Retraction

Retraction: Natural Microalgae Biofilm As A Tool To Clean-Up Mining Wastewater (IOP Conf. Ser.: Earth Environ. Sci. 775 012014)

S. Anbu Kumar¹, Shivam Gupta¹, Shubham Kumar¹ and Pawan Kumar Meena¹

¹ Civil Engineering Department, Delhi Technological University, Delhi, India
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It has come to the attention of IOP Publishing that this article should not have been submitted for publication because of its substantial replication without citation of an earlier-published paper (Adamu Yunusa Ugya, et al 2020, All Life, 13:1, 644-657). Consequently, this paper has been retracted by IOP Publishing. The authors agree to this retraction.

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Natural Microalgae Biofilm As A Tool To Clean-Up Mining Wastewater

S. Anbu Kumar1  Shivam Gupta2  Shubham Kumar3  Pawan Kumar Meena4
1 Civil Engineering Department, Delhi Technological University, Delhi, India
2 Civil Engineering Department, Delhi Technological University, Delhi, India
3 Civil Engineering Department, Delhi Technological University, Delhi, India
4 Civil Engineering Department, Delhi Technological University, Delhi, India

E-mail : 1 sanbukumar@dce.ac.in  2 shivamdtu0908@gmail.com  3 shubham2798@gmail.com  4 pkmcricket02@gmail.com

Abstract. Pollutants in amphibian conditions will in general change the network arrangement and exercises of biofilm cells. The making of excessive reactive oxygen species (ROS) which is caused due to the stress induced out of these pollutants play a major role in debasement of pollutants in oceanic conditions. This smaller than expected audit is pointed toward anticipating the proficiency of the utilisation of regular biofilm in water treatment coming about because of mining exercises. Additionally, it sums up the idea of mining by briefly expressing the stages engaged with mining and how the toxins delivered during mining can make harmful impacts on amphibian vegetation. Discussion on how the advancement of biodiversity is impacted by the ecological issues resulting from activities of mining was done. Microalgae assume a significant part in the alleviation of the effect of contamination coming about because of mining exercises. The cycle of toxins expulsion in freshwater by miniature green growth biofilm is by debasement and biosorption. Biosorption of hefty metals in mining wastewater was caused because of the extracellular polymeric substances (EPS). The kinetic model should be understood properly which explains the biosorption of hefty metals through physical and chemical reactions.

1. INTRODUCTION

Mining is the principal monetary action of many non-industrial nations. Mining was among the significant wellspring of fare in Nigeria before 1970. The over reliance on oil assets has strengthened distinctive mining practice in the nation because of absence of government will, mediation and usage of accessible guidelines. Mining in Nigeria is managed without thinking about the effects on the climate, and as a rule, recovery is never a phase in mining measures. Mining activity, be it little or huge scope, is intrinsically troublesome to the climate, delivering tremendous amounts of waste that can have a malicious effect for quite a long time. The danger of contamination from mining destinations keeps going even when the mining exercises are completed. Natural issues exist where mining exercises are done.

These issues show as corruption of woodland and biodiversity loss, tainting of soil, contamination of air and groundwater, clamor and vibrations, decay of common waste frameworks, regular land debasement, negative effect on earthbound and amphibian biological systems, financial and human

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wellbeing. The deteriorating climate brought about by mining happens mostly because of inadmissible and inefficient working practices and restoration measures. Subsequently, ensuring water quality is a pressing ecological test at mining and mineral preparing locales [1]-[3].

Explanation, vanishing, crystallisation, sterilisation, particle trade, film division, bundle plants and organic methods are some of the numerous advances utilised in wastewater treatment. These innovations are cost-insufficient and hard to use under field conditions, consequently in such a circumstance, there is an earnest need to consider common, straightforward and savvy procedures for control. The utilisation of common microalgae biofilm for cleaning of water coming about because of mining exercises is an option in contrast to ordinary and other natural strategies because of its cost-adequacy, the necessity of low innovative skill and good proficiency to eliminate supplements, weighty metals, natural and inorganic wastewater from wastewater.

Inorganic surfaces in relationship with normal freshwater microalgae biofilm envelops a few syntrophic gatherings of microorganisms. Foul extracellular framework encircles part cells shaping a biofilm which is made out of extracellular polymeric substances (EPS). EPS is delivered through aggregation of lipid, proteins, DNA of every individual framing characteristic microalgae biofilm. Network routine of part microorganism is implied by the parts of EPS in microalgae biofilm and possess 3D structure [4].

