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Pollution status of river Periyar

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Abstract – *Water plays a vital role in the socio-economic development of a country. Therefore, the availability of fresh water is of utmost importance in all aspects. The present study deals with the analysis of pollution status of Periyar river and suggestion of a natural treatment method for the removal of turbidity using natural coagulant, moringa oliefera leaves. For analyzing water quality, samples were collected from 5 different sampling points of Periyar River and performed tests for physico-chemical parameters like pH, BOD, COD, TSS, Turbidity, heavy metal concentration etc. The sampling sites were chosen by studying various anthropogenic activities and industrial operations carried out that cause heavy pollution by discharging large amount of sewage effluents into the river. The sampling sites were Aluva, Pathalam, Eloor, Eloor Ferry, Edayar. The results showed that the river is heavily polluted and there exist an unhealthy condition along the industrial stretch of Periyar river. After performing these tests, the project continues with experimenting the turbidity removal efficiency of Moringa Oliefera leaf powder. The optimum dosage and pH were 400 mg/L and 9 with turbidity removal efficiencies of 91% and 96% respectively. The study also point out the importance of Zero Liquid Discharge Technology in all industries and proper effluent treatment methods*.

***Key Words*: Turbidity, Coagulant, Anthropogenic activities, Sewage, Effluent**

1. INTRODUCTION

Kerala is one of the most populated locations in the world. Consequently, the rivers of Kerala is being heavily polluted due to various domestic and industrial activities. Periyar is the longest river of Kerala, known to be the 'Lifeline of Kerala', since it serves as the source of all socio-economic activities of the state. It has role in fields like power generation, domestic water supply, irrigation, tourism, industrial production, collection of fisheries and various resources. The Eloor-Edayar belt with almost 25% of Kerala's industries is the industrial hub of Kerala. Due to increased industrial activities and effluent discharge without proper treatment, river Periyar is dying day by day. The condition is very poor in the aspect of water quality. In this circumstance, study of pollution status of Periyar river and suggestion of treatment methods are crucial.

1.1 Causes of Pollution

The main reasons of pollution of riverine ecosystem are

- Sewage and Garbage
- Agricultural Run-off
- Industrial Pollution

The river recieves effluents from townships like Aluva, Paravur, Perumbavur, Kalady, Malayattur, Cheruthoni, Munnar, Vandiperiyar. The local bodies lack proper sewage treatment facilities which lead to direct discharge of untreated wastes to the river.

The intensive use of pesticides and fertilizers in agricultural land for large crop yield enrich the river water with harmful inorganic pollutants which cause serious threats to aquatic species and human by bio-magnification.

There are about 250 industries manufacturing chemical-petrochemical products, pesticides, rare earth elements, fertilizers etc. These industries use large quantity of river water as raw material and in turn discharge toxic effluents without proper treatment. This cause deterioration of water quality and thus lead to damage to various species in the environment.

Coagulation is the process of destabilization of colloids by the addition of chemicals that neutralize the negative charge by rapid mixing. The chemical used for coagulation is called coagulants and generally possess positive charge. The dissolved and suspended particles in the water carry negative charge which is neutralized by the positive charge of coagulants. The particles bind together and agglomerate while the reaction occurs. Thus, the increased weight of the agglomerated particles make them settle in the bottom which is called sedimentation. As chemical elements are expensive and may cause harmful effects, this study recommends the use of natural coagulant 'Moringa Oliefera Leaf' as coagulant for turbidity removal of sample.

2. METHODOLOGY

For studying pollution level of river Periyar and suggesting treatment methods, process was carried out by following steps:

- Field study
- Selection of sampling points
- Sample collection

- Water quality testing
- Experimenting natural treatment method for turbidity removal using Moringa Oliefera leaves.

