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Research Article

Color and odor removal from tannery waste water using natural coagulant and locally available commercial grade lime

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Abstract: Tannery industry is one of the large scaled industry which produces lot of organic wastes per day. Tannery effluents contain lot of hazardous elements which can affect human immunity when it is directly discharged in water bodies. Tannery waste water was collected and a novel approach of using natural coagulants and locally available commercial grade lime were used for coagulation and flocculation. The collected tannery waste water was basic in nature with ph of 8. Conductivity at 30˚c was found to be 98.5 mg/l. Transmittance is found to be 2% and other initial parameters like TDS, absorbance, turbidity, odor, color were also checked. 1N nitric acid is added at 15ml/l to the waste water for preservation. For coagulation and flocculation the ph was altered by using sulphuric acid and sodium hydroxide. Coagulation is done using natural coagulant moringa *olifera and lime* is used. The coagulants are aided with coagulant aid *(polyelectryolyte)* and some of the chemical coagulants like *alum, ferrous sulphate, Ferric chloride and calcium chloride*. The result was found to be effective in treating tannery waste waters. The initial parameters of the tannery waste water are reduced to satisfactory levels. Hence it is proven that natural coagulants and lime can be used for treatment of tannery waste waters.
Keywords: tannery waste waters, coagulation, *moringa olifera*, *lime*, parameters.

INTRODUCTION

Industrial wastewaters are clarified to remove turbidity and color from tannery industry. In a water treatment chemical treatment that will remove, color and turbidity present in raw water in the form of flocs. Coagulants neutralize the repulsive electrical charges (typically negative) surrounding particles allowing them to "stick together" creating flocks. Flocculants facilitate the sticking of the coagulated particles to form larger floccules and thereby fasten gravitational settling. Coagulation is the destabilization of colloids by neutralizing the forces that keep them apart. Cationic coagulants provide positive electric charges to reduce the negative charge of the colloids. As a result, the particles collide to form larger particles (flocks).Rapid mixing is required to disperse the coagulant throughout the liquid.

The enormous use of water in tannery industries has caused a serious problem of drainage of industrial waste water. Effluents from industries are deteriorating the surface and underground water quality through seepage, due to chemical constituents of undesirable concentration and thus creating water pollution. Heavy metals are groups of pollutants which are non biodegradable and tend to accumulate in living organisms. Heavy metals are toxic because they cannot be degraded biologically into harmless Products, hence they cause serious health hazards. All heavy metals at high concentrations have strong toxic effects and are an environmental threat . The pollutants of tannery wastes are of inorganic, organic and toxic nature and require elaborate treatment before disposal to prevent physical, chemical and biological pollution of the receiving body of water. Tannery wastewater with high concentration of dissolved solids, suspended solids, chloride, color, chromium etc. were being discharged every day in the receiving water.

Coagulation and flocculation processes are intended to form particles large enough to be separated and removed by subsequent sedimentation, or alternative clarification processes. The coagulation stage occurs when a coagulant, such as alum, is added to the water to neutralize the charges on the colloidal particles in the raw water, thus bringing the particles closer together to allow a floc to begin to form. The flocculation process, following coagulation, allows smaller particles formed during the rapid coagulation stage to stick into larger particles to form settleable and/or filterable floc particles. Numerous substances have been used as coagulant and flocculation aids, including alum[$Al_2(SO_4)3,18H_2O$], ferric chloride [$FeCl_3/6H_2O$],ferrous sulfate [$FeSO_4.7H_2O$] and calcium carbonate [$CaCO_3$].

As the chemical method helps to remove turbidity, color and chemical oxygen demand reduction. The present study is on the performance of coagulation and flocculation. An approach of this technology is made for Tannery Wastewater [1] also for different industrial wastewater treatment[2- 3], UNIDO: Regional programme for pollution control in the tanning industry in south-east Asia: Chrome balance in leather processing and a few other studied the coagulation for tannery wastewater treatment[4-6].

Study area:

Tannery waste water is collected from various leather tanning industry in Dindigul district. Totally there are 61 leather tanning industry in and around Dindigul district. These tannery industries produces approximately 20000 MLD of waste water per day. These waste waters are highly hazardous in nature and possess high heavy metals like lead, arsenic, chromium etc. Some tanning industries are not using zero liquid discharge technique in their effluent treatment plants and wastes are being let out in some manner. If they are mixed with some natural water bodies, they may contaminate water sources and causes environmental and human hazards. To eliminate these problems in that district a low cost novel approach of treatment of tannery waste water is done.

