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COD Reduction by Adsorption in Dyes & Dyes Intermediate Industry

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Abstract

In rapid industrialization of dyes and intermediate industry waste water treatment is the crucial problem. In dye and intermediate industry effluent, main problem arise is the COD reduction. Current days many industry used primary and secondary waste water treatment such as aeration. But in this method COD reduction rate is small as compare to tertiary treatment.

This paper includes COD reduction in dye & intermediate industry, particularly in H-acid by adsorption by using activated carbon and low cost lignite. Experimental work have been carried out by using this two adsorbent.COD reduction is depend upon two factors one is concentration of adsorbent and time of adsorption. At some concentration and some time COD reduction rate is higher and at some point it reduces by small value. One more point to be notice here is the effect of adsorbent on the sample before neutralization and after neutralization, so this process divided in stages, in which at some stage and at some particular concentration and at some optimum time COD reduction is higher with low concentration of adsorbent and in small time duration. In this particular case COD reduction by lignite is higher as compared to activated carbon.COD reduction by 1% and 2% activated carbon is less as compared to 1%,2% lignite. And with stage wise operation low concentration of adsorbent gives higher COD reduction. At the end references from which all the data has been taken are described.

Keywords— Dye Intermediate, COD reduction, Adsorption, Aeration, waste water treatment, Dyestuff, Neutralization.

I INTRODUCTION:

1.1 INTRODUCTION TO DYES AND DYES INTERMEDIATE INDUSTRY:

The synthetic dye industry today is vast and contains many groups of dying processes and dyes. From the synthesis of biological stains used in the preparation of microscope slides to the production of acetate rayon dyes and nylon dyes used in the preparation of commercial textiles, the industry continues to develop new processes and dyes to serve the needs and wants of humanity. One area of early synthetic dye chemistry though, azo dyes, remains one of the largest and most important to the

industry. The birth of azo dyes came in 1858, the same year Perkin started his factory for the production of mauve , although their value was not appreciated until Bottiger produced congo red, the first direct cotton dye, in 1884 . Johann Peter Griess had made the original discovery that a diazo compound could be derived from the reaction of nitrous acid with aromatic amines. Upon experimentation, he further concluded that this diazo compound could couple to another aromatic amine resulting in the formation of a dye. This area of chemistry has been greatly expanded and refined and now includes trisazo, tetrakisazo and polyazo dyes. The diazonium ion, containing the -N=N- chromospheres, serves as a weak electrophone which may perform an electrophonic aromatic substitution on an aromatic ring to produce a vast and diverse array of different dyes. Upon referral to the above discussion of the chemistry behind the colors, one can see how these dyes with their great amounts of conjugated Π bonds serve as excellent dyes. The future of the synthetic dye chemistry appears certain. As the global market continues to expand and western culture proceeds to penetrate even the world's most isolated regions, the demand for inexpensive dyestuffs will continue to rise. It is promising that this demand will be well met as "the possibilities of further synthesis [of dyes] are unlimited." With these prospects in sight for the synthetic dye chemistry, one might say that this industry certainly promises a bright and colorful future.

Ever since the beginning of humankind, people have been using colorants for painting and dyeing of their surroundings, their skins and their clothes. Until the middle of the 19th century, all colorants applied were from natural origin. Inorganic pigments such as soot, manganese oxide, hematite and ochre have been utilized within living memory. Palaeolithic rock paintings, such as the 30,000 year old drawings that were recently discovered in the Chauvet caves in France, provide ancient testimony of their application. Organic natural colorants have also a timeless history of application, especially as textile dyes. Synthetic dye manufacturing started in 1856, when the English chemist W.H. Perkin, in an attempt to synthesize quinine, obtained instead a bluish substance with excellent dyeing properties that later became known as aniline purple. Perkin 18 years old patented his invention and set up a production line. This concept of research and development was soon to be followed by others and new dyes began to appear on the market, a process that was strongly stimulated by Kékulé's discovery of the molecular structure of benzene in 1865. In the beginning of the 20th century, synthetic dyestuffs had almost completely supplanted natural dyes.

H-acid is a dye intermediate. It is used in the wide range of application in dye – stuff industry. In India, it is mainly manufactured by small and medium-sized enterprises (SMEs) with a production capacity of between 10 and 100 tones per month[68]. The manufacturer of H acid in Gujarat as well as outside Gujarat is given below.

1.2 Scope of Experimental Work:

Considering the limited resources usually available to small and medium enterprises, it is apparent that only simple and low-cost wastewater treatment methods can be put into practice by these companies. Accordingly, work can be undertaken by using inexpensive adsorbents viz lignite, fly ash, bentonite and activated carbon for studying adsorption characteristics with respect to the reduction of COD and color from concentrated wastewater streams from the H-Acid(dyes intermediate) plant.

