THINK INDIA JOURNAL

ISSN:0971-1260
Vol-22- Issue-14-December-2019

Efficacy Of *Lemna Minor* In The Reusage Of Sugar Mill Effluent

[1]Dr. A. Radha and [2]Dr. M. Mumtaz

[1]Department of Zoology, K. N. G. Arts College for Women (Autonomous) Thanjavur-7, Tamil Nadu, India

[2]Department of Zoology, M. S. S. Wakf Board College, Madurai-20, Tamilnadu, India

Abstract

It is very essential and important to test the water before it is used for drinking, domestic, agricultural or industrial purpose. Selection of parameters for testing of water solely depends upon for what purpose we use that water and what extent we need its quality and purity. Water contains different types of floating, dissolved, suspended and microbiological as well as bacteriological impurities. The present study analyzed the physic-chemical characters of the sugar mill effluent samples collected from the Kurungulam Arignar Anna Sugar mill, Thanjavur. The present analyses to investigate the efficacy of aquatic vascular plant *Lemna Minor* to bio concentrate heavy metals in water containing sugar mill effluent. Similarly with many studies the present study also revealed that the aquatic vascular plant *Lemna Minor* has ability to absorb pollutants in waste water.

Key words: sugar mill effluent, physic-chemical characters, Lemna Minor

Introduction

Sugar industry is one of the most important agro based industries in India and is highly responsible for significant impact on rural economy in particular countries economy in general. Sugar industries rank second among our agro based industries in India. Sugar industry is seasonal in nature and operates only for 120 to 200 days in a year (early November to April). A significant large amount of waste is generated during the manufacture of sugar and contains a high amount of production load particularly in items of suspended solids, organic matters, press-mud, biogases and air pollutants. (Bevan, 1971, Hendrickson et. al., 1971). These industries consume huge quantity of water and throw back almost an equal quantity of effluent which contains highly toxic materials in dissolved or suspended form. If this water is properly used or it is purified to recycled, a part of water shortage will surely be solved. The sugar industry requires nearly about 1200 to 1400 m3 M.T. of water in which it is released as waste water of cane crushed. Industrial development (either new or existing industry expansion) results in the generation of industrial effluents, if untreated results in water, sediment and soil pollution (Fakayode and Onianwa 2002, Fakayode 2005). The excessive amounts of heavy metals such as Pb, Cr and Fe, from industrial processes are of special concern because they produce water or chronic poisoning in aquatic animals (Ellis 1989). High levels of pollutants mainly organic

ISSN:0971-1260
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matter in river water causes an increase in biological oxygen demand (Kulkarni 1997), chemical oxygen demand, total dissolved solids, total suspended solids and fecal coli form make water unsuitable for drinking, irrigation or any other use (Hari 1994). There are trends in developing countries to use sewage effluent as fertilizer has gained much importance as it is considered a source of organic matter and plant nutrients and serves as good fertilizer (Riordan 1983). As farmers are mainly interested in general benefits, like increased agriculture production, low cost water source, effective way of effluent disposal, source of nutrients, organic matter etc, they are not well aware of its harmful effects of heavy metal contamination of soils, crops and quality problems related to health. Recent studies had proven that long term use of this sewage Physico-chemical Analysis of Sugar Industry Effluents 43 effluent for irrigation contaminates soil and crops to such an extent that it becomes toxic to plants and causes deterioration of soil (Quinn 1978, Hemkes 1980). This contains considerable amount of potentially harmful substances including soluble salts and heavy metals like Fe2+, Cu2+, Zn2+, Mn2+, Ni2+, Pb2+. Additions of these heavy metals are undesirable. Plants can accumulate heavy metals in their tissues in concentrations above the permissible levels which are considered to represent a threat to the life of humans and animals feeding on these crops and may lead to contamination of food chain. As observed that soil and plants contained many toxic metals, that received irrigation water mixed with industrial effluent (Adnan Amin 2010). The quality of ground water depends on various chemical constituents and their concentration, which are mostly derived from the geological data of the particular region. Industrial waste and the municipal solid waste have emerged as one of the leading cause of pollution of surface and ground water. The situation gets worsened during the summer season due to water scarcity and rain water discharge. Contamination of water resources available for household and drinking purposes with heavy elements, metal ions and harmful microorganisms is one of the serious major health problems. The recent studies in Haryana (India) concluded that the high rate of exploration then its recharging, inappropriate dumping of solid and liquid wastes, lack of strict enforcement law and loose governance are the cause of deterioration of ground water quality (Gupta 2009). Most of the rivers in the urban areas of the developing countries are the ends of effluents discharged from the industries. As many countries are experiencingrapid industrial growth and this is making environmental conservation a difficult task (Agarwal Animesh 2011).

