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An experimental study to evaluate the efficacy of herbal treatment for waste water

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ABSTRACT

Water is a renewable resource, made continuously available by hydrological cycle which operates through solar energy. It is also one of the most exploited resources of nature, as there are few or no stringent laws governing the usage of water for domestic and other purposes. In a country like India where majority of the population is below the poverty line, indiscriminate discharge of industrial and domestic waste into water bodies has multiplied the water scarcity problem, manifolds. Judicious usage of available resources and employing green technology to recycle water are the right paths for combating this universal problem. Towards this goal, the present work focuses on treating tannery effluent with plant products as a viable pre-treatment. The experiment had been designed to capture the efficacy of bio products in reducing the Total Dissolved Solids, and other parameters in order to improve the quality of tannery effluents.

KEYWORDS

Effluent pre treatment;
Waste water;
Herbal treatment.

INTRODUCTION

Water gets polluted in huge quantities everyday due to essential activities like agriculture, construction etc. Proceedings released after 29th WEDC International conference held in 2003 at Nigeria, brought out the shocking fact that 90% of Indian surface water was polluted[7]. Depending on nature and amount of pollutants entering it, water loses its natural properties (colourless, odourless and tasteless) and becomes effluent (turbid, assumes colour and odour). Among all the industrial wastes tannery effluents are ranked as the highest pollutants[15] as the process of converting hide to leather is very complex and requires a lot of synthetic chemicals. In developing countries, many industrial units are operating in small and medium scale. These industrial units can generate a considerable pollution load by discharging untreated effluents directly into the environment due to the poor enforcement of law.

Though it is desirable to prevent waste, it is not always feasible. In industries where waste cannot be prevented, economic, ecofriendly methods of treatment / pre-treatment will pave the way for sustainable development in addition to cost reduction of process / product.

Tanning is one of the oldest professions in India,

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with 2000 units spread mostly across Tamil Nadu, West Bengal, Uttar Pradesh, Andhra Pradesh, Karnataka, Rajasthan and Punjab. Leather tanning is almost wholly a wet process from which a large volume of liquid waste is continuously generated.

Due to the variety of chemicals added at different stages of processing of hides, the wastewater has complex characteristics. The tanning process and the effluents generated by tanneries is well documented[17,19,20]. Though there is a wide variation in the nature and extent of pollutants every report agrees on the role of the pollutants in degrading the environment[3,5,6,8,10,12]. This prompted the researchers' world wide to adapt different methods like adsorption, filtration, reverse osmosis, coagulation and flocculation etc[8,10,16,18]. Of late bioremediation of tannery effluents is being undertaken[12].

This paper studies the efficiency of neem and mango leaves as a pre-treatment for various stage effluents of leather processing industry.

Various parts of Mangifera indica (mango) and Azadirachta indica (neem) has been reported to contain bioactive compounds such as steroids, tannin, flavonoid, saponin, reducing sugars, cardiac glycosides and anthraquinone[1,4].

MATERIALS AND METHODS

Effluent: collection and dilution

The tannery effluents (soak liquor and lime effluent) were collected from a tannery around Chennai (India). The effluent was used with and without diluting as follows

Effluent for Experiment 1 : undiluted effluent (1:0)
Effluent for Experiment 2 : Effluent diluted with demineralised water (3:1)
Effluent for Experiment 3 : Effluent diluted with demineralised water (1:1)

Plant materials

Mature leaves of Mangifera Indica and Azadirachta indica were collected from local area (Kalavakkam, Sholinganallur and Melakottaiyur). The leaves were washed with tap water followed by distilled water and shade dried on absorbent paper. The thick veins were removed and the leaves were cut into small pieces and then weighed. Exactly 1 gram, 2 grams and 5 grams of cut pieces of leaves were weighed using a SHIMADZU (BL-220H) balance whose accuracy is 0.001g and used for analysis.

5g /100 ml of the leaves were soaked in water and the pH of the solution was checked after 24 hours.

Equipments

A digital pH meter (Elico LI-120) and Digital conductivity meter (Equip-Tronics EQ-664A) were used for all studies.

