E-ISSN: 2664-8784
P-ISSN: 2664-8776
IJRE 2024; 6(1): 20-23

www.engineeringpaper.net
Received: 12-02-2024
Accepted: 16-03-2024

AK Achuthan
UG Student, Department of Civil Engineering, Sri Manakula Vinayagar Engineering College, Puducherry, India

V Dhanushkumar
UG Student, Department of Civil Engineering, Sri Manakula Vinayagar Engineering College Puducherry, India

SP Sabarinathan
UG Student, Department of Civil Engineering, Sri Manakula Vinayagar Engineering College Puducherry, India

Correspondence
AK Achuthan
UG Student, Department of Civil Engineering, Sri Manakula Vinayagar Engineering College, Puducherry, India

Effects of natural coagulant in the treatment of pharmaceutical wastewater

AK Achuthan, V Dhanushkumar and SP Sabarinathan

DOI: https://doi.org/10.33545/26648776.2024.v6.i1a.51

Abstract
The objective of this work is to treat pharmaceutical wastewater by using inexpensive, environmentally benign ingredients as Natural coagulants. In this study, inexpensive coagulants, namely the powdered Neem leaves are used to treat the pharmaceutical wastewater. The leaves were harvested, sun-dried, and ground until they were the size of 300 and 150 micron sieve particles. Untreated Pharmaceutical wastewater was collected from industry. The chosen natural coagulant (namely Neem leaf powder), are individually added in different concentration of 1ml, 2ml, 3ml, 4ml, 5ml and 6ml in a 1000 ml wastewater taken in a beaker to find the optimum dosage using Jar test apparatus. The tests are carried out from the optimum dosage in different hydraulic retention time (2, 4, 6, 8hrs) by using natural coagulants. Conclusions are drawn based on the Chemical Oxygen Demand for the comparatives study of raw pharmaceutical wastewater by using natural coagulant in different sieve sizes for a COD Concentration. The maximum percentage of COD reduction was 85.90% at COD concentration with 150 µ under 8hrs HRT.

Keywords: Natural coagulants, low cost, pharmaceutical effluents, wastewater treatment, chemical oxygen demand, hydraulic retention time

Introduction
In India, the disposal of pharmaceutical wastewater poses a significant environmental challenge due to its complex composition and potential adverse effects on ecosystems and human health [1]. Traditional methods of wastewater treatment often on chemical additives, which can introduce additional pollutants and high operational costs. In recent years, there has been growing interest in exploring sustainable and eco-friendly alternatives for wastewater treatment [2]. Natural coagulants derived from plant sources, such as Neem leaves (Azadirachta indica) and moringa leaves (Moringa oleifera) [3], have emerged as promising coagulants for pharmaceutical wastewater treatment. These natural substances contain bioactive compounds that exhibit coagulation and flocculation properties, allowing them to effectively remove suspended solids, organic contaminants, and even certain pathogens from wastewater [4]. The efficacy of Neem leaves as natural coagulants has been demonstrated in various studies, showcasing their ability to reduce turbidity, chemical oxygen demand (COD), and other pollutants in pharmaceutical wastewater. Furthermore, the use aligns with the principle of green chemistry, promoting sustainability and environmental stewardship in wastewater management practices [5]. As there is a need to identify the particle size and HRT for the maximum COD reduction, an attempt with different sieve size and HRT is worked out in this study.

Materials
Pharmaceutical wastewater
The pharmaceutical wastewater is collected from a pharmaceutical company located in Kurumbapet, Puducherry. The pharmaceutical wastewater is collected in 10 litres plastic can.

Fig 1: Untreated Pharmaceutical Wastewater

Neem Leaves

Neem leaves are collected from a number of tall Neem trees and were allowed to dry at room temperature in a shade for a long time till the leaves becomes crispy as shown in Fig 2 and 3 that could be crushed into a fine powder in a mechanical grinder [6]. The Neem Leaf Powder (NLP) was sieved through 300 and 150 microns and retained in pan as shown in Fig 3. The NLP was preserved in glass bottles for future use as a coagulant.

Fig 2: Dried Neem Leaf

Fig 3: Neem Leaf powder

Methodology

The Neem Leaf Powder used with different sieve sizes of 300 and 150 µ. The reduction in percentage of COD is measured to understand the efficiency of Natural Coagulants used. The best dosage of Natural Coagulant for the chosen COD concentration by Jar test apparatus was found to be 3ml [7]. The same dosage is applied in different HRT's to understand the Maximum COD reduction.