The initial characteristics and parameters of the tannery waste water collected from various tanning industries are listed below:

Table 1: Initial waste water characteristics

S.NO	PARAMETERS	INITIAL VALUES
1	Ph	7.5-8
2	TDS	19730ppm
3	Conductivity	97.5ms/cm
4	Transmittance	2%
5	Odour	Objectionable
6	Colour	Brownish Pink
7	Absorbance	1.23
8	Turbidity	49 NTU

Sampling:

Sampling of tannery waste water is done at the main collection sump of effluent treatment plant from tannery industry and using grab sampling method, the sampling bottles are of 40 litre capacity which are cleaned several times with tap water, then with distilled water and rinsed fully with 1N HNO_3 for removal of living micro-organisms, pathogens and odour of the sampling bottle. Immediately the sample is aided with 15ml/l of 2N HNO3 is added for preservation of the sample. After collecting preserving the sample Initial parameters of the sample like ph, colour, odour, turbidity, transmittance, absorbance, TDS and conductivity were tested. The sample was basic in nature (ph 8) and it is brought to acidic condition (pH 5) by adding 1 drop of 1N H2SO4.

MATERIALS AND METHODS

Effect of natural coagulants in tannery waste water treatment:

Natural coagulants are most widely used in treatment of waste waters and it has proven quality in treatment of various waste waters from industries. Beltran-Heredia J et al [7] says that when alum was included along with the natural coagulants to know the impact, alum gave a relatively high effectiveness in removing the dye and they says that m.o along with alum is an real alternative coagulant for the removal of inorganic metal salts. Katayon et al [8] concluded from their studies that M.O is not effective in case of low turbid samples because of the low inter particle contact. They also says that the higher dosage of M.O will lead to increase the residual turbidity, and it will eventually lead to the saturation of polymer bridges sites and cause destabilisation of particles due to an insufficient number of particles to form more inter particle bridges. Raveendra Babu and Malay chaudhari [9] says that seed of M.O contains materials that are effective as coagulant, and direct filtration of water with M.O seed as coagulant brings about a substantial improvement in its aesthetic and microbial quality. And their study was suitable for home water treatment in rural areas of developing countries Vijaya kumar et al[10] concluded that the aluminium based coagulants will develop the diseases like Alziemer,s in human beings. So he says that it is therefore desirable to replace chemical coagulants with plant based coagulants to counteract the aforementioned drawbacks. In his view the advantages of using natural coagulants for waste water treatment are apparent: they are cost effectively, unlikely to produce treated water with extreme pH and highly biodegradable. Suleyman amuyibi et al [11] says that *M. Oleifera* showed a high coagulation activity for the high turbidity water. The coagulation activity was low for low turbidity water. Phanimadhavi and Raj kumar [12] concludes that while using natural coagulants, influence of the ph on the system found to be significant on turbidity removal. Their study clearly indicates that at optimum ph system conditions, there is significant reduction in coagulant dose required and in some cases a further increase in turbidity removal. And they also says that the utilisation of locally available natural coagulant was found to be suitable, easier, cost effective and environment friendly for water treatment Sri Suhartini et al[13] says that a protein extracted from M. Oleifera seed has demonstrated its effectiveness in wastewater systems [14] removing 99% of suspended solids without changing the ph of the water [8].

Mangale et al [15] concluded that *Moringaoleifera* seeds acts as a natural coagulant, flocculent, absorbent for the treatment of drinking water. It reduces the total hardness, turbidity, acidity,

alkalinity, chloride after the treatment. It also acts as a natural antimicrobial active against the micro-organisms which is present in the drinking water and decrease the number of bacteria. He also says that the combined use of *Moringaoleifera* seed powder and chlorine can give best results and the water can be suitable for drinking. Jelenaprodanovic et al [16] says that the addition of alum in primary settler could improve purification of wastewater to satisfactory level. But, as a result, a large quantity of aluminium will be discharged in nature, both as purified wastewater and treated sludge. Application of natural coagulants has a numerous advantages. Wastewater purification is good, production of biogas is enhanced and anaerobic sludge has not contained aluminium salts. Although the cost for common bean is higher than for alum, overall cost of wastewater treatment spokes in favour of application of natural coagulants. Its application represents important progress in sustainable environment.