TDS studies were carried out in accordance with "Standard Methods", eighteenth edition[2].

Experimental conditions and performance: room temperature studies

Experiment 1

100 ml of undiluted effluent sample was taken in 13 beakers and 1, 2, 5 g of neem and mango leaves were added to beakers containing soaking effluent. In one beaker no leaf was added (control). The mixture was stirred gently using a glass rod for 5 minutes and the samples were set aside for 24 hours without disturbance. For 48 hrs study the leaves were changed after 24 hours. The same procedure was repeated for lime effluent.

After the experimental time the samples were filtered through Whatman filter paper and the residue was discarded. The pH, Conductance and TDS of the filtrate were measured.

The above procedure and measurements were repeated for the two diluted effluents also

High temperature studies

Samples prepared similarly to Room Temperature Studies and were placed in Digital Hot Air Oven at 50^0C for 5 hours. The samples were removed after 5 hours and cooled to room temperature, filtered and analyzed as before.

The entire study was carried out thrice to check the reproducibility and the average values are reported.

RESULTS AND DISCUSSION

Use of herbs for clarifying and disinfecting water has been in practice for long time now[21]. Different stages of tannery effluents contain different pollutants. The current study has evaluated the use of two commonly avail-

able plant leaves to reduce the pollution load of Soaking and Lime effluents in which chromium content is negligible.

The effect of treating Soaking and Lime effluents with Neem and Mango leaves are given in Figures1 a-d and 2 a-d respectively. It was noted that diluting the effluent (1:1) brought about 30 - 40% of reduction in conductance, which is directly related to TDS. In most industries this method is being practiced to reduce TDS of effluent.

did not affect the treatment significantly.

The results of the present study reveals that adding 5g/100ml of fresh mango and / neem leaves to lime effluent reduced its TDS to about 30%. This may be due to the presence of protein in fresh neem (H"7 %) and mango leaves (about 6.5 -17 %)[13,14]. The role of proteins in clarifying waste water is known for more than a decade[9].

On carrying out the treatment at 50°C, it was observed that efficacy did not increase significantly Figures (3 a-d) suggesting that usage of thermal energy along with neem and mango leaves is not essential for obtaining about 30% reduction in the TDS of lime effluent.

