COMPARISION OF PHYTOREMEDIATION EFFICIENCY OF WATER HYACINTH AND TYPHA PLANT USING CETP WATER

DR. JYOTI G. KOLIYAR, SANKRANTI .K. SHARMA

Abstract: Phytoremediation through aquatic macrophytes system for the removal of pollutants and contaminants from various natural sources is a well established environmental protection technique. *Water hyacinth (Eichhornia crassipes*), is an invasive aquatic weed has been utilized for various research activities over the last few decades. *Typha latifolia* is the monoecious (having the reproductive organ in separate structure but born on the same individual). It is used for phytoremediation as it absorbs pollutants. This study compares the biosorption capacity of the *Water hyacinth* and *Typha latifolia* in reducing the concentration of pH, TDS, BOD, Chlorides and COD, Oil and Grease, in CETP effluent and to check whether which plant is suitable for reduction of pollution in CETP water.

Keywords: *Water hyacinth, Typha latifolia*, CETP effluent sample.

1.0 Introduction: Waste water is that water which carries waste generated by the various processes carried out in an industry. It is very important to treat the industrial waste water as it has numerous harmful effects (Macek T, Macekova M et al). Phytoremediation techniques for thetreatment of different types of wastewater have been used by several researchers. These techniques are reported to cost effective compared to other methods. Various contaminants like suspended solids, dissolved solids, electrical conductivity, hardness, biochemical oxygen demand, chemical oxygen demand, dissolved oxygen, nitrogen, phosphorous, heavy metals, and other contaminants have been minimized using *Water hyacinth* and *Typha latifolia*.. Phytoremediation is one of the biological wastewater treatment methods (Roongtanakat, N., Tangruangkiat, S.and Meesat, R., 2007), and is the concept of using plants-based systems and microbiological processes to eliminate contaminants in nature. The remediation techniques utilize specific planting arrangements, constructed wetlands (CW), floating-plant systems and numerous other configurations (Cunningham, S.D., William, R, B 1995).The removal of wastewater constituents is achieved by different mechanisms like sedimentation, filtration, chemical precipitation, adsorption, microbial interactions, and uptake of vegetation(D.A.Hammer), among which, the most effective technology is phytoremediation strategy using CW technology. Besides water quality improvement and energy savings, CWs have other environmental protection features such as promoting biodiversity, providing habitat for wetland organisms and wildlife (e.g. birds and reptiles in large systems)(Dixon,A,.Simon,M and Burkitt,T.,2003), serving climatic (e.g. less CO_2 production; hydrological functions and biomethylation)(Azaizeh,H., Salhaniet al 2003).These systems are generally cost effective, simple, and environmentally non-disruptive ecologically sound with low maintenance cost and low land requirements (Kirkpatrick, A.D., 2005). The principles of phytoremediation system are to clean up contaminated water, which include identification and implementation of efficient aquatic plant; uptake of dissolved nutrients and metals by the growing plants; and harvest and beneficial use of the plant biomass produced from the remediation system. The most important factor in implementing phytoremediation is the selection of an appropriate plant, which should have high uptake of both organic and inorganic pollutants, grow well in polluted water and easily controlled in quantitatively propagated dispersion (Roongtanakat, N., Tangruangkiat, S. and Meesat, R., 2007). The uptake and accumulation of pollutants vary from plant to plant and also from species to species within a genus (Singh, O.V., Labana, S., and Pandey et al 2003).The economic success of phytoremediation largely depends on photosynthetic activity and growth rate of plants, and with low to moderate amount of pollution. *Water hyacinth* and *Typha Latifolia* were selected for review because they efficiently remove pollutants with high reproduction rate, efficiency and tolerance of ecological factors. Phytoremediation is the use of plants and/or their associated microorganisms for environmental cleanup. This technology makes the use of the naturally occurring processes by which plants and their associated rhizospheric micro flora degrade and sequester organic and inorganic pollutants (Pilon-Smits, 2005).During the 1980s, the US Government initiated a large program for the development of environmental cleanup technologies (The Comprehensive Environmental Response, Compensation, and Liability Act or Superfund), which has accelerated the growth of a new productive research field worldwide (Kramer, 2005). Dedicated phytoremediation companies have appeared around the world to service a global market that is estimated

to be around US$ 100 million/year currently (Robinson et al,2003).

