



# **New 4<sup>th</sup> Generation Technology for Control of Water Hyacinth In Rivers and Lakes By JS Water Energy Life Co**

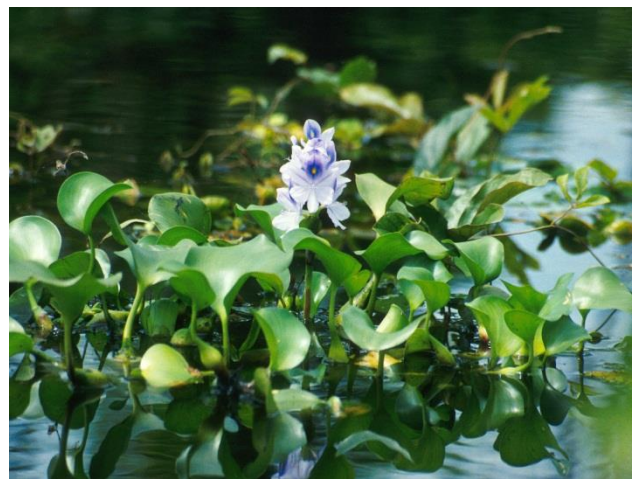
## **Introduction**

Water Hyacinths are ending up in many water ways largely due to eutrophication, reduction in water levels and release of phosphorous from the sediments into the water column caused by low levels of Dissolved Oxygen in such waterways.

The first response by waterway managers is to order physical removal of these water weeds. Soon after such removal, they return back to the waterway, sometimes with even more vengeance. Chemical control is currently allowed in some areas using special formulations like Glyphosate, etc. These bring temporary relief, but only after causing much stress to aquatic life. Biological control through weevils is also being employed in parts of the world. All these control methods target the symptoms (Water hyacinths) rather than the underlying cause (excess and imbalanced nutrients).



**Fig: 1 Water hyacinth Infestation**



**Fig: 2 Water hyacinth floating on the water**

## Water Hyacinth



**Fig: 3 Single water hyacinth plant**



**Fig: 4 Water hyacinth mat in bloom**

Water hyacinth is an aquatic plant which can live and reproduce floating freely on the surface of fresh waters or can be anchored in mud. Plant size ranges from a few inches to a meter in height. Its rate of proliferation under certain circumstances is extremely rapid and it can spread to cause infestations over large areas of water causing a variety of problems. It grows in mats up to 2 meters thick which can reduce light and oxygen, change water chemistry, affect flora and fauna and cause significant increase in water loss due to evapotranspiration. It also causes practical problems for marine transportation, fishing and at intakes for hydro power and irrigation schemes. It is now considered a serious threat to biodiversity. The plant originated in the Amazon Basin and was introduced into many parts of the world as an ornamental garden pond plant due to its beauty. It has proliferated in many areas and can now be found on all continents apart from Europe. It is particularly suited to tropical and subtropical climates and has become a problem plant.

## **Reasons for Proliferation**

Plant needs nutrients to grow, nutrients in particular phosphorus and nitrogen are important in understanding proliferation and production of water hyacinth. These nutrients are of particular importance because they can enhance water hyacinth biomass production when in short supply. The major factors for occurrence of water hyacinth in water bodies is nutrient enrichment, falling water levels and release of Phosphorous from the sediment into the water column due to low levels of Dissolved Oxygen.

Hydrological conditions play a key role in nutrient availability by transporting particulate and dissolved nutrients from the bottom to the surface of the water body and vice-versa. Nutrient load to the water body also depend on discharges to it from the catchments and atmosphere. When excess nutrients enter a water body, they stimulate growth of aquatic plants (algae and water hyacinth) leading to high biomass. These high biomass potentially lead to increased oxygen consumption and depletion in deep water. Oxygen deficiency leads to higher rates of denitrification in the water column and sediments and enhances release of N and P. So basically the aquatic plants growth in water body solely dependent on two factors: nutrients enrichment and waste discharge into it. In some cases atmospheric input of nitrogen as ammonium can promote an increase in water hyacinth.

## **Problem Statement**

Water hyacinth can cause a variety of problems when its rapid mat-like proliferation covers areas of fresh water. Some of the common problems are listed below:

- **Hindrance to water transport**

Access to harbors and docking areas can be seriously hindered by mats of water hyacinth. Canals and freshwater rivers can become impassable as they clog up with densely intertwined carpets of the weed.

- **Clogging of intakes of irrigation, hydropower and water supply systems**

Many large hydropower schemes are suffering from the effects of water hyacinth. The rapid reproduction rates of weeds and an increasing amount of time and money is being

invested in clearing it and to prevent it entering the turbine and causing damage and power interruptions. Water hyacinth is now a major problem in the dams also.

