Demonstration of the Effectiveness of Water Hyacinth (*Eichhornia Crassipes*) in the Pond Waste Water Purification of Moscow City Treatment Facilities

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Abstract: In this article we tried to demonstrate the effectiveness of water hyacinth (*Eichhornia crassipes*) in the pond wastewater purification of Moscow city treatment facilities. Nowadays the number of various reservoirs and rivers where the quality of water is estimated as unsatisfactory is catastrophically increasing. The greatest harm to the various sort of rivers and reservoirs bring drains as they get wastes of manufactures that causes pollution of rivers and reservoirs. Because of that reason, it is necessary to find out new technologies of clarification of water, as in the near future there will be problem with drinking water. Water hyacinth plant is one of the most effective method for solving of this problem.

Application of water hyacinth allows to clarify, drains and reservoirs from organic and bacteriological pollution and also provides natural creation of very attractive landscape. The method provides not only a purification of biogenic waste, but also the possibility of using it as water after irrigation, and for other industrial purposes. The amount of products of petroleum, industrial oils, manure, phenol, sulfates, phosphates, synthetic surfactants, mineral salts, pathogens respectively decreased in pond wastewater after adding of water hyacinth plants (*Eichhornia crassipes*) in a week. Sewage water clarification by water hyacinth plants is cheaper. On the other hand water hyacinth is an invasive plant so this method should be used in ponds under control.

Keywords: Water Hyacinth, *Eichhornia Crassipes*, Sewage Water Treatment, Water Purification

1. Introduction

Water hyacinth *Eichhornia crassipes* is very effective herbaceous perennial, floating plant which consists of a shortened stem with a rosette of oval leaves. Petioles are bubble-inflated. *Eichhornia crassipes*, a free-floating vascular plant that cause big ecological and socio-economic changes in an ecosystem (Center T.D, 1994). The plant is widely distributed in freshwater ponds and ditches in tropical and subtropical regions of the Americas and Asia. Unusually high biological productivity of the Eichhornia plant does not only satisfy the appetites of the ancient rulers of the Earth, but also in a long time the future inhabitants of the planet has cooled few natural sources of energy - oil and gas. It is an invasive plant. Most of the problems associated with Water hyacinths are due to its rapid growth rate, its ability to successfully compete with other aquatic plants, and its ease of propagation (Trinidad et al., 2008).

Eichhornia crassipes occupied freshwater systems in more than 50 countries and, according to recent climate change models, its distribution may expand into higher latitudes as temperatures rise (Rodrı´guez-Gallego et al., 2004; Hellmann, 2008; Rahel & Olden, 2008).

2. Actuality

Eichhornia - plant family Pontederiaceae; homeland of this plant is water reservoirs of tropical and subtropical regions of South America. When injected into the body of water the plant begins to grow, so that their numbers will grow in geometric progression (3-4 months every bush can produce up to 200 of their own kind). Capacity for rapid reproduction in the warm period of time (water temperature over 18 C), accumulation of nutrients through the root system development, as well as intolerance of cold (cessation of reproduction at a water temperature of less than +12 C) served as a prerequisite for the successful application of this plant for purification of waste water livestock complexes. However, no one has yet studied the effectiveness of this method for purification of storm water. Untreated rainwater contains a huge amount of polluted chemical, including heavy metals. Reduce chemical pollution is a priority facing modern science and residents of the city.

Moscow River is not only the main water supply of Moscow. In the river rain waters converted to wastewater by ecologic or natural processes. There are 27 of city treatment facilities to clarify of storm water, waste water and sewage water in Moscow. In addition, runoff flows into the river and through the outlets are not equipped with sewage treatment plants. The main volume of crude surface runoff flows through 41 large culvert ("Water Hyacinth", 2005).

There are many publications about Water hyacinth which show that it absorbs heavy metals (Tiwari, 2007), organic contaminants (Aoi & Hayashi, 1996; Zimmels, 2007) and nutrients from the water sources (Aoi & Hayashi, 1996). In California, researchers informed that water hyacinth leaf tissue has the same mercury concentration as the sediment beneath, suggesting that plant harvesting could help mediate mercury contamination if disposed of properly (Greenfield et al., 2006). Absorption capacity of Water hyacinth makes it a potential biological alternative to secondary and tertiary treatment for wastewater (Ho & Wong, 1994; Cossu, 2001)

In sewage systems, the root structures of water hyacinth (and other aquatic plants) provide a suitable environment for aerobic bacteria to function. Aerobic bacteria nourishes on nutrients and produce inorganic compounds that convert it food for the plants (Practical action: Technical Information Online Water Hyacinth 2011).

Water hyacinth grows quickly and can be harvested to supply rich and valuable compost. Water hyacinth has also been used for the removal or decrease of nutrients, heavy metals, organic compounds and pathogens from water (Gopal, 1987).

