

Bioremediation of Wastewater using Invasive Bivalves



D. Deepthi, V. Sree Lakshmi, M. Chaitanya Babu

Abstract: The contaminant concentration in water bodies are increasing with the increase in industrialization of the country. Pollution of water is measured by the parameters like BOD, COD, nutrients (N,P & K), and pathogens. The COD can occur due to industrialization pollutants. Eutrophication is caused due to the presence of N,P and K in the water bodies. The polluted water can be treated by chemical and physical methods. In physical treatment methods decontamination is done by using biological activities like biofiltration and bioaccumulation. In this study physical method (biofiltration) is adopted using 'invasive bivalves' as media. Wastewater can be decontaminated near to 85% using bivalves. The main types of the bivalves used in this study are *Dressina polymorpha*, *mytilus edulis* and *corbiculaflumina*. These bivalves decrease the contamination level and these will encompass nutrient and phosphorus removal for recovery of eutrophic sites. They have also capacity of removing biological and chemical contaminants from water. The mechanism involved to reduce the contaminant concentration is biofiltration using bivalves.

Key words: Biofiltration, Invasive Bivalves, *Dressinapolymorpha*, *Mytilus edulis*, *Corbicula flumina*, Eutrophication.

I. INTRODUCTION

Water is needed mostly for every production. With the increase in needs, water wastage also increases. The wastewater mainly polluted with the unwanted matter, and the unwanted matter depends upon the source of waste it produces. The unwanted matter in the water may be the soap and chemical traces, pathogens and biological waste from residential areas. This wastage is released into the nearby water bodies with partial or no treatment. Due to this disposal the concentration of the contaminants is increasing with the time. The most effected water bodies due to the improper treatment are lakes, canals, and oceans. With the increased contaminants the effect on the flora and fauna is also increased.

II. STUDY AREA

Samples are collected from canals and from industrial area near Warangal.

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The selected study area is industrialized and the area is expected to have many industries.

Hence it is intended to study the water quality in the area industrial area. Kakatiya canal water near Warangal, Dharmasagar canal water near Warangal, Nagarjuna fertilizers and chemical limited (NFCL) outlet water.

III. METHODOLOGY

Bio filtration technique is used for treatment of wastewater. In this study the treatment is done by making a model of filtration unit. In this filtration unit, bivalves are introduced as macro-organism for decontamination. These selected bivalves have the capacity of treatment of wastewater. After the initial testing it is clear that the water is contaminated, so it is mandatory to treat the sample and then only release into water bodies.

Bio filtration of Wastewater using bivalves:

In the treatment the considered parameters are time of contact of bivalves with the sample, variation of other parameters with the time of treatment. The time of contact is fixed as 1 Day, 2 Days, 3 Days, 5 Days and 7 Days. For each contact period the sample is collected and the contamination levels are determined.

IV. ANALYSIS AND DISCUSSIONS

The collected samples were tested for Parameters that are greatly reduced by bivalves have been tested for the collected samples and these are also the parameters that show great impact when disposed of without proper treatment. A biofilter is a media bed on which microorganisms bind and expand to form a biofilm layer. Therefore, biofiltration is usually referred to as a method of fixed film. A variety of microorganisms such as bacteria, fungi, yeast, etc., microorganisms such as protozoa, worms, larvae of insects, etc. form the biofilm. And polymeric extracellular substances(EPS). Typically the biofilm is slimy.

Organic matter and different water components diffuse into the biofilm where the treatment occurs, mostly by biodegradation. Oxygen can be supplied to the biofilm, either along with the water flow or in opposite direction to the water flow. Aeration occurs passively by the natural flow of air through the process or by forced air supplied by blowers. A biofilter model is prepared with a transparent material. It is provided with an inlet and outlet. The inside area of the biofilter is filled with media and the bivalves.

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When water enters from inlet the flow enters upwards by hydrostatic pressure. During the upward flow the wastewater gets in contact with the media and bivalves during this contact period the bivalves treat the wastewater, so that cleaned or treated water is collected from the outlet. It is observed that one grownup mussel can filter water.7-8 liters of water is added each day, Number of bivalves kept in the biofilter are 7numbers of each type, The reason for the keeping the three type of bivalves are introduced in the biofilter because all the three type of bivalves cannot reduce All the type of pollution, i.e., Quassy type of bivalve take algae, Phytoplankton as food, Zebra mussels take substrate as food and blue mussels degrade toxins and bacteria.

Water sample collection

Sample location is determined on the basis of the level of pollution of the water bodies, and most of the pollution is due to the disposal waste

In this study treatment of Wastewater using bivalves is adopted for decontamination of such sites either at the site or either in treatment units.

