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Biopurification of Mine Wastewater through Aquatic Plants– A Review

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***Abstract*— Bio-purification of wastewater through aquatic plants is an advanced technology of wastewater purification. Aquatic plants can be used for tertiary treatment of wastewater due to its capacity to assimilate nutrients. This invention uses a cheap and efficient, ecologically safe detoxification of industrial and coal mine wastewater and production of biomass. The advantages of this invention result with no pollution of hazardous substances and cost benefits. This paper briefly highlights on the role of aquatic plants for the purification of mine waste water.**

***Index Terms*— Coal Mining, Algae, Aquatic flora, Bio-purification, waste water treatment, Mine waste water.**

I. INTRODUCTION

The waste water can be formed by a variety of activities, including washing, bathing, mining, industrial activities and using the toilet e.t.c. The use of algae for treatment of water (as algae scrubber) was reported firstly by Dr. Walter Adey,1970s [1].

Vertiver grass was first recognized early in the 1990s for having"super absorbent" characteristics suitable for the treatment of wastewater and leachate generated from landfill in Queensland (Truong and Stone, 1996) [2].

The Bio-purification of waste water through algae is a new idea, and several techniques for exploiting the aquatic plant's fast growth and nutrient, removal capacity [3]. Algae are plants that have adapted to living in aquatic environments (saltwater or freshwater). They are also referred to as *hydrophytes or macrophytes*. These plants require special adaptations for living submerged in water, or at the water's surface [4,5,6].

Chemical properties of *Water Hyacinth* in compost is to add nutrients to soil and removing pollutants[7]. Water hyacinth (*Eichhornia crassipes*) treatment systems are generally known in tropical areas. The system with water hyacinth can operate at higher loading rates. Their end-use products can be utilized for mulch and organic fertilizer. Dry water hyacinth petioles can be woven into baskets and purse (Polprasert, 1996)[8].

Algal cells have the potential to rapidly accumulate lipids such as *triglycerides*,That contain fatty acids important for high value fatty acids and/or biodiesel production [9]. Some algae species have high oil/lipid content (upto 60% by weight) and can produce upto 15,000 gallons of oils per acre per year (due to their fast growth cycle) under optimum conditions.

Algal species can improve the quality of mine water by reduction in pH, Temperature, Nitrate, Iron, Chloride, Fluoride, Total Hardness, Sulphate, Calcium and Manganese [9].

The Esk Shire Council has recently installed a *Vetiver Grass* System to treat sewerage effluent at Toogoolawah in South East Queensland [2].

The aquatic plants like *Hydrilla* release the oxygen while carrying out the photosynthesis which ensures a continuous supply of oxygen for biodegradation.

Algae is good indicator of pollution because they have wide temporal and spittle distribution, respond quickly to the change in environment due to pollution. Some algae shows the types of pollution [10], such as many blue green algae occur in nutrient less water, while some grows organically polluted water [11].

Algae support aerobic bacterial oxidation of organic matter producing oxygen through photosynthesis while release carbon-dioxide and nutrients in aerobic oxidation used for growth of algal biomass [12].Algae have a solution to emerging environment problems, they removes excess wastes efficiently at minimal cost [13]

II. BIOPURIFICATION OF WASTE WATER THROUGH AQUATIC PLANTS

Bio-purification of waste water through aquatic plant helps not only in waste water treatment but also in cultivation. Carbonate, chloride, Phosphorous removal rate are commonly considered for waste water treatment, which allows the growth of aquatic flora as well as waste water treatment.

Process of waste water treatment through aquatic plants:

1. Algae- This bio-purification of waste water in waste stabilization pond. This is green treatment achieved by the growth of algae and heterotrophic bacteria. The algae is a product of photosynthesis in which oxygen is used by the bacteria as they aerobically oxidized the organic compound in the waste water and the end product of this bio oxidation is carbon–dioxide, which is fixed into cell carbon by the algae during photosynthesis.
2. VETIVER SYSTEM is based on the use of vetiver grass *(Vetiveria zizanioides L.)*, which was first recognized early in the 1990s for having a "super absorbent"

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characteristics suitable for the treatment of wastewater and leachate generated from landfill in Queensland (Truong and Stone, 1996)[2].

3. Hydrilla *(Hydrilla verticillata)* is a submerged perennial plant which is used as mulch, animal feed and aquarium decoration (Polprasert, 1996). It tolerates a wide range of water conditions and can grow at a lower light intensity. Some research reported that hydrilla and the other submerged plants play a major role [8].
4. Water-Hyacinth : The root of water hyacinth (*Eichhornia crassipes)* naturally absorb including lead, mercury, and strontium-90, as well as some organic compounds believed to be carcinogenic, in concentrations 10,000 times that in the surrounding water[14].

