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# Fishing Industry Waste Water Treatment by Polyelectrolytes

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***Abstract—*** *The fishing industries consume huge amount of water and also produce tonnes of waste water from fish preservation and fish tanks. The fishing industry wastewater treatment can be done by sequence of treatment processes such as sedimentation, coagulation. Characteristics of fishing industry wastewater are the color is light brown, pH is 8, COD is 576.0mg/l, $BOD_3$ is 185.0mg/l, VSS is 0.56mg/L, TSS is 110.5mg/l, conductivity is 39300.0µs/cm, oil and grease is 2.1mg/l, fecal coliform is >2400MPN, total phosphorous is 22.6mg/l, total nitrogen is 60.0mg/l, ammonical nitrogen is <0.05, TOC is 20.8mg/l and turbidity is 3.9NTU. The optimum dosage of aluminium chloride as a polyelectrolyte is found to be 100mg/l, optimum pH is 7 and optimum time 30min. The reduction in turbidity for the fishing industry wastewater is 79%, reduction in $BOD_3$ is 65%, reduction in COD is 66%, reduction in TSS is 87% and reduction in VSS is 61%, conductivity is 41%, oil and grease is 90%, total phosphorous is 94%, total nitrogen is 67% and TOC is 95% by the influence of the polyelectrolyte aluminium chloride. Optimum dosage of bentonite clay is 500mg/l, optimum pH is 6 and optimum time 45min. The reduction in turbidity for the fishing industry waste water is 62%, reduction in $BOD_3$ is 58%, reduction in COD is 61%, reduction in TSS is 80% and reduction in VSS is 73%, conductivity is 40%, oil and grease is 81%, total phosphorous is 92%, total nitrogen is 50% and TOC is 94% by the influence of the polyelectrolyte bentonite clay. Optimum dosage of ferrous sulphate monohydrate is 300mg/l, optimum pH is 7 and optimum time 45min. The reduction in turbidity for the fishing industry wastewater is 18%, reduction in $BOD_3$ is 49%, reduction in COD is 56%, reduction in TSS is 69% and reduction in VSS is 39%, conductivity is 30%, oil and grease is 76%, total phosphorous is 93% and TOC is 94% by the influence of the polyelectrolyte ferrous sulphate monohydrate. There is no change in fecal coliform and ammonical nitrogen by the effect of these polyelectrolytes. Similarly there is no change in total nitrogen by the effect of ferrous sulphate monohydrate.*

***Keywords— BOD-Biochemical oxygen demand, COD-Chemical oxygen demand, TOC-Total organic carbon, TSS-Total suspended solids, VSS-Volatile suspended solids***

## I. INTRODUCTION

Water pollution and water scarcity is a crucial environmental problem in India. The total amount of waste water generated from all Industries is about 83,048 mid. Total amount of waste water generated from fishing industries is about 14,300 $m^3$ daily. Fishing industry generates waste water with high content of compounds such as nitrogen, phosphorous, organic matter, salts, oil and grease. The effluents from these industries are subjected to a sequence of treatment processes to reduce the concentration of effluents. Effluents treatment are done to attain quality water for reuse and recycling of theses water for industrial processes. Water recycling means reusing treated wastewater for purposes such as agricultural and irrigation, industrial processes, domestic use etc. The previous work focuses on the treatment of fishing industry waste water by other polyelectrolytes and 100% removal efficiency is not attained. This work aims to make fishing industry more co efficient by reuse or recycling of waste water after treatment of waste water using polyelectrolytes such as Bentonite clay, Aluminium chloride and Ferrous sulphate mono hydrate. This work also evaluate the removal efficiencies of these three electrolytes and also analyze the parameters such as color, TSS, volatile suspended solids, TOC, COD, BOD, total phosphorous, total nitrogen, ammonical nitrogen, fecal coliform removal, conductivity, fats, oil and grease and pH.