Removing of heavy metals by traditional methods are expensive and may produce dangerous products. Phytoremediation is one of the alternative cheaper method that can be applied for soil and water decontamination (Gratao et al., 2005; Rahman & Hasegawa, 2011) *Eichhornia crassipes* demonstrated a hyper-accumulation capacity for chromium (Faisal & Hasnain, 2003), cadmium (Oliveria et al., 2001) and arsenic (Dhankher, 2002; Pereira et al., 2011).

The closest analogue of the claimed technical solution is a method of growing Eichhornia at hydro botanical advanced treatment of polluted water, including the preparation for the application of

Eichhornia as feed nutrient solution (Лялин, 2002).

3. Dynamics of Water Purification Using Eichhornia

One of the main indicators of this technology is the dynamics of treatment. It is the ability of plants to adapt certain conditions (temperature of water and air, light, day length, the concentration of ingredients) at a certain speed at a certain number of plant extract ingredients from various waste per unit of time: an hour, a day, a week, ten days, a month. Dynamics of cleaning depends primarily on the activity of the growing process in plants with their extraordinary ability to transpiration, which plays a major role in maintaining the redox processes in the plant root system. Dynamics cleaning (post-treatment) drains via Eichhornia determined periodic surveys coming in and out of the body of water it sinks per unit time. Frequency of analyzes of treated effluent determined by the stability of the following indicators: water and air temperature, the volume of incoming effluent concentrations of the ingredients and calendar time sampling.

When transplanting plants dynamics cleaning is divided into two periods. During the adaptation period, a comparative analysis is performed on the third day of landing on a daily basis to determine the exact time of the end of the adaptation period. After this, the analysis is repeated in seven days. In the case of sudden changes of parameters, the analysis is repeated. According to the results of the comparative analysis of laboratory waste, knowing the density of established plants, the volume of effluent passing and the concentration of the ingredients get your daily, weekly, etc. the trend of cleaning.With the help of comparative analyzes wastewater before and after treatment, it is time to determine the optimal filling of the reservoir area of plants capable of passing through them till required level clarification. The method provides not only a purification of biogenic waste, but also the possibility of using it as water after irrigation, and for other industrial purposes. Actively retrieved nitrogen, phosphorus, and their compounds, are destroyed phenol oil.

4. Material Method

The problem of sewage treatment of industrial and agricultural companies, domestic wastewater small towns and cultural and recreational areas is very important. Traditionally used treatment technologies of municipal, industrial and livestock waste provides mechanical separation of polluted water and artificial biological treatment of the liquid fraction (Rizhenko & Esentuki, 2001). Water hyacinth regulates water quality not only due to the filtration properties, but also the ability to absorb nutrients. Eichhornia's ability to save, utilization and transformation of many substances make them indispensable in the overall process of self-purification of water bodies. In Summer- Fall seasons of 2007, we carried out research on the effectiveness of water purification water hyacinth. Studies were carried out in the southwest region of Moscow. Our studies were based on the following steps:

1. The study of the scientific literature and internet resources.
2. Adding water hyacinth plants in selected ponds (figure 1&2).
3. Carrying out chemical experiments and analysis in the university laboratories before and after adding water hyacinth plants (figure 3&4).

