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Full Length Research Paper

Treatment of Pesticides Industry Wastewater by Water Hyacinth (*Eichornia crassipes*)

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Aquatic weed has greater impact on all kind of pollution reduction. Chemical and toxic industries are those which creates heavy pollution load in environment. Globally pesticides are toxic to non-target receptors including humans and reach them through food chain. Most of the pesticides are non-biodegradable due to b their molecular structure with stable internal bonds. Wastewaters from pesticide manufacturing industries originate from cleaning activities after batch operation during the synthesis processes. Wastewaters from agricultural industries and pesticide are big issue for environmentalist. Some methods are suggested in literature but noneconomical or non ecofriendly in that case treatment by low cost method is introduced to treat the pesticides waste water by aquatic weed.

Keywords: Biotic; dissolved; effluent; food; growth

INTRODUCTION

Industrialization is backbone for growth of any country. So many industries are running which are responsible for environmental disturbance. The disturbances are may be untreated waste which generated from process, production, cleaning or washing purpose (Celis et al., 2008). The waste generated from the industries creates serious effect on living thing existing on the earth. Some waste that much toxic in nature that it will damage for long life. In those categories pesticide industries play an important role (Cooke et al., 2004). Several hundred pesticides of different chemical nature are currently used for agricultural purposes all over the world. Because of their widespread use, they are detected in various environmental matrices, such as soil, water and air (Laperton, 2006). Pesticides are divided in to many classes, of which the most important are organochlorine and organophosphorous compounds. Organochlorine pesticides are known to resist biodegradation and therefore they can be concentrated through food chains and produce a significant magnification of the original concentration at the end of the chain (Mascolo et al., 2001). The general progression of pesticide development has moved from highly toxic, persistent and bio-accumulating pesticides such as DDT, to pesticides that degrade rapidly in the environment and are less toxic to non-target organisms. The developed countries have banned many of the older pesticides due to potential toxic effect to man and\or their impact on ecosystems, in favour of more pesticide formulations (Perrin-Ganier et al., 2001). In the developing countries, however, organochlorine pesticides still remain the cheapest to produce and, for some purposes, remain highly effective.

Table 1. Physicochemical parameter of pesticide industry waste water

S.No	Parameters	Parameter
1	Color	Blackish
2	pH	0.5-2.0
3	Temperature	40^{o}C
4	COD	3680
5	BOD	260
6	Total dissolved Solid	6215
7	Suspended Solid	50
8	Dissolved Solid	1650
9	Chloride	11
10	Sulphate	3840
11	Nitrogen	256
12	Phosphate	250

*E=Effluent,
*Except Color, pH and temperature all value is in mg/l

Developing countries maintain that they cannot afford, for reason of cost or efficacy, to ban certain older pesticides. The dilemma of cost/efficacy, versus ecological impacts, including long range transport, and access to modern pesticides formulations at low cost remains a contentious global issue (Wang and Li, 2008). Pesticide residues reach the aquatic environment through direct runoff, leaching, and careless disposal of empty container, equipment washing etc (Milindis, 1994). Surface water contamination may have ecotoxicological effects for aquatic flora and fauna as well as for human health if used for public consumption (Balkrishnan et al., 2011). Sediments are ecologically important components of the aquatic habitat, which play a significant role in maintaining the trophic status of any water body . Highly polluted sediments are adversely affecting the ecological functioning of rivers due to persistence in the environment and longrange transport (Singh et.al, 2005).

Pesticides played a vital role in the economic production of wide ranges of vegetable, fruit, cereal, forage, fibre and oil crops which now constitute a large part of successful agricultural industry in many countries. They lower crop losses, increase revenue to farmers from the additional marketable yield obtained with their use and thus lower the cost of production per unit output (Singh et al., 2004). Other benefits include: 1) reduced uncertainty of crop loss from pests, 2) increased profit to farm input suppliers (machinery, fertilizer, chemicals and seed companies) from increased sale, 3) benefit to consumers through de- creased price of raw foods or improved quality of food products and 4) benefit to society as whole (farmers, consumers, farm suppliers, food processors) from increased employment opportunities and expanded export of food products (Beg and Ali, 2008). Various innovative technologies have been reported in literature like inceration (Felsot et al., 2003), Ozone treatment (Shang et al., 2006), Hydroyslis(Badawi et al., 2001), Adsorptions (Chowdhury et al., 2011), Coagulation (Misra et al., 2013)etc, but they are cost intensive and are not ecofriendly in nature[7, 8, 9]. Other alternative for waste water treatment like aquatic weeds *Eichhornia crassipes* (water hyacinth) or *Pistias stratiostes* (water lettuce) are also present in literature due unawareness the method was ignore. With scientific design and proper care it shows better efficiency for many industrial water, which is economical and ecofriendly (Hansel et al., 2001).