## II. MATERIALS AND METHODS

### 2.1 Materials

The polyelectrolytes such as Bentonite clay, Aluminium chloride and Ferrous sulphate mono hydrate is used for treatment of fishing industry wastewater. The polyelectrolytes are collected from Chemind chemicals at Trissur. The fishing industry waste water is collected from Azhikode Jetty (Govt. of Kerala, Department of Fisheries and Regional Shrimp Hatchery) Azhikode in Trissur district

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**2.2 Methods**

2.2.1 Sedimentation

Sedimentation test using graduated cylinder is done before coagulation. The waste water taken in graduated cylinder is left undisturbed for a period of 2 hours. A sampling port is attached with graduated cylinder, 10 cm from the bottom, such that water from the middle layer is taken. The fishing industry waste water characteristics are evaluated after sedimentation.

## III. EXPERIMENTAL SET UP

Coagulation-flocculation can be employed by standard jar test. Three different polyelectrolytes such as Bentonite clay, Aluminium chloride and Ferrous sulphate mono hydrate is used. Several dosages of polyelectrolytes are taken. The dosages taken are 100mg/L, 200mg/L, 300mg/L, 400mg/L, 500mg/L and 600mg/L. Middle layer water from the graduated cylinder after sedimentation is taken and filled in each jar of 1000 mL and various coagulant dosages are added in each jar. Paddles are rotated at 150 rpm for 3 min for rapid mixing for floc formation. Paddles are rotated at 20 rpm for 15 min. Finally, it is left undisturbed for the flocs to settle. The supernatants is taken for analysis.

## IV. RESULTS AND DISCUSSIONS

**4.1 Initial characteristics of waste water**

The initial characteristics of fishing industry waste water such as color, pH, turbidity, BOD, COD, volatile suspended solids, total suspended solids, conductivity, oil and grease, fecal coliform, total phosphorous, total nitrogen, ammonical nitrogen, total organic carbon are being observed.

*Table.1: Initial characteristics of waste water*

| Parameters | Unit | Value |
|---|---|---|
| Color | - | Light brown |
| pH | - | 8.0 |
| Turbidity | NTU | 3.9 |
| COD | Mg/L | 576.0 |
| BOD | Mg/L | 185.0 |
| TSS | Mg/L | 110.5 |
| VSS | Mg/L | 0.56 |
| Conductivity | µs/cm | 39300.0 |
| Oil and grease | Mg/L | 2.1 |
| Coliform | MPN | >2400 |
| Total phosphorous | Mg/L | 22.6 |
| Total nitrogen | Mg/L | 60 |
| Ammonical nitrogen | Mg/L | <0.05 |
| Total organic carbon | Mg/L | 20.8 |

**4.2 Characteristics of waste water after sedimentation**

The characteristics of fishing industry waste water after sedimentation are being analyzed. such as color, pH, turbidity, BOD, COD, volatile suspended solids, total suspended solids, conductivity, oil and grease, fecal coliform, total phosphorous, total nitrogen, ammonical nitrogen, total organic carbon are being observed.

*Table. 2: Characteristics of waste water after sedimentation*

| Parameters | Unit | Value |
|---|---|---|
| Color | - | Light brown |
| pH | - | 8.0 |
| Turbidity | NTU | 3.9 |
| COD | Mg/L | 576.0 |
| BOD | Mg/L | 185.0 |
| TSS | Mg/L | 53 |
| VSS | Mg/L | 0.42 |
| Conductivity | µs/cm | 39300.0 |
| Oil and grease | Mg/L | 1.3 |
| Coliform | MPN | >2400 |
| Total phosphorous | Mg/L | 22.6 |
| Total nitrogen | Mg/L | 60 |
| Ammonical nitrogen | Mg/L | <0.05 |
| Total organic carbon | Mg/L | 20.8 |

**4.3 Optimum dosage**

The optimum dosage of polyelectrolytes are determined by varying the dosage of polyelectrolytes as 100mg/l, 200mg/l, 300mg/l, 400mg/l, 500mg/l and 600mg/l at original pH of fishing industry wastewater (pH =8.0). The optimum dosage adopted for polyelectrolytes are 100mg/l for aluminium chloride, 500mg/l for bentonite clay and 300mg/l for ferrous sulphate monohydrate.

**4.4 Optimum pH**

The optimum pH of polyelectrolytes are determined by varying the pH of polyelectrolytes as 3, 4, 5, 6, 7 and 8. The optimum pH adopted for polyelectrolytes are 7 for aluminium chloride, 6 for bentonite clay and 7 for ferrous sulphate monohydrate.

