

# Experimental Study On Treatment Of Sullage Waste Water Using Coagulants

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**Abstract** — All waters, especially domestic waste waters, contain both dissolved and suspended particles. Coagulation process is used to separate the suspended solids portion from the water. The present study aims to treat the sullage water by various coagulants *Zia mays*, *hibiscus rosa sinensis* as natural coagulants and ferric chloride, calcium carbonate and as chemical coagulants. The waste water treated by natural coagulants is economical and safe compared to chemical coagulants. For better removal efficiency, the waste water have to treated by using blending of natural and chemical coagulants which have the better removal efficiency. The ratio of natural and chemical coagulant is 2:1. They have high removal efficiency of turbidity, hardness, BOD, Total, suspended and dissolved solids. The treated water can be used for the car washing, gardening and irrigation purposes. Based on the experimental results, it was concluded that natural coagulant and blended coagulant efficiency which can be removed upto 80.88%, 83.82% of turbidity respectively compared to chemical coagulants.

**Keywords-** Waste water , *Zia mays*, *hibiscus*, coagulation.

## I. INTRODUCTION

The earth surface are covered by two third of water but only one percent is pure. The water scarcity and need for water becomes increased nowadays and the disposal of waste water is a global problem in almost all state across the country due to increasing trends. The only solution for that problem is reuse of waste

water and the treated water is used for various purpose to avoid the water scarcity.

Waste water is generally made of black water and grey water. Waste water that has been adversely affected in quality by anthropogenic influence. Grey water is also known as sullage water

is non industrial wastewater generated from domestic processes such as washing dishes, laundry and bathing. Grey water 65 of waste water .grey water is distinct from black water in the amount and composition of its chemical and biological contaminants. Grey water by definition does not include the discharge of toilets or highly focally contaminated waste water which is designated sewage or black water to indicate it contains human waste. The small traces of feces that enter the grey water stream via effluent from the shower, sink, or washing machine do not pose practical hazards under normal conditions, as long as the grey water is used correctly. Grey water usually contains some traces of excreta and is therefore not free of pathogens. The excreta comes from washing a person's anal area in the bath and shower, or from the laundry.

Demand on conventional water supplies and pressure on sewage treatment systems is reduced by the use of sullage water. Re-using sullage water also reduces the volume of sewage effluent entering watercourses which can be ecologically beneficial. In times of drought, especially in urban areas, greywater use in gardens or toilet systems helps to achieve some of the goals of ecologically sustainable development.

Greater quality of surface and ground water are preserved by natural purification .the benefits of sullage water recycling leads to reduction of water scarcity and helps in ground recharge ,reclamation of nutrients. Sullage water use yields the satisfaction of taking responsibility for the wise husbandry of an important resource. The sullage recycle systems are ideal for residential colonies as well as hotels, hospitals and large institutions. Such systems would help reduce infrastructural costs on public water supply systems as well as avoid heavy losses of water through leakages during distribution through public supply pipelines

. Population growth usually increases demand for water in all sectors of economy: agricultural, industrial and domestic. Due to rapid population growth, unplanned urbanization, surface water pollution and continuous ground water extraction. To

deal with this complicated situation, some innovative measures should be taken to minimize the use of potable water. Recycle and reuse Grey water, rainwater harvesting during monsoon are good options for saving fresh drinking water.

There are several methods to treat the sullage water like ultra filtration, reverse osmosis., etc but the ecofriendly and economic method is coagulation process. It has reduced environmental impact and it is cost effective when compared to rain water harvesting method.

**II. MATERIALS AND PREPARATIONS**

**2.1. Materials**

The coagulants which are used in this study are Zia mays , hibiscus rosa sinensis as natural coagulants . Ferric chloride and calcium carbonate as chemical coagulants. The descriptions are given below:

**2.1.1. Zia Mays**

Zia mays, corn or maize, is a annual grass in the Poaceae (grass family). The maize plant is often 3 m (10 ft) in height, though some natural strains can grow 12 m (39 ft). The stem is commonly composed of 20 internodes of 18 cm (7.1 in) length .In moderate amounts, they also supply dietary fiber and the essential minerals, magnesium and phosphorus whereas other nutrients are in low amounts .they are used in waste water treatment and has the water soluble protein.

