Treatment of Tannery Effluent Using Strychnos Potatorum

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Abstract- *Water is employed for several purposes by humans but the extent of purity of the water being consumed is extremely crucial since it's an immediate effect on health. Safe beverage should generally be free from heavy metals, turbidity, organic compounds and pathogen. Conventional treatments of water include sedimentation, filtration and disinfection. Among the coagulating agents utilized in water treatment, ferric sulphate or alum (aluminium, sulphate) is a few of the foremost widely used salts. Aluminium is strongly neurotoxic and may be involved in the development of Alzheimer's disease. Known incontrovertible fact that most of the chemical disinfectants used for antibacterial activity generate various unwanted chemicals referred to as disinfection by products (DBPs) in water. There DBPs are associated with harmful effects on humans such as haemolytic anaemia, cancer risk, nervous system effect and liver effects. In this project raw tannery effluent is collected from pallavaram tannery effluent industry and treated using a natural coagulant Strychnos Potatorum. Performance of Strychnos Potatoram seed extract as primary coagulant are compared with the performance of alum. The effectiveness of Strychnos Potatoram of different dosage were taken and checked for the efficiency dose on tannery waste water in the removal of turbidity, total hardness, pH, COD, BOD and total dissolved solids (TDS) are investigated. The results obtained from this study has satisfied the parameters for discharging the effluent to public sewer.*

Keywords- Coagulating agent, Natural coagulant, Purifying efficacy, Rural population, Strychnos potatorum seed powder, Unsafe drinking water sources.

Abbreviations- DBP, disinfection by products, pH, power of hydrogen, COD, chemical oxidation demand, BOD, biological oxygen demand, TDS, total dissolved solids.

I. INTRODUCTION

Developing countries are facing portable water supply problem because of inadequate financial resources. The cost of water treatment is increasing and the quality of water is not stable due to suspended and colloidal particles. About 1.2 billion people still lack of safe drinking water and more than 6 million children die due diarrhoea in developing countries every year, surface water contains dissolved organic and inorganic substance, living organisms, suspended solids. Incessantly increasing industrialization and rapid urbanization have considerably enhanced the rate of water pollution. The decreasing supplies of natural resources of water have caused a serious constraint for industrial growth and for a rational standard of urban living. Textile, leather and Chemical industries are one of industries, which is considered as highly polluting industries. Due to bad effect of textile and chemical wastes in environment many industries were forced to close their industries. They introduced some method to treat the waste water but all the methods were based on the chemicals. Here we made an attempt to know the effect of natural coagulant in the treatment of textile and Chemical waste water alternative to the use of synthetic chemicals. The natural coagulant which we used in this work is Strychnos potatorum. Mostly the waste water arising out of these industries are matching the industrial waste water condition. Strychnos potatorum is the best natural coagulant discovered so far that replace aluminium sulphate (alum), which used for water treatment around the world. Several other natural flocculants were tested around the world for the water treatment. The result obtained by adding Strychnos potatorum proved that the plant can be used for the treatment of turbidity transmittance and removal of colour in industrial waste water. Turbidity, Total suspended solids, Total dissolved solids and colour removal is one of the most important in water treatment process, which generally achieved using coagulants. Many coagulants were widely used in conventional water treatment processes, based on their chemical characteristics. The coagulants are classified into inorganic, synthetic organic polymers and natural coagulant. The application of natural materials for clarifying turbid water of rivers is ancient and home-based practice in tropical developing countries where these natural materials acts as primary coagulant. Among them tropical tree Moringa Oleifera and Opuntia Dilleni, which contain active agent with excellent activity and coagulating properties.

II. MATERIALS AND METHODOLOGY

A. NATURAL COAGULANT

Natural coagulants are naturally available bio-degradable material which has the property similar to the chemical coagulant and it creates flocs. Eg: Moringo Oliefera, Cicer Orientinum, Dolihous Lablab.

B. STRYCHNOS POTATORUM

Clearing nut is deciduous, much furcate compact or average sized tree, or off and on a shrub, growing from 4 - 18 metres tall. The bole can be up to 100cm in diameter. The plant has a diverse of local medicinal purpose and also used locally to simplify water prior to drinking it. The seeds are sold as a water purifier in inhabitant markets. In gallery forest, in Brachystegia woodland, semi evergreen bushland, often on river banks, on banks of dry riverbeds, or on termitaries from sea level to altitude of 1,600 metres. Young fruits - occasionally eaten or made into preserves. The seeds are used for the treatment of a gamut of infirmity including those affecting the liver, kidneys and stomach; gonorrhoea, leucorrhoea, bronchitis, chronic diarrhoea, strangury, kidney and bladder stones, diabetes and eye diseases [1].