Solution preparation:

Moringa olifera (drum stick) seed was taken and dried in sunlight for few days till it looses all its fluid contents and then it is powdered to get fine particles. Then it is sieved using 75 micron sieve. 20gms of seed powder was weighed and mixed with 250ml of distilled water. It was filtered using filter paper and the extract is used as coagulant. 15gms of coagulant aids like alum, ferrous sulphate, calcium carbonate were mixed with 250ml of distilled water.

200ml of preserved sample is taken in a clean 500ml glass beakers and dosages of 5ml, 6ml, 7ml, 8ml of various coagulant combinations were given to the samples. The coagulant combinations taken were *alum+moringa olifera, alum+lime, lime+moringa, lime+ferrous sulphate.* Polyelectrolyte solution is added in each beaker containing sample to enhance the coagulation process. Then the samples with coagulants are placed in jar testing apparatus. Initially flash mixing is done for 10 seconds and normal mixing of 150rpm is given to the samples for 10 minutes. Then the detention time of 30minutes is given. Final parameters of the samples were checked after 30minutes of detention time after removing the sample from jar test apparatus.

RESULTS AND DISCUSSION

The below table portraits by varying the dosage of coagulants the change in initial parameters of waste water is drastically changed to lower acceptance satisfactory limits. The conductivity is reduced to 70.2ms/cm, Transmittance is increased to 76% and neutral ph is achieved.

Table 2: Final parameters

Effect of alum + moringa olifera

S .no	Dosage Mg/L	Ph		Conductivity ms/cm		Transmittance %	
		Initial	Final	Initial	Final	Initial	Final
1	5	5	7	97.5	83.2	2	31
2	6	5	7	97.5	82.7	2	32
3	7	5	6	97.5	79.6	2	38
4	8	5	7	97.5	77.7	2	42

Effect of alum + lime

S .no	Dosage Mg/L	Ph		Conductivity ms/cm		Transmittance %	
		Initial	Final	Initial	Final	Initial	Final
1	5	5	7	97.5	76.7	2	19
2	6	5	6	97.5	75.8	2	21
3	7	5	7	97.5	72.3	2	22
4	8	5	7	97.5	70.7	2	27