- **Blockage of canals, rivers, lakes etc. causing flooding**

Water hyacinth can grow so densely that a human being can walk on it. When it takes hold in water body, it can become so dense that it forms an herbivorous barrage and can cause damaging and dangerous flooding.

- **Micro-habitat for a variety of disease vectors**

The diseases associated with the presence of aquatic weeds in tropical developing countries are among those that cause the major public health problems: malaria, schistosomiasis and lymphatic filariasis. Some species of mosquito larvae thrive on the environment created by the presence of aquatic weeds, while the link between schistosomiasis (bilharzia) and aquatic weed presence is well known.

- **Increased evapotranspiration**

Various studies have been carried out to ascertain the relationship between aquatic plants and the rate of evapotranspiration compared with evaporation from an open-surfaced water body. The rate of water loss due to evapotranspiration can be as much as 1.8 times that of evaporation from the same surface but free of plants. This has great implications where water is already scarce.

- **Problems related to fishing**

Water hyacinth can present many problems for the fisherman. Access to sites becomes difficult when weed infestation is present, loss of fishing equipment often results when nets or lines become tangled in the root systems of the weed and the result of these problems is more often than not a reduction in catch and subsequent loss of livelihood. In areas where fishermen eke a meager living from their trade, this can present serious socio-economic problems. Fishermen of these areas complain that snakes become prevalent too.

- **Reduction of biodiversity**

Where water hyacinth is prolific, other aquatic plants have difficulty in surviving. This causes an imbalance in the aquatic micro-ecosystem and often means that a range of fauna that relies on a diversity of plant life for its existence will become extinct. Diversity

of fish stocks is often affected with some benefiting and others suffering from the proliferation of water hyacinth. This also results in water quality deterioration.

## **Conventional Solutions**

There are several popular control mechanisms for preventing the spread of, or eradication of, water hyacinth. The 3 main mechanisms used are biological, chemical and physical control. Each has its benefits and drawbacks. Chemical control is the least favored due the unknown long-term effects on the environment and the communities with which it comes into contact. Physical control, using mechanical mowers, dredgers or manual extraction methods, is used widely but is costly and cannot deal with very large infestations. It is not suitable for large infestations and is generally regarded as a short-term solution. Biological control is the most widely favored long-term control method, being relatively easy to use, and arguably providing the only economic and sustainable control.

### **Biological control**

Biological control is the use of host specific natural enemies to reduce the population density of a pest. Several insects and fungi have been identified as control agents for water hyacinth. These include a variety of weevils, moth and fungi. Biological control of water hyacinth is said to be environmentally benign as the control agents tend to be self-regulating. Control programs are usually inexpensive due to the fact that the control agents are known and only a small numbers of staff are required to run such programs. One major drawback is that it can take a long time to initiate such projects because it can take several years for the insect population to reach a population density sufficient to tackle the pest problem.

### **Chemical control**

The application of herbicides for controlling water hyacinth has been carried out for many years. The common herbicides are 2,4-d, Diquat and Glysophate. It has been found that there is a good success rate when dealing with small infestations but less success with larger areas. Application can be from the ground or from the air and requires skilled operators. As mentioned earlier the main concern when using herbicides is the environmental and health related effects, especially where people collect water for drinking and washing.

### **Physical control**

Mechanical removal of water hyacinth is seen as the best short-term solution to the proliferation of the plant. It is however costly, using either land-based 'clamshell' bucket cranes, draglines or booms or, alternatively, water based machinery such as mowers, dredges, barges or specially designed aquatic weed harvesters. Such methods are suitable for only relatively

small areas. Many of these techniques require the support of a fleet of water and land-based vehicles for transporting the large quantities of water hyacinth which is removed. Mats of water hyacinth can be enormous and can have a density of up to 200 tonnes per acre. Manual removal of water hyacinth is suitable only for extremely small areas. It is difficult, labour intensive work and in some areas there is serious health risks associated with the work. Transportation of the harvested weed is also costly, because it has such high water content. Chopping can reduce the volume and the water content. Besides these three mainstream forms of control, it is also suggested that method, namely the reduction of nutrient inputs to the water. Although strictly speaking this is a preventative method, it can be argued that a reduction in nutrients in the water body will result in a reduction in the proliferation of water hyacinth. In recent decades there has been a significant increase in the level of nutrients dumped into waterways from industrial and domestic sources as well as from land where fertilizers are used or where clearance has caused an increase in run-off.

