Treatment of agrochemical/Pesticide Wastewater by Coagulation/Flocculation Process

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Abstract:

Agrochemical/Pesticide wastewater posses great pollution problems due to its high Chemical Oxygen Demand (6000-7000mg/L), Biochemical Oxygen Demand (2000-3000mg/L), high Total Dissolved Solids (12000-13000mg/L) and highly alkaline pH in the range of 12-14. Moreover the wastewater depicts wide variation in the wastewater characteristics depending on the type of agrochemicals manufactured and on the use of raw materials utilized. Additionally the high pH and TDS also add to the environmental problems. Because of these problems, conventional treatment units which employ activated sludge process (ASP) trickling filters do not usually work properly. It was thus proposed to subject this wastewater to physicochemical treatment using different coagulants and coagulant aids. Commonly available and cost effective coagulants; alum, ferrous sulphate, polyaluminium chloride (PAC) and also a polyelectrolyte Magnafloc were studied. Results indicated that this wastewater from agrochemical/ pesticide manufacturing unit is amenable to physicochemical treatment and can be applied both as a pretreatment technology and also as a final polishing treatment. As the wastewater is highly alkaline lime treatment was not tried. Optimum dose of 300mg/L, 250mg/L and 300mg/L for alum, FeSO4 and PAC were observed respectively. Based on these optimum doses, polyelectrolyte Magnafloc in different doses was tried. Alum: Magnafloc dose of 300:0.25 mg/L were found to be the best with COD reduction of 55.76%.This article discusses in detail the results obtained in physicochemical studies.

Keywords: Agrochemical, Pesticide wastewater, Coagulants, Polyelectrolyte, coaggulation, flocculation.

Introduction

Pesticide/Agrochemical manufacturing industry wastewater poses pollution problems due to the toxic components, high chemical oxygen demand (COD) (6000-7000 mg/l), biochemical oxygen demand (BOD) (2000-3000 mg/l); high Total dissolved solids (TDS) (12000-13000 mg/l) and high alkaline pH in the range of 12-14. The most important portion of contamination due to this wastewater is observed in agricultural areas and in surface waters that come from agricultural areas. Major quality of pesticide pollution is released during pesticide manufacturing. Pesticide, usually have direct adverse effects on the living organisms. Pesticides are highly toxic and carcinogenic in nature even at picogram loads[1]. Moreover it persists in nature for long period of time. The process of pesticide removal from the industrial wastewater is of great importance because of well-known pesticide resistance to microbial degradation and has tendency to bio-accumulate in the soil fauna and flora. Pesticides are carcinogenic and mutagenic in nature[2]. Hence biological treatment processes have their own limitations like toxicity and inefficiency in performance. Acclimatized microbial culture can be used for the treatment of this wastewater. At this juncture chemical coagulation, photo-oxidation, chemical oxidation, simple sedimentation, nano-filtration, adsorption etc. can be tried[3, 4]. But chemical oxidation and photo oxidation techniques are energy intensive and simple coagulation methods are more suitable.

Pesticide wastewater distinguishes itself because of its toxic and persistent nature in the environment. This wastewater depicts wide variation in its characteristics based on the pesticide production; raw materials used and water consumption and wastewater flow[5]. This wastewater has been reported to be treated by electrochemical techniques namely electro-oxidation, electro-coagulation and electro-fenton methods[6]. Various innovative technologies have been reported in literature but they are cost intensive and are not ecofriendly in nature[7, 8, 9].

A typical unit manufacturing herbicides and few chemical intermediates like metalgxyl, Dextrinol, propiconazole, hexaconazole (all herbicides) and 1, 2- Pentanediol, 2,4-Dichloroacetophenone was identified and the wastewater from this unit was collected for experimental work. Wastewater flow of this unit is around 68 m^3/day. Almost 85% of the total water is generated as wastewater. Because of the wastewater toxicity conventional biological treatment units which employ anaerobic filter, activated sludge process or trickling filters usually malfunctions, creating environmental problems. Hence, an alternative treatment process was envisaged which can be used either independently or in tandem with the conventional treatment units as pretreatment or a polishing process.

One of the treatment options seemed viable for the pollution abatement of pesticide wastewater is physicochemical treatment. Based on the literature review few selected common coagulates like Alum, Poly Aluminum Chloride (PAC), ferrous sulphate ($FeSO_4$) and Polyelectrolyte were identified for the treatment. Ferrous sulphate ($FeSO_4$), Alum, Poly Aluminum Chloride (PAC) were used independently and in combinations with the addition of Polyelectrolyte Magnafloc were studied in detail. As the pH of thewastewater was highly alkaline; Lime was not selected.

The present article describes the investigation conducted in selecting coagulants and polyelectrolyte for pesticide wastewater treatment and optimizing the conditions for successfully reducing COD, BOD, SS and TDS.

Experimental Details

Combined wastewater from the pesticide manufacturing unit was collected and characterized. The samples were analyzed as per the standard methods [10]. The experiments were carried out using the jar test apparatus. Six beakers of 1 ltr capacity were used in which neutralized wastewater was taken for detail studies. Coagulants stock solution were prepared and used for the complete set of each test. While using jar test apparatus, initially the samples were flash mixed for one minute at high rpm of 100 and later at 40 rpm for half an hour. After half an hour mixing the samples were settled for half an hour. Supernatant liquid was drawn and subjected to various important parameters and sludge volume settled was also noted.

Results And Discussions

Pesticide wastewater shows variation in COD, BOD, SS and TDS. This may be due to the different production process for different pesticides. Table 1 shows the actual wastewater characteristics which was used for the experiments.