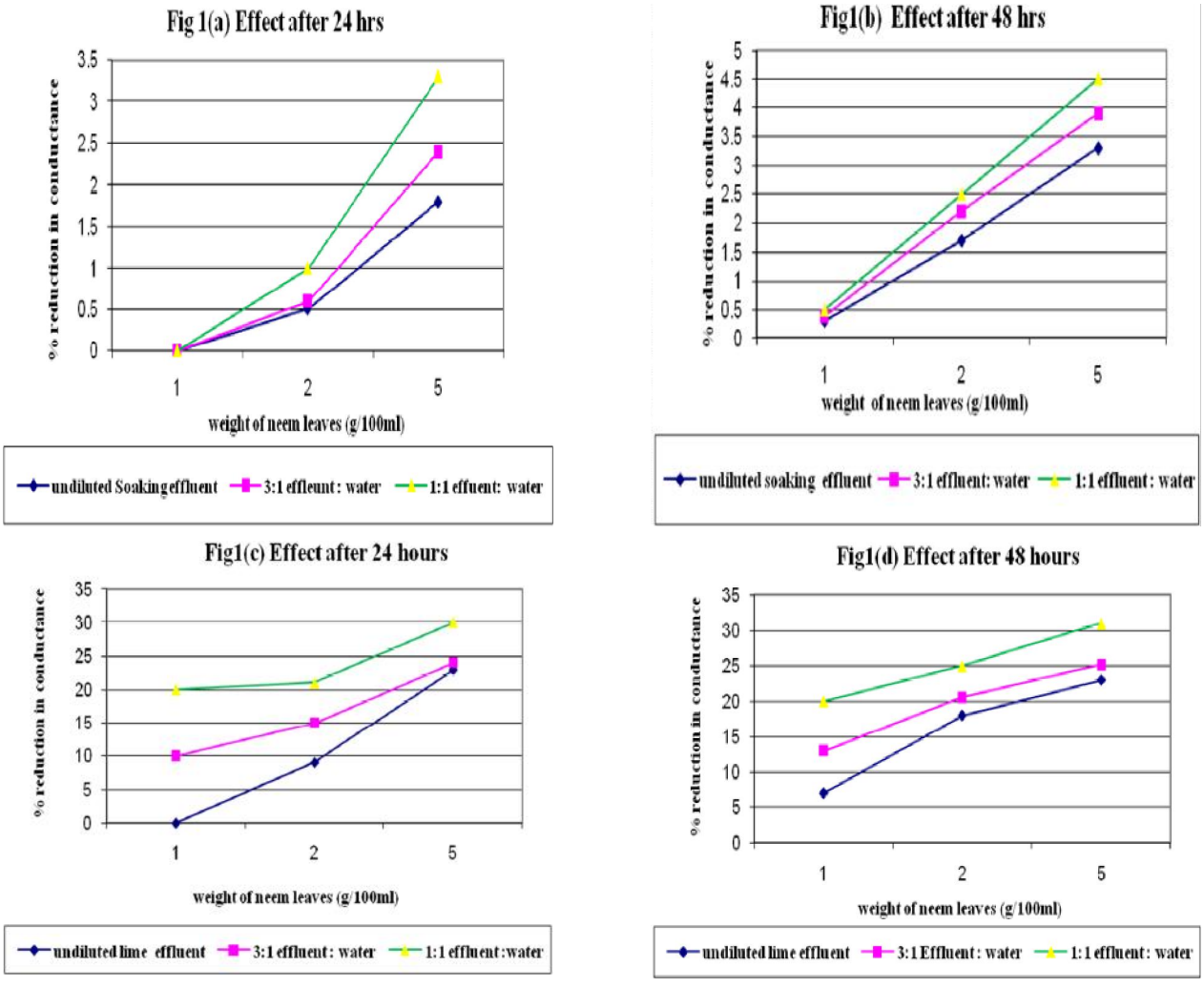

Figure 1(a-d) : Effect of Neem leaves on the conductance of Soaking and Lime Effluent

Both the leaves were not effective in reducing the conductance of soaking effluent. However for lime effluent there was a significant decrease in conductivity which was found to be supported by decrease in TDS also (TABLE 1).

Though the decrease in conductivity and TDS were proportional to the amount of leaves, time of contact

Mangiferin was quantitatively extracted from the leaf of Mangifera indica[11]. The conclusive structure of mangiferin has been established as 2-C-β-D-gluco-