In this study an attempted has been made to reduce the physicochemical parameters of the pesticide by aquatic weed. Water hyacinth was choosing as treatment material for waste water. The reduction of chemical oxygen demand, biological oxygen demand, total phosphorus, nitrogen, dissolved solid and suspended solid was examine with retention time. During the experiment time increase or decrease in dry weight, total amino acid, protein and chlorophyll on water hyacinth was also studied.

MATERIAL AND METHOD

Material

The synethic water was produced in Labotary with some pesticide material; the initial waste water quality was mentioning Table. 1. The aquatic wee-

Figure 1. Water hyacinth

d (water hyacinth) was collected from lake of northern region of Ethiopia.

Method

The study for aquatic system, healthy water hyacinth (Eichornia crassipes) with an initial average weight of 60 gram was collected, which is shown in Figure 1. The water hyacinth was washed thoroughly with distilled water to remove particles adhering to the plants. A cement pond was developed with dimension of 2(m) length, 2(m) breadth, and 1(m) depth was maintained and synethic water was discharge on it. The cleaned plants (55g each) were introduced into the vessels with the roots submerged in the effluent and were kept under sunlight for 22 days. The fresh weight of the plants was determined using physical balance every 2days.

Analytical method

Laboratory Tests: Total nitrogen (TN), total phosphorus (TP), chemical oxygen demand (COD), biological oxygen demand (BOD), dissolved solid (DS) and volatile suspended solids (VSS) were analyzed according to the standard methods (APHA, 1999; 2005).

Amino Acid: Amino acid content was determined by the method of Moore and Stein. 0.5 g of plant sample was homogenized in 10 ml of 80% ethanol. The homogenate was centrifuged for 10 minutes at 800 g. One ml of the extract was taken in the test tube and add 1 ml of 0.1 N HCl to neutralize the sample. To this, one ml of ninhydrine reagent was added and heated for 20 minutes in a boiling water bath. Later, 5 ml of the diluents solution was added and heated again in water bath for 10 minutes. The test tubes were cooled and read the absorbance at 570 nm in a UV-spectrophotometer.

Estimation of Protein: Protein content was determined by the method of Lowery. 0.5 g of plant sample (shoot) was homogenized in 10 ml of 20% Trichloro Acetic Acid (TCA). The homogenate was centrifuged in 10 minutes for 300 g. The supernatant was discharged and the pellet was re-extracted with 5 ml of 0.1 N NaOH. One ml of the extract was taken in a test tube and 5 ml of reagent ‘C’ (protein reagent) was added. This solution was mixed well and kept in dark for 10 minutes. Later, 0.5 ml of folin phenol reagent was added and the mixture was kept in dark for 30 minutes. The sample was read at 660 nm in