**4.5 Optimum time**

The optimum time of polyelectrolytes are determined by varying the time intervals of polyelectrolytes as 15min, 30min, 45min, 60min, 75min and 90min. The optimum time adopted for polyelectrolytes are 30min for aluminium chloride, 45min for bentonite clay and 45min for ferrous sulphate monohydrate.

**4.6 Final characteristics of waste water**

Fishing industry waste water is being treated with polyelectrolytes aluminium chloride, bentonite clay,

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ferrous sulphate monohydrate with optimum dosage, optimum pH and optimum time and final characteristics of treated fishing industry waste water is being analyzed.

**4.7 Effect of aluminium chloride**

Fishing industry waste water is being treated with polyelectrolyte aluminium chloride with optimum dosage of 100mg/l, optimum pH 7 and optimum time of 30min and final characteristics of treated fishing industry waste water is being analyzed.

*Table.3: Final characteristics of waste water treated by aluminium chloride*

| Parameters | Unit | Aluminium chloride |
|---|---|---|
| Color | - | Colorless |
| pH | - | 7.0 |
| Turbidity | NTU | 0.8 |
| COD | Mg/L | 196.0 |
| BOD | Mg/L | 65.0 |
| TSS | Mg/L | 14.5 |
| VSS | Mg/L | 0.22 |
| Conductivity | µs/cm | 23240.0 |
| Oil and grease | Mg/L | 0.2 |
| Coliform | MPN | >2400 |
| Total phosphorous | Mg/L | 1.38 |
| Total nitrogen | Mg/L | 20 |
| Ammonical nitrogen | Mg/L | <0.05 |
| Total organic carbon | Mg/L | 1.10 |

**4.8 Efficiency of aluminium chloride**

To determine the efficiency of aluminium chloride, the optimum dosage, optimum pH and optimum time can be maintained. Optimum dosage is 100mg/l, optimum pH is 7 and optimum time 30min. The reduction in turbidity is 79%, reduction in $BOD_3$ is 65%, reduction in COD is 66%, reduction in total suspended solids is 87% and reduction in volatile suspended solids is 61%, conductivity is 41%, oil and grease is 90%, total phosphorous is 94%, total nitrogen is 67% and total organic carbon is 95%.

**4.9 Effect of bentonite clay**

Fishing industry waste water is being treated with polyelectrolyte bentonite clay with optimum dosage of 500mg/l, optimum pH 6 and optimum time of 45min and final characteristics of treated fishing industry waste water is being analyzed.

*Table.4: Final characteristics of waste water treated by bentonite clay*

| Parameters | Unit | Bentonite clay |
|---|---|---|
| Color | - | Colorless |
| pH | - | 6.0 |
| Turbidity | NTU | 1.5 |
| COD | Mg/L | 224.0 |
| BOD | Mg/L | 78.0 |
| TSS | Mg/L | 22.1 |
| VSS | Mg/L | 0.15 |
| Conductivity | µs/cm | 23550.0 |
| Oil and grease | Mg/L | 0.4 |
| Coliform | MPN | >2400 |
| Total phosphorous | Mg/L | 1.86 |
| Total nitrogen | Mg/L | 30 |
| Ammonical nitrogen | Mg/L | <0.05 |
| Total organic carbon | Mg/L | 1.25 |

**4.10 Efficiency of bentonite clay**

To determine the efficiency of bentonite clay, the optimum dosage, optimum pH and optimum time can be maintained. Optimum dosage is 500mg/l, optimum pH is 6 and optimum time 45min. The reduction in turbidity is 62%, reduction in $BOD_3$ is 58%, reduction in COD is 61%, reduction in total suspended solids is 80% and reduction in volatile suspended solids is 73%, conductivity is 40%, oil and grease is 81%, total phosphorous is 92%, total nitrogen is 50% and Total organic carbon is 94%.

**4.11 Effect of ferrous sulphate monohydrate**

Fishing industry waste water is being treated with polyelectrolyte ferrous sulphate monohydrate with optimum dosage of 300mg/l, optimum pH 7 and optimum time of 45min and final characteristics of treated fishing industry waste water is being analyzed.