The microorganisms creating freshwater microalgae biofilm are physiologically not the same as other planktonic cells of a comparative living being coasting in a freshwater climate. Common biofilm comprises various sorts of miniature organisms, these either take care of autotrophically or heterotrophically. Autotrophic life forms present in common biofilms comprise miniature green growth and cyanobacteria, though heterotrophic living beings incorporate microorganisms, parasites and protists. A characteristic biofilm is structured by these organisms encircled by EPS on outside of either a fake or normal substrate. The EPS of characteristic biofilm is the motivation behind why biofilm can oppose natural pressure, consequently causing the debasement of poisons in sea-going conditions. This smaller than normal audit is subsequently pointed toward estimating the productivity of the utilisation of characteristic microalgae biofilm for treatment of water coming about because of mining exercises [5].

2. THE CONCEPT OF MINING

Mining can be characterised as the cycle by which minerals coming about because of geographical cycles are removed from the lithosphere. These monetarily important minerals are a mix of various materials which include coal, metals, chalk, measurement stone, potash, dirt etc. The way toward mining includes the extraction of non-sustainable assets, for example, coal, unrefined petroleum and flammable gas which is autonomous of material originating from agronomic exercises and also the materials made in research facility. The unanswered inquiry regarding mining activities is its negative natural effect which has prompted the production of various laws pointed toward diminishing the negative part of mining on the climate. The stages associated with mining exercises incorporate prospecting, exploration, development, exploitation and reclamation as shown below in Figure number 1 [6].
3. ENVIRONMENTAL IMPACTS DUE TO MINING ACTIVITIES

Natural issues coming about because of mining exercises are because of the immediate or circuitous effect of mining rehearsals. These issues are of nearby, provincial and worldwide concern and emerged from the emanation during mining exercises. These outflows prompted ecological issues, for example, sinkholes, disintegration, soil pollution, water tainting (surface and groundwater) (as shown in Figure number 2), extinction of species and weakening of quality of air. The way toward mining is related with soil debasement and disintegration prompting the obliteration of enormous territories of land. Disintegration and debasement are because of mining exercises, for example, open pit and overburden mining, development, and so on. Soil corruption is because of the tainting of soil by the substance toxins created during mining exercises. One significant impact of soil disintegration coming about because of mining exercises is relation with water assets defilement and decrease in variety of life. The contaminations created during mining exercises can saturate springs and dirty subsurface water or dissolve within close by run-off water prompting increment in contamination, stream sedimentation, obstructing of streams and loss of biodiversity [7]-[8].
4. THE EFFECT ON BIODIVERSITY DUE TO MINING ACTIVITIES

Change of atmosphere coming about because of mining exercises is related with unsettling influence and determination antagonistic wellbeing impacts on both amphibian and earthly creatures. Harm to the first site is more negative to biodiversity in light of the fact that the toxins delivered during mining exercises are poisonous and can straightforwardly or in a roundabout way influence biodiversity.

The alteration of the territory is related according to variation in pH and also the climate which thus makes unsettling influences the encompassing network. Cosmopolitan species are probably going to adjust according to the adjustment in pH and climate. On the other hand, indigenous species are influenced because of slight variety in the state of their environment which builds the danger of annihilation [9]-[10].

5. THE EFFECT ON AQUATIC ORGANISMS DUE TO MINING ACTIVITIES

Mining affects the amphibian climate in a total unexpected way. One of these includes immediate harming; which happens when toxins are bioavailable in the water or potentially openly portable in the silt. Toxins can genuinely influence sea-going creatures. Models remembering high groupings of suspended residue for a stream will in general restrict entrance of light due to which algal biomass is lessened. Biomass is limited because of metal oxide bath through covering green development or substrate of theirs, in like manner hindering colonisation. Likewise, temperature, precipitation, pH, saltiness, metal fixations in a flow could over the lengthy haul influence oceanic networks. Change in pH or climate influence dissolubility of metal which makes it even more bioavailable so that living beings can take it. It is important that metal impurities persevere in the environment for quite a while as long as 90 years after pyrite mine conclusion. Mine wastes cause trouble in algal networks prompting diminished essential efficiency. Both physical and compound changes in sea-going conditions will in general influence diatoms populaces [11]-[12].