**2.1.2. Hibiscus rosa sinensis**

Hibiscus rosa sinensis belongs to malvaceae family and native to East Asia. It is commonly known as hibiscus, Hawaiian hibiscus, and shoeblack plant. small tree growing 2.5–5 m (8–16 ft) tall and 1.5–3 m (5–10 ft) wide, with glossy leaves . It can also be used as a pH indicator. When used, the flower turns acidic solutions to a dark pink or magenta color and basic solutions to green..It is considered to have a number of medical uses.

**2.1.3. Ferric chloride**

Ferric chloride is the coagulant of choice for many industrial and sanitary wastewater treatment applications, due to its high efficiency, effectiveness in clarification, and utility as a sludge dewatering agent. The chemical leaves slight residual color, and offers very good turbidity removal. The determination of the optimum pH range and coagulant concentration ultimately depends on the raw water characteristics, and differs for each water source.

**2.1.4. Calcium carbonate**

**Calcium carbonate** is a chemical compound with the formula CaCO<sub>3</sub>. It is a common substance found in rocks as the minerals calcite and aragonite Calcium carbonate is the active ingredient in agricultural lime and is created when calcium ions in hard water react with carbonate ions to create limescale. It is medicinally used as a calcium supplement or as an antacid, but excessive consumption can be hazard. Calcium carbonate is

added to swimming pools, as a pH corrector for maintaining alkalinity and offsetting the acidic properties of the disinfectant agent.

**2.2. PREPARATION OF MATERIALS**

The seed pods of Zia Mays and . Hibiscus rosa sinensis are collected, and dried naturally by sunlight. And remove the seeds from the pod manually. The dried seeds were ground to fine powder by domestic blender. This powder was sieved through 250µm sieve.

**III. PHYSIO-CHEMICAL CHARACTERISTICS OF THE SULLAGE WATER**

The sample collected was characterised initially on parameters such as pH, BOD, chloride, COD, TSS, TS, TDS, ammoniacal nitrogen, fluoride, DO and hardness,

**TABLE 1 INITIAL CHARACTERISTICS**

<i>Parameters</i>	<i>Sullage water characteristics</i>
pH	6.21
BOD	42
CHLORIDE	344.34
COD	520
TSS	7000
TS	4400
TDS	2600
HARDNESS	853
AMMONIACAL NITROGEN	2.3
FLUORIDE	3.74
DO	4.65

Table 1 shows the characteristics of sullage waste water.

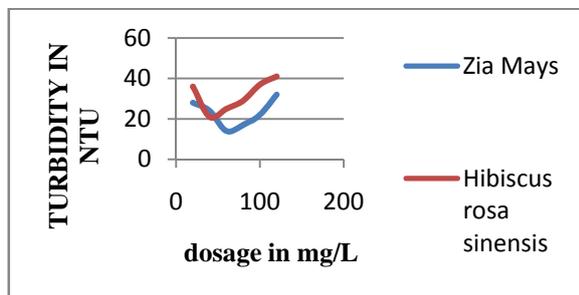
**IV. RESULTS AND DISCUSSION**

**A. COAGULATION PROCESS USING NATURAL COAGULANTS**

The coagulation process was done using Zia Mays and Hibiscus rosa sinensis as natural coagulant. In order to determine the optimum dosage of coagulant, different concentration of Zia mays and Hibiscus rosa sinensis powder is being added. Such as 20, 40, 60, 80, 100, 120 mg/L in which the optimum dosage for Zia mays is determined as 60mg/L and 40mg/L respectively.

**TABLE 2 JAR TEST EXPERIMENT USING NATURAL COAGULANTS**

dosage (mg/L)	turbidity(Zia Mays)NTU	turbidity(Hibiscus) NTU
20	28	36
40	24	21
60	14	25
80	17	29
100	22	37
120	32	41



**FIG 1 OPTIMUM DOSAGE CURVE FOR NATURAL COAGULANTS**

**B CHARACTERISTICS OF TREATED WATER**

The characteristics of treated water by using Zia Mays and Hibiscus rosa sinensis.

