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EFFLUENT TREATMENT EMPHASIS ON SPECTROSCOPY

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Abstract:

Now a day's water quality is a challenging problem to the society and the government. Water sources such as river, pond etc., are heavily polluted by the industrial effluent, so treating effluent is necessary. Waste water discharged from the fertilizer industry is one of the sources of environmental contamination. It discharges their wastewater into river after treating the Effluent present initial. Various stages of treatment were done in the effluent treatment plant of the factory. The principal contaminants are Phosphate, Fluorine, and Ammonia cal Nitrogen. The Raw effluent was treated with lime ($Ca(OH)_2$) in order to remove the pollutants from the effluent. This study was carried out to check the parameters such as pH, TDS, TSS, Phosphate, Fluorine, Ammonia cal Nitrogen and found to be in compliance with the permissible limit of Kerala State Pollution Control Board. The water quality parameters were analyzed using various analytical techniques. The metals (Ca, Mg, Zn, Fe) present in the samples were analyzed by Atomic Absorption Spectroscopy and phosphate by UV-Vis spectrophotometer.

Keywords: - Effluent, water quality parameters, UV-Vis spectrophotometer, Atomic Absorption Spectroscopy.

1. INTRODUCTION

Growing population & industrial growth challenges the quality of water & the present effluent management. Since olden days agriculture was the mainstay of our people and due to the development of industrial sector all the agricultural the land has been transferred for industrial usage and further other available lands started to lose its fertility, thereby the yield of food grain become lower & lower. So in order to enrich the soil fertility the chemical fertilizer was the only hope. The fertilizer companies paved the way to overcome these obstacles. The immediate objective was to grow more food using wonder enricher, chemical fertilizer. Besides these advantages there is a lot of chances for the Periyar river to get polluted since wastes are disposed to it. In order to avoid this & to maintain ecological balance Kerala State Pollution Control Board (KSPCB) had put forward standards for the effluent which is being let out into the water bodies.

The fertilizer companies have strived to minimize effluent generated & save environment by taking suitable pollution control measures. In the present study I am discussing about the various pollution controls treatment practices followed by the fertilizer companies. The evolution of green chemistry and increase in awareness about pollution recognizing the responsibility to

society, the fertilizer companies chalked out plans to remove the pollutants in effluents strictly following the standards laid down by KSPCB.

Fumes generated in the reactor i.e., the gases from the dryer are scrubbed & the gases are further treated in the knock out chamber where water is circulated for washings. The leaking out from circulating system forms the major part of waste water. Floor washing a gland leak from the various pumps join the raw effluent stream. The waste water contains phosphate, fluorine & ammonical nitrogen as pollutant. The different sources of effluents are as follows:

1. H_2SO_4 Plant
2. H_3PO_4 Plant
3. Ammonia Phosphate Plant

The effluent treatment plant is designed to treat 350 m^3/hr of raw effluent containing a maximum 1000 mg/l phosphate, 500mg/l of fluoride as fluorine to a clean effluent containing 5 mg/l phosphate as P & 1.5 mg/l of fluoride as fluorine.

Various methods are used to treat the effluent such as biological and chemical methods. In this present study we are focusing more on chemical treatment using lime. The nutrients like Nitrogen&phosphorus compounds discharged into the environment can cause serious problems such as Eutrophicationin Rivers and lakes in the soundings where the water is being discharged untreated and also deterioration of water sources, which causes hazards to human health. Furthermore, nitrates can also form nitrosamines and nitrosamides are potentially carcinogenic compounds.[1,2,3]Initially the waste water from the fertilizer companies was treated using lime and then the remaining nitrate content by using various carbon sources.[4]

The waste water treatment of various factories are studied earlier such as stainless steel factory, Pesticide industry, building and construction chemicals factory and plastic shoes manufacturing[5].

VinayM. Bhandarietal. Has reported a case study of industrial wastewater form fertilizer factory. The important characteristics we reanalyzed such as COD, AmmoniacalNitrogen, and Total dissolved and suspended solids. Adsorption and Hydrodynamic Cavitation techniques are used to treat the effluent.[6]

Hawks and Dave [7] reported that the pollution caused by fertilizers and inorganic wastes can bring about drastic changes in the composition of the microbial flora and fauna of anyreceiving aquatic system. Although bacterial degradation processes are largely responsible for natural oxygen depletion within the water column (Bell and Dutka [8] Hawker and Avan [9]) most of the literature or contributions to the mineralization of fertilizer production wastes are concerned with microbial activity on sedimentary material (Bell and Dutka, Hawker and Avan [9]. With reference to the above work obire etal., [10]I studied the Impact of the effluent from National Fertilizer Company of Nigeria (NAFCON) limited to the Okrika creek phosphate, ammonia and urea in the NAFCON outfall effluent, exceeding the FEPA standards with the tendency for depleting available oxygen in the Okrikacreek.