6. POLLUTION IN FRESHWATER SURROUNDINGS DUE TO MINING ACTIVITIES

The poisons delivered while performing mining exercises happen to be natural and inorganic. Natural contaminations are isolated in the direction of two divisions against extremity namely hydrophilic and hydrophobic natural poisons. The polar natural impurity which can be dissolvable with water can be considered hydrophilic contamination, on the other hand non-polar including insoluble natural pollutant is known as hydrophobic natural foreign substance. Hydrophilic impurities are natural toxins that don't promptly influence freshwater environment attributable toward this non-industriousness value and capacity of breaking up into the water, regular illustration to hydrophilic foreign substance incorporates natural contaminations with moderately little alkyl gathering, for example, liquor and carboxylic acids (CH3, C2H5, C3H7 and C4H5). Another significant model is named methyl tertiary butyl ether (MTBE). Hydrophobic toxins are the most troubling natural impurities because of their diligence's tendency and failure to break down in water, illustration of these poisons incorporates dichloro-diphenyl-trichloroethane (DDT), polychlorinated bi-phenyls (PCBs), poly-brominated diphenyl ethers (PBDEs), polychlorinated di-benzodioxins (PCDDs), polychlorinated di-benzofurans (PCDFs), poly-sweet-smelling hydro-carbons (PAHs), benzene toluene, ethylbenzene and xylene (BTEX). Inorganic toxins incorporate substantial metals, phosphorus mixes, nitrogen mixes, halide mixes, sulphide mixes, and so on [13]-[14].

Hefty metals can be considered as utmost tenacious inorganic impurities because they have non-biodegradable limit. By and by, these components may be found in a low focus in the climate yet they
will in general be hindering amphibian greenery because of their capacity to bioaccumulate along the evolved way of life. The compounds which have phosphorous and nitrogen are likewise troubling to climate because of their commitment to eutrophication that prompts developments of unsafe green growth. Destructive microalgae can be hazardous to new water living space because of the development of green growth sprouts. Microalgae blossoms change in shading from green, yellow or earthy coloured tone contingent upon the types of miniature green growth included. This sprout is caused because of unnecessary use of supplements by hurtful miniature green growth especially in sluggish water bodies, for example, lakes and lakes.

These sprouts created through freshwater microalgae are incredibly poisonous for freshwater biota since sprouts will in general hinder the fishes’ gills and further freshwater macro-invertebrate also exhausts the accessible broke down the oxygen present into the freshwater natural surroundings prompting the demise of beings living in freshwater. Blossoms can likewise make a biological system to be impractical in light of the fact that they will in general be toxic to the more modest fishes plus all the channel feeder living beings which feeds on aquatic living beings. This poisonousness penetrates the food web coming about through passing of full scale plants in natural water conditions. [15]-[16].

Destructive microalgae can likewise influence sea-going profitability since they keep daylight energy from infiltrating profound through alternative freshwater belts prompting decrease of variety of living beings in freshwater territory.

The counteraction of daylight by unsafe miniature green growth can be founded on staining of freshwater territory through destructive microalgae or because of arrangement of broad layer on outside of freshwater by freshwater microalgae. Unsafe microalgae blossom likewise influences the versatility of freshwater fauna, for example, coral and can likewise influence other freshwater greenery from approaching daylight for photosynthesis since they lowered this freshwater verdure and furthermore fill in as a shade, consequently keeping daylight energy from arriving at the life forms. Hurtful microalgae can create mycotoxins that affect freshwater ecology especially fishes along with other miniature plus large scale spineless creatures.

7. ESTABLISHMENT AND ARRANGEMENT OF NATURAL FRESHWATER MICROALGAE BIOFILM

Freshwater microalgae are those microbes which are adjusted with a freshwater climate. These microalgae are known to be unicellular and free living beings whose size ranges from about 4-178 micrometer. Microalgae can use CO₂, water and light to perform photosynthesis so that they get the energy needed for metabolic exercises. Development of microalgae likewise relies upon significant supplements, for example, nitrogen and phosphorus. Normal freshwater microalgae biofilms are shaped from connection between free-skimming microalgae to natural substrate. The underlying new water microalgae which structures biofilm can connect with the substrate from outset with assistance of powerless Van der Walls power of fascination and hydrophilic impact prior to join forever to expanding thickness of the freshwater microalgae. The cycle of biofilm development with the aid of freshwater microalgae conceivably isolated in five phases. These phases incorporate starting connection, lasting connection, beginning development, perpetual development and scattering [17].