**TABLE 3 CHARACTERISTICS OF TREATED WATER**

Parameters	Zia Mays	Hibiscus
pH	7.56	7.83
Turbidity	13 NTU	21 NTU
Hardness	475 mg/L	490 mg/L
Chloride	144.75 mg/L	165.43 mg/L
Ammoniacal nitrogen	0.11 mg/L	0.318 mg/L
Fluoride	0.162 mg/L	0.661 mg/L
Dissolved oxygen	12.68 mg/L	11.04 mg/L
TS	1900 mg/L	1735 mg/L
TDS	1316 mg/L	1017 mg/L
TSS	584 mg/L	718 mg/L
BOD	16.83 mg/L	16.20 mg/L
COD	108 mg/L	120 mg/L

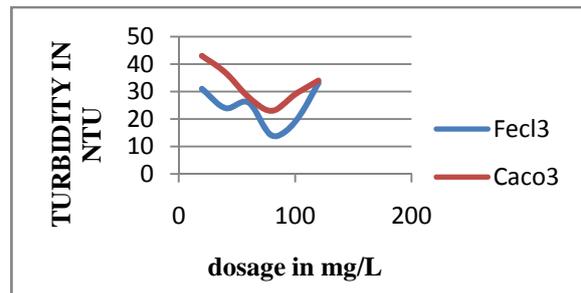
Table shows the removal efficiency of Zia mays and Hibiscus with the maximum of 80.88% and 69.11% respectively.

**C COAGULATION PROCESS USING CHEMICAL COAGULANTS**

The coagulation process was done using Ferric chloride and calcium carbonate as chemical coagulant. In order to determine the optimum dosage of coagulant, different concentration of Ferric chloride and calcium carbonate is being added. Such as 20, 40, 60, 80, 100, 120 mg/L in which the optimum dosage for Zia mays is determined as 60mg/L and 80mg/L respectively.

**TABLE 4 JAR TEST EXPERIMENT USING CHEMICAL COAGULANTS**

Dosage (mg/L)	Turbidity(Fecl <sub>3</sub> ) NTU	Turbidity(Caco <sub>3</sub> ) NTU
20	31	43
40	26	37
60	14	28
80	19	23
100	24	29
120	33	34



**FIG 2 OPTIMUM DOSAGE CURVE FOR CHEMICAL COAGULANTS.**

**D CHARACTERISTICS OF TREATED WATER**

The characteristics of treated water by using Ferric chloride and Calcium carbonate

**TABLE 5 CHARACTERISTICS OF TREATED WATER**

Parameters	Fecl <sub>3</sub>	Caco <sub>3</sub>
pH	7.46	7.72
Turbidity	14 NTU	23 NTU
Hardness	470 mg/L	503mg/L
Chloride	138.25mg/L	156.334 mg/L
Ammoniacal nitrogen	0.008 mg/L	0.326 mg/L
Fluoride	0.364 mg/L	0.972 mg/L
Dissolved oxygen	12.48 mg/L	10.52 mg/L
TS	1680 mg/L	1863 mg/L
TDS	1047 mg/L	1142 mg/L

TSS	633 mg/L	721 mg/L
BOD	13.6 mg/L	17.1mg/L
COD	208 mg/L	240mg/L

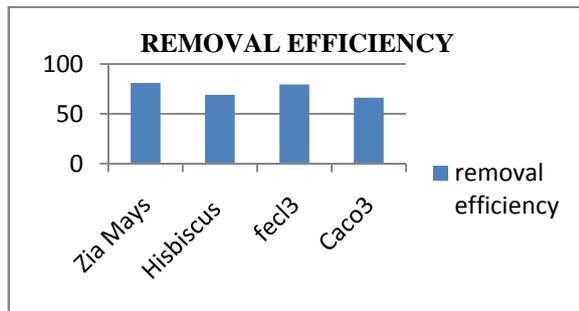
Table shows the removal efficiency of Zia mays and Hibiscus with the maximum of 79.41% and 66.17% respectively..