Table 1: Unit wise Characterization of Existing Wastewater Treatment Plant

Parameters	**Raw wastewater**	**After primary Treatment**	**After Secondary Treatment**		**After tertiary treatment**
			BR-I	**BR-II**	
pH	12-14	7.0~8.5	5.5-6.5	5.0-5.5	5.5-6.5
Chemical Oxygen Demand (COD)	6000~7000	4000-5500	2000	1500	<1200
Biological Oxygen Demand (BOD)	2000~3000	1800-2500	800	600	<500
Total Suspended Solids	250~300	<100	<70	<60	<60
Total Dissolved Solids	12000~13000	<10000	<8000	<8000	<7000

*All values are expressed in mg/lit except pH.

*All values are average of 10 days sampling.

A detail study on the effectiveness of alum, ferrous sulphate ($FeSO_4$), PAC individually and in combination and also with the addition of polyelectrolyte on the optimal dose of coagulants were carried out. Alum being the most cost effective chemical selected for studies was tried first with the pesticide wastewater. As the wastewater pH was very alkaline (i.e. 12-14), the pH was adjusted to 7.0 with the help of hydrochloric acid, before the start of the experiment. An amount ------ of HCl was required to neutralize the wastewater during first stage from initial pH in the range of 12-14 to 7.0. Neutralized pesticide wastewater was then subjected to chemical treatment (second stage) using different coagulants. Initial alum doses between the ranges 50-400 mg/L was tried. pH did not show much variation in all the alum doses studied and it remained between 7.4 and 6.4. Maximum COD, BOD reduction were 32.16% and 64.68% respectively at alum dose of 600 mg/L. COD reduction showed a jump from 21.83% at 250 mg/L alum dose to 26.87% reduction at 300 mg/L alum dose. This reduction increased further by marginally by 3.0% at 350 mg/L dose of alum and when it was increased to 400 mg/L COD reduction further increased by 2.23%. This trend indicates that beyond 300 mg/L dose of alum, COD reduction started decreasing gradually. Moreover it is not worth increasing the chemical dose further to obtain only marginal increase in COD reduction. Hence it is very clear from the results shown in Table 2 and Figure 1 that alum dose of 300 mg/L seems optimal. Even suspended solids removal of 39.03% is achieved at this dose. Only TDS removal is minimum throughout the doses studied. It can be inferred from the results that 360 m/L dose as optimal. After 300 mg/L dose there was only marginal suspended solids removal. Wherever the wastewater warrants only suspended solids removal as a primary treatment, prior subjectivity the wastewater to biological treatment thereby reducing the load considerably on secondary biological system.

Table 2: Results of Treatability Studies Of Pesticide Effluent Using Coagulant: Alum mg/L

Parameters	Raw waste water	Neutra lized waste water	Doses of Alum (mg/L)							
			50	100	150	200	250	300	350	400
pH	12	7.5	7.4	7.4	7.3	7.3	7.1	7.0	6.8	6.4
Suspended Solids (SS)	3391	2122	1650	1575	1540	1505	1454	1294	1274	1263
% removal of SS	-	37.42	22.25	25.76	27.43	29.06	31.49	39.03	39.94	40.47
Total Dissolved Solids(TDS)	12236	9050	8767	8591	8341	8192	7969	7916	7684	7624
% Removal of TDS	-	26.04	3.13	5.07	7.83	9.48	11.94	12.53	15.09	15.76
Chemical Oxygen Demand	8587	7072	6454	6234	6026	5869	5528	5171	4955	4797
% Removal of COD	-	17.64	8.73	11.84	14.78	17.01	21.83	26.87	29.93	32.16
Biological Oxygen Demand	3688	3163	2730	2688	2625	2521	2402	2275	2133	2066
% Removal of BOD	-	14.23	13.70	15.03	17.02	20.31	24.06	28.08	32.56	34.68

Coagulant ferrous sulphate ($FeSO_4$) was used in the range of 50-400 mg/L dose. There appeared a gradual increase in COD, BOD and SS removal as the ferrous sulphate ($FeSO_4$) dose increased from 50-

250 mg/L but later gradually the efficiency of removal slowed down. Ferrous sulphate ($FeSO_4$) gave a SS removal of 52.21% with corresponding COD, BOD reduction of 34.61% and 35.12% respectively at the ferrous sulphate concentration of 250 mg/L.