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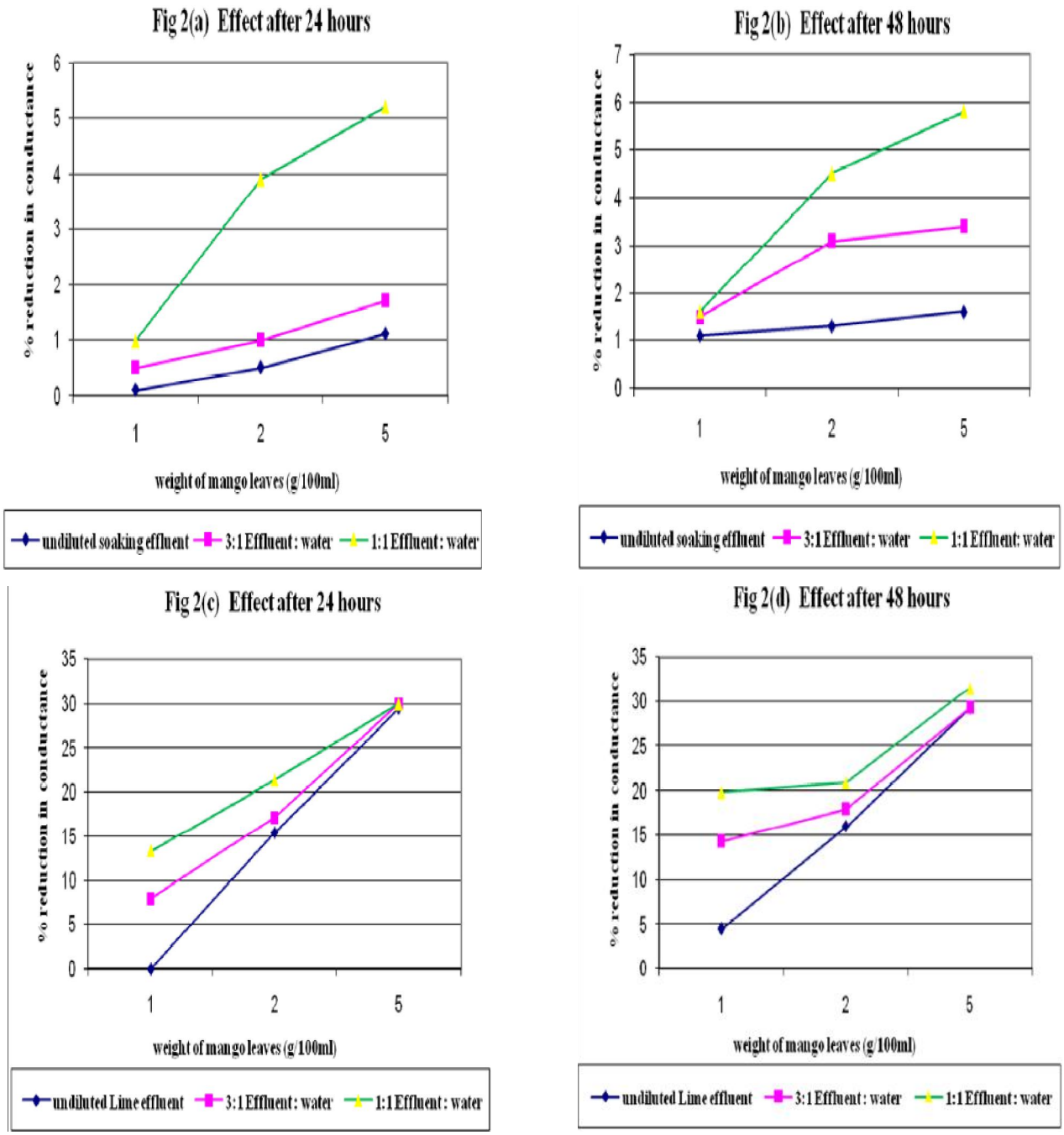

Figure 2(a –d) : Effect of Mango leaves on the conductance of Soaking and Lime Effluent

pyrano-syl-1,3,6,7-tetrahydroxyxanthone. Mangiferin has been traditionally used as anti-inflammatory, analgesic, antioxidant, immunomodulator and in obesity treatment, particularly for diabetes type II.

Neem leaves mainly yield quercetin (flavonoid) and nimbosterol (β- sitosterol) as well as a number of liminoids (nimbin and its derivatives). Quercetin (a polyphenolic flavonoid) is known to have antibacterial and antifungal properties[14].

These chief constituents of neem and mango leaves are essentially acidic in nature. The pH of the deionised water after 24 hours of soaking neem and mango leaves was found to be 6 and 5.3 respectively. pH of soaking effluent was < 6 (acidic) while that of lime effluent is >12 (alkaline) at the time of collection. This difference in the pH of the effluents may be the reason for the difference in the efficacy between soaking and lime effluent treatments.

TABLE 1 : Total Dissolved Solids (TDS in ppm) before and After Herbal Treatment

Time in hrs	Wt of leaves (g/100ml)	100%	75%	50%
Soaking Effluent				
Neem				
24	0	33771	26839	19334
	1	33771	26839	19334
	2	33602	26678	19141
	5	33163	26195	18696
48	0	33771	26839	19334
	1	33670	26783	19237
	2	33197	26249	18850
	5	32657	25792	18464
Mango				
24	0	33771	26839	19334
	1	33738	26704	19145
	2	33597	26571	18580
	5	33380	26383	18329
48	0	33771	26839	19334
	1	33401	26436	19025
	2	33332	26007	18464
	5	33231	25927	18213
Lime Effluent				
Neem				
24	0	12474	9639	6363
	1	12474	8676	5090
	2	11351	8193	5021
	5	9617	7326	4454
48	0	12474	9639	6363
	1	11601	8386	5090
	2	10229	7654	4772
	5	9605	7181	4390
Mango				
24	0	12474	9639	6363
	1	12474	8878	5517
	2	10553	7975	4995
	5	8795	6747	4454
48	0	12474	9639	6363
	1	11913	8261	5103
	2	10478	7904	5033
	5	8819	6815	4359