Fig. 1. Strychnos potatorum seed.

C. COLLECTION OF TANNERY EFFLUENT

Collection of industrial (Tannery) effluents is done at the main collecting tank by using grab sampling method. Sample were collected immediately for the study. Before conducting the study initial characteristics of waste water is noted. The raw water is characterized in terms of some physical and chemical parameters before treatment. The evaluated parameters were colour, turbidity, pH, total suspended solids and total dissolved solids. The coagulation sedimentation process was conducted by using coagulation and flocculation process (jar test apparatus). The efficiency of the process is evaluated by measuring the turbidity, total suspended solids and total dissolved solids [2].

Fig. 2. Tannery effluent.

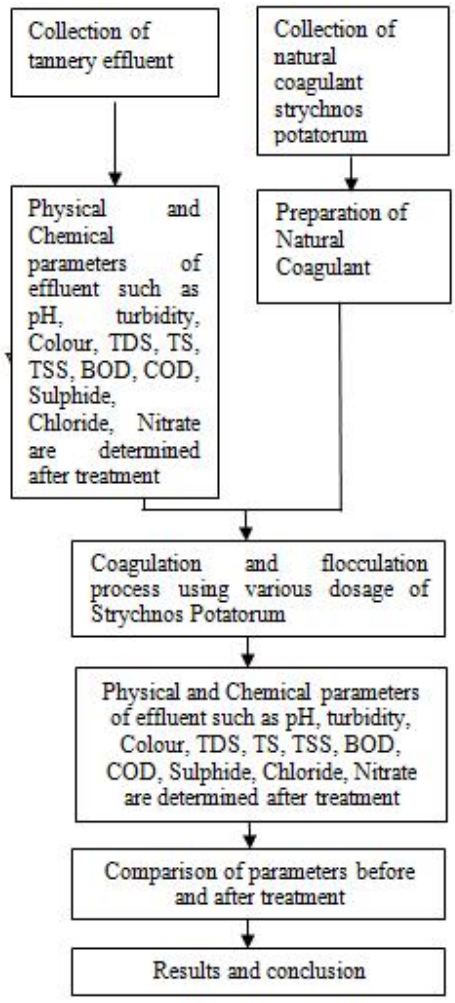

Fig. 3. overview of methodology

D. COLLECTION AND PREPARATION OF NATURAL COAGULANT

Strychnos potatorum seeds were detached from the plants, kept for sun dry and external shells were removed. Then the dried seeds were crushed and ground to a medium fine powder. By weighing the different solutions of different dosage were prepared [3].

E. COAGULATION AND FLOCCULATION PROCESS

Jar test is comprehensively used experimental methods for coagulation flocculation. A conventional jar test apparatus was used in experiments to coagulate samples of Tannery effluent water using natural coagulants. It was carried out as a batch test, accommodating a series of six beakers together of 1 litre capacity with six spindle steel paddles. Before operating jar test, sample was mixed homogenously. This study incorporates batch experiments, which involves rapid mixing, slow mixing and sedimentation.

Fig. 4. Coagulation and Flocculation process Using Multiple spindle stirrer

The indispensable dose of hitherto prepared powder of Strychnos Potatorum 0.3, 0.5, 0.7, 1, 2, 3, 4 g\100 ml was added simultaneously. The paddles are immersed in the jars, the apparatus was turned on and whole procedures in jar test were conducted in different rotating speed, which consists of rapid mixing (100 rpm per minute) for 1 minute and slow mixing (30 rpm) for 10 minutes. After the agitation being stopped, the suspensions were allowed to settle for 1 hour. At last, the sample was taken using a pipette from the middle of supernatant for physicochemical measurements, so that effect of coagulant dose on coagulations could be studied the samples ought to be measured for turbidity, pH, total suspended solids and total dissolved solids [4].

III. RESULTS AND DISCUSSION

A. INITIAL CHARECTERISTICS OF THE RAW EFFLUENT

The experimental result obtained for the determination of the optimum dosage of Strychnos Potatorum for the primary treatment of Tannery effluent, by coagulation and flocculation process using multiple spindle stirrer apparatus are as follows. The initial characteristics of Tannery effluent is above the standard disposal range. So, it can be reduced by using Strychnos Potatorum by coagulation and flocculation process.