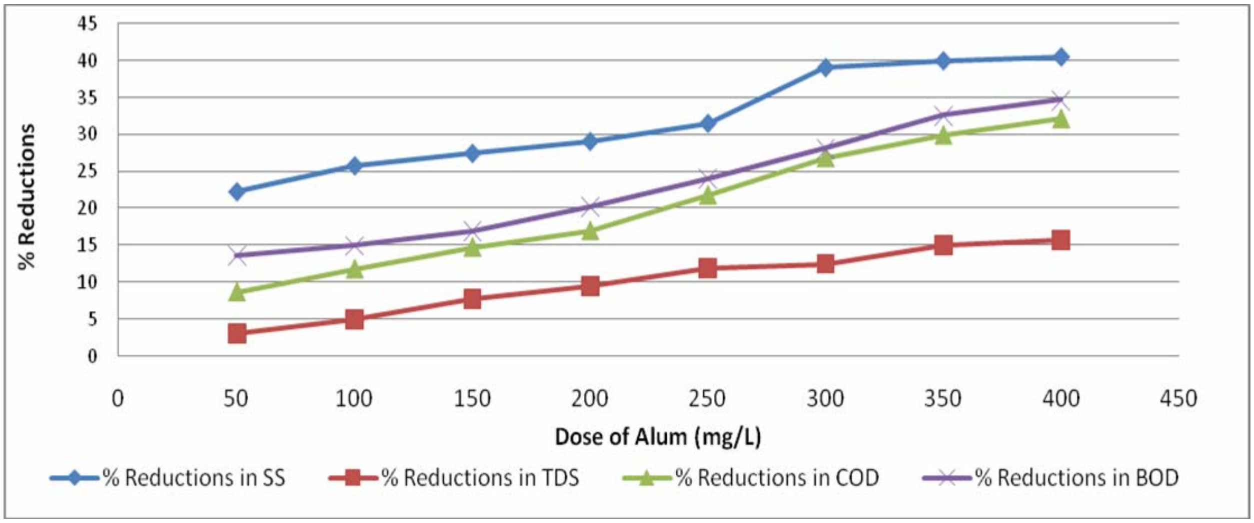

Figure 1 Physicochemical Treatability of Combined Wastewater from Pesticide Industry using Coagulant: Alum mg/L

TDS removal was very poor and was in the range of 2.55%-14.83% in the lowest and highest concentration of ferrous sulphate ($FeSO_4$) respectively. (Table 3 and Figure 2) sludge generation was comparatively lesser than alum.

Table 3 Results of Treatability Studies Of Pesticide Effluent Using Coagulant: Ferrous Sulphate mg/L

Parameters	Raw waste water	Neutralized waste water	Doses of $FeSO_4$ (mg/L)							
			50	100	150	200	250	300	350	400
pH	12	7.5	7.3	7.3	7.2	7.1	7.0	6.8	6.4	6.2
Suspended Solids (SS)	3391	2122	1377	1292	1187	1081	1014	994	963	949
% removal of SS	-	37.42	35.09	39.12	44.05	49.08	52.21	53.18	54.62	55.29
Total Dissolved Solids(TDS)	12236	9050	8816	8731	8586	8161	8044	7872	7759	7708
% Removal of TDS	-	26.04	2.58	3.53	5.13	9.82	11.12	13.02	14.27	14.83
Chemical Oxygen Demand	8587	7072	5577	5263	5006	4846	4624	4502	4372	4351
% Removal of COD	-	17.64	21.13	25.57	29.21	31.47	34.61	36.33	38.17	38.47
Biological Oxygen Demand	3688	3163	2572	2478	2299	2239	2052	2011	1926	1855
% Removal of BOD	-	14.23	18.68	21.66	27.32	29.21	35.12	36.42	39.11	41.35

Sludge volume varied between 27 ml at the lowest dose of 50 mg/L while it was around 69.2 ml at the highest dose of 400 mg/L. but BOD, COD, SS removal increased very marginally after 250 mg/L dose. Considering all the removal rates it appears that 250 mg/L dose is optimum. Ferrous sulphate ($FeSO_4$) imparted slight colour to the effluent at this dose. Moreover this dose of 250 mg/L can be used in sedimentation unit to achieve good SS removals.

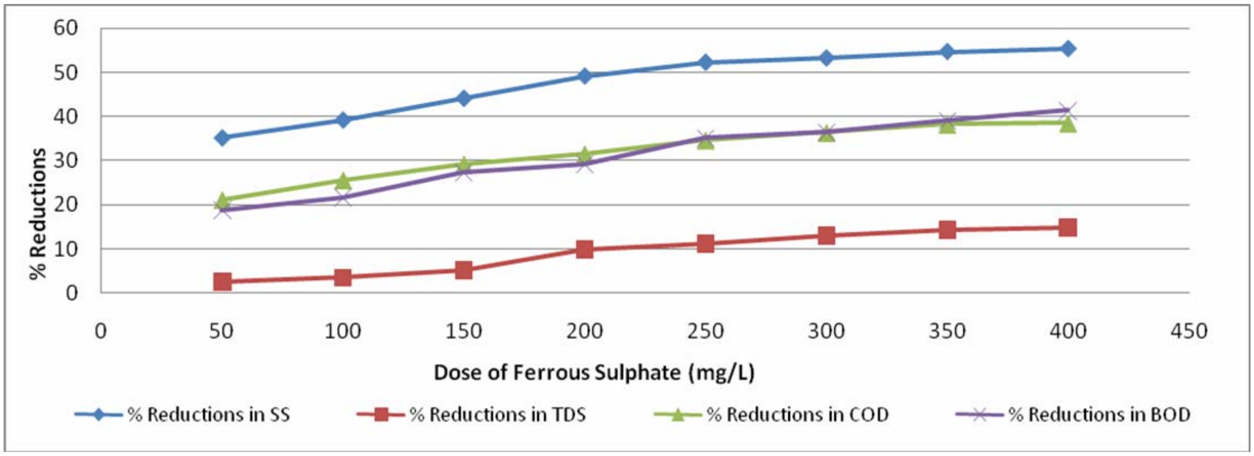

Fig 2: Physicochemical Treatability of Combined Wastewater from Pesticide Industry using Coagulant: $FeSO_4$ mg/L

Recently more stress is being given to the use of Polyaluminium Chloride (PAC) instead of alum in water treatment plants; due to its better coagulation property of wastewater having high turbidity. Considering this quality of PAC was also studied for pesticide wastewater.PAC was studied in the range 150 mg/L to 400 mg/L. In this experiments PAC did not show any appreciable reduction. It was more or less same as that of alum. When PAC concentration increased gradually to 100, 150, 200, 250, 300, 350 and 400 mg/L. SS removal increased slowly and it was 56.35% at 300 mg/L but increased marginally to 57.02% and 58.13% at 350 mg/L and 400 mg/L dose respectively. At 250 mg/L dose of PAC, the SS removal was 50.90% and suddenly it jumped to 56.35% at 300 mg/L dose of PAC. COD and BOD reductions were not very appreciable and were 30.80% and 38.10% respectively as seen in the Table 4 and Figure 3.