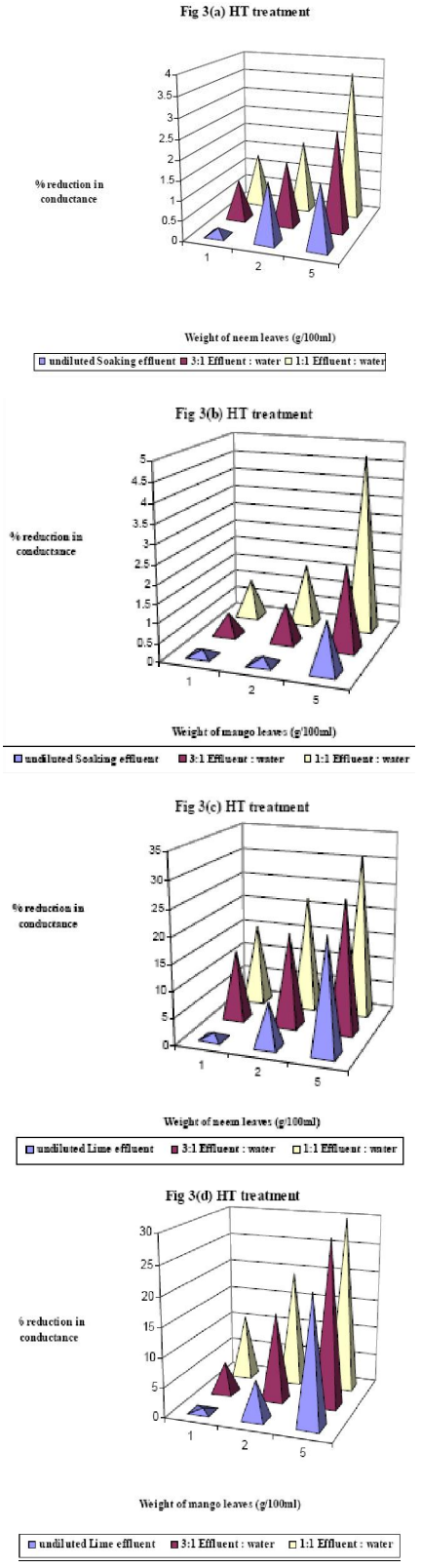

Figure 3(a- d) : Effect of Neem and Mango leaves at 50°C for 5 hrs on the conductance of Soaking and Lime Effluent.

There was a slight increase in the pH of the soaking effluent and a slight decrease in the pH of the lime effluent during dilution as acidity and alkalinity decreases with 50% dilution. During treatment with fresh Neem and Mango leaves there was further change in the pH