Adsorption of pollutants from effluent stream of H-Acid manufacture:

1.3 Objective:

Whereas activated carbon is the most widely used adsorbent, it is found to be quite expensive. Considering the resource constraints experienced by the small scale industries, they use adsorption technique only if it is cost effective. Inexpensive adsorbents like lignite and bentonite could be, therefore, considered for detailed studies with respect to their performance in treating different waste water streams from H-Acid manufacturing plant.

1.4 Approach:

The conventional flow-sheets of industrial wastewater treatment shown below include the primary treatment oil and grease removal, pH adjustment and clarification, the secondary treatment which may consist of biological/chemical treatment and clarification, and depending on the quality of the waste water and the statutory discharge standards, tertiary treatment with activated carbon.

During primary treatment, neutralization of the waste water results in to increase of salts. Salts in high concentration inhibit biological activity and may cause an increase in non-settle able suspended solids in the treated waste water. The flow sheet shown below is, therefore, proposed wherein adsorption with inexpensive adsorbents is employed prior to the conventional primary treatment for increasing the efficiency of subsequent biological treatment.

This is expected to reduce refractory organics as well as BOD of the wastewater substantially at the first stage of wastewater treatment itself, facilitating further treatment.

1.5 Rathi-Puranik mathematical model:

Experimental data obtain in present investigation has been co-related by Rathi-Puranik equation which is as under:

$$\text{Log(CODRT)} = mt + c$$

Where,
CODRT= ci-c/t
Ci= initial concentration
C= concentration at time t
T= time in minute

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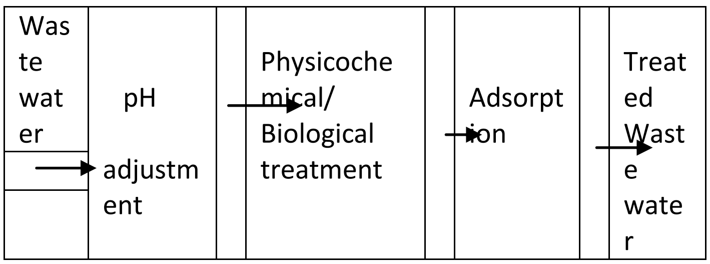
C= constant

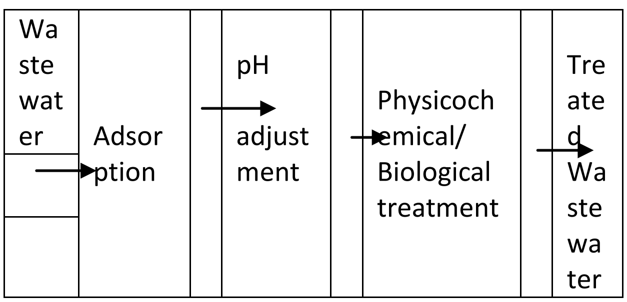
2. EXPERIMENTAL WORK:

Experimental work for this study is done at Environment department of L.D.college of engineering. Experimental methodology for this is simple adsorption by using two adsorbent, activated carbon and lignite powder with respect to different time.

Flow sheet-1



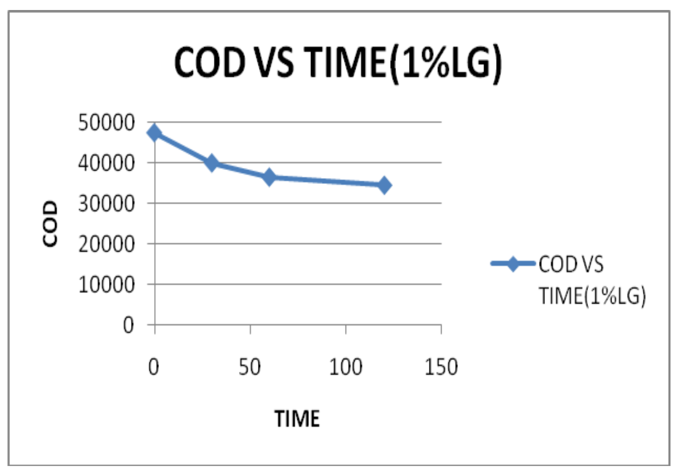
Flow sheet-2



3. RESULT :MATHEMATICAL MODEL:

					Rathi-puranik model	
ci	T min	c	Codrt= ci-c/t	LOG(CODRT)	Codrt = (ci-c)/t	Log(CODRT)
48500	0	48500	-	-	-	
	10	47700	80	1.903	80	1.903
	20	47000	70	1.845	75	1.875
	30	46500	50	1.698	66.67	1.824
	45	43200	220	2.342	117.77	2.071
	60	41000	146.67	2.166	125	2.097
	90	38600	80	1.903	110	2.041
	120	36000	86.67	1.937	104.17	2.018

In this experimental work H-Acid effluent is treated by using different adsorbent quantity for different time duration. Effluent used is highly acidic and second one is neutral effluent. And first one acidic effluent is treated stage wise in which in first stage adsorption is done and then after in second stage this treated sample is neutralized and then experiment is done with same adsorption quantity that is used for stage-1.analysis is done by using standard COD method.



