Physicochemical Treatment of Dyes and Pigment Manufacturing Industrial Waste-Water Using Poly-Aluminium Chloride

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Abstract— The aim of this study is to compare the performance of polyaluminum chloride (PAC) and alum as coagulants to extract a particular type of dye from a solution containing dye. To this end, the effect of pH, coagulant dosage, coagulant aids, and initial concentration of dye on the efficiency of removal of dye was investigated. The removal of dye was, according to the findings, completely dependent on the pH variations. Total elimination of the dye occurred when the pH for PAC and alum reached 7 and 5 respectively. Both coagulants effectively eliminated the dye in their optimal pH range with relatively low dosages. By adding kaolinite as a coagulant aid, the efficiencies for removal tended to increase, especially for lower PAC and alum dosages. As the initial concentration of dye increased, PAC and alum represented different behaviours. In the case of PAC, the amount of the extracted dye per unit mass of coagulant first increased and reached a maximum value, 2.1 mg dye / mg PAC, and then quickly decreased. Although for alum, Q increased gradually as dye concentration rose and reached 2.8 mg dye / mg alum. Despite the rise in dye concentration in the range of 25-250 mg / l, there was no decrease in Q for alum. Waste water treatment chemicals are used for basic packaging, such as auxiliary and water-soluble fluids; lime and soda ash permit pH adjustment and water stabilization; Ca (OH) 2 is used for pH adjustment; activated gas carbon (PAC) can eliminate the taste and smell of contaminants and contaminants; NH3 -N 5712mg / L dye and wastewater treatment plants and 42000mg / L COD.

Keywords: NH_3, Ca(OH), Polly-Aluminium Chloride, Coagulation-Flocculation, PH and Temperature

I. INTRODUCTION

Dye compounds are some of the most essential chemicals used in various industries, such as textiles, paper, printing and plastics. High-color waste dissipation impedes light penetration, decreases dissolved oxygen and disturbs marine life. In fact, several colors have been found to be capable of producing carcinogenic aromatic amines in the reduction process [1].

At the other hand, these compounds are soluble without sufficient treatment, and can persist for a prolonged period of time in the environment. We must also be separated from wastewater before discharge, in order to comply with the environmental laws for the receiving waters [2].

Coagulation / flocculation, adsorption using activated carbon, membrane filtration, and advanced chemical oxidation such as H2O2 / UV and O3 are the commonly used methods that efficiently eliminate dyes and paint materials. Everyone has its own advantages and disadvantages. A common issue with most of them is their relatively high cost of use on a wide scale [3].

Coagulation / flocculation is one of the most common operations in water treatment trains and wastewater treatment units. It is also one of the most successful forms of chemical treatment for extracting dye from the industrial wastewater. The key advantage of this approach is the absence of coloring due to the removal of coloring molecules from the effluents and not due to partial decomposition of colours. [4]

Which can contain harmful and toxic aromatic compounds. This method can also be used in large-scale operations with fairly high operability and cost-efficiency. A drawback of this approach is that it might not be possible to successfully extract certain high-soluble, low molecular and cationic dyes. Another restriction associated with this tech-nique is sludge disposal during the coagulation process. [5]

Aluminum and ferric-based salts such as magnesium, ferric chloride and ferric sulfate are the most common coagulants used for water and wastewater treatment. Recently, inorganic polymer flocculants (IPFs) have been quickly developed and commonly used to treat water and wastewater based on traditional iron and aluminum salts. Another of the standard forms of polyaluminum chloride (PAC) has become the most commonly used.

The main purpose of this study is to compare the output of polyaluminum chloride and alum as coagulants to extract a particular type of dye that is widely used in Iran's textile industry. The research focuses on the effects of pH, coagulant dosage, coagulant aids (kaolinite and bentonite), and initial concentration of dye on efficiency of removal of dye.[6-8]

A. Collection solutions and reagents

Laboratory-scale experiments were conducted. Commercial grades of PAC (30 percent Al2O3 w/w) and lime {$Ca(OH)_2$} have been used as coagulants. The waste water used in this analysis – dye Industry (Indichem industry, gujrat-india) – is a natural dye and commonly used in India's textile industry. [9]

Coagulation is a primary method in any type of water treatment system, and must be done using cost-effective, commonly used coagulants. Chloride in polyaluminium, Al(OH)x(C1)y. It is successful in some waters, requiring less pH-adjustment and less sludge production. [10-12]

II. MATERIALS AND METHODS:

Waste water of indichem industry have high COD, TDS, Odour and Ph., Analyzes of the samples reveal heavy ammonia, TDS, COD, aniline and big difference in COD to BOD ratio is therefore not possible for biological treatment. Then some alternative methods are needed to optimize the

reduction of COD by combining different coagulants.[13-16]

Wastewater quality was determined by its high concentration of ammonia (5423mg / L), COD (31000mg / L) and Total dissolved solids (54650mg / L).