*Table. 4: Final characteristics of waste water treated by ferrous sulphate monohydrate*

| Parameters | Unit | Ferrous sulphate monohydrate |
|---|---|---|
| Color | - | Light brown |
| pH | - | 7.0 |
| Turbidity | NTU | 3.2 |
| COD | Mg/L | 256.0 |
| BOD | Mg/L | 94.0 |
| TSS | Mg/L | 34.5 |
| VSS | Mg/L | 0.34 |
| Conductivity | µs/cm | 27345.0 |
| Oil and grease | Mg/L | 0.5 |
| Coliform | MPN | >2400 |
| Total phosphorous | Mg/L | 1.52 |
| Total nitrogen | Mg/L | 60 |
| Ammonical nitrogen | Mg/L | <0.05 |
| Total organic carbon | Mg/L | 1.29 |

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**4.12 Efficiency of ferrous sulphate monohydrate**

To determine the efficiency of ferrous sulphate monohydrate, the optimum dosage, optimum pH and optimum time can be maintained. Optimum dosage is 300mg/l, optimum pH is 7 and optimum time 45min. The reduction in turbidity for the fishing industry wastewater is 18%, reduction in $BOD_3$ is 49%, reduction in COD is 56%, reduction in total suspended solids is 69% and reduction in volatile suspended solids is 39%, conductivity is 30%, oil and grease is 76%, total phosphorous is 93% and total organic carbon is 94% by the influence of the polyelectrolyte ferrous sulphate monohydrate.

## V. CONCLUSION

The characteristics of fishing industry wastewater are color is light brown, pH is 8, COD is 576.0mg/l, $BOD_3$ is 185.0mg/l, volatile suspended solids is 0.56mg/L, total suspended solids is 110.5mg/l, conductivity is 39300.0µs/cm, oil and grease is 2.1mg/l, fecal coliform is >2400MPN, total phosphorous is 22.6mg/l, total nitrogen is 60.0mg/l, ammonical nitrogen is <0.05, total organic carbon is 20.8mg/l and turbidity is 3.9NTU. The optimum dosage of aluminium chloride as a polyelectrolyte is found to be 100mg/l, optimum pH is 7 and optimum time 30min. The reduction in turbidity for the fishing industry wastewater is 79%, reduction in $BOD_3$ is 65%, reduction in COD is 66%, reduction in total suspended solids is 87% and reduction in volatile suspended solids is 61%, conductivity is 41%, oil and grease is 90%, total phosphorous is 94%, total nitrogen is 67% and total organic carbon is 95% by the influence of the polyelectrolyte aluminium chloride. Optimum dosage of bentonite clay is 500mg/l, optimum pH is 6 and optimum time 45min. The reduction in turbidity for the fishing industry wastewater is 62%, reduction in $BOD_3$ is 58%, reduction in COD is 61%, reduction in total suspended solids is 80% and reduction in volatile suspended solids is 73%, conductivity is 40%, oil and grease is 81%, total phosphorous is 92%, total nitrogen is 50% and total organic carbon is 94% by the influence of the polyelectrolyte bentonite clay. Optimum dosage of ferrous sulphate monohydrate is 300mg/l, optimum pH is 7 and optimum time 45min. The reduction in turbidity for the fishing industry wastewater is 18%, reduction in $BOD_3$ is 49%, reduction in COD is 56%, reduction in total suspended solids is 69% and reduction in volatile suspended solids is 39%, conductivity is 30%, oil and grease is 76%, total phosphorous is 93% and total organic carbon is 94% by the influence of the polyelectrolyte ferrous sulphate monohydrate. Hence aluminium chloride as a polyelectrolyte is effective for treatment of fishing industry wastewater, and the treated fishing industry waste water can be used for irrigational purposes. This study focuses on the fishing industry waste water treatment by using polyelectrolytes such as aluminium chloride, bentonite clay and ferrous sulphate monohydrate by varying dosage, pH ant time. The scope of further study can be done by varying temperature, salt, sequence of chemical addition and rapid mixing.

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An acknowledgement section may be presented after the conclusion, if desired.

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