Pollutants Removal from Distilleries and Breweries Spent Wash A Case Study of Aligarh Up

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***Abstract* - The principal pollution effects of the wastewaters of these fermentation industries on a water course are multiple in natures. An attempt has been made to high light the treatment of distillery spent wash by using natural adsorbent. The results obtained herein indicate the feasibility of activated carbon used as an adsorbent for removal of pollutants from distillery spent wash. The results show the significant amount of reduction of pollutants by activated carbon. The study concluded that adsorbent dosage, contact time and effluent dilutions are important parameters affecting the pollutants removal by adsorption.**

***Keywords* - Distillery Waste water, treatment, activated carbon adsorption.**

I. THE NEED FOR TREATING DISTILLERY EFFLUENT

The distillery sector is one of the seventeen categories of major polluting industries in India. These units generate large volume of dark brown coloured wastewater, which is known as "spent wash". Liquid wastes from breweries and distilleries possess a characteristically high pollution load and have continued to pose a critical problem of environmental pollution in many countries. The principal pollution effects of the wastewaters of these fermentation industries on a water course are multiple in natures. High temperature of the wastewaters may instantaneously kill fish and other aquatic organisms, thus destroying the flora and fauna of a river, when the wastewaters are discharged into it. The most damaging effect of the wastewaters of the fermentation industries, especially distillery, on a stream is caused by high concentration of readily decomposable organic matters present in the waste waters. Due to decomposition of soluble and suspended organic matters present in the wastewaters, high BOD (Biochemical Oxygen Demand) and COD (Chemical Oxygen Demand) of the wastewaters results, causing rapid depletion of the oxygen content of the water, thus creating a foul smell. This further promotes growth of nuisance organisms and can render the stream totally unfit for propagating fish life and for the purpose of drinking, personal hygiene, recreation and other purposes. The distillery effluents, when drained into a water source, make it susceptible for the propagation of harmful microbes. Thus creating serious biological hazards like the generation and propagation of the water borne diseases. This required that the effluents of the distillery are either treated or utilized profitably.

Sampling location

The water samples were brought from the industry "Wave distilleries and breweries private limited" located at village Ahmadpura, kali nadi, harduagunj, 16 km from Aligarh and analyzed for different parameters in the environmental engineering laboratory of civil engineering department, Z.H.C.E.T, Aligarh Muslim University, Aligarh, Uttar Pradesh, India. Dark plastic bottles of 2 liters capacity each with a stopper were used for collecting samples. Each bottle was washed with 2% nitric acid and then rinsed three times with distilled water. The bottles were then preserved in a clean place. The bottles were filled leaving no air space, and then the bottle was sealed to prevent any leakage and stored in a cool place. Each container was clearly marked with the name, location and date of sampling.

Sample characteristics

The sample was collected directly from distillery effluent outlet pipe which is discharging the effluent into Kali nadi. Sample which was collected is colour less giving an unpleasant smell of like burnt sugar the temperature of the sample is high around 30° C.

II. PREPARATION OF SAMPLE DILUTIONS

In order to check the effect of different dilutions of spent wash on removal efficiency of different pollutants and different type of heavy metals from the wastewater the spent wash has been diluted to three different dilutions i.e. 25% of sample, 50% of sample and 100% pure sample. Each dilution sample of 600ml quantity has been prepared taking 25% and 50% sample and diluting it to 600 ml with distilled water. Third sample is pure spent wash of 600 ml quantity.

III. EXPERIMENTAL WORK AND ANALYSIS

Experiment consists of adsorption carried out with different adsorbent dosage and contact time with the three different dilutions of sample.

Adsorbent dosage of 2g, 5g, and 10g with the corresponding contact time of 6hr, 12hr and 24hr for each sample was used with each dilution. Each diluted sample of 600 ml quantity is divided into three parts of 200ml quantity each. There are total nine samples three from each diluted sample of 200ml quantity each. Each concentrations each sample is taken in a volumetric flask of

250ml and added with a desired adsorbent dose. Each flask was shaken for one hour and the samples was filtered and collected for analysis after desired contact time. Whole adsorption test was performed at room temperature.

Table .1: showing varying adsorbent dose with contact time at different dilutions

Sample no.	25% dilution		Sample no.	50% dilution		Sample no.	100% sample	
	Ad(g)	Ct(hr)		Ad(g)	Ct(hr)		Ad(g)	Ct(hr)
1	1	6	1	1	6	1	1	6
2	5	12	2	5	12	2	5	12
3	10	24	3	10	24	3	10	24

Ad: adsorbent dose (gram) Ct: contact time (hour)

For Atomic Absorption Spectroscopy

Heavy metals like cadmium, copper and chromium were analyzed by using atomic absorption spectrometer. Working standard solutions were prepared containing desired concentration of heavy metals which is to be analyzed in distillery spent wash from standard solutions of heavy metals which are available in market of standard concentration i.e.1000 ppm.