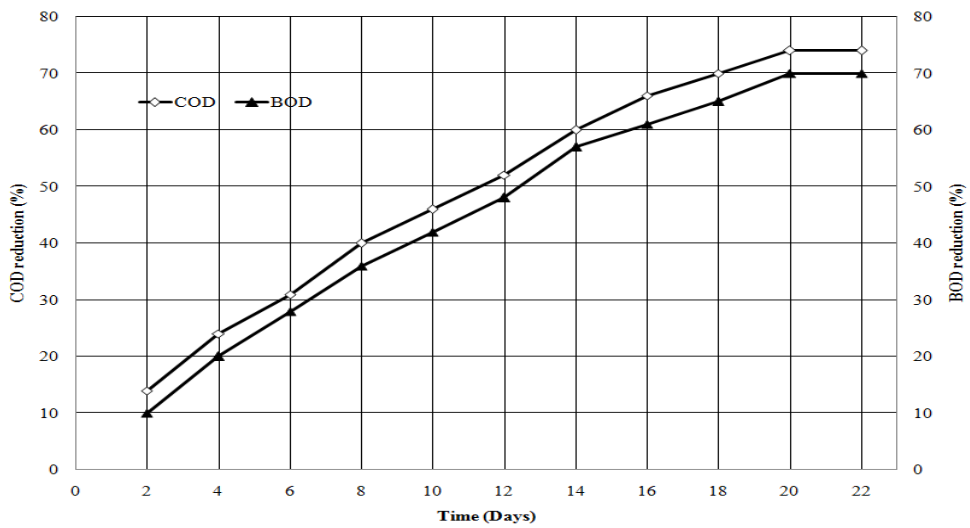

Figure 2. Effect on reduction chemical oxygen demand and biological oxygen demand by water hyacinth

the UV-spectrophotometer.

Estimation of Chlorophyll: Five hundred mg of fresh leaf material was taken and ground with help of pestle and mortar with 10 ml of 80% acetone. The homogenate was centrifuged at 800 rpm for 15 minutes. The supernatant was saved. The residues were re-extracted with 80% acetone. The supernatant was saved and utilized for chlorophyll estimation. Absorbance was read at 645, 663 and 480 nm in the UV-spectrophotometer.

RESULT AND DISCUSSION

Effect on COD and BOD reduction: The effect on COD and BOD reduction was carried out for continuously 22days, which is shown in Figure 2. It was found the pollutant were decrease with increase in time. The maximum 74% COD and 70% BOD reduction was observed at 20 days after it became constant. When treatment time was 2, 4, 6, 8, 10, 12, 14, 16, 18days the COD 14, 24, 31, 40, 46, 52, 60, 66, 70% and BOD 10, 20, 28, 36, 42, 48, 57, 61, 65% was found. Organic matter is commonly measured in terms of BOD and COD; it's mainly composed of proteins, carbohydrates and fats. The decrease in organic matter with treatment indicates metabolites reaction started which dilute the organic matter and used as feed for them. All organic materials or wastes can be broken down or decomposed by microbial and other biological activity (biodegradation). Although some inorganic substances are included in this category, most are organic compounds that can exhibit a biochemical oxygen demand (BOD) because oxygen is used in the degradation process (Reddy and DeLaune, 2008). At the bottom of pond anaerobic decomposed was occurred, which microbes absorbed there oxygen from organic matter and released carbon dioxide and methane.

Effect on total nitrogen and phosphorus: The effect on total nitrogen and phosphorus reduction was carried out for continuously 22days, which is shown in Figure 3. It was observed that nutrient reduction was increase with increase in treatment time. The maximum 60% nitrogen and 58% phosphorus was found in 18 days of treatment after that it became constant for 20 and 22 days. When the treatment time was 2, 4, 6, 8, 10, 12, 14, 16 days the phosphorus 8, 15, 21, 28, 34, 40, 47, 52% and nitrogen 7, 14, 22, 29, 36, 42, 49, 54% respectively. The nutrients are always present in water and thus it supports aquatic life. Here the primary focus is on fertilizing chemicals such as nitrates and phosphates. While important for plant growth, too much of nutrients encourage the overabundance of plant life and can result in environmental damage called "eutrophication". This can occur at either microscopic level in form