Biological methods used to assess the biodegradability of chemicals often employ activated sludge as inoculums since chemicals that ultimately enter the environment are often discharged through as wastewater.

Biological wastewater treatment involves the transformation of dissolved and suspended organic pollutants to biomass and evolved gases [11&12].

The activated sludge process is the most generally applied biological wastewater treatment technique. In the ASP, a bacterial biomass suspension the activated sludge is responsible for the removal of pollutants [13].

Seema jilani etal., treated toxic organics in industrial waste water using the activated sludge process for a pesticide factory [14].

2. MATERIALS AND METHOD

The wastewater from the fertilizer company was selected for this study. The effluent present in the sample are treated in various stages of the effluent treatment plant. Fig 1. Shows the Block Diagram of Effluent Treatment Plant. Raw effluents coming from sulphuric acid plant &

phosphate plants are coming to the equalization tank A.The solid particles are collected in the bottom of the tank A. And supernatant liquid effluent is overflowed to the B-Tank. From B-Tank it is pumped to the flash mixer tank where it is reacted with lime slurry.

$$CaO + H_2O \rightarrow Ca(OH)_2 \text{ (Lime)}$$

The principal contaminants like phosphate, ammonium sulphate and fluoride on reacting with lime form CaF_2 and Calcium Phosphate.

$$2F^- + Ca(OH)_2 \rightarrow CaF_2 + 2OH^-$$

$$3Ca(OH)_2 + 2PO_4^{2-} \rightarrow Ca(PO_4)^{2-} + OH^-$$

$$(NH_4)_2SO_4 + Ca(OH)_2 \rightarrow NH_4OH + CaSO_4$$

Then it is passed into the clarifloculator where insoluble fluroapatite ($Ca_{10}(PO_4)_6F_2$) is formed at pH 10.when thestoichiometric ratio (15:1) of P_2O_5 toF is achieved. In this stage most of the phosphate as well as remaining fluoride are removed.

The remaining part of the treated water was stripped in a stripping pond where NH_3 was liberated.

$$NH_4 + OH^- \rightarrow NH_3 + H_2O$$

Finally the treated water sent to the A-Drain. This is used for washing, cleaning and diluting acids.

Estimation of available CaO in burnt lime.

CaO present in the burnt lime is estimated by Sugar and iodine method.

Spectroscopic analysis

The metals present in the water sample were analyzed by (GBC AVANTA Version 2.02model flame Atomic absorption spectroscopy) and the phosphate by UV/Visible Spectrophotometer (Hitachi U-2001).

Estimation of dissolved solid

The total dissolved solid was estimated by evaporating sample in a previously weighed dish and it dried in an oven at 180$\pm$2^{o}c about 1hr. The suspended solids was estimated by filtering the sample and the filter paper is dried and it dried in an oven at 180$\pm$2^{o}c about 1hr. The total solids was estimated by evaporating sample in a previously weighed dish about 103-108^{o}c.

Estimation of Ammoniaand Fluorine

Total ammomia present in the sample was analyzed by Automatic Titrator (Mettler Toledo DL-53). And the fluoride content were analyzed by ion selective electrode (Mettler Toledo M_A 235pH/Ion Analyzer)

Estimation of pH

PH of the samples is determined using pH meter (Mettler Toledo pH meter).

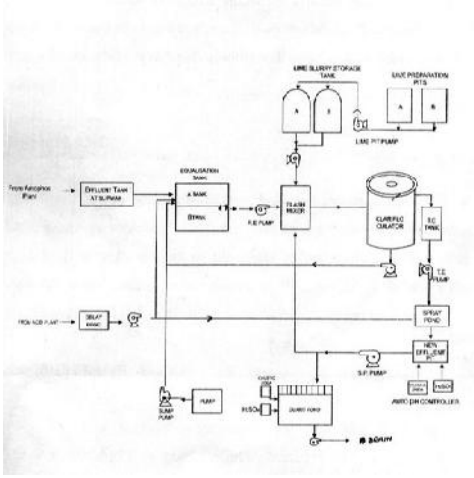

Figure 1. The Block Diagram of Effluent Treatment Plant.

3. RESULTS AND DISCUSSION

The percentage of Cao present in the lime was analyzed by sugar and Iodine method prior making it into slurry. Results shows that in sugar method 72.4% and in Iodine method it is 68% of Cao present which shows The Cao percentage is acceptable and we can use it for making lime for treating effluent.