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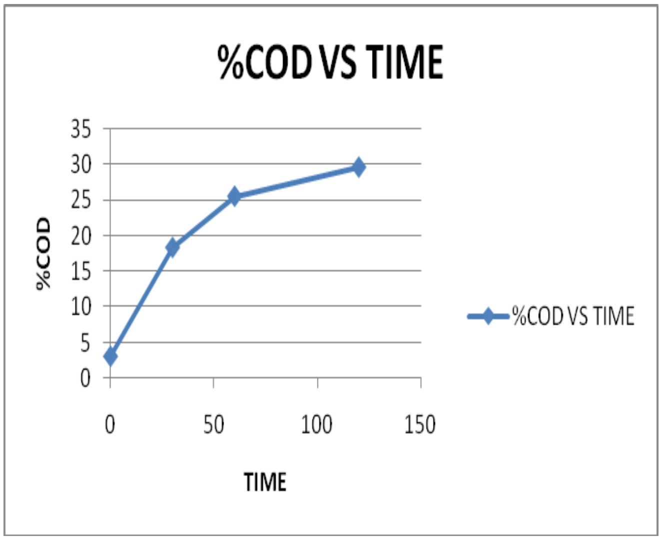
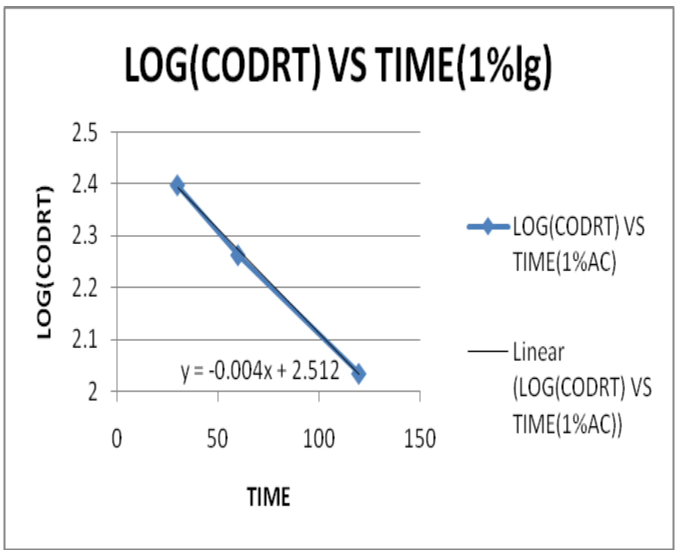
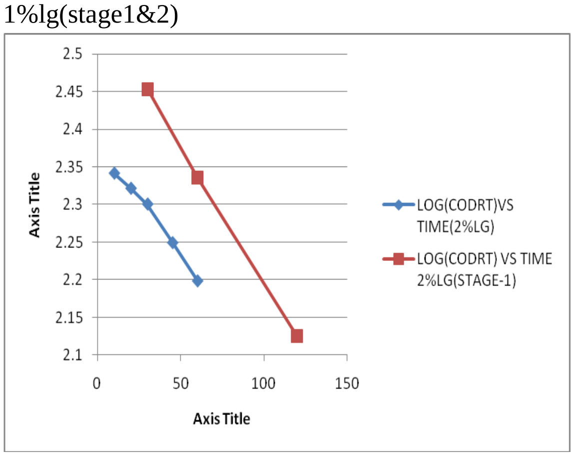


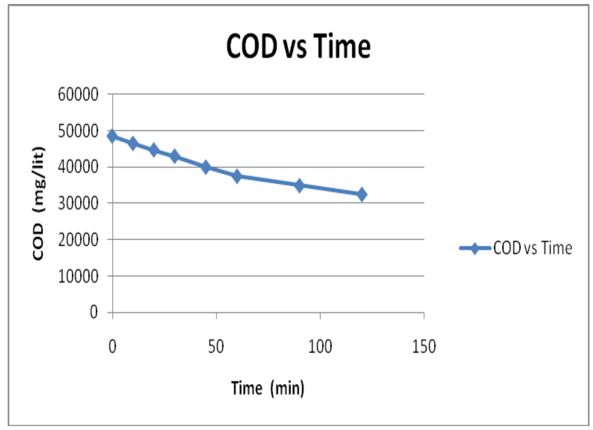


1%lg(stage-1 &2)