With a view to reduce the cost and quantity of chemical requirement, combination of chemicals and polyelectrolyte (Magnafloc) addition were studied. Few combinations namely Alum: PAC, Alum: Magnafloc, PAC: Magnafloc, Ferrous sulphate ($FeSO_4$): Magnafloc were studied in detail.

Initially a combination of alum and different doses of PAC were studied. Optimum alum dose of 300 mg/L was kept constant and different PAC dose varying from 50 mg/L to 400 mg/L was tried as indicated in Table 5 and Figure 4. From the results it can be seen that alum: PAC dose of 300:200 mg/L seems optimum. Removal of SS, COD, and BOD were 48.98%, 43.02% and 44.21% respectively. Individually PAC resulted 300 mg/L dose as optimum but in combination with alum it gave 200 mg/L as optimum that is the dose has reduced by 100 mg/L. but volume of sludge produced was excessive and this is not suitable combination for primary treatment.

Table 4: Results of Treatability Studies of Pesticide Effluent using Coagulant: Poly Aluminium Chloride (PAC) mg/L

Parameters	Raw waste water	Neutralized waste water	Doses of PAC (mg/L)							
			50	100	150	200	250	300	350	400
pH	12	7.5	7.4	7.3	7.2	7.1	7.0	6.8	6.6	6.2
Suspended Solids (SS)	3391	2122	1315	1245	1177	1109	980	926	911	888
% removal of SS	-	37.42	38.02	41.30	44.53	47.72	50.90	56.35	57.02	58.13
Total Dissolved Solids(TDS)	12236	9050	8850	8712	8569	8444	8242	8126	7909	7861
% Removal of TDS	-	26.04	2.21	3.73	5.31	6.70	8.93	10.21	12.61	13.14
Chemical Oxygen Demand	8587	7072	5742	5586	5360	5165	5049	4894	4772	4709
% Removal of COD	-	17.64	18.80	21.01	24.21	26.97	28.60	30.80	32.52	33.42
Biological Oxygen Demand	3688	3163	2523	2481	2385	2249	2122	1958	1928	1903
% Removal of BOD	-	14.23	20.23	21.56	24.58	28.89	32.92	38.10	39.04	39.83

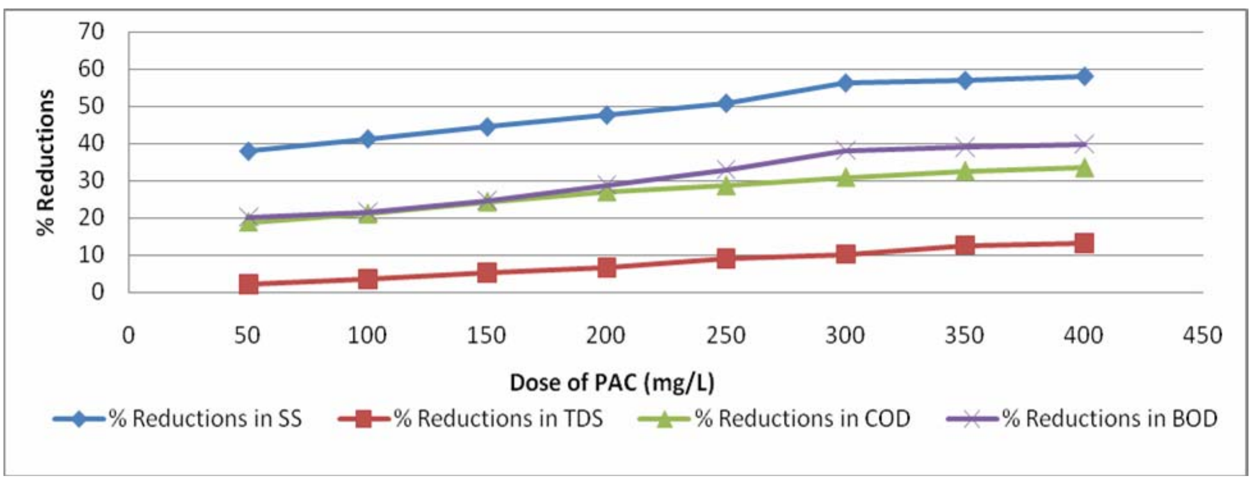

Fig 3: Physicochemical Treatability of Combined Wastewater from Pesticide Industry using Coagulant: PAC mg/L

Optimum alum dose of 300 mg/L as constant dose with various polyelectrolyte doses of 0.1, 0.15, 0.20, 0.25, 0.30, 0.35 and 0.40 mg/L were tried as is indicated in Table 6 and Figure 5. It is seen from the results that only alum dose of 300 mg/L resulted in 39.03% removal in suspended solids, but it increased to 67.54% likewise COD and BOD reductions increased from initial reduction of 26.87% and 28.06% to

55.76% and 57.47% respectively. So it is very clear that Alum: Polyelectrolyte (Magnafloc) is more efficient in COD, BOD and SS removals than only alum. These results were achieved at the optimum Alum: Magnafloc combination of 300: 0.25.