It is very essential and important to test the water before it is used for drinking, domestic, agricultural or industrial purpose. Selection of parameters for testing of water solely depends upon for what purpose we use that water and what extent we need its quality and purity. Water contains different types of floating, dissolved, suspended and microbiological as well as bacteriological impurities. Some physical test should be performed for testing of its physical appearance such as temperature, colour, odour, pH, turbidity, TDS etc, while chemical tests should be Physico-chemical Analysis of Sugar Industry Effluents 44 perform for its BOD, COD, dissolved oxygen, alkalinity, hardness and other characters. For obtaining more and more quality and purity water, it should be tested for its trace metal, heavy metal contents and organic i.e.

ISSN:0971-1260
Vol-22- Issue-14-December-2019

pesticide residue. It is obvious that drinking water should pass these entire tests and it should contain required amount of mineral level. Only in the developed countries, all these criteria's are strictly monitored. As very low concentration of heavy metal and organic pesticide, other pollutants are present in waste water; a highly sophisticated analytical instruments and well trained manpower are required. Different physic chemical parameters are tested regularly for monitoring quality of water.

METERIALS AND METHODS

Sample Collection

The sample collected for the studies were from Arignar Anna Sugar mill Kurungulam Thanjavur. The Plant samples were collected from Arul Nursery, Thanjavur. Samples of sugar industry effluents were collected in plastic containers. The physico-chemical analysis of sugar mill effluents was carried out as per the standard methods for analysis of water, waste water and industrial effluents was done at the chemical Laboratory The following physicochemical parameters of Sugar industry effluent studied are as follows

Colour

In the present investigation the colour of the untreated effluent was light black. It was observed visually.

Odour

It was categorised as objectionable or non-objectionable by direct smelling of the sample

pH

One of the important biotic factors that serve as an index for pollution. It was determined by using the pH meter. The factors like photosynthetic exposure to air, disposal of industrial water and domestic sewage affect pH. The wide narration in the pH value of effluent can affect the rate of biological reaction and survival of various microorganisms. The pH of potable water is not pathologically significant. Acid water with a pH of less than about 4 usually has a sour taste. The U.S. Public Health Service (1946) states that the maximum pH of treated drinking and culinary water on carriers subject to Federal quarantine regulations should be about 10.6. Optimum pH for fish is between 7.8 and 8.5 while acid water with pH below 4.4 and strong basic waters with pH greater than 8.8 generally causes gill irritation and death (Ellis, 1944). pH in conjunction with other factors affects the corrosion potential of water on metals. For detailed discussion the

ISSN:0971-1260
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chemist is referred to the work of Langelier (1946, p. 169). Low pH also increases the corrosive action of water on concrete (Antill,'1937, p. 1803). Extremes in pH cannot usually be tolerated by industry. The optimum pH for irrigation water depends on the type of crops to be grown and on the physical and chemical properties of the soil. Acid soils will tolerate the more alkaline water and some alkaline soils will tolerate the more acid water.