Characteristics of Pharmaceutical Wastewater

Table 1: Initial Characteristics of Pharmaceutical Wastewater

Sl. No	Parameters	Initial Reading in mg/l
1.	pH	5.96
2.	Turbidity	817 NTU
3.	Total solids	2178
4.	Suspended solids	366
5.	Total Dissolved Solids	1012
6.	Volatile suspended solids	260
7.	Conductivity	1641
8.	Total alkalinity	440
9.	Chlorides	280
10.	COD	6416
11.	BOD	1100
12.	Phenolic compound (C6H5OH)	BLQ(LOQ:0.002)
13.	Phosphate	27

Result and Discussion

When the Neem leaf powdered of size 300 µ is subjected to different HRT's the pharmaceutical wastewater undergoes treatment and as shown as Table 2.

Table 2: Shows Variation of parameters of different HRT in 300 µ sieve size at concentration of COD 6000 mg\L in Pharmaceutical wastewater using Neem leaf.

SL. No	Parameters	Initial Reading in mg/l	2HRT in mg/l	4HRT in mg/l	6HRT in mg/l	8HRT in mg/l
1.	pH	5.96	6.82	6.70	6.67	6.58
2.	Turbidity	817 NTU	320 NTU	261 NTU	127 NTU	92 NTU
3.	Total solids	2178	1170	1171	1134	1114
4.	Suspended solids	366	187	179	172	166
5.	Total Dissolved Solids	1812	983	992	962	948
6.	Volatile suspended solids	260	130	120	107	101

7.	Conductivity	1641	1503	1583	1489	1377
8.	Total alkalinity	440	398	371	364	354
9.	Chlorides	280	221	183	178	154
10.	COD	6416	4528	3426	1786	1286
11.	BOD	1100	920	870	620	510
12.	Phenolic compound (C6H5OH)	BLQ(LOQ:0.002)	BLQ(LOQ: 0.001)	BLQ(LOQ: 0.001)	BLQ(LOQ: 0.002)	BLQ(LOQ: 0.002)
13.	Phosphate	27	14	13	13	13

The pH remains in the range of 6.58 to 6.82 under different HRT which is an amenable situation for the biological degradation of wastewater. The Total Dissolved Solids reduction was maximum 52% at 8 HRT and with Minimum percentage reduction at 2HRT. The COD value reduced to 1286mg/l from 6416 mg/l for 8 Hrs HRT, which shows that an increased in HRT leads to maximum reduction of COD.

Table 3: Variation of parameters of different HRT in 150 µ sieve size at concentration of COD 6000 mg\L in Pharmaceutical wastewater using Neem leaf.

SL No	Parameters	Initial Reading in mg/l	2HRT in mg/l	4HRT in mg/l	6HRT in mg/l	8HRT in mg/l
1.	pH	5.96	6.65	6.66	6.54	6.55
2.	Turbidity	817 NTU	210 NTU	181 NTU	105 NTU	78 NTU
3.	Total solids	2178	1110	990	972	960
4.	Suspended solids	366	174	154	144	134
5.	Total Dissolved Solids	1812	936	836	828	818
6.	Volatile suspended solids	260	110	105	103	97
7.	Conductivity	1641	1491	1472	1432	1348
8.	Total alkalinity	440	354	342	286	254
9.	Chlorides	280	178	154	151	134
10.	COD	6416	2132	1862	1546	1106
11.	BOD	1100	770	680	540	420
12.	Phenolic compound (C6H5OH)	BLQ(LOQ:0.002)	BLQ(LOQ: 0.002)	BLQ(LOQ: 0.002)	BLQ(LOQ: 0.002)	BLQ(LOQ: 0.002)
13.	Phosphate	27	14	13	13	13

When the Neem leaf powdered was added to pharmaceutical wastewater with 150 micron sieve the changes in the characteristic are shown in pH, TDS and COD are mentioned in Table 3 and fig 4. The pH remains in the range of 6.65 to 6.55 under different HRT which is an amenable situation for the biological degradation of wastewater. The Total Dissolved Solids reduction was maximum 54.85 % at 8 HRT and with Minimum percentage reduction at 2HRT. The COD value reduced to 1106mg/l from 6416 mg/l for 8 Hrs HRT, which shows that an increased in HRT leads to maximum reduction of COD by using the natural coagulant at a sieve size of 150 micron.