In AAS concentration of various metals present in the effluent were analysed. Table 1-4 shows that concentration of Ca, Fe, and Zn& Mg.

Table 1 Elememt Calcium__Atomic Absorption Spectroscopy

Sample	Concentration (ppm)	Absorption
Standard 1	24.88	0.176
Standard 2	99.88	0.724
Sample 1	55.67	0.374
Sample 2	19.85	0.140

Table 2 Element Iron

Sample	Concentration (ppm)	Absorption
Standard 1	1.00	0.05
Standard 2	5.00	0.25
Sample 1	0.6	0.033
Sample 2	0.24	0.013

Table 3 Element Zinc

Sample	Concentration (ppm)	Absorption
Standard 1	1.00	0.140
Standard 1	3.00	0.371
Sample 1	0.3	0.043
Sample 2	1.26	0.172
Sample 3	0.73	0.100
Sample 4	1.08	0.152

Table 4 Element Magnesium

Sample	Concentration (ppm)	Absorption
Std1	8.260	0.199
Std2	49.57	0.877
Sample 1	18.649	0.330
Sample 2	10.484	0.200
Sample 3	3.184	0.069

Table 1 exhibits the analysis of Ca and it shows that concentration for sample 1 & 2 55.67 & 19.85 respectively. This is noted as very low concentration.

Table 2 shows the analysis result of Fe the concentration of Fe in sample 1& 2 was 0.6&0.24 which is very low concentration.

Table 3 shows the results of Zn. It lies in the range of 0.7-1.26 ppm and the Table 4 shows Mg is 3-19 ppm. The spectral analysis shows that every metal are very low in concentration.

The phosphate concentration were analysed by UV/Vis Spectrophotometer shows the results obtained and it shows that initially. In raw effluent the concentration was about 0.210 ppm. By passing various tanks followed by treatment it is getting lowered as 0.150, 0.025 corresponding to B tank and Treated plant. After treatment in the final outlet A-Drain it is about 0.011 ppm. Comparing to the raw effluent the treated water having low value shows that the phosphate is connected into $Ca_3(PO_4)_2$and then apatite on reacting with lime. So, the Fertilizer factory efficiently removed the phosphate content present in the raw effluent.

The total dissolved solid is find out as 1.160 ppm& total suspended solids was 0.351 ppm and total solids was 1.46 ppm.

The result of water quality parameters of the effluent for a week period and KSCPB Standards for industrial effluents are given in table 6.

From the above results we came to know that how the fertilizer companies treated the effluents in a novel way. Initially the samples from the R.E. (Raw Effluent) contain high level concentration of effluents. The concentration of the effluents going on decreasing from B-Tank, Spray Pond, Gourd Pond and finally at the E-Drain & A-Drain the effluents levels are within the limit specified by KSPCB (Kerala state pollution control board) (Ref. Daily Monitoring report).

Sometimes the levels of parameters exceeds in that case the water was treated again according to which parameter exceeds.

In Day1 the pH level in the E-Drain is 8.5 which exceed the limit. So the pH is adjusted with the help of automatic pH adjustor which is located in the E-drain by treating it with base.

The fluorine concentration in the raw effluent is high (16) (Ref. Day 6) after treating with lime it is decreased to 1.5 in the Gourd pond where it is coming under the limit specified by the KSPCB. Finally at the A-Drain the concentration is coming down the limit.

The total ammonia is very high (302.8) (Ref. Day 3). After the air stripping of it is decreased to a 17.79 which is coming below the limit (75 mg/L). At the end (A-Drain) it is 31.8.

From the above results we conclude that the fertilizer companies effluents which is going to Periyar river is free of contaminants and the parameters are within the limit.

Fig 1&2 shows the daily monitoring of various parameters of effluent in E-drain and Guard pond.