In this experiment I used apparatus are- Six 500ml beaker, PH Meter, TDS mete, weight scales, sample collection bottles, funnel, and filter paper.

Chemicals required- PAC, Lime {Ca $(OH)_2$ }, fine sand and activated charcoal.

A. Procedure

1) For this analysis, the effects of different parameters on the efficiency of dye removal were calculated by a six beaker jar-test apparatus.
2) Beaker had 500 ml of the solution to the dye. For the rapid mixing of the dye containing solutions at 200 r / min a time of 1hr was required followed by a 3hr slow mixing cycle at 30 r / min.
3) Initial PH of waste water of dye industry is 9.2.
4) Beaker 1 had waste water added with PAC in a few quantity. This solution mixed continuously by magnetic stirrer. PAC decrease PH of solution 9.2 to 4 in 3 hr.
5) Then add calcium hydroxide (lime) until PH lies to 7.
6) This process take 5-6 hr, treated solution need to filter by filter paper.
7) Water that had been processed without color and order. This water passes through special arrangements in funnel to activated charcoal, sand, and cottons.
8) This method had used with different Ph such as 4, 5, 5.5, 6, 10 and 11.13.

III. EXPERIMENTAL ANALYSIS:

Textile and pigment industries waste water consist ammonia as main pollutants. Concentration of ammonia changes with pH given below-

pH	Ammonia
4	200
5	100
5.5	45
6	30
10	28
11.13	27

Table 1: pH changes with ammonia

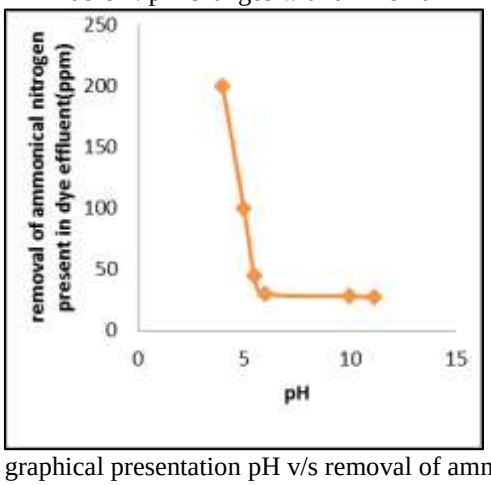

Fig. 1: graphical presentation pH v/s removal of ammoniac nitrogen present in dye effluent.

1) Effect of temperature on waste water:-

temperature	ammonia
25	200
27	150
29	43
30	40
32	39
35	36

Table 2: temperature and ammonia.

2) Graph-

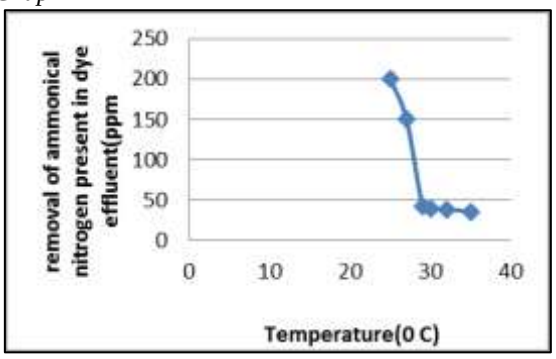

Fig. 2: temprature v/s ammonia removals

In waste water treatment PAC is used as coagulants. PAC reduced Ph of waste water and calcium hydroxide increse PH of solution.

pH	PAC required	calcium hydroxide required
4	3.1017	6.083
5	2.4933	4.522
5.5	2.267	2.961
6	2.0569	1.299
10	1.1703	31.5
11	1.6659	35.867

Table 3: amount of PAC and Calcium hydroxide used

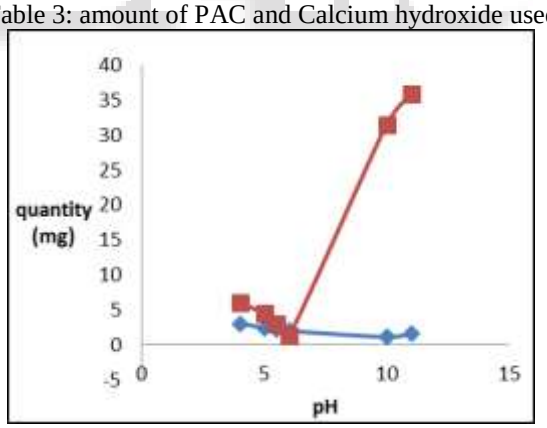

Fig. 3: Graphical presentation of table 3 (pH v/s PAC and calcium).