Table 5: Results of Treatability Studies of Pesticide Effluent
Using Constant Dose of Alum (300mg/L) + PAC

Parameters	Raw waste water	Neutralized waste water	Poly Aluminium Chloride Concentrations (mg/L)							
			50	100	150	200	250	300	350	400
pH	12	7.5	7.0	6.9	6.9	6.8	6.8	6.4	6.2	6.2
Suspended Solids (SS)	3391	2122	1271	1205	1154	1083	1058	1035	982	964
% removal of SS	-	37.42	40.08	43.21	45.60	48.98	50.12	51.24	53.74	54.56
Total Dissolved Solids(TDS)	12236	9050	8623	8430	8307	8098	7877	7853	7768	7656
% Removal of TDS	-	26.04	4.72	6.85	8.21	10.52	12.96	13.23	14.17	15.40
Chemical Oxygen Demand	8587	7072	4483	4355	4064	4029	4008	3967	3898	3847
% Removal of COD	-	17.64	36.60	38.41	42.53	43.02	43.32	43.90	44.87	45.60
Biological Oxygen Demand	3688	3163	2101	2049	1929	1765	1740	1724	1707	1681
% Removal of BOD	-	14.23	33.56	35.22	38.99	44.21	44.98	45.51	46.02	46.86

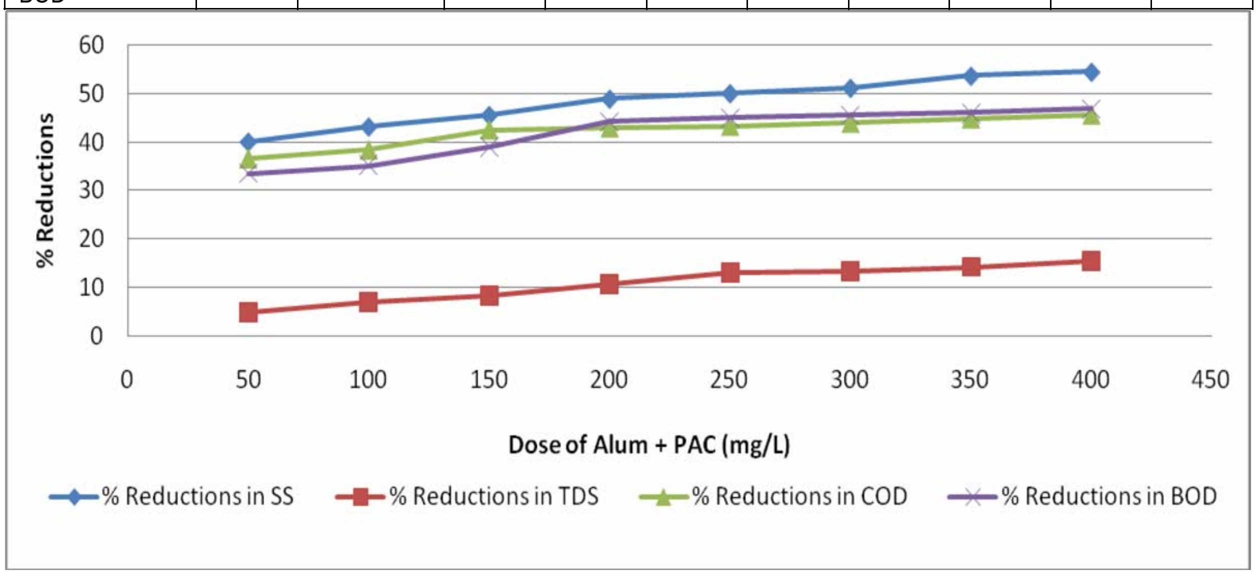

Fig 4: Physicochemical Treatability of Combined Wastewater
from Pesticide Industry using Coagulant: Alum (300mg/L) + PAC mg/L

Experiment using constant dose of PAC along with different doses of Magnafloc polyelectrolyte were also carried out. Optimal dose of polyaluminium chloride (PAC) arrived at earlier experiment was around 300 mg/L. This 300 mg/L PAC was kept constant and different volumes of polyelectrolyte (Magnafloc) was added. Polyelectrolyte concentration varied between 0.10 to 0.40 mg/L. results are shown in Table 7 and Figure 6. From the results it can be inferred that PAC: Magnafloc combination of 300: 0.30 mg/L is very effective with a SS, COD, and BOD removals of 68.70%, 49.61% and 55.19% respectively. In the absence of any other suitable coagulants; this combination can be applied to achieved efficient removal of SS of 68.70% thereby reduce the organic load on the secondary biological system. Initial cost may be more but in long-term run it will be very congenial.

Table 6: Results of Treatability Studies of Pesticide Effluent
Using Constant Dose of Alum (300mg/L) + Synthetic Polyelectrolyte (Magnafloc)

Parameters	Raw waste water	Neutralized waste water	Magnafloc Concentrations (mg/L)						
			0.10	0.15	0.20	0.25	0.30	0.35	0.40
pH	12	7.5	7.0	7.0	7.0	6.9	6.9	6.9	6.8
Suspended Solids (SS)	3391	2122	825	809	781	689	657	638	634
% removal of SS	-	37.42	61.12	61.86	63.20	67.54	69.03	69.94	70.12
Total Dissolved Solids(TDS)	12236	9050	8677	8441	8234	8016	7883	7862	7714
% Removal of TDS	-	26.04	4.12	6.73	9.02	11.43	12.90	13.13	14.76
Chemical Oxygen Demand	8587	7072	3436	3403	3350	3128	3043	2993	2962
% Removal of COD	-	17.64	51.40	51.87	52.63	55.76	56.97	57.67	58.11
Biological Oxygen Demand	3688	3163	1518	1488	1433	1345	1284	1264	1326
% Removal of BOD	-	14.23	52.01	52.96	54.70	57.47	59.40	60.05	58.08