### **New 4<sup>th</sup> Generation Bio Control Technology**

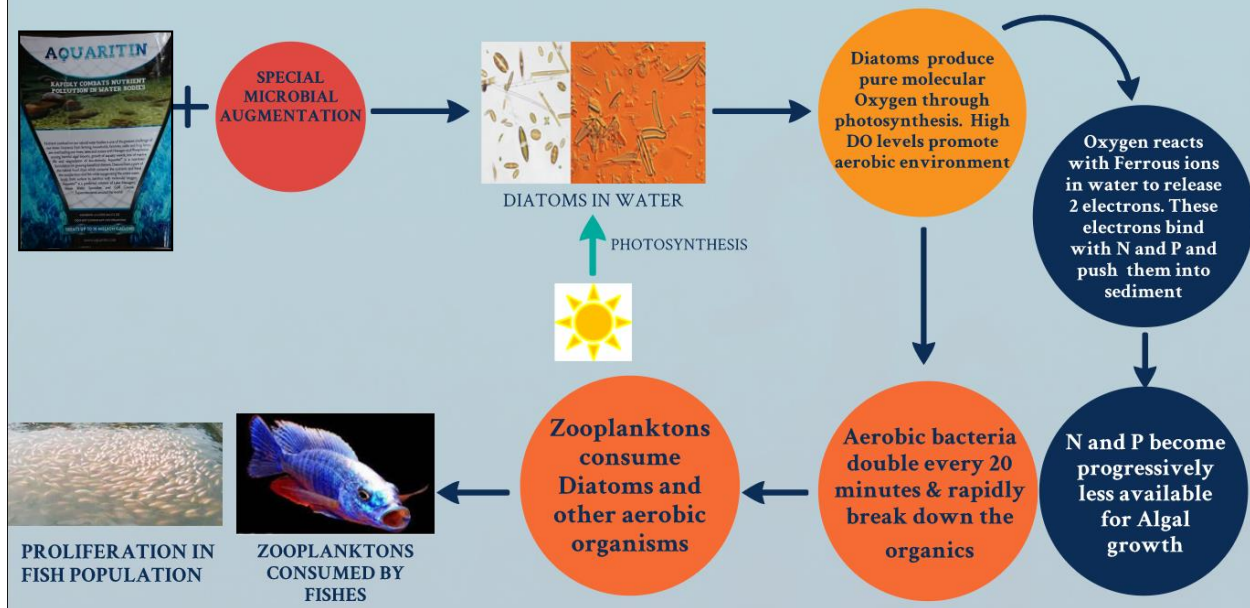
Maintaining water quality and stabilizing pollution parameters is one of the biggest concerns facing the waste water management industry. Existing technologies are not able to reduce the high concentration of nutrients. Due to this, plant growth increases in the water body dramatically and adds to sludge accumulation at the bottom, thereby affecting the aquatic ecosystem adversely.

Phyco nutrients are a consortium of inorganic nutrients that are targeted at the growth of the more evolved diatom algae that can consume excess nutrients and trigger the release of pure oxygen even in low light levels prevailing in water bodies infested with water hyacinths.

Upon dosing of phyco nutrient in polluted water-body, the Nano Silica base carries essential nutrients to Diatom Algae, which photo-synthesize consuming N, P, and CO<sub>2</sub>, along with the trace minerals supplied through Phyco Nutrient formulation. The waste from the photosynthesis is Oxygen which gets released into the water thereby rapidly reducing oxygen demand (BoD and CoD) within the water-body. A progressive reduction in excess water hyacinths, invasive weeds, Blue Green algae and other kinds of water vegetation is evident after dosing phyco nutrients in water over a length of time. Higher DO levels in water promote aerobic environment in water which is 20 times faster than anaerobic processes and it does not lead to generation of toxic gases like H<sub>2</sub>S and Methane. The aerobic bacteria degrade pollutants to the base constituents. The metabolic and photosynthetic activities of the diatoms help in the keeping the nutrients in the water body in balance and hence gradually eliminate the growth of water hyacinths.




# HOW DOES IT WORK?



## Benefits of the Technology

- Starving out of Water hyacinths throughout-competition by diatom algae.
- Limiting regrowth of water hyacinths.
- Increase of DO levels limiting release of P from sediment
- Molecular oxygen produced by Diatoms accelerates degradation of organic waste at bottom.
- Reduction in BoD levels.
- Reduction in Fecal Coliform levels and Pathogens.
- Reduction in amount of sludge at the bottom.
- Mitigation and Elimination of foul odor.
- Increase in the clarity of the water.
- Due to the release of pure Oxygen and the Diatoms acting as a major carbon sink, because of their highly efficient autotrophism, will improve the environment around the drains and the river.

## Method of Execution

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- A small part of the lake is taken up . This section is segregated by rope and water hyacinths are pushed/removed physically.

- The section is dosed intensively with phyco nutrients and bioaugmentation material for about 14 days. This area will have reduced nutrient levels.

- The section will now be expanded through in sections to other parts of the lake and simialr intensive treatment is followed.Physical removal of water hyacinths will be carried out simultaneously.