Principle of determination

See sec. C: 2c for the principles of pH-meter operation.The pH obtained in the laboratory may not be the same as that of the water at the time it was collected owing to reactions with sediment, hydrolysis, and oxidation taking place within the sample bottle. Also the pH may change appreciably through loss of dis-solved gases, the absorption of fumes in the laboratory, and from the deposition of calcium carbonate or other salts. Therefore, a value more representative of the pH at the time of collection is obtained if the determination is made as soon as the sample bottle is opened.

RESULTS AND DISCUSSION

The Physico- Chemical parameters It is very essential and important to test the water before it is used for drinking, domestic, agricultural or industrial purpose. Selection of parameters for testing of water solely depends upon for what purpose we use that water and what extent we need its quality and purity. Water contains different types of floating, dissolved, suspended and microbiological as well as bacteriological impurities. A significant large amount of waste is generated during the manufacture of sugar and contains a high amount of production load particularly in items of suspended solids, organic matters, press-mud and air pollutants. The Physico- Chemical parameters of sugar mill effluent were analysed and are listed in table 1. Some physical test should be performed for testing of its physical appearance such as temperature, colour, odour, pH, turbidity, TDS etc, while chemical tests should be Physico-chemical Analysis of Sugar Industry Effluents f0r BOD, COD, dissolved oxygen, alkalinity, hardness and other characters were done.

Aquatic plants are known to accumulate and bioconcentrate heavy metals. in the present study aquatic vascular plant Hydrilla Vacillate was cultivated in water containing sugar mill effluent. Physico chemical analysis of polluted water sample is very important to get exact idea

ISSN:0971-1260
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about the quality of water and to compare results of different physico chemical parameter values with standard values. Aftab Begum et al. (2005) studied various physico-chemical parameters and analysis of untreated fertilizer effluent and her results revealed that the parameters like EC, TDS, TSS, BOD, COD and ammonia are high compared to permissible limits of CPCB (1995), and fungal analysis showed the presence of 15 species isolated on Malt Extract Agar (MEA) medium thereby indicating the pollution load of the effluent. However the enrichment of these metals by bio-magnification and bioaccumulation in edible components produced in water is accepted to produce a remarkable effect on the river water Brahamani which is of deep public concern. Pawar Anusha et al. (2006) has studied the bore well and dug well water samples from a highly polluted industrial area - Nacharam. Sample were collected and analysed for physicochemical parameters by adopting the standard methods for examination of waste water. In the present investigation the colour of the untreated effluent was light black. It was observed visually, Odour It was categorised as objectionable or non-objectionable by direct smelling of the sample, the pH of sugar Industry effluent is in between 6.0 to 7.6, Avasn (2001), observed the pH of the sugar Industry effluent discharges from Tummapala sugar factory, Anakapalli (Andhra Pradesh) was 6.5 to 8.8., In the present investigation the pH value of the untreated effluents was 6.5 in November.

Table 1. Physico chemical parameters of the Sample Treated with *Hydrilla Verticillata* Auatic plant

Sl.No	Parameters	Values (Cont	Effluent treated with *Hydrilla Verticillata* after 15 days	Effluent treated with *Hydrilla Verticillata* after 30 days
1	Colour	Light Black	Light Black	Light Black
2	Odour	Unpleasant	unpleasant	Reduced Unpleasant
3	PH	6.56	6.61	6.67
4	Turbidity (NTU)	94	92	89
5	Total Suspended Solid mg/l	250	247	245
6	Total Dissolved Solid mg/l	510	508	506

ISSN:0971-1260
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7	Total Kjeldahl Nitrogen(as N) mg/l	8.2	8.16	8.14
8	Biological Oxygen Demand (3 days at 270C) mg/l	520	536	524
9	Chemical Oxygen Demand mg/l	680	646	623
10	Copper (as Cu) mg/l	0.018	0.014	0.013
11	Zinc (as Zn) mg/l	0.058	0.055	0.052
12	Dissolved Phosphate (as P) mg/l	2.5	2.23	2.17
13	Sodium (as Na) mg/l	124	118	113
14	Potassium(K) mg/l	20	18.4	17.2
15	Sulphate(SO_4) mg/l	12.1	10.2	9.92
16	Alkalinity mg/l	130	134	136.7
17	Calcium mg/l	48	45.3	42.2
18	Magnesium mg/l	17.4	15.2	14.26