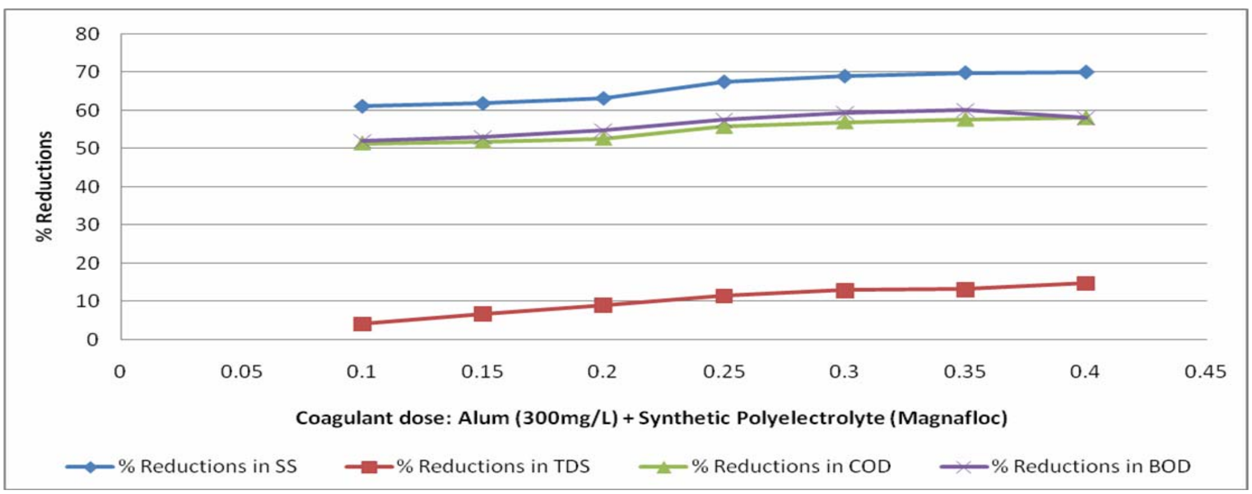

Fig 5: Physicochemical Treatability of Combined Wastewater
from Pesticide Industry using Coagulant: Alum (300mg/L) + Magnafloc (mg/L)

Last but not the least, the final experiments were tried using optimum dose of ferrous sulphate ($FeSO_4$) and different dose of polyelectrolyte. This polyelectrolyte is anionic in nature. Based on earlier experiments ferrous sulphate ($FeSO_4$) concentration of 250 mg/L was obtained as optimum. Using this dose as constant different doses of polyelectrolyte (Magnafloc) doses used were 0.1, 0.15, 0.20, 0.25, 0.30, 0.35 and 0.40 mg/L. Results obtained is shown in Table 8 and Figure 7. It can be seen from the results that polyelectrolyte (Magnafloc) dose of 0.25 mg/L with 300 mg/L of $FeSO_4$ is optimum. Removal of SS, COD, and BOD at this optimal dose was 50.23%, 51.13% and 52.80% respectively.

A summary of the results is depicted in Table 9 and Figure 8. In general, it was seen during the experiments that total dissolved solids removal was very insignificant with all coagulants and their combination.

Table 7: Results of Treatability Studies of Pesticide Effluent
Using Constant Dose of PAC (300mg/L) + Synthetic Polyelectrolyte (Magnafloc)

Parameters	Raw waste water	Neutralized waste water	Magnafloc Concentrations (mg/L)						
			0.10	0.15	0.20	0.25	0.30	0.35	0.40
pH	12	7.5	7.0	7.0	7.0	6.9	6.9	6.9	6.8
Suspended Solids (SS)	3391	2122	885	869	745	719	664	655	644
% removal of SS	-	37.42	58.31	59.05	64.87	66.09	68.70	69.13	69.66
Total Dissolved Solids(TDS)	12236	9050	8750	8546	8346	8224	8039	7813	7785
% Removal of TDS	-	26.04	3.31	5.57	7.78	9.13	11.17	13.67	13.98
Chemical Oxygen Demand	8587	7072	4610	4580	4300	4120	3988	3960	3895
% Removal of COD	-	17.64	38.18	40.23	42.19	44.73	49.61	50.00	50.91
Biological Oxygen Demand	3688	3163	1737	1709	1543	1460	1417	1408	1382
% Removal of BOD	-	14.23	45.08	45.96	51.20	53.83	55.19	55.73	56.31

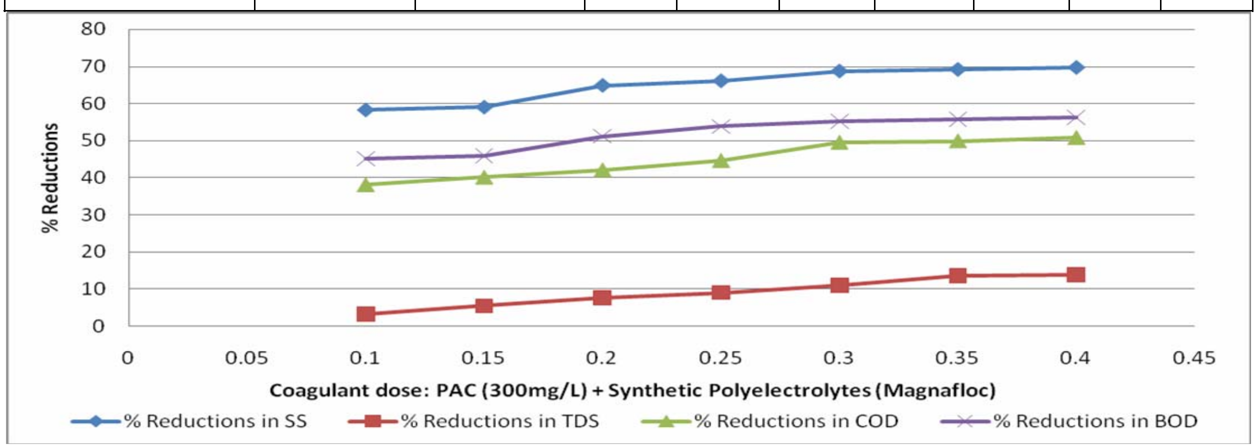

Fig 6: Physicochemical Treatability of Combined Wastewater from Pesticide Industry using Coagulant: PAC (300mg/L) + Synthetic Polyelectrolytes (Magnafloc)