2.1 Field Study

The primary procedure was thorough study of the area. This helps to identify the causes of pollution which include domestic and industrial activities. Based on this study, some industries causing pollution are listed below

Table -1: Various industries responsible for pollution of Periyar river

INDUSTRIES	PRODUCT	POLLUTANTS	EFFECTS
FACT(Fertiliser and Chemicals Trvancore)	FACTAMFOS, Ammonium Sulphate, Ammonium Phosphate	Heavy metals like Mercury, Lead, Cadmium, Copper etc	Diseases like cancer, Birth defects, Depression
TCC(Travancore Cochin Chemicals)	Caustic soda lye (32%), Caustic soda lye (48%), Caustic soda flakes, Liquid Chlorine, Hydrochloric acid	Hg, Nacl	Asthma, Bronchitis, Cancer, birth defects
HIL(Hindustan Insecticides Ltd.)	Insecticide, Pesticide, Herbicide, Fungicide, Sanitizer, Weedicide, Biopesticide	Mercury, Copper, Zinc, Lead, Chromium	Cancers, Allergic dermatitis, stomach ulcers, birth defects, Asthma
IREL(Indian Rare Earth Ltd.)	Ilmenite, Rutile Zircon, Garnet Silliminate, Rare Earth Chloride, Thorium Nitrate,	Lead, Zinc Lead, Zinc	Cancer
CMRL(Cochin Minerals and Rutile Ltd.)	Rutile or Titanium oxide crystals	Ferrous Chloride	Brown hues to water

2.2 Selection of sampling sites

Different sampling sites were selected by understating the major cause of pollution is industrial discharge. The sampling sites were Aluva, Pathalam, Eloor, Eloor Ferry, Edayar.

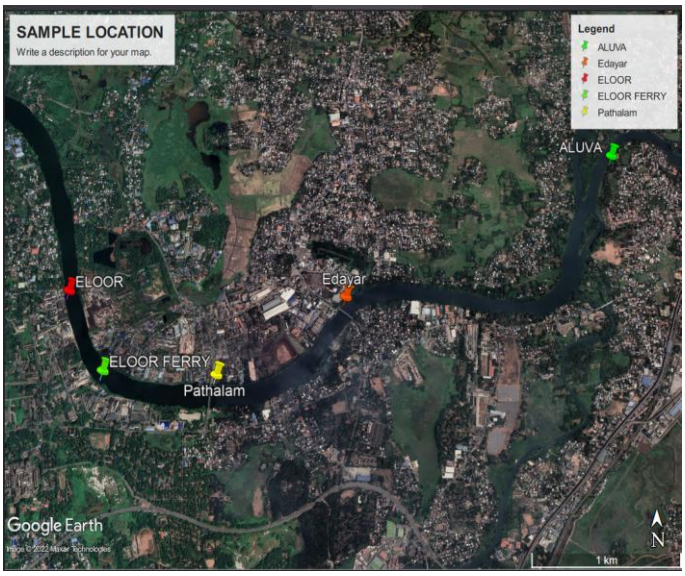

Fig -1: Sampling sites

2.3 Collection of samples

Samples were collected from the five different locations, 20 cm below the surface of the river. About 3 liters of sample was collected in sterile containers from each location for testing physico-chemical parameters to determine the water quality.

2.4 Performance of physico-chemical tests

Tests like pH, DO(Dissolved Oxygen), BOD(Biological Oxygen Demand), COD(Chemical Oxygen Demand), TSS(Total Suspended Solids). Chloride, Heavy metal concentration, (Lead, Mercury, Cadmium) and turbidity was performed according to the location and industrial discharge regulated.

2.5 Coagulation using natural coagulant to remove turbidity

In order to remove the turbidity of water sample, a natural coagulant, Moringa oliefera leaf powder was used. The leaves were collected from households in my locality. After drying these leaves for 3 days and grinded in domestic blenders, it was used for performing jar test. Test was performed under varried pHcondition by adding 0.1 M HCl solution and also varied coagulant dosage.

Fig -2: Moringa oliefera leaf

3. RESULTS AND DISCUSSIONS

The observations of tests performed are as follows.