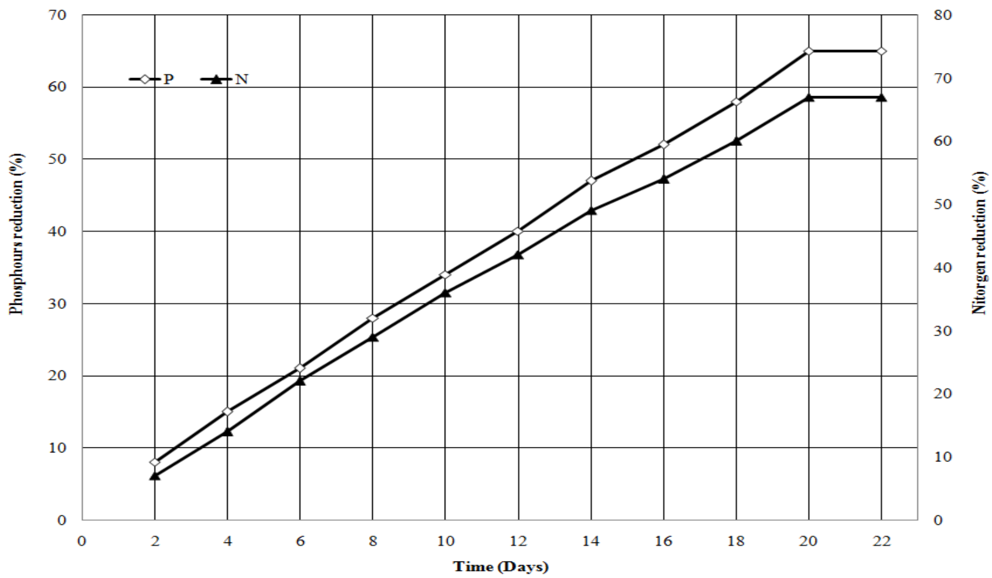

Figure 3. Effect on reduction total phosphorus and nitrogen by water hyacinth.

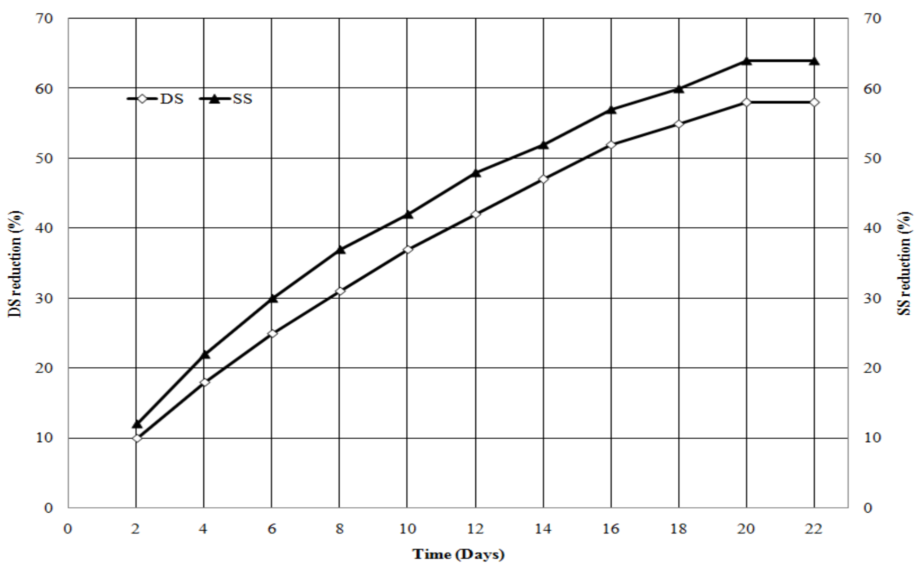

Figure 4. Effect on reduction total dissolve solid and suspended solid by water hyacinth

of algae or macroscopic level in form of larger aquatic weeds. The diurnal change in dissolved oxygen is of serious concern. During day time oxygen remain supersaturated due to photosynthetic contribution of oxygen. But during night the oxygen is depleted as the algal mass consumes significant amount of oxygen. Nitrates and phosphates contributed through anthropogenic sources (Rajendran et al., 2005).

Effect on dissolve solid and suspended solid: The effect on total dissolved solid and suspended solid reduction was carried out for continuously 22days, which is shown in Figure 4. It was found that DS and SS was increase with increase in