III. ECONOMICS

Bio-purification of waste water through algae is low cost method and environment friendly, this method removes heavy metal and toxic substance [15]. Many algae can be taken up and accumulate many radioactive minerals in their cells even from greater concentration in their water [16]. Different algal species purify water, it is worth to emphasize that algal technology in primary, secondary and tertiary stages [17].Algae has an important role in self- purification of organic pollution in natural waters [18]. Algae remove nutrient, heavy metal, pesticides, organic and inorganic toxic substances from water by accumulating their cells [19,20] and algae may be used successful for waste water treatment as a result of their bioaccumulation abilities.

Water hyacinth (*Eichhornia crassipes*) – An efficient and economic adsorbent for textile effluent treatment [21].

The ability of *Vetiver Grass* to act as a primary purifier of waste water an answer to low cost sanitation and fresh water pollution.[22].

The economic benefits accruing from Lake Istokpoga to various economic sectors in the Highlands County area when the incidence of invasive aquatic weeds, especially hydrilla is kept at a minimum.[23].

IV. IV. ENVIROMENTAL BENEFITS

Pollution of the atmosphere with hazardous substance like ammonium, carbon-dioxide and orthophosphate as main nutrient source of algae [24**]. Grobbelaar et al**. reported that to oxygen releases 1.9gO2/1g of algal biomass [25]. Algae using nitrogen and phosphorous in growth may remove the nutrient load of waste water frown a few hours to a few day [26]. In comparison to common treatment system oxidation pond increase dissolved oxygen and pH concentration because algae remove phosphorous, sedimentation, ammonium, hydrogen, sulphur, high pH in algal waste water purification leads to pathogen disinfection [27]. Some species of algae have capacity to remove heavy metal i.e. chrome by Oscillatoria [28,29], cadmium, copper and zinc by *chlorella vulgaris* lead by *chlamydomnas* and *molybdenium* by *scendsmus chlorelloids* may remove successfully [30,31,32].Algae has adapting ability to sub-lethal concentration; accumulation of heavy metals in cells may be potentially toxic effect to the other circles of food web [33].

Five algal species are selected which are good bio-indicators of pollutant in river in England, Stigeoclonium tenue is present at the down strem margin of the heavily part of river, Nitzschia palea and Gamphonema parvulum always appear to be dominant in the mild pollution zone whilest cocconeis and chamesiphon reported to occurs in unpolluted part of the stream or repurified zone [34]. Navicula accomda is good indicator of organic pollution, the same species Gamophema [35], which is commonly found in highly polluted water. Amphora ovalis and Gyrosigma attenuatum are also introduced as good example of diatoms affected by high organic content of water [36].

The application, treatment of wastewater through hydrilla, of this may offer enormous public health, environmental and cost benefits [37].

Application of the Vetiver Grass Technology (VGT) for wastewater treatment is a new and innovative nutrient removal technology and it is a green and environmentally friendly wastewater treatment technology as well as a natural recycling method.[38]

Application of the water hyacinth waste water treatment and clean-up of polluted environment [39].

V. FUTURE SCOPE

In upcoming future, waste water purification through aquatic plants costs less for the removal of heavy metal and toxicity. Purification from waste water through aquatic plants which prevent the pollution in comparison to varies chemical waste water purification.[21,22,23,37]. The purified water can be used in agricultural field which encourage the growth of crops. There are so many company use algal purified water for fermentation. Combining algae for waste water remediation with Biofuel production is an economically feasible process. The waste water treatment plants are an invaluable source of algal as a feedstock for a variety of purpose.

VI. CONSTRAINTS

In water algal species producing massive surface growth or blooms that in turn reduce water quality and affects its use. During bio-purification of wastes water through algae, pollutants are produced which are toxic to fish and also mankind and animal using polluted water. Algae can play significant part of food chain of aquatic life thus alters the number and kind. Algae observes more oxygen which decreases the oxygen amount in water, leading to disturbance in ecosystem of aquatic animals.

Water hyacinth and hydrilla has high transpiration rate due to which purified water collected will be less and less efficient[40].

Vertiver grass dies in summer having seasonal constrant.

VII. CONCLUSION

Bio-purification of waste water through aquatic plants are environmental friendly and sustainable. Waste water treatment through hydrilla, water hyacinth and vertiver grass are environmentally beneficial but each one has some ecological affect. They usually covers all the surface water which leads to not to grow aquatic animals, ex fish. Supply of oxygen reduces having same for sunlight.

We can use these plants for purification as advantage is more compare to drawback.

Bio-purification of waste water through aquatic plants which is applied to improve the quality of waste water removes solids substances, heavy metal and toxicity. In future,this process must be improved to extent to economical and environmental friendly which requires intensive research in future.

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