1.1 **Aim And Objectives:** The overall aim of the study is to phytoremediate CETP effluent by using *water hyacinth* and *Typha* plant and to compare the Phytoremediation efficiency of both plants (*Water hyacinth* and *Typha*) in treating CETP effluent.The objective is to provide appropriate report of the efficiency of *Water hyacinth* and *Typha* inwaste water treatment and to recommend its use in industrial sector.

1.2 Material And Methods: The study area was Common Effluent Treatment Plant. CETP handles wastewaters from various types of industries and the nature of the mixed wastewater is highly varying in terms of characteristics and flow. The effluent from extended aeration tank was collected by random sampling using 5 litre polyethylene can for phytoremediation process. A pilot scale treatment process of CETP effluent using water hyacinth and *Typha* was setup in addition various physicochemical parameters like pH, oil and Grease, Biological Oxygen Demand, Chemical Oxygen Demand, Chloride and Total Dissolved Solids was also analyzed.

1.3 Results and Discussion: The samples collected was analyzed for various physicochemical parameters as well as was compared with Industrial Discharge standards prescribed by Maharashtra Pollution Control Board. The detailed description of the parameters is as enlisted below:-

pH: pH is a numeric scale used to specify the acidity or basicity (alkalinity) of an aqueous solution. It is roughly the negative of the logarithm to base 10 of the concentration, measured in units of moles per liter, hydrogen ions. More precisely it is the negative of the logarithm to base 10 of the activity of the hydrogen ion.As pH levels move away from this range (up or down) it can stress animal systems and reduce hatching and survival rates. The further outside of the optimum pH range a value is, the higher the mortality rates. The more sensitive a species, the more affected it is by changes in pH. In addition to biological effects, extreme pH levels usually increase the solubility of elements and compounds, making toxic chemicals more "mobile" and increasing the risk of absorption by aquatic life .The initial pH of the effluent was 7.8 which slightly decreased after treatment with both plant used and was found to be 7.1 by *Water hyacinth* and 6.8 by *Typha plant* and was found to be within the permissible level.

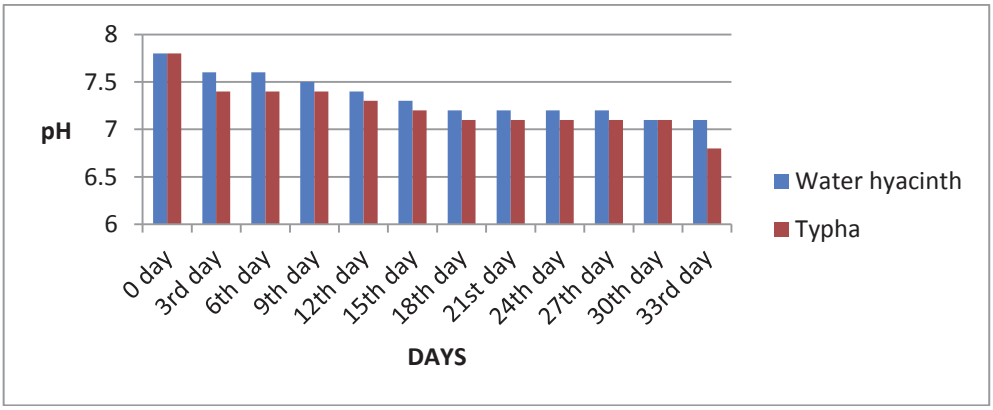

Figure 1: Day wise variations of pH parameter

Oil and Grease: Oil and grease is defined as any material that can be recovered as a substance soluble in solvents. The Oil and grease of CETP effluent before phytoremediation was found to be 85mg/l. After the treatment process O&G was found to be 44mg/l and 31mg/l by *Water hyacinth* and*Typha* which is found to be beyond the permissible level set by MPCB thus it is recommended that oil and grease of effluent should be removed by separator technique before phytoremediation process.