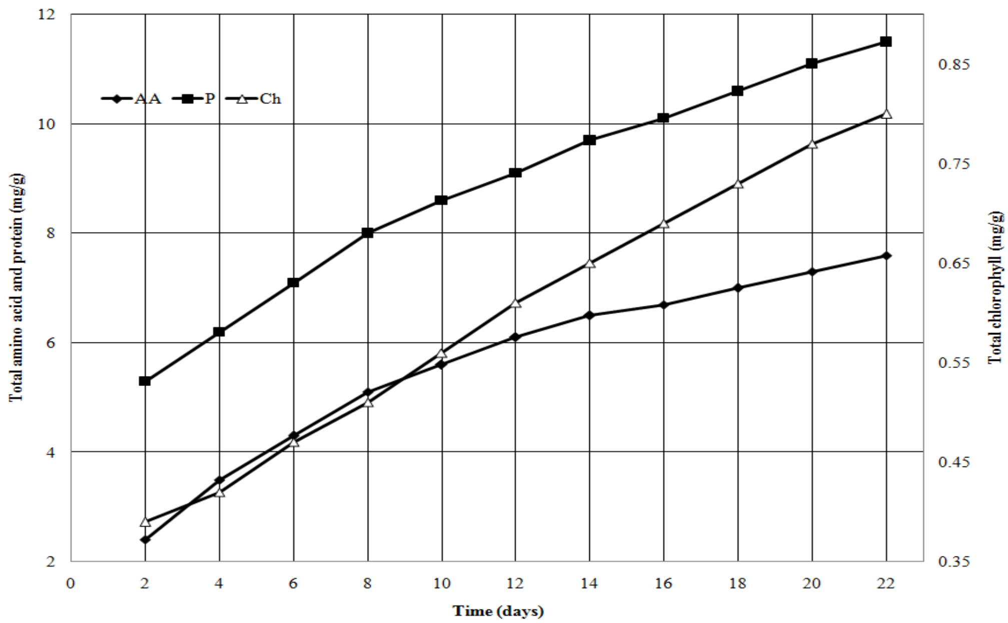

Figure 5. Effect on total amino acid, protein and chlorophyll by water hyacinth

treatment time. The maximum reduction 58% dissolved solid and 64% of suspended solid was observed at 20days of experiment. When the experiment time was 2, 4, 6, 8, 10, 12, 14, 16, 18days the dissolved solid 10, 18, 25, 31, 37, 42, 47, 52, 55% and suspended solid 12, 22, 30, 37, 42, 48, 52, 57, 60% reduction was found. The dissolved solids mainly consist of bicarbonates, carbonates, sulphates, chlorides, nitrates and phosphates of calcium, magnesium, sodium, and potassium with traces of iron, manganese and other minerals. The amount of dissolved solid is important consideration in determining its suitability for irrigation, drinking and industrial uses. In general, waters with a total dissolved solids <500 mg/l are most suitable for drinking. Higher dissolved solids may leads to impairment in physiological processes in the human body. For irrigation water dissolved solid are very important criteria due their gradual accumulation resulting in salinization of soil (Doong et al., 2002).

Effect of total amino acid, protein and chlorophyll: The effect on total amino acid, protein and chlorophyll was carried out for continuously 22days, which is shown in Figure 5. It was found that biochemical parameters were increase with increase in experiment time. The maximum 7.6mg/g amino acid, 11.5mg/g protein and 0.8mg/g chlorophyll was observed on 22 days respectively. The results show when the treatment time was 2, 4, 6, 8, 10, 12, 14, 16, 18, and 20days, the amino acid 2.4, 3.5, 4.3, 5.1, 5.6, 6.1, 6.5, 6.7, 7, 7.3mg/g, protein 5.3, 6.2, 7.1, 8, 8.6, 9.1, 9.7, 10.1, 10.6, 11.1mg/g and chlorophyll 0.39, 0.42, 0.47, 0.51, 0.56, 0.61, 0.65, 0.69, 0.73, 0.77mg/g was found. The high yield of plants at high concentrations might depend on the enhanced biosynthesis of pigments, carbohydrates and proteins. Chlorophyll estimation is one of the important biochemical parameters which are used as the index of production capacity. The effluent from the pesticide increases the chlorophyll and carotenoid content, which may favourable pigments system. The increase in protein might be due to adsorption of the most of the necessary elements by plants. The level of amino acids also increases this may be due to the inverse relationship between protein and amino acids where protein content was increased and amino acid were low. Initial rise in amino acids content may be due to higher protease enzyme activities which suggest that proteins are in continuous state of turnover and amino acids newly incorporated into proteins are