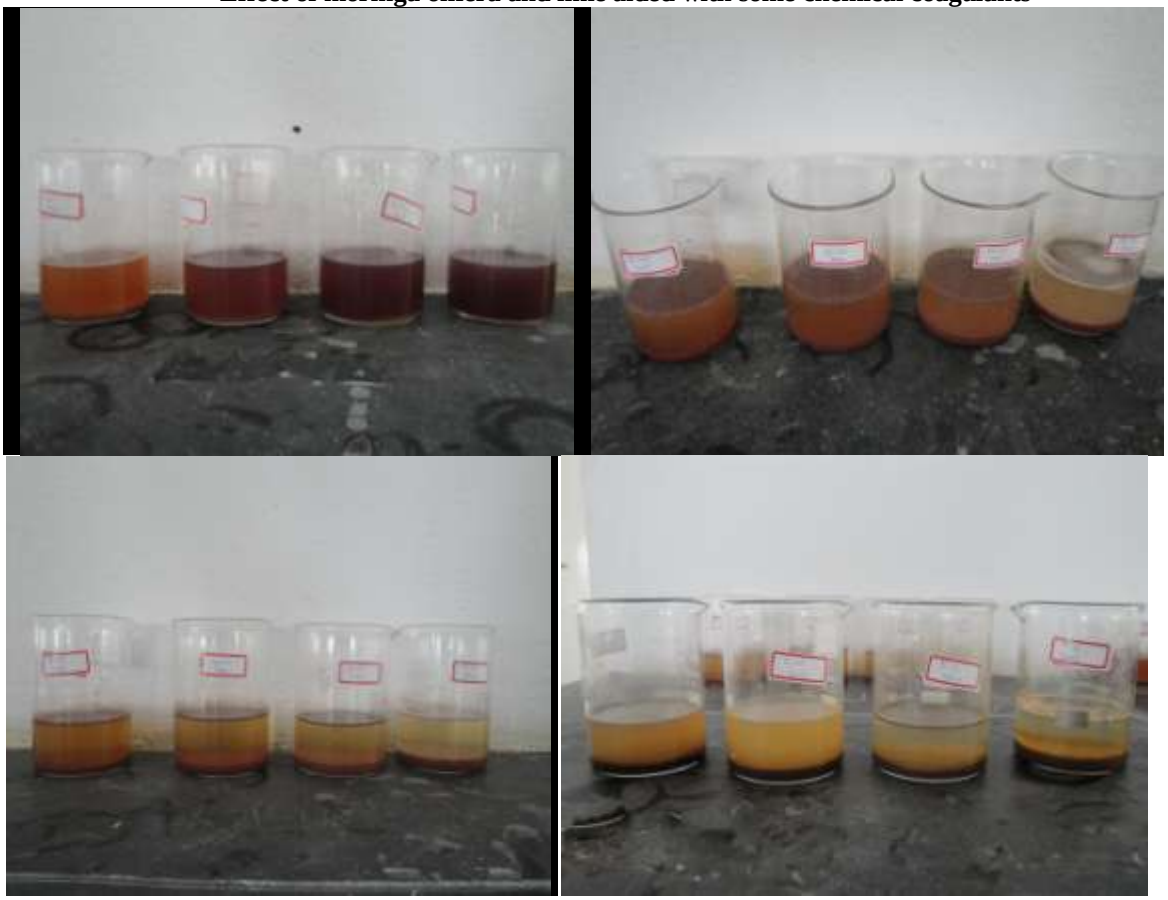
Effect of lime + moringa olifera

S .no	Dosage Mg/L	Ph		Conductivity ms/cm		Transmittance %	
		Initial	Final	Initial	Final	Initial	Final
1	5	5	7	97.5	84.6	2	16
2	6	5	6	97.5	82.7	2	21
3	7	5	6	97.5	80.6	2	23
4	8	5	7	97.5	80.6	2	25

Effect of lime + ferrous sulphate

S .no	Dosage Mg/L	Ph		Conductivity ms/cm		Transmittance %	
		Initial	Final	Initial	Final	Initial	Final
1	5	5	6	97.5	88.3	2	24
2	6	5	6	97.5	94.9	2	33
3	7	5	7	97.5	95.6	2	62
4	8	5	7	97.5	82.1	2	76