Biological Oxygen Demand: BOD is the amount of dissolved oxygen needed (i.e. demanded) by aerobic biological organism break down organic material present in a given water sample of certain temperature over a specific time period. If effluent with high BOD levels is discharged into a stream or river, it will accelerate bacterial growth in the river and consume the oxygen levels in the river. The oxygen may diminish to levels that are lethal for most fish and many aquatic insects. As the river re-aerates due to atmospheric mixing and as algal photosynthesis adds oxygen to the water, the oxygen levels will slowly increase downstream.BOD of effluent before treatment was found to be 425mg/l. After the treatment process BOD value decreased to 110mg/l &99mg/l by *Water hyacinth* and Typha respectively. The BOD value after treatment process with *Water hyacinth* was found slightly above the

range and the Typha was within the range as per the industrial discharge limits by MPCB this indicates that Typhaplant have shown better efficiency than Water hyacinth in BOD reduction

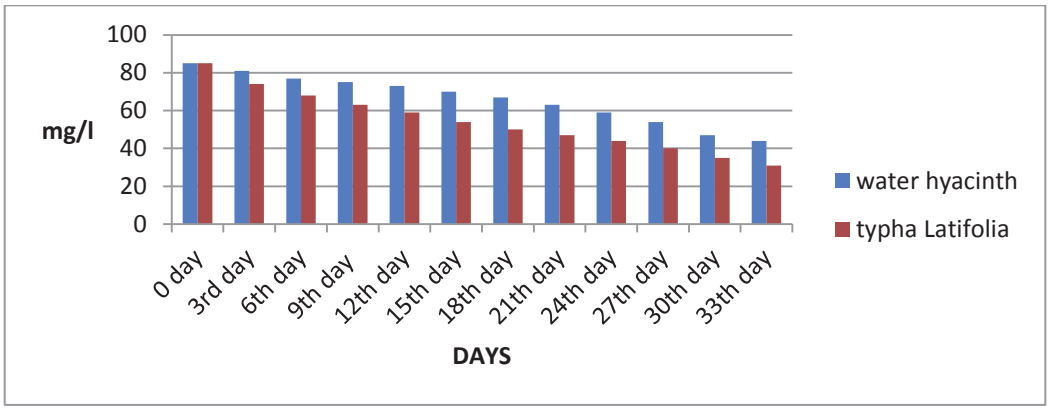

Figure 2: Day wise variations of Oil and Grease parameter

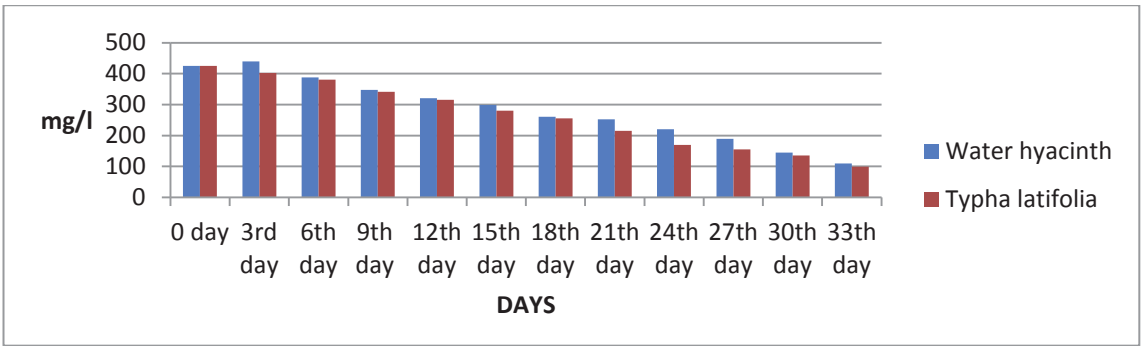

Figure 3: Day wise variations of Biological Oxygen Demand (mg/l)