Table 1: Initial characteristics of Tannery effluent

Parameters	Value
pH	7.64
Turbidity	38.1 NTU
Colour	Black
Chloride	2.304g/lit
BOD	842.19mg/lit
COD	4360mg/lit
TS	7725mg/lit
TVS	3200mg/lit
TFS	4525mg/lit
TSS	3.4ml/lit
TSS	2175mg/lit
Nitrite	7010mg/lit
Sulphide	356.8mg/lit

B. DETERMINATION OF OPTIMUM DOSAGE OF EFFLUENT

The effluent from tannery industries are treated with Strychnos Potatorum seed powder with different dosage of 0.3g, 0.5g, 0.7g, 1g, 2g, 3g, 4g. The corresponding pH, turbidity, colour, chloride, BOD, COD, sulphide, Total solids (TS), Total volatile solids (TVS), Total suspended solids (TSS), Total Settleable solids (TSS), nitrate value have been mentioned in below graphs.

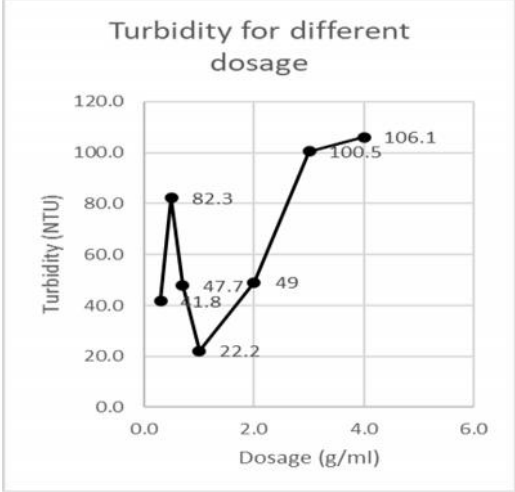

Fig. 5. Turbidity for different dosage

From the different dosage, for 1% treatment gives the optimum level of concentration and reduce the turbidity of the effluent. Similarly, for the determination of effectiveness of the natural coagulant, raw effluent is

treated with 1% Alum solution and compare the reduction in physical and chemical characteristics. Thus, optimum dosage of the seed treated water is 1%. Further increase in the dosage level there will be no change both in colour and turbidity. Alum is not giving any changes to the effluent.

C. COMPARISON OF CHARECTERISTICS OF TREATED WATER WITH RAW TANNERY EFFLUENT

pH. By Coagulation-flocculation process using natural coagulant Strychnos Potatorum, the pH in tannery effluent were reduced from 7.64 to 6.8 at the dosage of 1g and 7.1 for 1% Alum. Hence the pH of the effluent is reduced better to standard level when compared to raw.

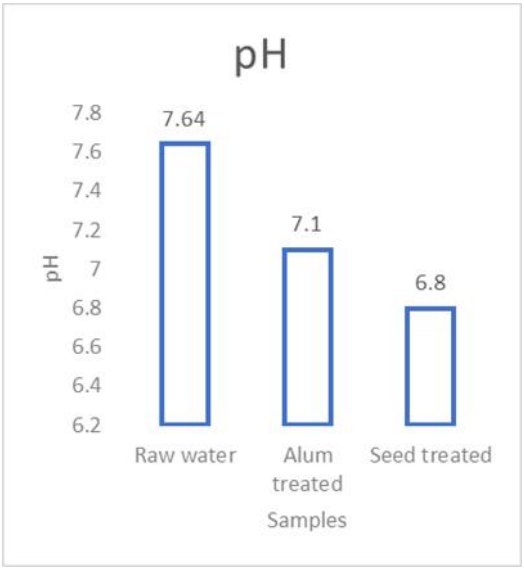

Fig. 6. pH

TURBIDITY. While utilizing Strychnos Potatorum as coagulant, for the optimum dosage of 1g gave 58.27% turbidity removal in tannery effluent, but in case of alum, there will be no changes happen. Ultimately by treating with optimum dosage of natural coagulant will reduce the turbidity level more when compare to other artificial coagulants. Turbidity level for the seed treated water is 22.2, which will come near to IS standards.

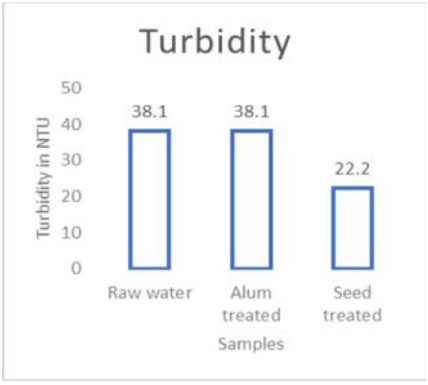

Fig. 7. Turbidity

CHLORIDE CONCENTRATION. When the effluent treated with the natural coagulant, chloride concentration reduced to nearly half of the original concentration. It is desirable to treat the effluent with seed for chloride removal when compared to Alum.