Table-2: Water quality Parameters of the samples

Sampling site	Water quality parameters	Observed Value(mg/L)	Permissible limit(mg/L)	% variation
Aluva	pH	8.5	7.5	13
	DO	5	30	
	BOD	29	20	
	COD	140	120	
	TSS	108	10	98
	Chloride	240	250	4
Pathal-am	pH	6.5	7.5	13
	DO	6.3	30	79
	BOD	55	30	83
	COD	150	120	25
	TSS	18.4	10	84
	Chloride	240	250	4
Eloor	pH	7.8	7.5	4
	Turbidity(NTU)	45	5	2
	DO	7.2	30	79
	BOD	55	30	83
	LEAD	0.42	0.3	40
	TSS	19	10	90
	Mercury	0.052	0.03	73
	Nitrate	180	160	12.5
Eloor Ferry	pH	7.2	7.5	4
	DO	12	30	60
	BOD	40	30	33
	COD	150	120	25
	TSS	7	10	30
	Chloride	325	250	30
	Cadmium	1.2	0.003	39900
	Nitrate	170	160	6
Edayar	pH	6.5	7.5	15
	DO	6.3	30	79
	BOD	55	30	83
	COD	170	120	41
	TSS	6	10	40
	Chloride	320	250	28

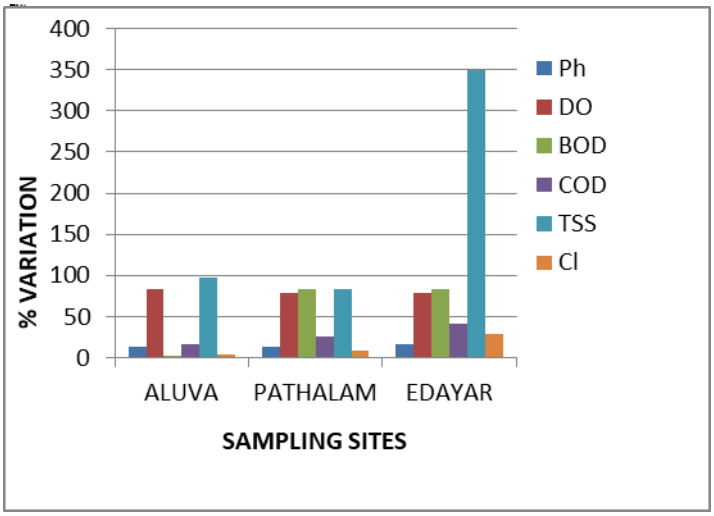

Chart-1: Percentage variation of parameters with permissible limit

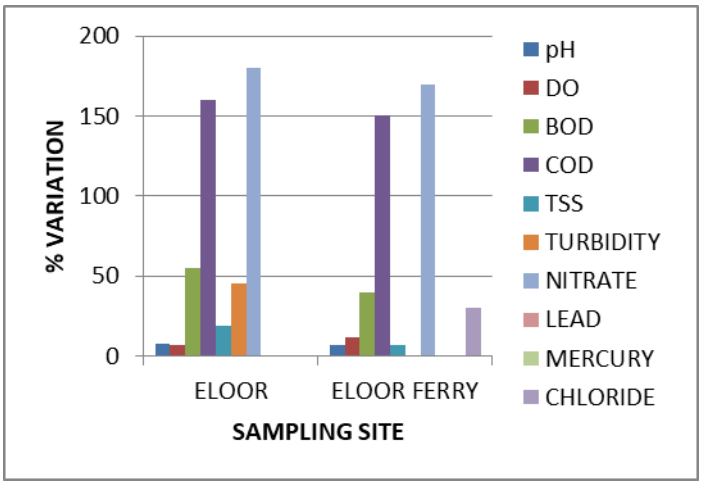

Chart-2: Percentage variation of parameters with permissible limit

From the above results, it is clear that the samples show unhealthy condition of the river water. The large variation of different parameters says that the river is highly polluted.

Table below shows the turbidity removal efficiency of Moringa Oliefera leaf powder as the coagulant with varying dosage and Ph.

Table-3: Turbidity removal efficiency with respect to varying dosage

Dosage of Coagulant (mg/l)	Initial turbidity (NTU)	Final turbidity (NTU)	Turbidity removal efficiency (%)
100	45	39.6	12
200	45	32.85	27
300	45	16.65	63
400	45	4.05	91
500	45	22	51.11

Table-4: Turbidity removal efficiency with respect to varying pH

pH	Initial turbidity (NTU)	Final turbidity (NTU)	Turbidity removal effeciency (%)
5	45	37.8	16
6	45	26.1	42
7	45	20	55.55
8	45	14.9	67
9	45	1.8	96