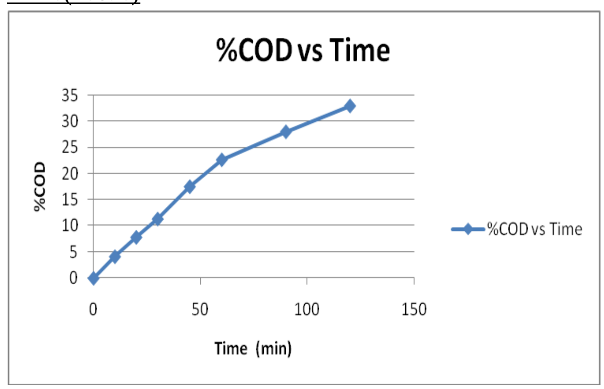
1%lg(stage1&2)



Graph: COD Vs Time(2%ac)

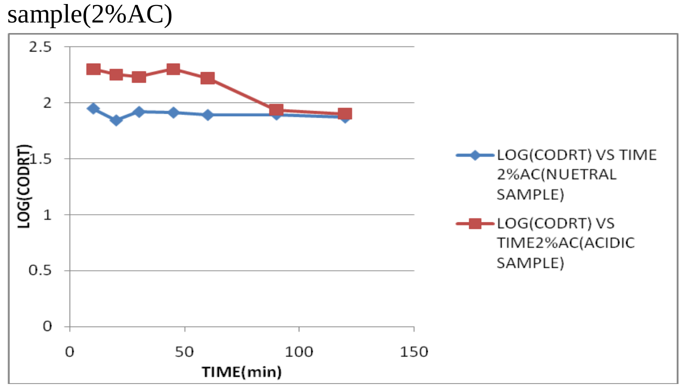


Graph: %COD Vs Time(2%ac)



2% AC ACIDIC SAMPLE(COD reduction rate)

Effect of adsorbent on acidic an neutral sample(2%AC)



2% LG(NUETRAL % ACIDIC SAMPLE

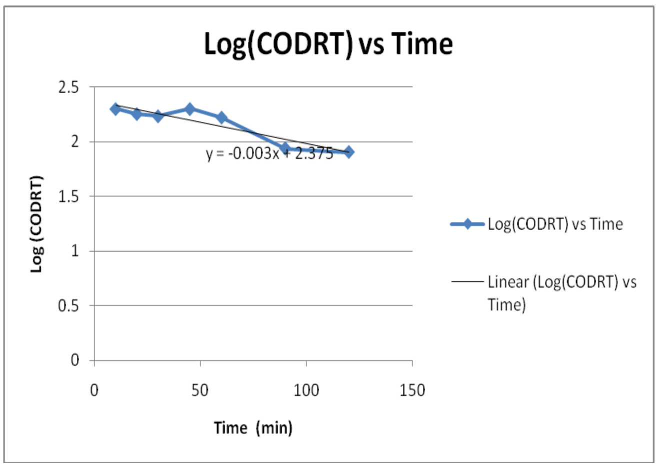
4. CONCLUSION AND FUTURE SCOPE:

CONCLUSION

The high cost activated carbon is replaced by low cost lignite.

Changing innovation has been proposed adsorption is carried out before neutralization operation, rate of COD reduction are expected to be highest hence modified has been proposed in this investigation for liquid effluent treatment –liquid effluent from H-Acid plant.

Thus, either in existing plant, more quantity of effluent can be handled, or keeping effluent quantity same ,effluent treatment can carried for lesser contact time, operational cost can be decreased for the both categories.



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Adsorption with 1%,2% activated carbon and lignite(stage-1) highly acidic sample							Adsorption with 1%,2% activated carbon and lignite(stage-2) neutralized sample					
Time in min	COD*50 1%AC	%COD 1%AC	COD*50 2%AC	%COD 2%AC	COD*50 1%LG	%COD 1%LG	COD*50 2%AC	%COD 2%LG	COD*25 1%LG	%COD 1%LG	COD*25 2%LG	%COD 2%LG
Initial	48500	-	48500		47500	-	47500	-	34500	-	31500	-
10	47700	1.649	46500	4.124	-	-	-	-	31500	8.695	29300	6.984
20	47000	3.093	44700	7.835	-	-	-	-	30000	13.04	27300	18.7
30	46500	4.124	43000	11.34	40000	18.367	39000	20.40	28000	17.9	25500	19.1
45	43200	10.92	40000	17.525	-	-	-	-	25000	23.0	23500	26.5
60	41000	15.46	37500	22.68	36500	25.51	34500	29.59	23500	24.05	22000	27.7
90	38600	20.41	34900	28.04	-	-	-	-	-	-	-	-
120	36000	25.77	32500	32.98	34500	29.59	31500	35.71	-	-	-	-