Table 8: Results of Treatability Studies of Pesticide Effluent Using Constant Dose of FeSO4 (300mg/L) + Synthetic Polyelectrolyte (Magnafloc)

Parameters	Raw waste water	Neutralized waste water	Doses of Magnafloc (mg/L)						
			0.1	0.15	0.2	0.25	0.3	0.35	0.4
pH	12	7.5	7.0	7.0	7.0	6.9	6.9	6.9	6.8
Suspended Solids (SS)	3391	2122	1273	1220	1122	1056	1040	1023	1005
% removal of SS	-	37.42	40.00	42.50	47.12	50.23	50.98	51.78	52.63
Total Dissolved Solids(TDS)	12236	9050	8766	8560	8359	8066	7957	7855	7818
% Removal of TDS	-	26.04	3.14	5.41	7.63	10.87	12.08	13.20	13.61
Chemical Oxygen Demand	8587	7072	4172	3965	3634	3456	3399	3379	3351
% Removal of COD	-	17.64	41.00	43.92	48.61	51.13	51.93	52.21	52.61
Biological Oxygen Demand	3688	3163	1828	1746	1581	1493	1476	1464	1445
% Removal of BOD	-	14.23	42.19	44.79	50.02	52.80	53.33	53.70	54.31

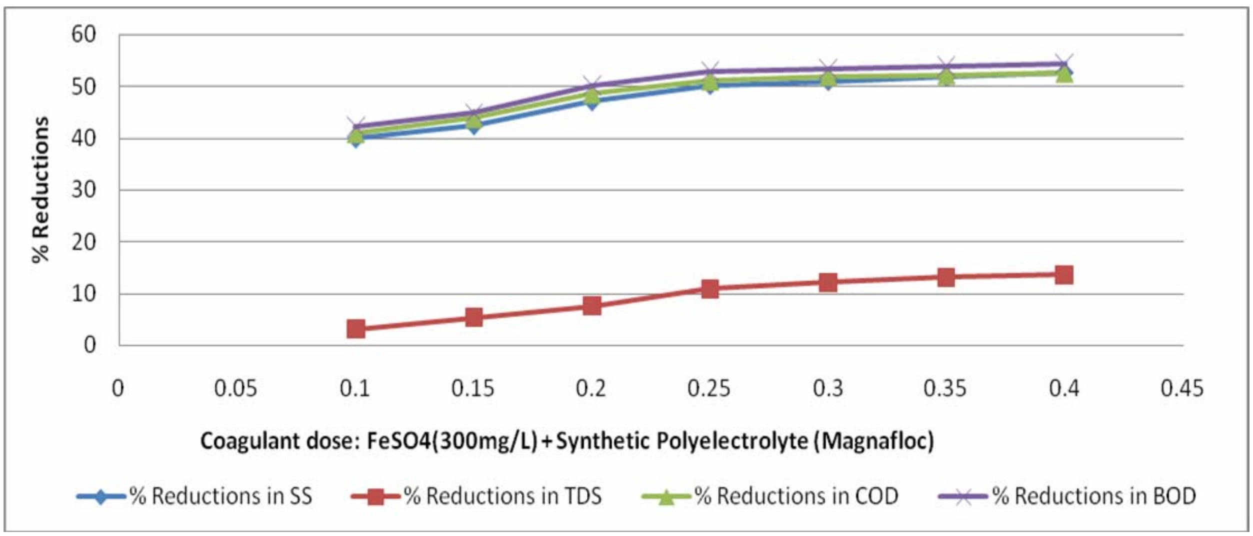

Fig 7: Physicochemical Treatability of Combined Wastewater from Pesticide Industry using Coagulant: Synthetic Polyelectrolyte (Magnafloc) (300mg/L) + PAC mg/L

Table 9: Physico-Chemical Treatability Using conventional Coagulant dose and its combination with poly electrolyte

Conventional coagulants + synthetic polyelectrolyte doses	Optimum doses of coagulants + synthetic polyelectrolyte (mg/L)	Removal efficiency							
		SS (mg/L)	% R in SS	TDS (mg/L)	% R in TDS	COD (mg/L)	% R in COD	BOD (mg/L)	% R in BOD
Alum	300	1294	39.03	7916	12.53	5171	26.87	2275	28.08
$FeSO_4$	250	1014	52.21	8044	11.12	4624	34.61	2052	35.12
PAC	300	926	56.35	8126	10.21	4894	30.80	1958	38.10
Alum + PAC	300 + 200	1083	48.98	8098	10.52	4029	43.02	1765	44.21
Alum + Magnafloc *	300 + 0.25	689	67.54	8016	11.43	3128	55.76	1345	57.47
PAC + Magnafloc **	300 + 0.30	664	68.70	8039	11.17	3988	49.61	1417	55.19
$FeSO_4$ + Magnafloc	250 + 0.25	1056	50.23	8066	10.87	3456	51.13	1493	52.80