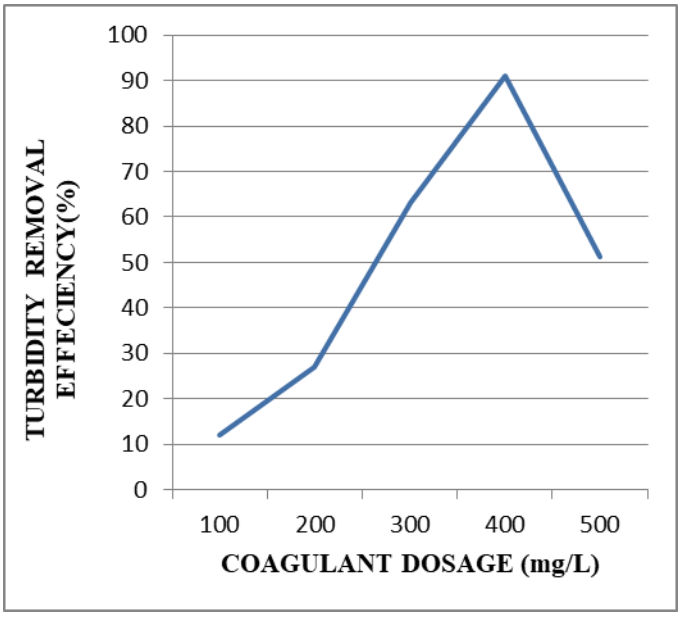

Chart-3: Turbidity removal efficiency versus varying coagulant dosage

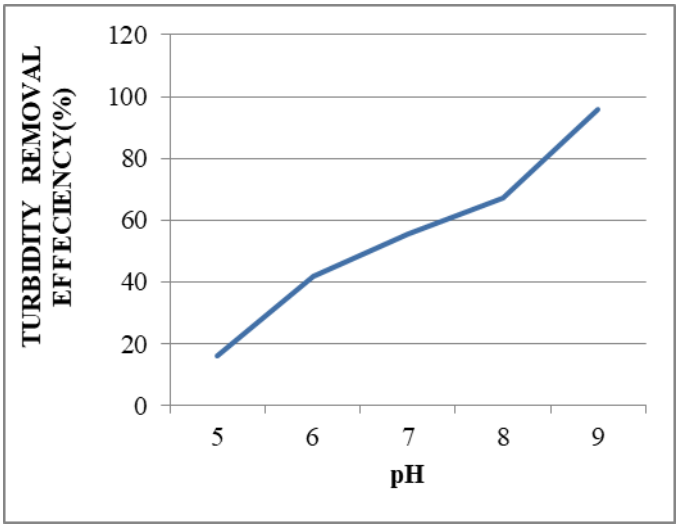

Chart-4: Turbidity removal efficiency versus varying pH

From the results, it is clear that the efficiency of turbidity removal increases as the coagulant dosage and pH is increased. Therefore, the turbidity removal efficiency is directly proportional to the pH and coagulant dose. Also, the optimum dosage of coagulant and the optimum pH was observed as 400 mg/L and 9 respectively. The maximum turbidity removal efficiencies were found to be 91% and 96 % in coagulation with varying coagulant dosage and varying pH respectively.

4. CONCLUSIONS

Water pollution is a serious problem due to rapid urbanization. The increasing population and the water demand raises the necessity of proper treatment and disposal of industrial effluents as this leads to surface water deterioration, poor ground water quality etc. The study shows that Periyar river is highly polluted due various domestic and industrial activities carried out. Industries must strictly follow Zero liquid discharge technology. This is the primary step to be followed to reduce discharge of toxic substances. State and Central authorities must take necessary action against the violation of rules and regulation regarding these operation. Also, appointing monitoring committees can also bring changes.

Since, sewage treatments using chemicals is costly and poses a problem of large quantity of sludge disposal, a natural coagulant was experimented for turbidity removal ie, moringa oliefera leaf powder. The study shows that it is effective in turbidity removal. As the Ph

And coagulant dosage increases, the turbidity removal efficiency also increased. The optimum dosage of coagulant and the optimum pH was observed as 400 mg/L and 9 respectively. The maximum turbidity removal efficiencies were found to be 91% and 96 %.

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