A. TDS Analysis:

TDS is a parameter of water quality, after experiments check every treated water TDS.

pH	TDS
4	54
5	61
5.5	91
6	43
10	56
11.13	117

Table 4: every sample of different PH having different TDS.

Total dissolve solid (TDS) calculated by TDS meter

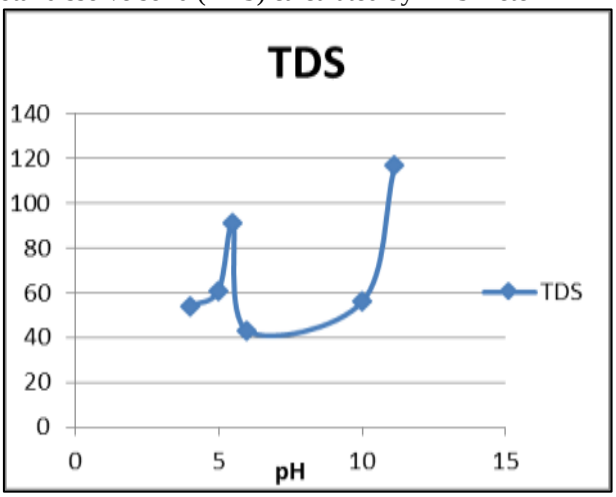

Fig 4: TDS v/s PH curve

B. COD (Chemical Oxygen Demand) Analysis:

COD is important parameter in waste water treatment. If COD is less it means water is pure, if COD is high it means water is more polluted. Waste water contain many pollutants.

Ammonia is main pollutant of textile and dye manufacturing industries waste water. In this study COD is belongs to ammonia present in waste water.

PAC increase PH of waste water this PH neutralize by calcium hydroxide (lime).

The COD removals % is analysis with PH is mention in table no.5

pH	COD % Removal
4	62
5	68
5.5	73
6	81
10	65
11.13	59

Table 5: COD% removals with PH

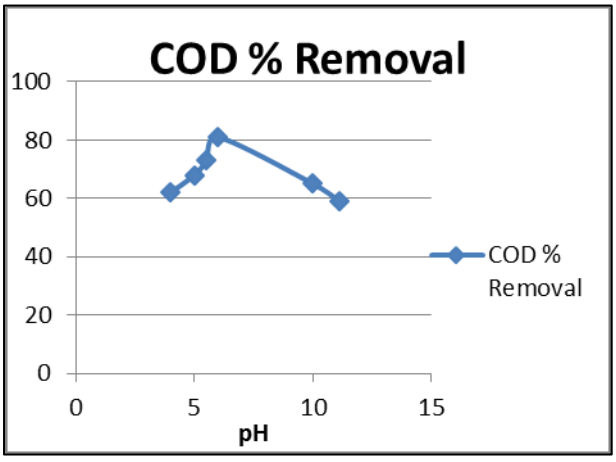

Fig. 5: COD% removal vs PH curve

IV. RESULTS:

Analysis of table no. 1 and graph 1 results that when Ph increase the concentration of ammonia is decrease.

When Ph is more than 11.3 the ammonia present in solution is disappear.

From table no.2 and figure 2 results that concentration of ammonia in waste water decrease with increase temperature.

Table no. consist amount of PAC and Calcium hydroxide used in waste water treatment, figure no. 3 show that the optimum Ph is 6 which use less amount of PAC and calcium hydroxide.

Table no 4 based on TDS off treated water. Table no. 4 and figure 4 show that minimum TDS find at PH 6. It mean that waste waters PH is decrease 9.2 to 6 by using PAC and increase from 6 to 7 by using calcium hydroxide.

Table no. 5 show that removal of COD% which is based on formula:-

$$\%\text{COD REMUVAL} = \frac{(\text{COD initial} - \text{COD final})}{\text{COD initial}} * 100$$

According figure no. 5 maximum %COD removal is find at PH 6 which is 81%.

V. CONCLUSION:

This study concluded that waste water treatment by using PAC give batter result. In this study PAC give optimum PH at 6 give low TDS and high COD % removal by using small quantity of calcium hydroxide.

For this analysis, the performance of PAC was examined for wastewater treatment under various parameters and conditions. Dye removal efficiency of PAC coagulants was severely affected by pH variations. The pH range, in which the efficiency of the method was consistently high, was also wider for PAC. Coagulants effectively removed the dye with a relatively low dosage. As the pH decrease was not always beneficial for improving the removal of dye, and no re-stabilization or reduction in the removal of dye was also observed.

In future more scope for waste water treatment by using PAC as coagulants.

The primary aim of wastewater management is to protect the environment in a manner that is commensurate with public health and socio-economic issues. It is determined which form of coagulant should be used prior to final disposal, depending on the condition of the wastewater.

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