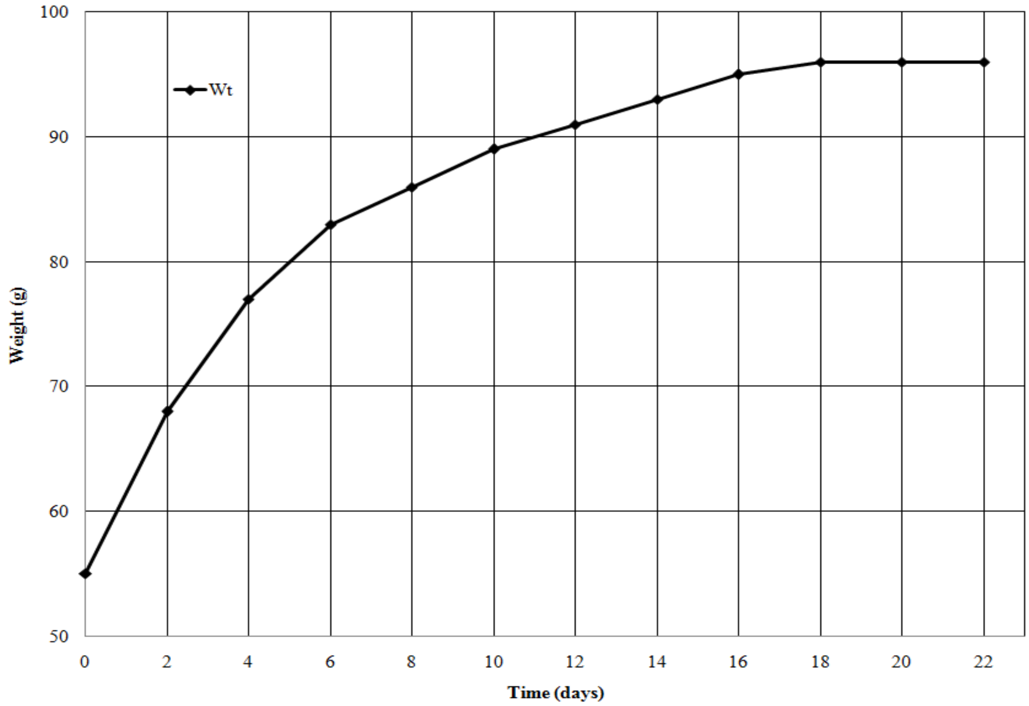

Figure 6. Effect on weight by water hyacinth

not in association. The breakdown of protein into amino acids is also adversely affected due to effluent toxicity. Hence poor availability of nitrogen may be a causative factor for reduction in protein content (Street et al., 2007).

Effect on weight of aquatic weed: The effect on total amino acid, protein and chlorophyll was carried out for continuously 22days, which is shown in Figure 6. It was found that weight was also increase with increasing in treatment time. Maximum 96g was observed on 22 days of treatment of waste water. When the experiment time was 2, 4, 6, 8, 10, 12, 14, 16, 18 and 20 days the weight was increase 68, 77, 83, 86, 89, 91, 93, 95, 96gram. The increase in weight may be due to utilization of waste water as food material for growth and development. The greatest response to effluent pollutants indication of a stress and direct response to the generation of superoxidase radical by pollutants induced blockage of the electron transport chain in the mitochondria. It means effluent concentration do not affect shoot and root peroxidase activity (Hao and Athanasios, 2004).

CONCLUSION

It is concluding that to treat the pesticide industry waste water hyacinth show good efficiency. The physicochemical parameter was decrease with this aquatic weed, chemical oxygen demand 74%, biological oxygen demand 70%, total phosphorus 58%, nitrogen 60%, suspended solid 64%, and dissolved solid 58%. The biochemical parameters amino acid was 7.3mg/g, protein 11.5mg.g and chlorophyll 0.8mg/g was increases. The weight of weed was also increase to 96gram in 22days of treatment. The treatment with water hyacinth is economically and ecofriendly. Grown-up plants and dead plant biomass must be removed in order to keep an optimum plant density and to prevent the return of contaminants into the produced water sample due to decomposition processes.

Removed plants are act as biomass and it can be used as manure for agricultural purpose.

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