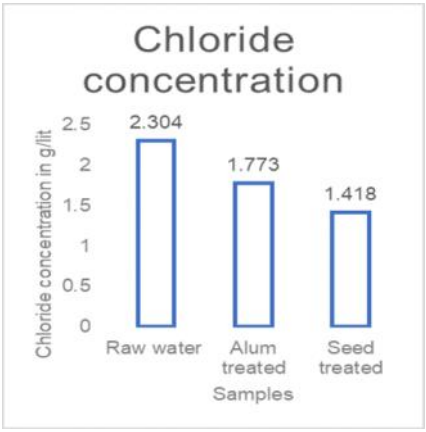

Fig. 8. Chloride concentration.

BOD CONCENTRATION. By performing coagulation-flocculation process using natural coagulant Strychnos Potatorum, which gives optimum dosage of 1g, showed BOD removal at maximum rate when compared to Alum. Thus, the seed can reduce the BOD due to the sedimentation of biological content during the settling time.

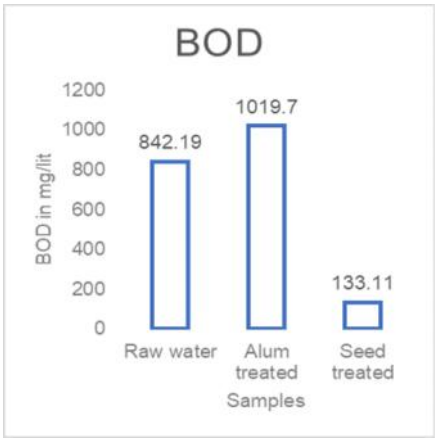

Fig. 9. BOD concentration.

COD CONCENTRATION. The COD concentration is initially present in the effluent at 4360 mg/lit. This will drastically reduce the dissolved oxygen content. In the tanning process various chemicals were used to manufacture the leather, these are all accumulated in the effluent. Hence it is not unusual to notice the higher COD content. By treating with natural coagulant COD get reduced to 1540 mg/lit. Though the range is high, it is better when reduced in primary treatment itself.

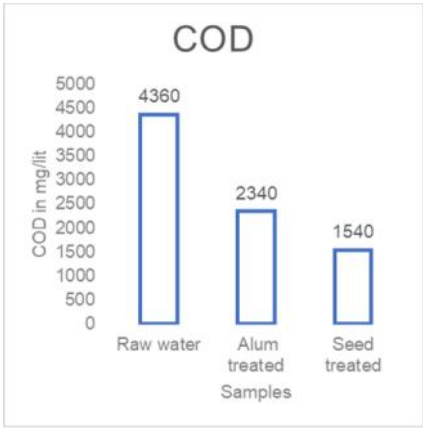

Fig. 10. COD concentration.

SOLIDS. Hence by treating with seed, total solids of the effluent reduced at the maximum rate than alum, but it will not satisfy with the Indian standards. It needs further treatment to reduce the solids.

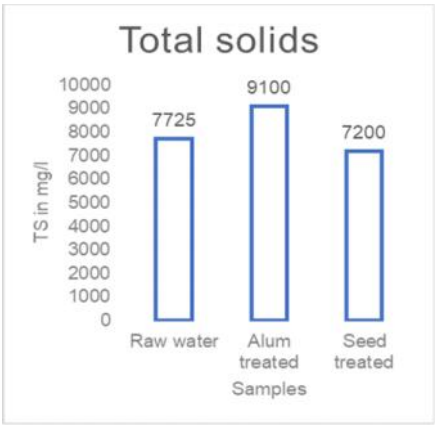

Fig. 11. Total solids.

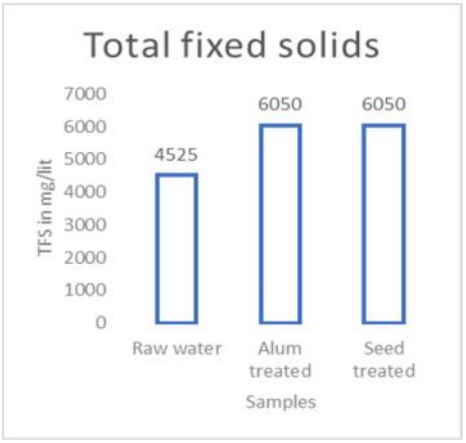

Fig. 12. Total fixed solids.