The phases of regular freshwater biofilm spoke to in Figure 3 portray that during the underlying and perpetual connection arranges, the EPS was not shaped because of the perceivability of the substrate, however the quantity on the substrate of freshwater microalgae during the underlying connection phase is less as compared to the lasting connection stage. The EPS was shaped during the underlying development, lasting development and scattering stage, regardless of the broadness of the characteristic freshwater biofilm of perpetual development and scattering phases is broader when
compared to underlying development phase. The reason behind greater biomass of the freshwater microalgae were found during the development and scattering stages when contrasted with the connection stage is inferable from the way that when in connection phase, small amount of freshwater microalgae couldn’t secure with substrate rather it appended to the EPS during the development and scattering stages. The scattering phase is last phase of freshwater biofilm microalgae arrangement. It is the phase where freshwater microalgae biofilm sets up and might go through structural and size adjustments. Proteins, for example, dispersin B assume a significant part for diffusion of freshwater microalgae biofilm in light of the fact that they can debase the EPS. These freshwater biofilms get typically discovered normally upon strong substrates lowered with amphibian conditions, despite the fact that they can here and there shape a drifting mat on the surfaces of sea-going living space. Microalgae biofilm regularly develops to a plainly visible level however will in general contain different sorts of microorganisms incorporating microbes, protozoa, archaea and growths alongside every gathering of living being assuming some specific metabolic job [18].

Figure 3. Biofilm formation process:

primary attachment
lasting attachment
primary maturation
lasting maturation
dispersion.

8. NUTRIENT AVAILABILITY

For development of biofilm normally, new water microalgae used the supplements that are available in amphibian climate, for example, nitrate. Despite the fact that, during the early development phase of freshwater microalgae, the phones are metabolically dynamic and will in general use a greater number of supplements as compared to late development phase where it is metabolically little dynamic. This guideline will in general be inconsequential for normal freshwater biofilm development in light of the fact that during the development phase, the biological film isn't yet stabilised dependent on less thickness and also nonattendance of EPS, along these lines spending lesser measure of supplements contrasted with later development phase where the microalgae becomes completely developed, which settles serenely to the natural substrate because it has higher thickness. The arrangement of EPS additionally adds to the high convenience of supplements on the grounds that the EPS helps the connection of other non-microalgae life forms which likewise need supplements to endure. Studies have indicated that raised supplements focus in amphibian conditions will in general advance EPS creation while supplement starvation prompts the corruption of EPS bringing about the unit of the contributing creature in the biofilm arrangement. The reason behind denial of biomass of microalgae to utilise in creation of lipid is due to huge measure of supplements spent by the microalgae biofilm in
later phase during development. On the other hand, it also braces the inspiration that sea-going bodies consisting of microalgae biofilm don’t allow green growth sprouts.

9. EXTRACELLULAR MATRIX (EPS) OF MICROALGAE BIOFILM

To give biochemical and underlying scaffoldings which build the freshwater biofilm, EPS grid is used. It is a 3-D organisation comprising various acids. The section of this EPS in biofilm affiliation is used for encasing the phones, also furthermore help during interchanges, biological signs and quality trade. The EPS additionally assumes a function in the outer processing of toxins on the grounds that the lattice traps extracellular compounds and keeps them in closeness to the member cells.

Freshwater microalgae with biofilm affiliation will probably have various attributes for free-gliding microalgae because there is some connection happening mutually with the microalgae and creatures inside film’s thick and ensured climatic conditions. Motivation behind why the microalgae is profoundly impervious when we talk about cleansers or antitoxins is on grounds that the thick extracellular framework and the external layer of cells secure the inside of the network [19].

10. FUNCTION OF NATURAL FRESHWATER MICROALGAE BIOFILM IN DEGRADATION OF MINING WASTEWATER POLLUTANTS

Mining exercises result in creation of wastewater. This affects the freshwater flora. Due to characteristic rule during the creation of this microalgae biofilm, some dangers exist and then this new water microalgae film is used to treat mining wastewater. This assists in limiting that danger, and it makes it effectively open and financially savvy.