Effect of moringa olifera and lime aided with some chemical coagulants



Change in pH

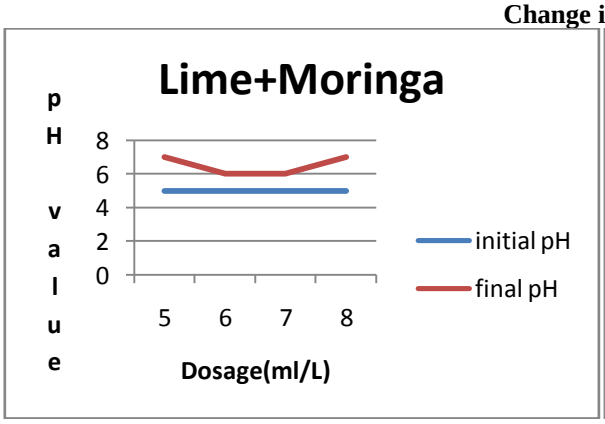


Fig.1

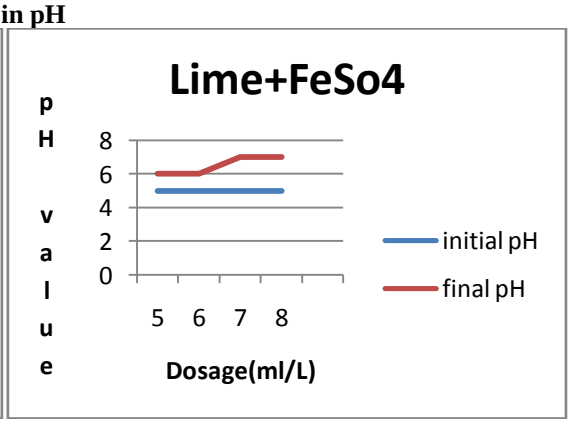


Fig.2

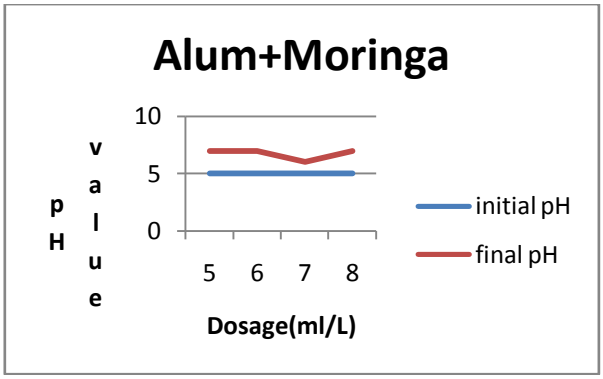


Fig.3

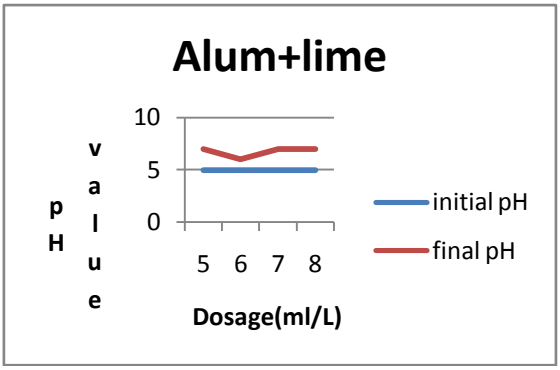


Fig.4

Change in conductivity:

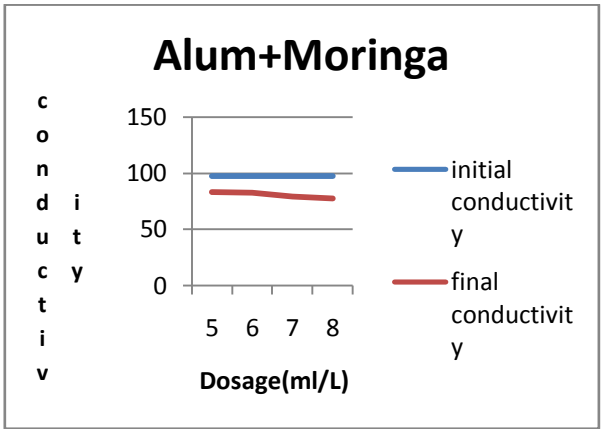
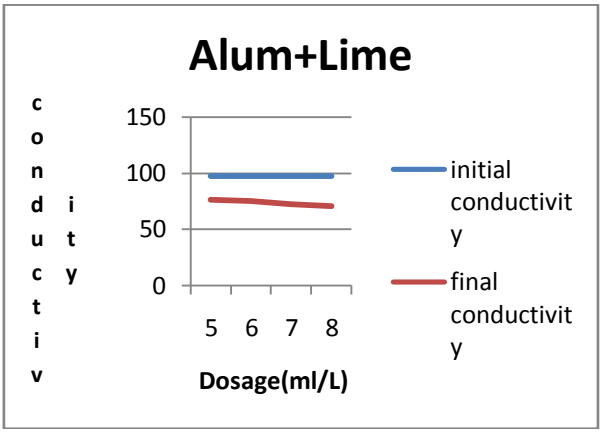


Fig.5



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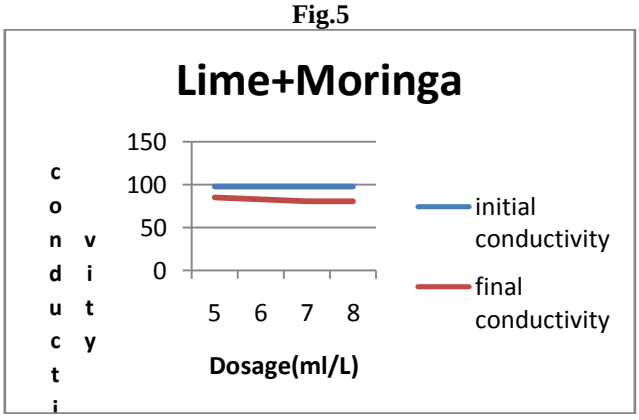

Fig.7

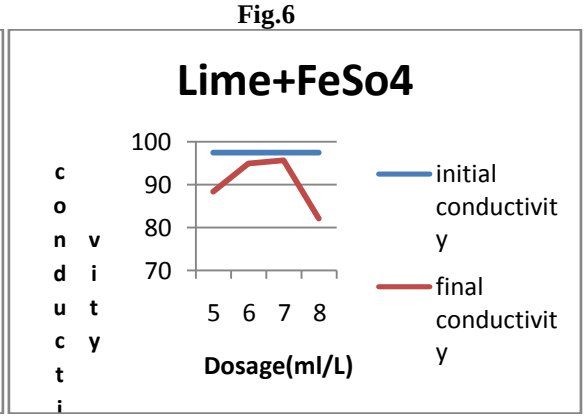

Fig.8

Change in transmittance:

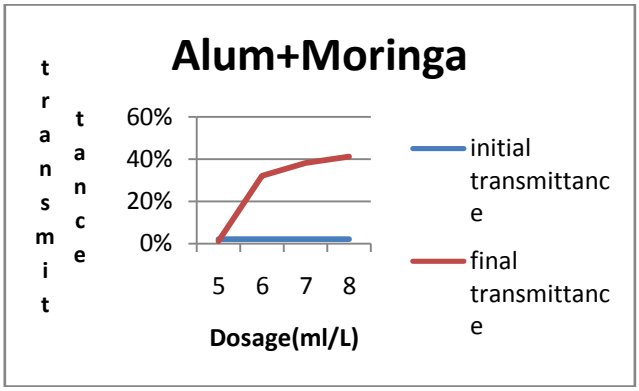

Fig.9

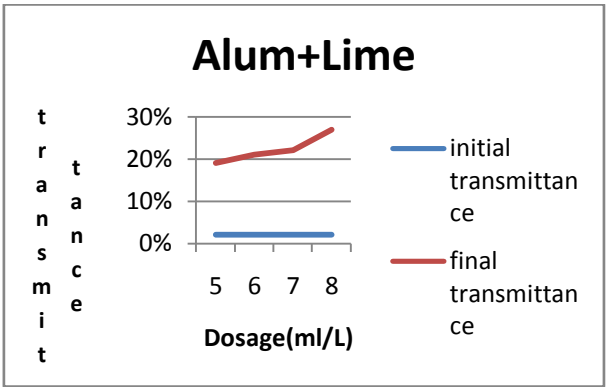

Fig.10

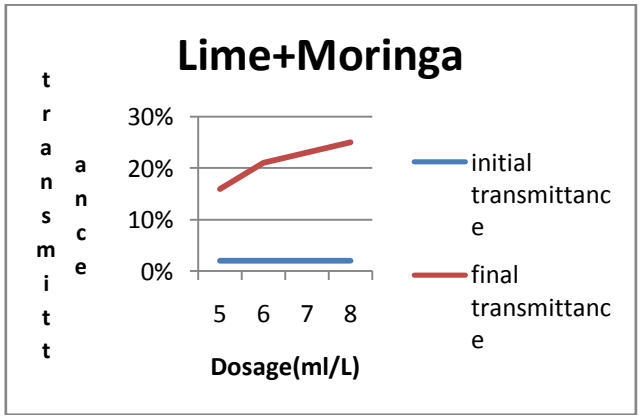

Fig.11

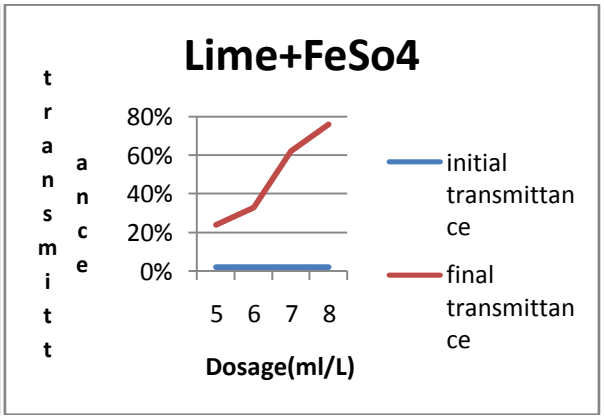

Fig.12

Conclusion:

Thus it was proven that natural coagulants can treat tannery industry waste water efficiently. Moringa olifera (drum stick) seeds are available abundantly all over tamil nadu. And also by using moringa olifera seed extract as coagulant sludge volume index in treatment operation will be reduced

When compared to other treatment processes and coagulants. Transmittance was increased to 76% . Color and odor were removed completely. Other initial parameters were also reduced drastically. Lime is also available in tamil nadu and it has proven quality in removing hazadrous elements in waste waters. Fig 1-4 represents the change in pH concentration from acidic conidition (pH 5) to a neutral pH range(pH 6). Fig 5-8 represents the change in conductivity of the waste water and it is reduced to accepted level. Fig 9-12 represents the change in transmittance value from 2% to 76%. These results proves the effectiveness of natural coagulant and lime in colour and odor removal of leather tanning industry wastewater. So, this can be applied for large scale treatment process in tannery effluent treatment units for color and odour removal.

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