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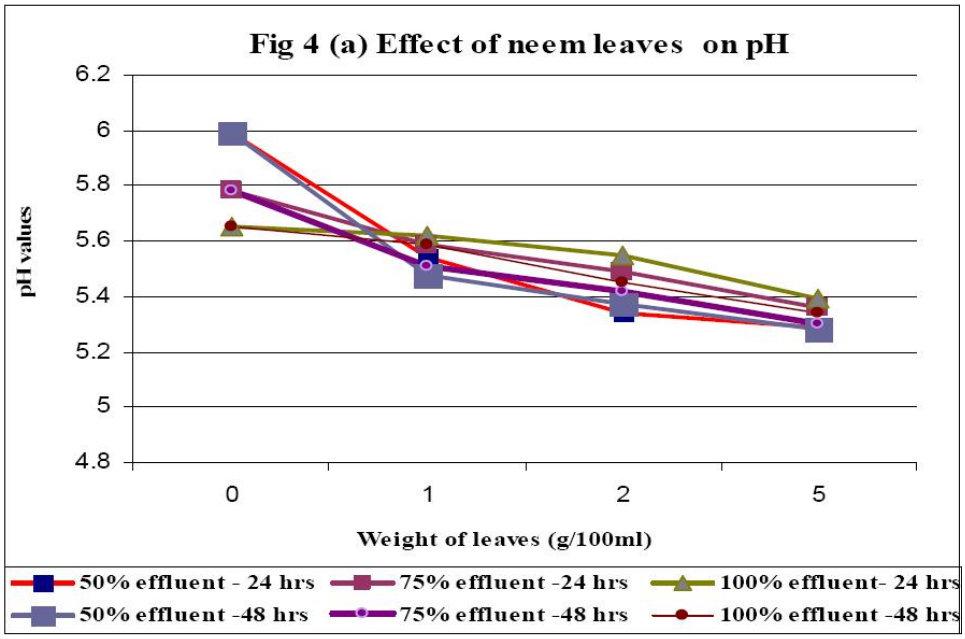


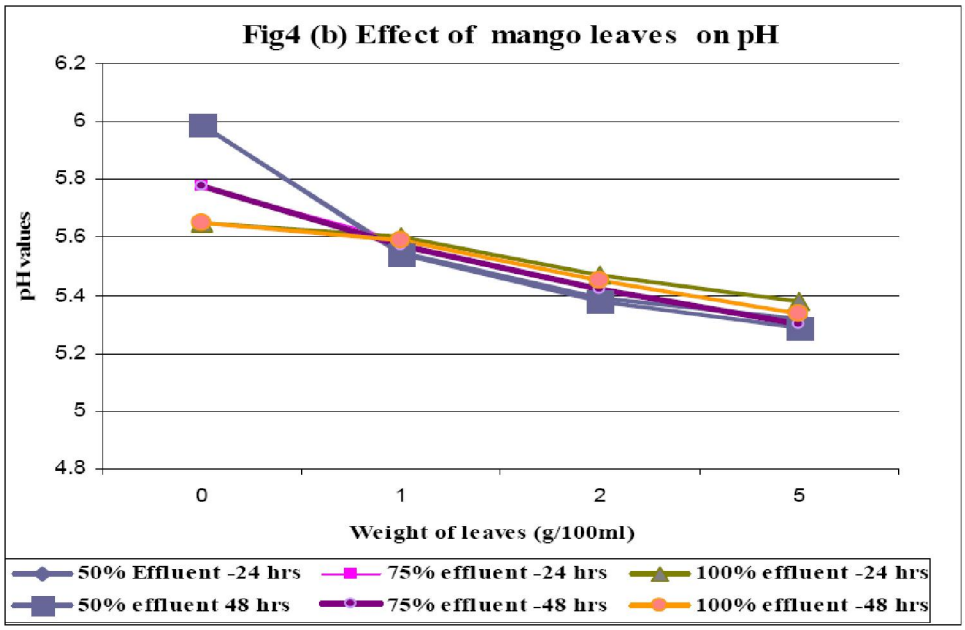
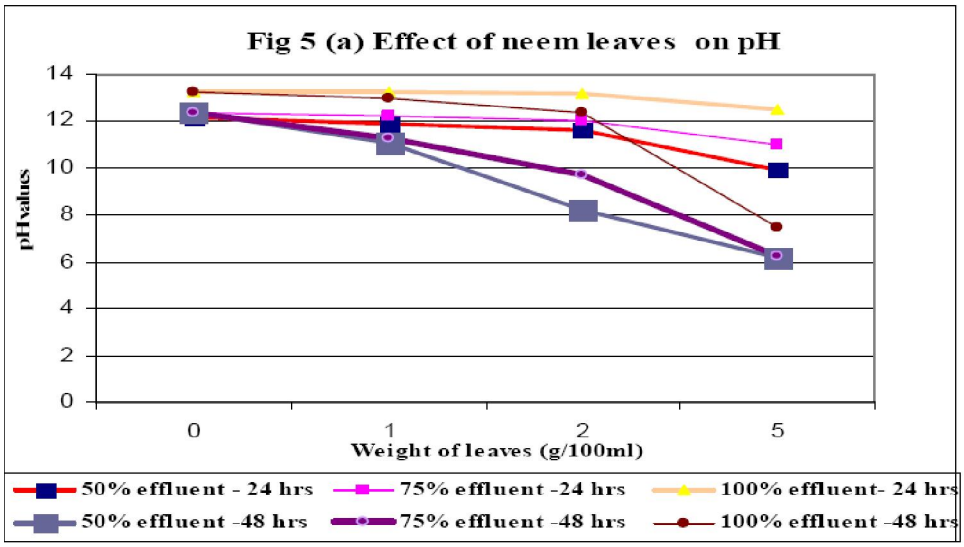