The instruments associated with poison corruption by microalgae biofilm are a characteristic cycle including biosorption and connection. Since a large number of microalgae cells are associated with microalgae biofilm development, these biofilms can biodegrade or biotransform contaminations coming about because of mining exercises by one or the other debasement or amassing. The capacity of microalgae biofilm to bring about the corruption in poisons that exist with mining wastewater can be because of the protein exercises created by the individual microalgae cells in the biofilm or because of the expanded degree of responsive oxygen species (ROS) delivered because of the high measure of microalgae cells shaping the biofilm.

Numerous examinations have indicated that freshwater microalgae biofilm can create responsive oxygen species (ROS) which is equipped for oxidising steady natural compound, consequently achieving the debasement of these mixes into CO2, CO32– and H2O with the items being used by the freshwater microalgae for biomass creation. Studies show that freshwater microalgae biofilm can create ROS of high focus, which is equipped for corrupting determined natural mixes, for example, tetra-chlorobenzene, alkyl halides, trichlorobenzene or some substantial natural mixes, for example, PCBs. These examinations additionally uncover a fact which says the ROS created by this microalgae could be equipped for debasing toxins that contain sulphur in light of the possibility of ROS to desulfurize thio carbonyl mixes, for example, thiouacil, thioamides and thioureas to carbonyl mixes.

Freshwater microalgae have cell association like microbes yet are distinctive about their capacity in carrying out the process of photosynthesis. This ability of freshwater microalgae that can carry out photosynthesis can be critical for existence on land and water on the grounds that during the photosynthetic cycle, they are destined to debilitate the ozone harming substances especially CO2 created during mining exercises prompting the creation and arrival of more oxygen.

Microalgae biofilm can eliminate inorganic sub-positions, for example, phosphorus, alkali and nitrogen exacerbates existing within freshwater natural surroundings through biomass creation with
the help of these materials, subsequently keeping the material from amassing to some harmful stage within living space of freshwater. Freshwater microalgalgae are likewise ready to oxidise or decrease poisonous metals in freshwater conditions, accordingly forestalling the poisonousness to freshwater biota. This is likewise conceivable through the creation and arrival of ROS by freshwater microalgalgae which oxidises these harmful metals and turn them into operable components. Investigations of marine climate demonstrate that ROS created through marine microalgalgae would be equipped for expanding the measure of iron which would exist in climate through a little decrease of ferric mixes [20].

11. CONCLUSION AND FUTURE DIRECTION

Mining exercises adversely change oceanic as well as earthly environments hugely. The water created will in general influence the flora and fauna of getting surface water and furthermore represent some basic danger for general wellbeing of earthbound living beings. The perpetual high quality mining exercises in non-industrial nations are troubling because of the danger related with it. Most high quality mining is completed without natural effect appraisal (EIA), and accordingly, the destiny of the ecological contaminations created during mining exercises isn't thought of. These informal mining exercises are the reasoning behind lead harming in three neighbourhood government zones in Nigeria in March 2010.

Microalgalgae biofilm is also utilised like an instrument in refurbishing of water contamination coming about because of mining exercises. This is on the grounds that microalgalgae biofilm can happen normally in sea-going conditions, and hence its utilisation with respect to field conditions can never be a troublesome undertaking. Improvement shown by natural factors, for example, light and supplements should help in development of microalgalgae biofilm. Microalgalgae biofilm will in general forestall the events of green growth sprouts which is the serious danger to the freshwater climate. The reproductions of natural elements can likewise motivate this microalgalgae biofilm to deliver a greater measure of receptive oxygen species (ROS) which may control the development of microorganisms, in this manner limiting the deficiency of broken down oxygen.

Despite the fact that, microalgalgae biofilm eliminates poisons present in water resulting from mining wastewater by corruption and biosorption. Still, further exploration is needed for explaining whether the proteins delivered through microalgalgae biofilm in the course of the corruption cycle are the sole commitment of the whole cells participating in biofilm or that of the extracellular lattice. Additionally, part of EPS in cycle of biosorption of substantial metal expulsion from water resulting from mining needs to be investigated and also get clarified about its evacuation instrument. It is likewise imperative to extensively comprehend the motor model which clarifies the synthetic and actual responses of hefty metal assimilation from outside of this microalgalgae biofilm.

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