- Water quality tests will be conducted in order to procure the results of the changes occured as a result of phyco-nutrient dosing.

- Further plan of action will be decided and the dosing of the entire lake will be carried out accordingly.



# Effect of Phyco-Remediation



Lake covered with Water Hyacinth



Boats used for physical removal of water hyacinths and for dosing.



Significant improvement in water quality and clarity after initial phase.



Lesser water hyacinths after initial dosing with phyco nutrients.

## How does Phyco nutrients work on sludge and sediments?

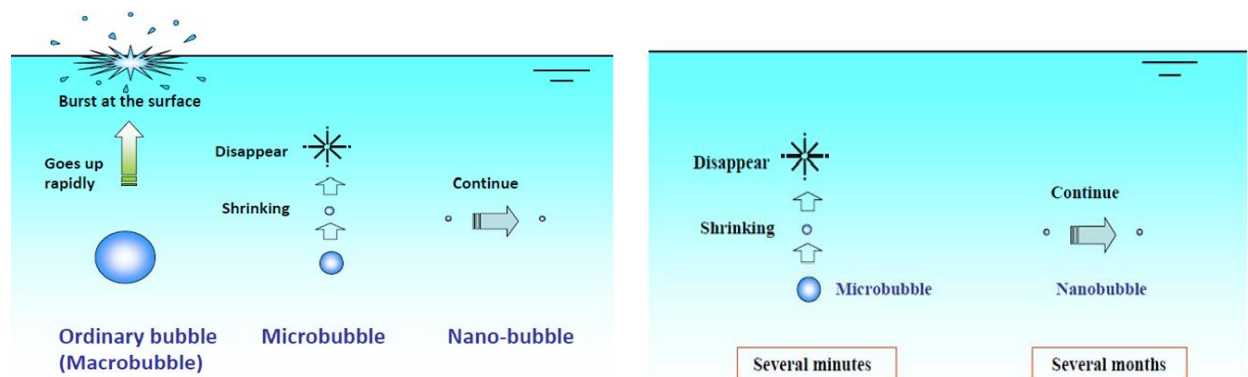
The kind of waste that is being dumped in the water body is basis for its behavior. Over time, the waste settles down on the bed of the water body leading to formation of sludge. The sludge binds with other waste material and as more of these wastes are discharged into the water, the sludge bed keeps getting thicker. This makes the water body shallow and prone to flooding. The sludge also traps nutrients prohibiting the diatoms to grow and multiply and these nutrients act beneficial to the growth of water weeds and water hyacinths.

The demand thus arises for a technology that performs dredging of sludge and releases the trapped nutrients for the diatoms hence starving the water weeds and hyacinths.

Phyco Remediation provides a solution to this problem:

After subsequent dosing, our product Aquaritin along with special microbial augmentation enables the diatoms in the benthos layer to multiply rapidly. Diatoms produce a large amount of oxygen at the molecular level (Nano bubbles of oxygen) infused into the sludge bed, hence breaking and degrading the sludge. The mass of sludge reduces due to the action of oxygen at molecular levels and it gets bio-dredged and digested. Hence, on using Phyco nutrients to remediate sludge in a polluted water body, specifically where amount of organic waste is higher, need of mechanical dredging is totally eliminated.

As diatoms produce oxygen in the form of nano-bubbles, and not as coarse bubbles as in the case of many aerators , it delivers many advantages associated with nano-bubbles. Nano bubbles can pervade microscopic spaces in the organic pollutants and aerate them from within. Nano bubbles may remain suspended in water for months which is important for increase in Dissolved oxygen in water bodies.



**Fig: 5 Production of nano-bubbles in water body using Phyco nutrients**

## **Conclusion**

High concentration of nutrients in the water body gives rise to growth of water hyacinths. Water hyacinths cover the entire water body bed and inhibit light to enter into the lake; water hyacinths also trap nutrients and make them unavailable for other aquatic animals. The death and decay of hyacinths also adds to the sludge in the lake bottom, further increasing the problem points in the lake.

On physical removal of water hyacinths and subsequent dosing of phyco-nutrients, the hyacinths are removed and kept off from growing back. The sludge along with various problem points for other aquatic fauna to prosper are checked up on and improved. The water quality is improved drastically. Fish like grass carp is released into the lake when DO levels exceed 3 mg/l. These fish also keep the vegetative growth under control.

In flowing rivers, a modified procedure is followed.

It typically takes 3 to 12 months to starve out and physically remove the excess water hyacinths weeds for the lake and rivers depending upon the concentration and wastewater inflow .

In sum, it can be said that a balance between vegetative and aquatic growth can be brought with this technology in an efficient way.

## **Costing**

Costing can be made available on request.

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