IV. ANALYSIS OF SPENT WASH BEFORE ADSORPTION

Following are the parameters in a tabular form which were analyzed initially i.e. before adsorption for the three dilutions of 25%, 50% and 100% pure sample and with different adsorbent dose and contact time.

Table 2: Showing parameter analyzed before adsorption.

Parameters	For 25% sample dilution	For 50% sample dilution	For 100% pure sample
COD(mg/l)	1200	2560	3200
TDS(mg/l)	361	491	675
DO(mg/l)	3.0	1.7	1.2
Cu(ppm)	-	-	8.9
Cd(ppm)	-	-	0.2
Cr(ppm)	-	-	2.3

V. RESULT AND DISCUSSION

The following graphs will give better illustration of the results obtained following the analysis of spent wash. Here the results obtained are graphically represented for various wastewater quality parameters.

For 25% effluent dilution

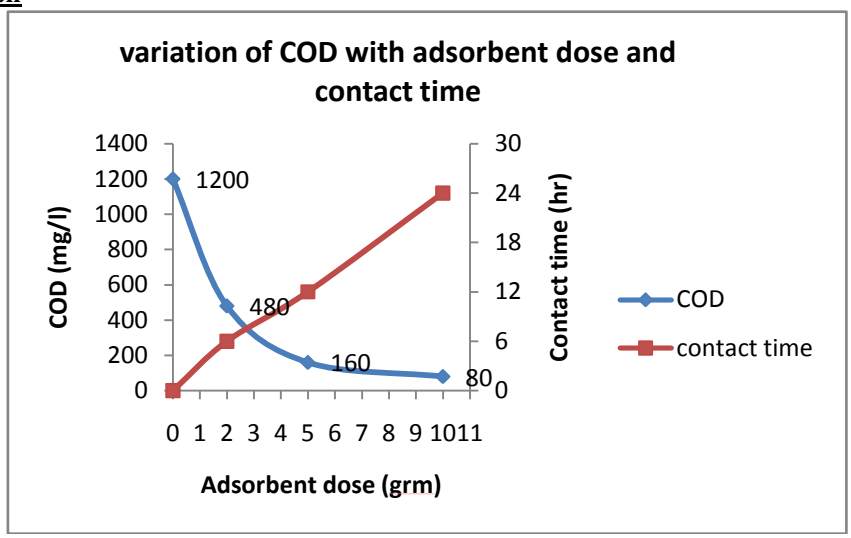

Figure 1: variation of COD with adsorbent dose and contact time

In Figure 1 COD decreases with increase in adsorbent dose up to 10gm and contact time of 24hr and then attains a constant value with increase in adsorbent dose and contact time. The maximum percent removal 93.33% has been observed at an adsorbent dose of 10gm/200ml, contact time of 24hr with 25% diluted sample. The result can also be summarized in Table 3.

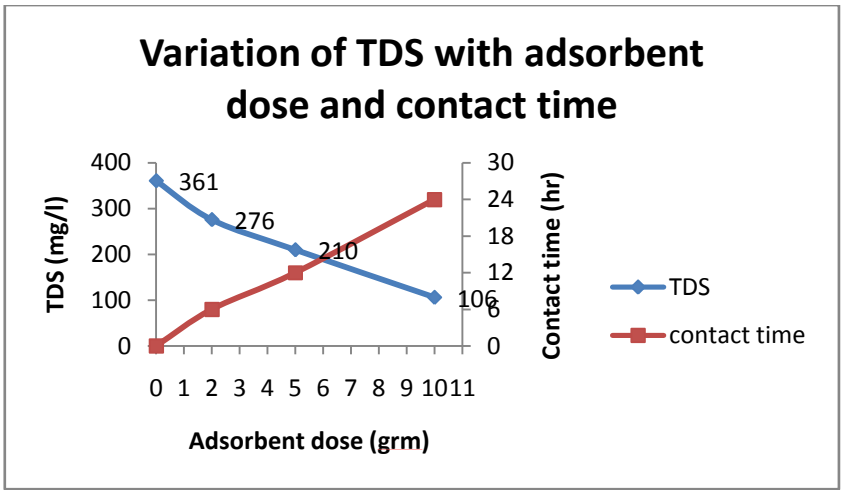

Figure 2: variation of TDS with adsorbent dose and contact time

In Figure 2 TDS decreases with increase in adsorbent dose up to 10 gm and contact time of 24hr. The maximum percent removal 70.6% has been observed at an adsorbent dose of 10 gm / 200 ml, contact time of 24hr with 25% diluted sample.