NITRATE CONCENTRATION. Concentration of nitrate also reduced while treating the effluent with seed. But when it is done with Alum of same concentration, removal of nitrate is very less. Thus, it is desirable to use seed to remove nitrate contents effectively.

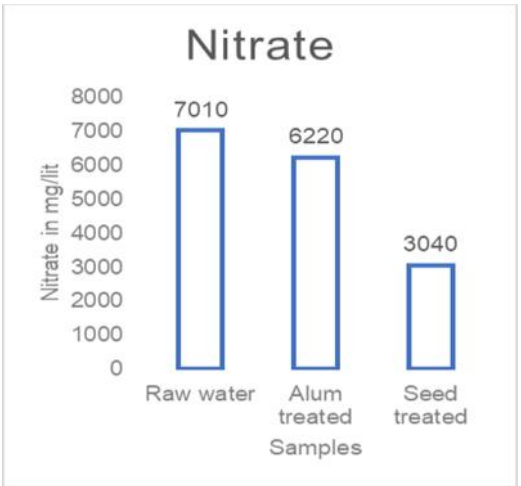

Fig. 13. Nitrate

SULPHIDE CONCENTRATION. When treating with natural coagulant at 1% dosage, sulphide concentration also reduced to half than raw. Sulphide is the important chemical in the tanning process. Thus, it will cause serious effect to the environment when it is disposed without any prior treatment.

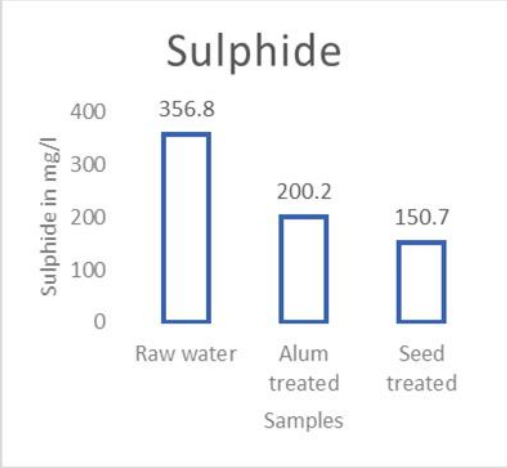

Fig. 14. Sulphide

D. CHEMICAL EFFLUENT REMOVAL EFFICIENCY BY STRYCHNOS POTATORUM

In this work we obtained that while adding the Strychnos Potatorum, the optimum dosage for chemical effluent is 1g/500ml. The maximum reduction in total settleable solids, BOD, COD, Nitrate, Sulphide were found to be 85%, 84.19%, 64.68%, 56.63%, 57.76%. But in the case of Alum, most of the test give negative effect. For example, when the effluent is treated with alum, there will be no change in the BOD. Thus, natural coagulant gave the abrupt change in the characteristics of effluent.