4 samples are collected from the different areas near Warangal where the contamination chances are high.

Testing of samples:

For these 4 samples initial testing is done to determine the contaminant concentration levels. The selected parameters to determine the contamination are as follows:

Total nitrogen, Ammonical nitrate, Phosphorus, BOD, COD, presence of pathogens by using MPN value.

Table1 : Parameters and Standards

Parameter	CO D (mg /l)	BO D (mg /l)	Total Nitro gen (mg/l)	Nitrat e Nitro gen (mg/l)	Phosph orus (mg/l)	MP N per ml	E- Co li	Ph
Dispo- sal Standa rds	250	30	100	10	5.0	100	Ni l	6. 5- 8. 5

Table 4.1: Kakatiya canal water near Warangal

Sample 1	Initial value	Day 1	Day 2	Day 3	Day 5	Day 7
DO (ppm)	6.3	6.65	4.6	4.7	4.35	4.32
COD (ppm)	405	382	265	166	95	29.5
BOD (ppm)	89	85	67	52	25	22
Total Nitrogen as N (ppm)	155	125	100	95	54	17
Nitrate Nitrogen (ppm)	21.2	17.5	11.2	8.9	5	2.2
Phosphorus (ppm)	8.8	6.78	5.31	4.45	3.16	1.82
MPN (per 100 ml)	200	152	87	58	35	18
PH	7.28	7.58	7.57	7.78	7.89	8
Hardness (ppm)	800	652	425	225	120	38
TSS (ppm)	525	450	315	250	150	50
Salinity	35	35	35	35	35	35

(ppm)						
E-coli	Present	Nil	Nil	Nil	Nil	Nil

Table 4.2: Dharmasagar canal water Warangal.

Sample 2	Initial value	Day 1	Day 2	Day 3	Day 5	Day 7
DO (ppm)	8.5	6.5	5.65	4.79	4.67	4.23
COD (ppm)	280	205	150	95	62	23
BOD (ppm)	58	42	36	27	17	9
Total Nitrogen as N (ppm)	110	95.4	85	73	35	5
Nitrate Nitrogen (ppm)	18	14	11.5	8.2	5.5	2
Phosphorus (ppm)	8.5	7.2	5.48	3.52	1.15	0.6
MPN (per 100 ml)	130	115	102	88	35	15
PH	7.56	7.62	7.78	7.82	7.9	8.06
Hardness (ppm)	750	580	350	220	105	26
TSS (ppm)	335	226	105	95	70	15
Salinity (ppm)	35	35	35	35	35	35
E-coli	Present	Nil	Nil	Nil	Nil	Nil

Table 4.3: sample from NFCL outlet 1

Sample 3	Initial value	Day 1	Day 2	Day 3	Day 5	Day 7
DO (ppm)	6.35	5.35	5.05	4.65	4.27	4.1
COD (ppm)	7.5	658	428	236	146	76
BOD (ppm)	22	19	13	10	7	3
Total Nitrogen as N (ppm)	115	95	75	59	47	21
Nitrate Nitrogen (ppm)	22.4	21	17.4	16.2	12.2	8.2
Phosphorus (ppm)	15.2	12	10	7.6	4.32	2.02
MPN (per 100 ml)	95	66	54	46	20	12
PH	7.54	7.62	7.64	7.68	7.84	7.88
Hardness (ppm)	680	552	435	225	95	25
TSS (ppm)	613	550	425	300	215	95
Salinity (ppm)	35	35	35	35	35	35
E-coli	Present	Nil	Nil	Nil	Nil	Nil

Table 4.4: NFCL outlet

Sample 4	Initial value	Day 1	Day 2	Day 3	Day 5	Day 7
DO (ppm)	6.31	6.2	6.1	6.0	5.7	5.5
COD (ppm)	300	245	143	98	54	21
BOD (ppm)	95	85	78	49	34	14
Total Nitrogen as N (ppm)	170	118	115	102	87	69
Nitrate Nitrogen (ppm)	28	18.6	17.8	14.7	12.1	8.12

Phosphorus (ppm)	8.6	6.65	5.02	3.75	1.84	1.02
MPN (per 100 ml)	485	325	215	118	78	21
PH	7.45	7.5	7.6	7.6	7.8	8.0
Hardness (ppm)	980	815	516	355	135	75
TSS (ppm)	620	513	345	215	125	80
Salinity (ppm)	35	35	35	35	35	35
E-coli	Present	Nil	Nil	Nil	Nil	Nil

The test results of samples for different days

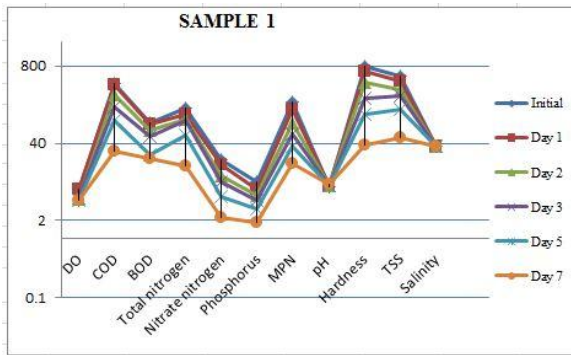


Figure 1: Kakatiya canal water near Warangal.