Chemical Oxygen Demand: COD is the measure of oxygen equivalent to the requirement of oxidizing content by strong chemical agent. The COD test is helpful in indicating toxic conditions and presence of biologically resistant organic matter. High COD levels decrease the amount of dissolved oxygen available for aquatic organisms and thus aquatic organisms do not get enough oxygen to survive, it also affects aesthetic value of water. The COD of CETP effluent before phytoremediation was found to be 845mg/l which after the treatment process reduced to257mg/l &250mg/l by *Water hyacinth* and Typha ,reduction by*Water hyacinth* was above the range while reduction by Typha was in the given range of MPCB this indicates thatTypha plant is more capable in reducing COD Of CETP effluent than *Water hyacinth*.

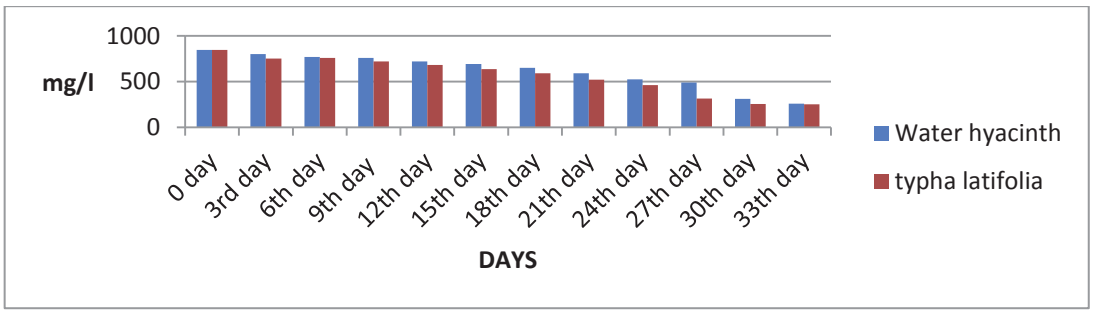

Figure 4: Day Wise variations of Chemical Oxygen Demand (mg/l)

Chloride: Chlorides in the form of Cl^- ions are the major inorganic cations present in waste water. High level of Chloride effluent can be toxic to many forms of aquatic life. Aquatic species of concern include fish, macroinvertebrates, insects, and amphibians Salinity stress on sensitive aquatic communities can impact species diversity. The presence of salt also releases toxic metals from sediment and when released into the water can inhibit nutrients and dissolved oxygen within the water that aquatic species rely on. The Chloride content of effluent before phytoremediation was found to be 1600 mg/l

which after the treatment process decreased to 567mg/l & 552mg/l by *Water hyacinth* and *Typha* respectively which is well within the permissible limit prescribed by MPCB for industrial effluents discharge.

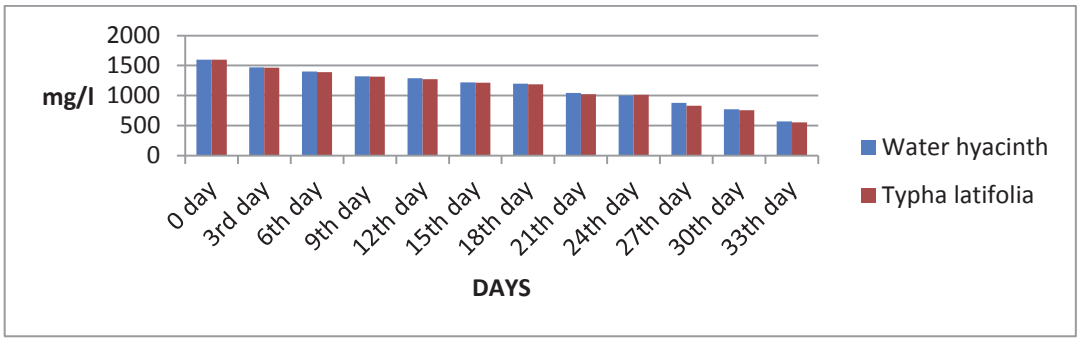

Figure 5: Day Wise Variations of Chloride (mg/l)