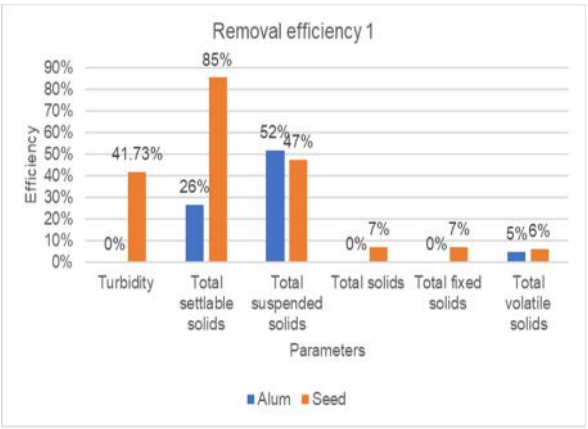

Fig. 15. Effluent removal efficiency 1

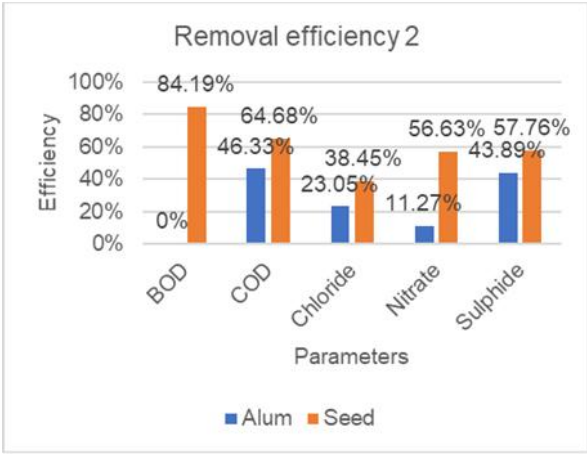

Fig. 16. Effluent removal efficiency 2

E. TREATED WATER PARAMETERS

The table below compares the Indian standards disposal range (IS 3306:1974) with parameters of treated tannery effluent by Strychnos potatorum. pH and Turbidity of effluent which are treated by natural coagulant comes within (nearly) Indian Standard disposal range, but by the same dosage of alum, it not reduces its characters. Tannery effluent treated by natural coagulant show BOD came within permissible disposal range. It shows that Alum performs less efficiently compares to Strychnos Potatorum.

Table 2: Treated water parameters and standards IS 3306-1974

Parameters	Standard Disposal Range IS 3306-1974	Parameters of Tannery effluent before treatment	Parameters of Tannery effluent after treatment	
			Alum	Strychnos Potatorum
pH	5.5 – 9	7.64	7.1	6.8
Turbidity (NTU)	0 - 70	38.1	22.2	38.1
Colour		Black	black	Dark yellow
Chloride (g/L)	0.6	2.504	1.773	1.418
BOD (mg/L)	500	842.19	1019.7	153.11
COD (mg/L)		4360	2340	1540
TS (mg/L)		7725	9100	7200
TVS (mg/L)		3200	3050	3000
TFS (mg/L)		4525	6050	6050
TSS (ml/L)		3.4	2.5	0.5
TSS (mg/L)	200-300	2175	1150	1050
Nitrate (mg/L		7010	6220	3040
Sulphide (mg/L)		356.8	200.2	150.7

IV. FUTURE SCOPE

The seed powder can be placed in treatment of secondary treated waste water because of its higher efficiency in terms of reducing the toxic parameters to maximum extent. Also the developing countries fails to treat waste water due to inadequate financial resources, so waste water is directly discharged in water bodies which leads to contamination of water bodies and causes several health issues. This study attempts to suggest primary treatment of such effluents in more economical way using natural coagulant like Strychnos potatorum for colour, pH, turbidity, Solids removal, BOD, COD, Chloride ions and economically reduces the

contamination of water bodies. Instead of its biodegradable nature, the ultimate waste materials are easy to dispose without any prior treatment.

V. CONCLUSION

This project was successfully carried out for the removal of physical and chemical characteristics from tannery effluent using the Strychnos potatorum seed powder. The coagulation influencing parameters such as pH, initial turbidity and SP dosage were optimized for the maximum removal of chemical and physical characteristics from the tannery effluent. The performance of the present system was also compared with the same dosage of alum. Some of the important findings that were observed from the present study are as follows:

1. The ideal Strychnos Potatorum dosage for the maximum turbidity removal was calculated as 1%.
2. The maximum removal of turbidity was measured at optimum condition as follows: For tannery effluent – from 38.1 NTU to 22.2 NTU.
3. BOD of effluent which is treated by SP coagulant comes within Indian standards disposal range (842.19 mg/lit to 133.11 mg/lit).
4. Among two coagulant used in the study, maximum BOD, COD (4360 mg/lit to 1540 mg/lit), Chloride (2.304 g/lit to 1.418 g/lit), nitrate (7010 mg/lit to 3040 mg/lit), sulphide (356.8 mg/lit to 150.7 mg/lit) reduction is found.
5. In coagulation – flocculation process at optimum dosage, Settleable solids of the effluent reduced, beyond that there will be no effect.
6. Efficiency of SP stock solution on water samples depend in the initial turbidity. At optimum dosage, the percentage of turbidity removal was found to be increased with the initial turbidity.
7. The main objective of the study is to reduce effluent parameters cost effectively using natural coagulant SP seed powder under coagulation – flocculation process is achieved with some parameters.
8. Hence natural coagulant can be used in primary treatment of tannery effluent in most economical manner. It aids in water treatment with limited efficiency, to avoiding health effect from residual aluminium. It is an effective coagulant for tannery effluent as compared to alum.
9. Hence it is concluded that SP seed has the potential to be utilized for tannery effluent. Even for raw tannery effluent, the results suggested that SP seed powder is effective at the concentration of 1 ppm as a coagulant to treat tannery effluent.

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