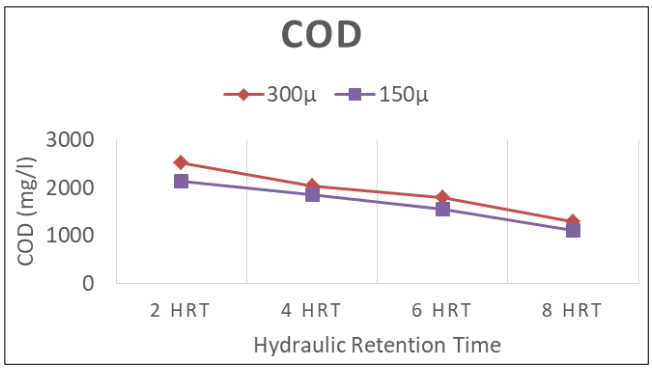

Fig 4: Variation of COD for different sieve size at different HRT in COD concentration of 6000 mg\L in pharmaceutical wastewater

Conclusions

- The optimum dosage for COD concentration 6000 mg/l was 3 ml/L and when subjected to different HRT of 8 Hrs it shows a maximum reduction of COD for 150µ.
- The Maximum COD reduction in Neem Leaf Powder (NLP) at COD concentration of 6000 mg/l was 1106mg/l.
- The rate of reduction of COD level is 82.76% while utilizing Neem leaf powder as a Natural Coagulant with 150µ sieve size at 8hrs HRT.
- Therefore, maximum COD level is reduced in Neem leaf powder at the 8hrs HRT in 150µ sieve at the COD Concentration of 6000 mg/l have best efficiency of Natural Coagulant. Hence the Sludge obtained from the process is also used as a Fertilizer.

References

1. Ahmad SRS. Plant-based versus metal-based coagulants in aquaculture wastewater treatment: Effect of mass ratio and settling time. J Water Process Eng. 2021 Oct;43:102269. DOI:10.1016/j.jwpe.2021.102269.
2. Bayisa D. Papaya seed extract as coagulant for potable water treatment in the case of Tulte River for the community of Yekuset district, Ethiopia. Environ Challenges. 2021 Aug;4:100198. DOI:10.1016/j.envc.2021.100198.
3. Kakoi B, Kaluli JW. Banana pith as a natural coagulant for polluted river water. Ecol Eng. 2016 Sep;95:699-705. DOI:10.1016/j.ecoleng. 2016.07.015.
4. Ali EN, Muyibi SA. Moringa oleifera seeds as natural coagulant for water treatment. In: Proceedings of the 13th International Water Technology Conference (IWTC 13); c2009; Hurghada, Egypt.
5. Farah Amira B. Utilisation of natural plant-based fenugreek (Trigonella foenum-graecum) coagulant and okra (Abelmoschus esculentus) flocculant for palm oil mill effluent (POME) treatment. J Environ Chem Eng.

2021 Feb;9(1):104667. DOI:10.1016/j.jece.2020.104667.
6. Fermino LDS, Castro AD. Water treatment with conventional and alternative coagulants. In: Pedrangelo C, editor. Chemical Engineering Transactions. Vol. 57. 2017. DOI:10.3303/CET1757100.
7. Camacho FP, Sousa VS. The use of Moringa oleifera as a natural coagulant in surface water treatment. Chem Eng J. 2017 Jun;313:226-237. DOI:10.1016/j.cej.2016.12.031.
8. Gandiwa BI, Moyo LB, Ncube S. Optimisation of using a blend of plant-based natural and synthetic coagulants for water treatment: (Moringa oleifera-Cactus Opuntia-alum blend). S Afr J Chem Eng. 2021 Feb;34:158-164. DOI:10.1016/j.sajce.2020.10.007.
9. Kayzas GZ, Deliyanni EA. Modified activated carbons from potato peels as green environmentally friendly coagulants for the treatment of pharmaceuticals effluents. Chem Eng Res Des. 2015 Jan;97:135-144. DOI:10.1016/j.cherd.2014.08.020.
10. Muniz GL, Borges AC. Performance of natural coagulants obtained from agro-industrial wastes in dairy wastewater treatment using dissolved air flotation. J Water Process Eng. 2020 Mar;37:101453. DOI:10.1016/j.jwpe.2020.101453.