Figure 1&2: Adding of water hyacinth plants into selected ponds

Figure 3: Pond`s situation before adding water hyacinth

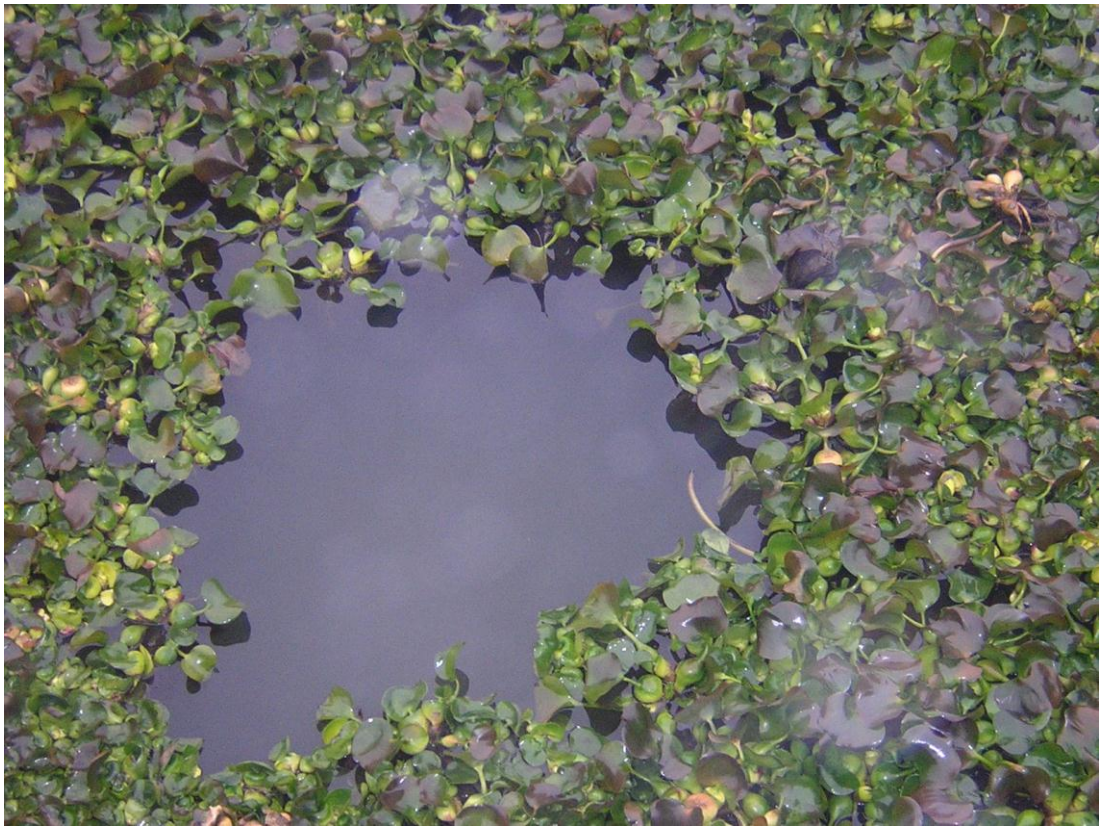

Figure 4: Pond`s situation after adding water hyacinth

5. Results

The results of studies conducted in October, according to the efficiency of waste water treatment water hyacinth (Eichhornia).

Table 1: Result of studies after clarification by hyacinth (figure 4)

Index	before clarification	after clarification by hyacinth
Alkalinity, mg/l	2,4	2,0
Rigidity, mg/l	1,6	1,0
Chlorides, mg/l	37,9	14,5
Sulfates, mg/l	98,0	42,1
Phosphates, mg/l	1,4	0,3
Nitrates, mg/l	6.2	0,25
Ammonia nitrogen, mg/l	0,94	6,9
Dry remains, mg/l	430,5	105,4
total number of microbes	0,410	2,310
Coli-index	1563	420

Table 2: Results of analyzes of potable water and industrial water after cleaning Eichhornia

Ingredients	potable water drains		industrial water drains	
	First day	After 7 days of treatment	First day	After 7 days of treatment
Suspended substances, mg/l	298	17,2	91,7	15,2
COD mgO_2/ l	533	109,8	384	110
BOD mgO_2/ l	120	35,6	85,7	16,4
NH_4, mg/l	40,7	3,3	1,2	-
Phosphates mg/l	5,7	0,4	1,4	0,05
Iron, mg/l	3,0	1,3	3,0	0,82
Alkali, mg/l	8,0	4,8	-	-
Detergents, mg/l	1,36	0,25	-	-
Sulfides, mg/l	7,5	-	-	-
Oil products, mg/l	2,6	-	-	-
Phenols, mg/l	85,0	-	-	-

COD: Chemical Oxygen Demand

BOD: Biological Oxygen Demand

According to Table 1 and Table 2 we can conclude the following statements:

- The amount of industrial wastes, chemicals and biological pathogens were respectively absorbed by the roots of water hyacinth plants in ponds.
- Purified water by Eichhornia and other process in bioponds can be sent to natural reservoirs or supplied to factory for a variety of industrial purposes, and sanitary indicators
- Practice of exploiting ponds Eichhornia showed its high efficiency and reliability. Hydro botanical application processes of purification of industrial and domestic waste water to create a closed water supply system.
- Application of water hyacinth allows to clarify, drains and reservoirs from organic and bacteriological pollution and also provides natural creation of very attractive landscape. The problem of forage can be particularly solved within year.

6. Conclusion

Hydro botanical application processes can be used at the treatment of industrial and domestic waste water. But these processes need a closed system of water plants. The cleaning process can take place throughout the year, since rhizomes, stems and leaves of plants under certain conditions, can function in autumn-winter period (Кручинина & Дмитриева, 1999; Rizhenko & Esentuki, 2001).

It is worth noting that such a comprehensive approach to solving environmental problems for a type allows companies to implement a technology that has minimal environmental impact on the environment. And in the future it will be possible to create at treatment facilities entire ecosystems with aquatic vegetation, which will regulate the cleaning process specifically for each type of waste.

The experiments were carried out and implementation of various types of waste, including waste water pulp and paper, petrochemical industry, livestock, etc. Its application allows you to clear drains and watercourses and from organic and of bacteriological contaminants without disturbing the ecological community ponds and beaches, as well as to ensure the creation of a very attractive natural landscape and the apparent improvement of adjacent territories.

The problem of feed may be partially solved in the course of the year: it is enough to implement this method on a particular object. Green mass obtained with its reservoir or reservoirs may miss subsequently to from their treatment plants to feed livestock or poultry. Besides finally eliminated accumulated over many years the risk of ecological disaster. Sanitary doctors, whose profession is not conducive to emotional evaluations, nevertheless were amazed - the composition of the water meets the standards applicable to outdoor ponds and swimming pools. In the climatic conditions of central Russia the use of this plant can be applied to solve a large number of issues management; assists and enables us to find additional funds to solve many problems and needs of the production.

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