Total Dissolved Solids: The TDS is a measure of all kinds of solids i.e suspended,dissolved and volatile solids. High TDS value can affect the aquatic organisms, excessive total dissolved solids can produce toxic effects on fish and fish eggs TDS can also affect water taste, and often indicates a high alkalinity or hardness . In water with a very high TDS concentration, cells shrink. These changes can affect an organism's ability to move in a water column, causing it to float or sink beyond its normal range .The TDS of effluent before phytoremediation was found to be 3500mg/l which after the treatment process decreased to 990mg/l & 960mg/l by *Water Hyacinth* and *Typha* and is within the acceptable limits specified by MPCB for industrial effluents discharge.

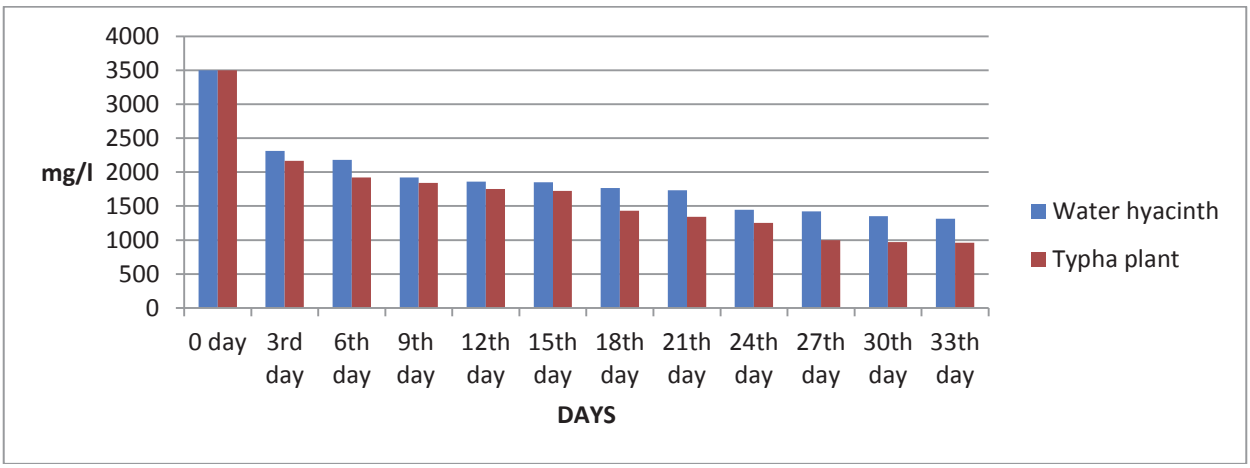

Figure 6: Day Wise variations of Total Dissolved parameter (mg/l)

1.4 Conclusion: Phytoremediation is a technology that is based on the combined action of plants and their associated microbial communities to degrade, remove, transform, or immobilize toxic compounds located in soils, sediments, ground water and surface water. It has been used to treat many classes of contaminants including petroleum hydrocarbon, chlorinated solvents, pesticides, explosives, heavy metals and radionuclide's in soil and polluted water. It is one of the biological waste water treatment methods and is the concept of using plant based system to eliminate contaminants in nature. The parameters considered are Chemical Oxygen Demand, Chlorides, Oil and Grease and Total Dissolved Solids which indicates the efficiency of the process to reduce the contaminants from Common Effluent Treatment Plant effluent.

The Oil & grease of waste water was found to be decreased during the treatment process by *Water hyacinth* 48.23% and by *Typha* 63.53% reduction was achieved. It is within the standard limit set by MPCB.If the effluent with high oil and grease discharge in water form a layer on the water surface prohibiting the mixing of oxygen water reducing DO level leading to stress condition.