The sugar industry requires nearly about 1200 to 1400 m3 M.T. of water in which it is released as waste water of cane crushed. Industrial development (either new or existing industry expansion) results in the generation of industrial effluents, if untreated results in water, sediment and soil pollution (Fakayode and Onianwa 2002, Fakayode 2005). This study reveals that these parameters increase with the addition of marble slurry leading to deterioration of the overall quality of the groundwater

Oxygen dissolved in water is derived from the air and from the oxygen given off in the process of photosynthesis by aquatic plants. The solubility of oxygen in water is dependent upon the partial pressure of oxygen in air, the temperature of the water, and the mineral content of the water. The origin of these pollutants is mainly from the entry of effluents from surrounding industries. Two major industries in the Ariyalur and Reddipalayam were selected and the waste water discharged from these units were collected and subjected to analysis. The values of different parameters were compared with the standard values given by Tamil Nadu Pollution Control Board. The reasons for variations are analysed and remedial measures were suggested (Gnana 2005). In mineral based industry among various environmental issues the water pollution has posed most Chapter-II Physico-chemical Analysis of Sugar Industry Effluents 46 disastrous effect and complex challenges for undertaking necessary remedial measures. The sources of water pollution in different mineral based industries including mining, mineral processing,

ISSN:0971-1260
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integrated iron and steel plant and nonferrous metal industries are described. Various liquid effluent treatments and techniques of both physico-chemical and biological parameters have been described and discussed. The process in each case being used commercially, have been outlined. (Jena and Mohanty 2005). Premlata Vikal (2009) has worked out on physicochemical characteristics of Pichhola lake water. He studied various parameters like air and water temperature, pH, free CO2, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, conductivity, total dissolved solids, hardness, total alkalinity, chloride, nitrate, phosphate and sulphate. The results revealed that the values of conductivity, COD, and sulphate were found to cross the standard limits in water samples. The coefficient of correlation (r) among various physicochemical parameters was also made. Gupta et al (2009) analyzed water samples from 20 sampling points of Kaithal for their physicochemical characteristics. Analysis of samples for pH, Colour, Odour, Hardness, Chloride, Alkalinity, TDS etc. are done to test the physico-chemical parameters. On comparing the results against drinking water quality standards laid by Indian Council of Medical

Research (ICMR) and World Health Organization (WHO), it is found that some of the water samples are non-potable for human being due to high concentration of one or the other parameter. Thus an attempt has been made to find the quality of ground water in and around Kaithal City town, suitable for drinking purposes or not. Basawaraj simpi et al. (2011) studied monthly changes in various physic chemical parameters of Hosahalli water tank in shimoga district Karnataka. Saravanakumar and Ranjith Kumar (2011) present paper studies about groundwater quality of Ambattur industrial area in Chennai City. They studied the parameters such as pH, total alkalinity, total hardness, turbidity, chloride, sulphate, fluoride, total dissolved solids and conductivity

CONCLUSION

There has been a growing awareness in recent years about the utility of biological methods in tackling the problem of industrial pollution. these are both easy and cost effective. In this connection the role of aquatic plants, because of their ability to absorb pollutants, has been recognized world wild in the treatment of waste water.

ACKNOWLEDGEMENT

ISSN:0971-1260
Vol-22- Issue-14-December-2019

The authors express sincere thanks to the head of the Department of Zoology, K. N. G. Arts College for Women (Autonomous) Thanjavur, Tamil Nadu, India and Department of Zoology, M. S. S. Wakf Board College, Madurai, Tamilnadu, India for the facilities provided to carry out this research work.

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