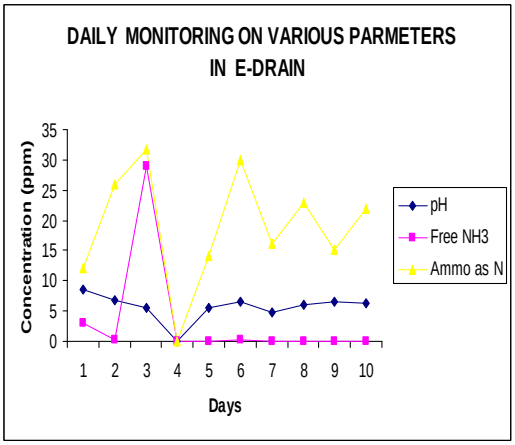

Figure 2 Daily monitoring on E-drain

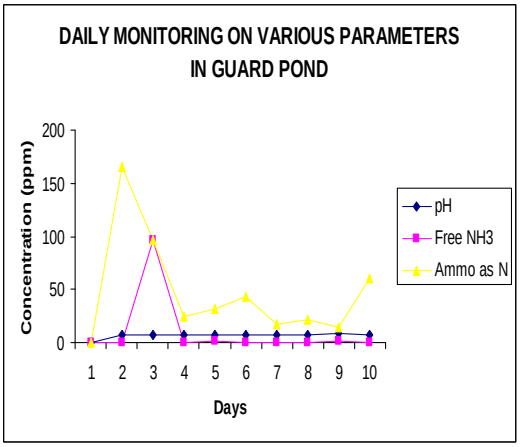

Figure 3 Daily monitoring on Guard Pond

R.E. = Raw Effluent Tank G.P. = Gray Pond T.E. = Treated Effluent Plant S.P. = Spray Pond R.E.(S) = Raw Effluent from N.D. =Not Found

Table-6 Dailymonitoring Report

Days	Sampling Point	pH	Free NH_3	Total Ammonia N	Total Phosphate p	Fluorine
Day 1	R.E.	6.5	0.55	180	14.41	20
	B-Tank	2.6	N.D	145	58	1.5
	T.E.	8.8	70	165	0.8	1.0
	E-drain	8.5	2.97	12	N.D.	N.D.
Day 2	R.E.	6	0.8	894	686	16
	B-Tank	1.8	N.D.	153	47	2.5
	G.P.	6.5	0.52	165	2.0	1.0
	E-drain	6.7	0.15	26	N.D.	N.D.
Day 3	R.E.	5.8	676	302.8	207	11.2
	B-Tank	1.8	85	60.93	9	1.6
	G.P.	6.9	96	96.28	2.06	0.56
	S.P.	5.7	18.4	17.79	0.06	0.35
	R.E (S)	6.0	102	75	N.D.	N.D.
	E-drain	5.6	2.9	31.8	N.D.	N.D.
Day 4	R.E.	6.6	2.2	485	240	6.0
	B-Tank	5.8	0.06	75	18	1.5
	G.P.	6.9	0.20	24	0.5	0.5
	A-drain	6.5	0.05	15	N.D.	N.D.
Day 5	B-Tank	2.2	N.D.	59	8.0	1.0
	G.P.	7.2	1.34	31	0.5	0.5
	A-drain	5.5	0.01	14	N.D.	N.D.
Day 6	R.E.(P)	5.3	0.07	272	672	16
	B-Tank	3.2	N.D.	78	15	4
	G.P.	7.0	0.42	43	0.5	1.5
	S.P.	6.0	0.01	16	0.5	N.D.
	R.E (S)	8.8	56.4	133	0.5	N.D.
	E-drain	6.6	0.13	30	N.D.	N.D.
	A-drain	7.6	1.80	41	0.5	1.0.
Day 7	R.E.	6.9	66.8	1980	1420	22.0
	B-Tank	4.1	N.D.	128	23	2.0
	G.P.	7.3	0.39	17	0.5	1.0
	R.E (S)	7.5	4.52	143	N.D.	N.D.
	E-drain	6.6	N.D.	16	N.D.	N.D.
Day 8	R.E.	6.4	4.6	1706	1127	14
	B-Tank	7.7	5.62	100	8.0	1.5
	S.P.	8.0	1.77	19	0.5	1.0

CONCLUSION

In therush of industrialization, it became expedient for people generate wastes, a significant portion of which is considered to be hazardous.

The world with chemical industrial face formidable environmental regulatory challenges in treating, disposing and maintaining parameters within the limits has become great importance to the factory to avoid environmental issues. Treating the effluent with lime is one of the best methods for removing the principal contaminants like phosphate, fluorine and ammonia cal nitrogen. It dilutes the effluent effectively and the concentration and toxicity of the pollutant. The result (Table 6) indicate that addition of lime in the treatment successfully reduce the harmfulness of the wastewater. The quality of wastewater being obtained from the fertilizer company after treatment acceptable with KSCPB limits. A-Drain water contains phosphate, so it is used for watering the plant. Moreover, it is used for washing and diluting the acids.

For analysing various parameters of water several physic-chemical methods are widely utilized. Spectroscopic analysis renders modern look to this study. The results obtained from Atomic Absorption Spectroscopy (Table 1-4) shows that the concentration of metals (Ca, Fe, Zn and Mg) are very low.

Finally all the water characteristics like pH, TDS, TSS, Phosphate, Fluorine,

Ammoniacal Nitrogen are compliance with the permissible limit of Kerala State Pollution Control Board.So, the fertilizer factory treating the effluent efficiently and discharge waste water into Periyar river after treatment is having no harmful contaminants.

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