The BOD value of waste water was found to be decreased during treatment process by *WaterHyacinth* 74.11% and by *Typha* 76.71% reduction was achieved. If water is having high Biological Oxygen Demand, aerobic bacteria will utilize the available Dissolved Oxygen of water. In case of

excessive Biological Oxygen Demand there will be deficiency of Dissolved Oxygen and water will be in anaerobic condition resulting in mortality of living aquatic organisms; release of ammonia, methane, CO_2 etc. In absence of oxygen, anaerobic bacteria become active. When Biological Oxygen Demand value is medium, water will possess excessive nutrients causing algal bloom. Such condition is again dangerous because during day time water will be supersaturated with oxygen (due to photosynthesis in presence of sun light), but at late night Dissolved Oxygen may be zero or close to zero. This is primarily due to utilization of oxygen for respiration by plants and animals (without any production of oxygen in absence of sunlight). For this purpose BOD must be maintained up to certain level in any surface water body.

The Chemical Oxygen Demand value of waste water was reduced after the treatment process.69.58% and 70.42% reduction was achieved by *Water hyacinth* and *Typha*. If the effluent with high COD value is discharged in water body it may result in organic and inorganic load which cause depletion in dissolved oxygen leading to major shifts in the diversity of aquatic organisms. Species that cannot tolerate low DO levels would be replaced by pollution tolerant organisms.

The Chloride value of waste water dropped off after the treatment process.64.56% and 65.5% reduction was achieved by *Water hyacinth* and *Typha*. The effluent with high chloride content corrode the pipes and cause scaling in the pipes and boilers used in the industry. If such effluent is discharged then it may affect the osmoregulation of aquatic organisms and also harm the phytoplanktons which are primary producer thus affecting the overall productivity of water body.

The Total Dissolved Soilds value of waste water found to be minimized after the treatment process.71.77% and 72.57% reduction was achieved by *Water Hyacinth* and *Typha*. If the effluent with TDS value is discharged in water body it may result in reduces the light penetration and thus reducing photosynthetic activity and primary productivity of water body. This might have further reduced the dissolved oxygen content of water suppressing the aquatic flora and fauna. It also affects the gills of fish and thus, resulting in various respiratory problem which proves to be fatal.

Hence the result indicates that the test plants reduce all the parameters to a significant level. It can be concluded that phytoremediation process of waste water using *Water hyacinth* and *Typha* is a predominant method which is economically feasible. It is an available knowledge and technique for removal of water contaminants and advances in waste water treatment can be integrated to asses and control pollution.

A comparative study was done by using both the plants and It was recorded that reduction in parameters by *Typha* plant was more efficient than the *Water Hyacinth*. Hence it can be concluded that the phytoremediation technique using *Typha* can be used for the treatment of Common Effluent Treatment Plant effluent as over the conventional techniques because this technique is less expensive, no maintenance cost and can be performed in controlled condition. It is an alternative or complimentary technology that can used along with or, in place of mechanical conventional clean intensive. It is an insitive remediation technology that utilizes the inherent abilities of living plants. It is also an ecological friendly solar energy driven clean up technology, based on the concept of using nature to clean nature.

1.4 References:

1. *Rita Ganava, Reena Ganava, R.R.Kanhere, Hemant Pandit,* Endosulfan induced Changes in Oxygen Consumption And Haematological Parameters in Tilapia Mossambica; Life Sciences International Research Journal , ISSN 2347-8691, Volume 2 Spl Issue (2015): Pg 7-10
2. Azaizeh, H., Salhani, N., Sebesvari, Z. and Emons, H., 2003, the potential of rhizosphere microbes isolated from a constructed wetland to biomethylate selenium. J. Environ. Qual.
3. D.A. Hammer, Constructed wetlands for wastewater treatment, 2nd (ed.), Lewis, Chelsea, Michigan, 1989.
4. Vishnu Agarwal, Preetam Verma,, Efficacy of Ciprofloxacin Containing Eudragit; Life Sciences International Research Journal , ISSN 2347-8691, Volume 1 Issue 1 (2014): Pg 6-11
5. Danalewich, J.R., T.G.Papagiannis, R.L.Belyea, M.E.Tumbleson and L.Raskin.Characterization of waste stream, current treatment practices, and potential for biological nutrient removal.1998.
6. *B.S.Behera, S.Dash, A.Mohanta, T.R.Das, S.Behera,* Front Line Demonstrations on Need Based Plant Protection in the Important Solanaceous Vegetables Impact in Enhancing Productivity and Profitability Under Farmers' Field in Mayurbhanjdistrict of Odisha; Life Sciences International Research Journal , ISSN 2347-8691, Volume 2 Issue 2 (2015): Pg 5-8
7. Delgado, M., Bigeriego, M., Walter, I. and Guardiola, E., 1994, Optimization of conditions for

