic activities of the cell skin and its viability the pili enhance the reductive precipitation of dissolvable U (VI) and also prevent it from pervading inside the cell. Therefor the conclusions support a model that conductive pili act the prior mechanism for the deduction of uranium and cellular protection in it. The entering of uranium into soil and groundwater poses a major menace to human health. Stimulation of microbial communities to fix these radionuclides has revealed to be an effective method for uranium remediation although being an intolerable method at last. Microbial reduction of U (VI) faces several complexities because the uranium cannot destroy easily; after the remediation’s processes U (VI) can adsorb to sediments and prevent it’s from reduction and cause that being consistence in a polluted area. Additionally biotic and abiotic processes oxidize the fixed U (IV) so it is concluded in a reversal of remediation process. This problem will abate the in situ bioremediation value of uranium if the experts don’t concentrate on them in comparison to traditional ex situ methods. The absorption of decreased uranium in weapons will create a requirement for the remediation of uranium demand in areas of conflict in the near future. The researchers that have investigated on this method have offered that bioremediation could be used in the market at once. However more current research requires being absorbed into uranium bioremediation technique to make better both competency and
into liability of this process. The use of electrodes as electron benefactors for the microbial community could arrange for reduced costs of remediation as well as the use of them for the complete removal of fixed U (IV) from sediments and also as well as the use of protected sensors that is based on field reveals potential for streamlining the monitoring of uranium pollution in area’s bearing remediation. For enhanced breathing could arrange for faster and more complete reduction of U (VI) in polluted areas with a minimal gathering of acceptable biomass. At last a more complicated method is needed for in situ bio-remediation of uranium to lead to the issue of tolerability. This research that is studied in these papers offers different groups of microorganism that can tend to tolerable reduction and sequestration of U (VI) but the experts need more studying to distinguish how they use this knowledge to aid a complicate microbial community in the field.

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References