Figure 4(a & b) : Effect of neem and mango leaves on pH of Soaking Effluent

for both the effluents.

The effect of neem and mango leaves on various concentrations of soaking effluent is given in Figures4a and b respectively. There is a decrease in the pH on treatment for all effluent and inhibitor concentrations. However this decrease is undesirable and insignificant after 48 hrs contact time.

The effect of neem and mango leaves on various concentrations of lime effluent is given in Figures5a and b respectively. There is a decrease in the pH on treatment for all effluent and inhibitor concentrations. However this decrease is significant as the pH has fallen from >12 to<7 during 48 hours treatment for both leaves. As per EPA the pH of effluent can be in the range of 5.5-9.0. The lime effluent pH attained permissible range of about 7 for undiluted effluent after 48 hrs contact with both neem and mango leaves and about 6 for 1:1 dilution after 48 hrs contact with both neem and mango leaves. This is also in consistent with the results obtained for conductivity and TDS.



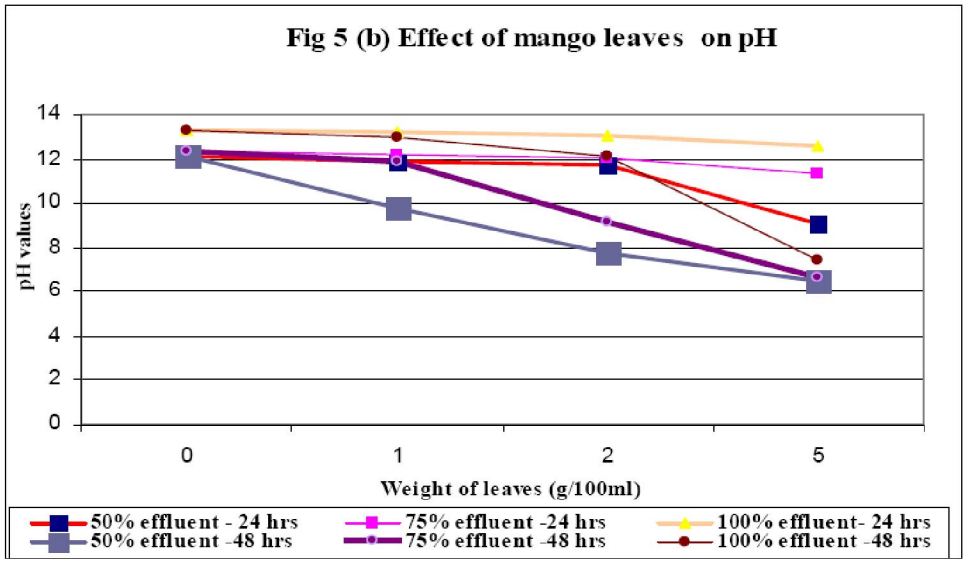


Figure 5(a & b) : Effect of neem and mango leaves on pH of Lime Effluent

CONCLUSION

The treatment efficacy is consistent as shown by a change in conductivity, TDS and pH.

The same level of reduction of the pollutants which is achieved by diluting the effluent to 50% can be achieved by adding 5g/100ml of fresh neem / mango leaves. This suggests that a simple green practice can pave new way for sustainable development there by reducing the need for dilution and dispersion.

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