the growth of water hyacinth in biological treatment. Rev. Int. Contam. Ambient.

8. Erakhrumen, A.A. 2007. Phytoremediation: an Environmentally Sound Technology for Pollution Prevention, Control and Remediation in Developing Countries. *Educational Research and Review*.
9. *Prajitha N. Kutty, Padma V. Deshmukh,* Antibacterial Activity of *Murraya Koenigii, Amarathus Spinosus* and *Daucus Carota* on Nosocomial Infections; Life Sciences International Research Journal , ISSN 2347-8691, Volume 2 Spl Issue (2015): Pg 11-17
10. J. Vymazal, H. Brix, P.F. Cooper, R. Haberl, R. Perfler and J. Laber, Removal mechanisms and types of constructed wetlands., In: Constructed Wetlands for Wastewater Treatment in Europe, Vymazal J, Brix H, Cooper PF, Green MB and Haberl, R. (eds), Backhuys Publishers, Leiden, pp. 17-66, 1998.
11. Mahajan ,Sudesh Kumar Yadav, Enhanced Anthocyanin Content in Transgenic Monika; Life Sciences International Research Journal , ISSN 2347-8691, Volume 1 Issue 1 (2014): Pg 12-17
12. Macek T,Macekova M et al,Exploitation of plants for removal of Organics in environment remediations,biotechnology advances,2002,volume 18.
13. *Alka Kulshreshtha,* Antidiabetic Effect of *Ocimum Sanctum* in Streptozoticin ; Life Sciences international Research Journal , ISSN 2347-8691, Volume 2 Issue 1 (2015), Pg 308-310
14. Reddy, K.R. and Sutton, D.L., 1984, Water hyacinths for water quality improvement and biomass production. J. Environ. Qual., 13(1), 1-9.
15. Roongtanakiat, N., Tangruangkiat, S. and Meesat, R., 2007,
16. Singh, O.V., Labana, S., Pandey, G., Budhiraja, R., Jain, R.K., 2003,
17. Phani Deepika Polalpalli, Isolation And Identification of Invertase Enzyme From Tooth Decay Sample; Life Sciences International Research Journal , ISSN 2347-8691, Volume 1 Issue 2 (2014), Pg 452-455
18. Susarala.S. Medina, V.F.et al, Phytoremediation: An Ecological Solution to Organic Chemical Contamination "Ecological Engineering.2002."
19. Dr. D. Krupa Daniel, Prevalence of Flat Feet Among School Children; Life Sciences International Research Journal , ISSN 2347-8691, Volume 1 Issue 2 (2014), Pg 456-466
20. Trivedi RK, Pattanshetty SM, Treatment of waste water using Water hyacinth, 2002, Volume 45(12), Issue 329-334.
21. *R. B. Patil, S. V. Bhoite, R. B. Jadav, N. D. Dalvi,* "Yield and Yield Components, Quality Parameters influenced By Sowing of Different Bt. Cotton Cultivars With Various Plant Spacing." ; Life Sciences International Research Journal , ISSN 2347-8691, Volume 2 Spl Issue (2015): Pg 5-8

Dr. Jyoti G. Koliyar & Sankranti .K. Sharma
Department of Environmental Science, SIES(Nerul) College of ASC,
P-1C, Sector V, Nerul, Navi Mumbai 400706.