**E REMOVAL EFFICIENCY**

The removal efficiency of natural and chemical coagulants are determined by the value of reduction of turbidity.

**TABLE 6 REMOVAL EFFICIENCY OF COAGULANTS**

S.NO	COAGULANTS	REMOVAL EFFICIENCY (%)
1	Zia mays	80.88
2	Hibiscus	69.11
3	Fec <sub>13</sub>	79.41
4	Caco <sub>3</sub>	66.17



**FIG 3 REMOVAL EFFICIENCY OF COAGULANTS**

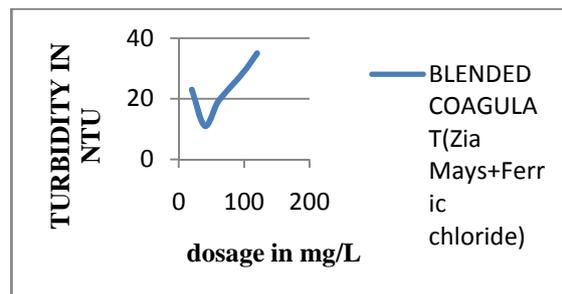
The removal efficiency of Zia Mays and Ferric chloride are almost same. These results are compared with blending of natural and chemical coagulants .

**F. COAGULATION PROCESS USING BLENDED COAGULANTS**

In order to determine the optimum dosage of coagulant, different concentration of Blended coagulation powder is being added in the 2:1 ratio of zia mays and ferric chloride because of effective removal efficiency. The dosage value as 20, 40, 60, 80, 100, 120 mg/L in which the optimum dosage for blended coagulant is determined as 40 mg/L.

**TABLE 7 JAR TEST EXPERIMENT USING BLENDED COAGULANTS**

Dosage (mg/L)	Turbidity(ZiaMays +Ferric chloride) NTU
20	23
40	11
60	19
80	24
100	29
120	35



**FIG 4 OPTIMUM DOSAGE CURVE FOR BLENDED COAGULANTS**

**G CHARACTERISTICS OF TREATED WATER**

The characteristics of treated water by using Zia Mays and Hibiscus rosa sinensis.

**TABLE 8 CHARACTERISTICS OF TREATED WATER**

Parameters	Blended coagulants
Ph	7.38
Turbidity	11 NTU
Hardness	436 msg/L
Chloride	131.41 mg/L
Ammoniacal nitrogen	0.072 mg/L
Fluoride	0.983 mg/L
Dissolved oxygen	11.89 mg/L
TS	1592 mg/L
TDS	1112 mg/L
TSS	480 mg/L
BOD	12.86 mg/L
COD	103 mg/L

Table shows the removal efficiency of blending of Zia mays and ferric chloride with the maximum of 83.82%

**V. CONCLUSION**

In this study, it was found that most of natural materials can be used as coagulants. In last few years, great interest has been for using natural coagulants for treatment of waste water. In conclusion, the use of coagulants like zia mays,

hibiscus rosa sinensis, momordica charantia, ferric chloride, calcium carbonate and ferric sulphate has high removal rates for turbidity, hardness, total, dissolved and suspended solids, BOD and COD.

The quality of the waste water treated by using natural coagulant is comparable to the quality of the wastewater treated by chemical coagulant is almost same. But the removal efficiency of natural coagulant is better than chemical coagulant. The highest removal efficiency among the six coagulants is the zia mays about 80.88% and ferric chloride about 79.41%. The use of natural coagulant is economical and safe. Some cases chemical coagulants cause hazards effects among people. The efficiency of blended coagulation of zia mays and ferric sulphate is high about 83.82%. So we suggest both natural coagulants and blending of natural and chemical coagulant for the treatment of sullage water.

More research is needed to achieve a greater efficiency in contaminant removal with respect to certain modifications in its functional group or various treatment procedures of the plant and its part that can be focused upon in near future. The reuse of waste water is necessary in the future because of the water scarcity.

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