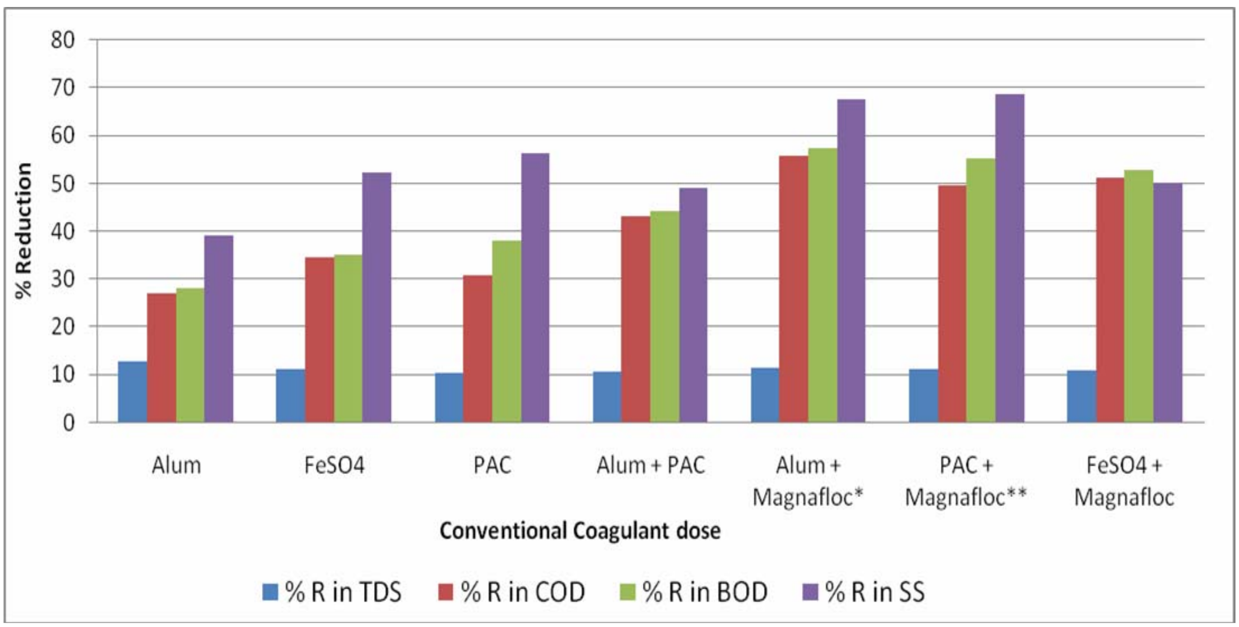

Fig 8: Physicochemical Treatability of Combined Wastewater from Pesticide Industry using Conventional Coagulants

Conclusion

From the above studies it can be concluded that pesticide wastewater can be treated by Physico chemical methods. The results have shown that all the coagulants used individually or in combination, and also with coagulant aid can remove moderate degree of COD, BOD and SS from pesticide/ agriochemical wastewater. Individually alum was least effective while PAC individually gave good results. Alum in combination with polyelectrolyte gave very efficient removals with respect to SS, COD, and BOD. They were 67.54%, 55.76% and 57.47% respectively. Overall TDS removals were very poor.

Combination of Alum: PAC of 300: 200 resulted in moderate removals in COD, BOD and SS. But considering the cost of chemicals this option does not seem viable.

References

1. Anonymus, International Agency For Research On Cancer (IARC) Monographs, IARC, Lyon, France, Vol. 54, Suppl. 7, Pp. 40-51 (1987)
2. S. Sahinkaya, C. Ozdemir and M. Karatas, Use Of Fenton’s Reagents For Removal Of Pesticides From Industrial Wastewater, Modern Management Of Mine Producing, Geology And Environmental Protection, SGEM-2007, Bulgaria, vol.1, pp. 421-434 (2007)
3. C. Ozdemir, S. Sahinkaya and M. Onucyildiz, treatment of pesticide wastewater by physicochemical and fenton processes, Asian J. of Chem.,Vol. 20 (5), pp. 3795-3804 (2008).
4. R. Mishra, S. Satyanarayan, Performance Evaluation of Agrochemical Wastewater Treatment Plant, M. Tech dissertation submitted to North Maharashtra Jalgaon University, Jalgaon, India
5. Balkrishnan Ramesh Babu, Kamal Mohamed SeeniMeera and PerumalVenkatesan, Removal of Pesticides by Electrochemical Methods- A Comparative Approach, Sustain. Environ. Res., 21(6), 401-406 (2011).
6. Arapoglou D., A. Vlyssides, C. Israilides, A. Zorpas and P. Karlis, Detoxification of Methyl-parathion Pesticide in Aqueous Solution by Electrochemical Oxidation, J. Hazard. Mater., 98 (1-3), 191-199 (2003).
7. Andrade L. S., L.A.M. Ruotolo, R.C. Rocha-Filho, N. Bocchi, S.R. Biaggio, J. Iniesta, V. Garcia-Garcia and V. Montiel, On the Performance of Fe and Fe, F-doped Ti-Pt/PbO_2 Electrodes in the electro-oxidation of the blue reactive 19 dye in simulated Textile wastewater, Chemosphere, 66 (11), 2035-2043 (2007).
8. Kabdasli I., B. Vardar, I. Arslan-Alaton and O. Tunay, Effect Of Dye Auxiliaries On Color And COD Removal From Simulated Reactive Dyebath Effluent By Electrocoagulation. Chem. Eng. J., 148(1), 89-96 (2009).
9. Clesceri LS, Franson MAH, Eaton AD, Greenberg AE. Standard methods for the examination of water and wastewater. 20th Eds., 1998, APHA, AWWA, WPCA, Washington D.C., USA.