From the above Graphs it is clear that the COD is removed near to 90%, total nitrogen levels decreased above 90%, removal of pathogens is possible upto 88%. That means the contamination concentration decreases with increases in time of treatment.

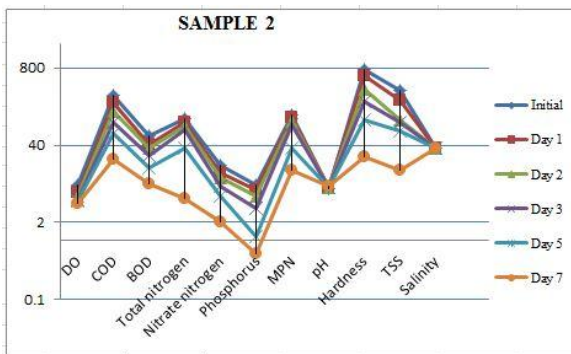


Figure 2: Dharmasagar canal water

MPN concentration and removal efficiency with increase in treatment duration in days From the above Graphs it is clear that the COD is removed near to 90%, total nitrogen levels decreased above 90%, removal of pathogens is possible upto 88%. That means the contamination concentration decreases with increases in time of treatment.

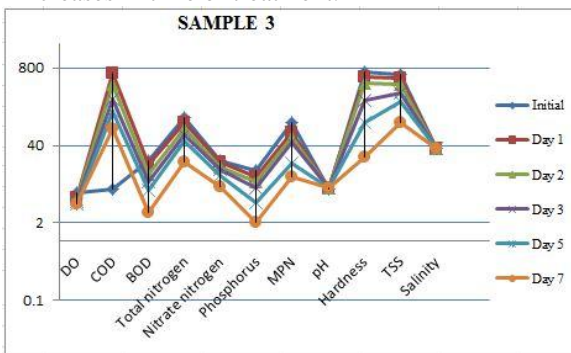


Figure 3: Wastewater from industrial area.

From the above Graphs it is clear that the COD is removed near to 82% ,total nitrogen levels decreased above 90%, removal of pathogens is possible upto 97%. That means the contamination concentration decreases with increases in time of treatment.

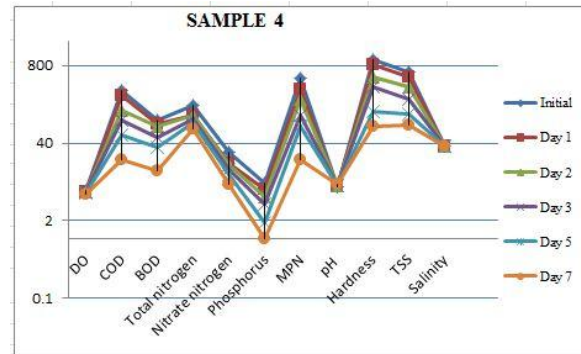


Figure 4: Wastewater from industrial area.

From the above Graphs it is clear that the COD is removed near to 90%, total nitrogen levels decreased above 90%, removal of pathogens is possible upto 98%. That means the contamination concentration decreases with increases in time of treatment.

V. CONCLUSIONS

Wastewater containing nitrates and phosphorus in various forms causes eutrophication; eutrophication decreases the DO and increases the BOD. As the bivalves take the contaminants like algae, substrate as their food the contamination level decreases with increase in time of treatment. The selected type of bivalves (*dreissenarostriformisbugensis*, *dreissenapolymorpha*, and *mytilus edulis*) can treat this type of Wastewater successfully. These type of bivalves can remove COD upto 80% for 3 days of treatment, and the Nitrates and Phosphorus levels are brought down upto 80-90% for 7 days of treatment, bivalves can reduce pathogens upto 90-95% with 7days of treatment. So these Animalia kingdom organisms can be used for treating the wastewater. These bivalves can treat polluted water bodies by simply harvesting them, they can be used in industrial treatment plants as the substitute of microorganisms in biological treatment. The only drawback is their growth should be controlled otherwise they will take control over the other aquatic animals in the water bodies.

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