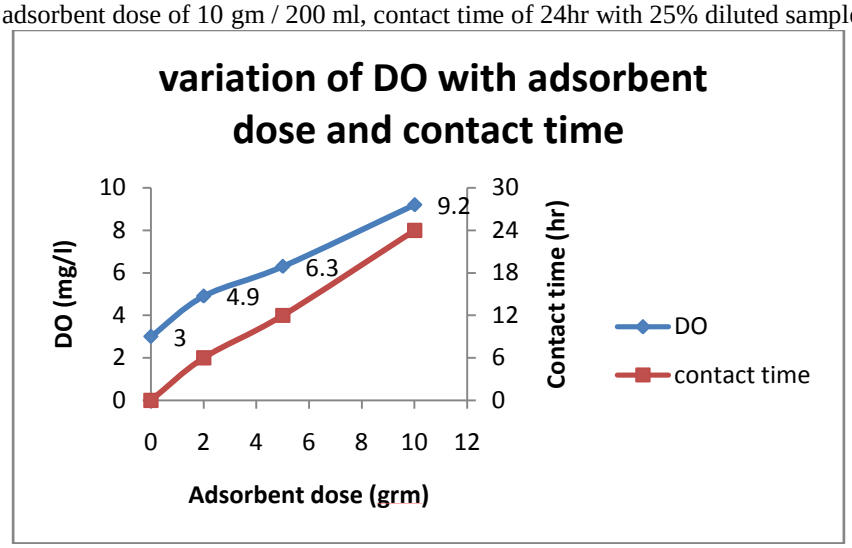

Figure 3: Variation of DO with adsorbent dose and contact time

In Figure 3 DO increases up to a maximum value of 9.2 with increase in adsorbent dose up to 10gm and contact time of 24hr. The maximum percent removal 67.39% has been observed at an adsorbent dose of 10 gm / 200 ml, contact time of 24hr with 25% diluted sample. The result can also be summarized in Table 3.

For 50% effluent dilution

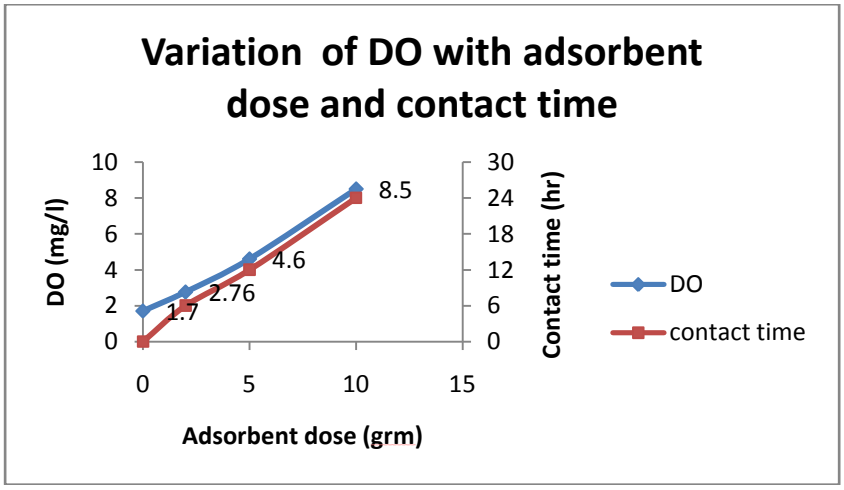

Figure 4: variation of DO with adsorbent dose and contact time

In Figure 4 DO increases up to a maximum value of 8.5 with increase in adsorbent dose up to 10gm and contact time of 24hr. The maximum percent removal 80% has been observed at an adsorbent dose of 10gm/200ml, contact time of 24hr with 50% diluted sample. The result can also be summarized in Table 4.

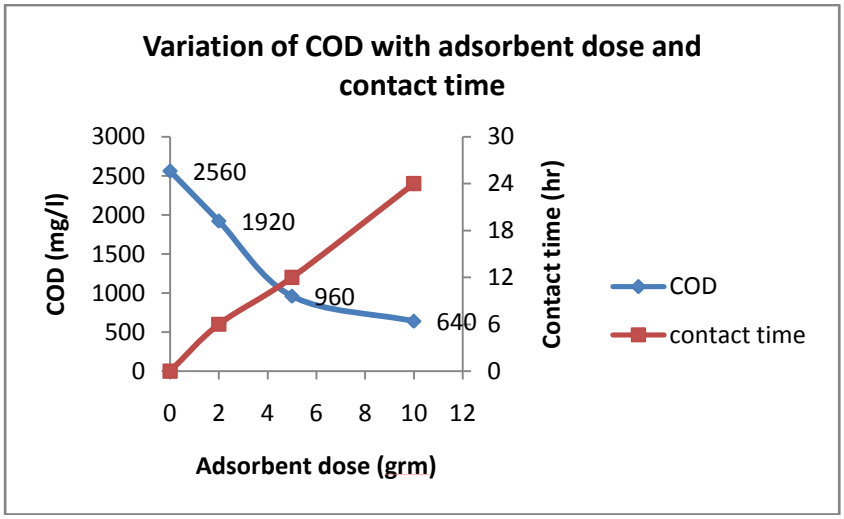

Figure 5: Variation of COD with adsorbent dose and contact time

In Figure 5 COD decreases with increase in adsorbent dose up to 10 gm and contact time of 24hr and then attains a constant value with increase in adsorbent dose and contact time. The maximum percent removal 75% has been observed at an adsorbent dose of 10 gm / 200ml, contact time of 24hr with 50% diluted sample.

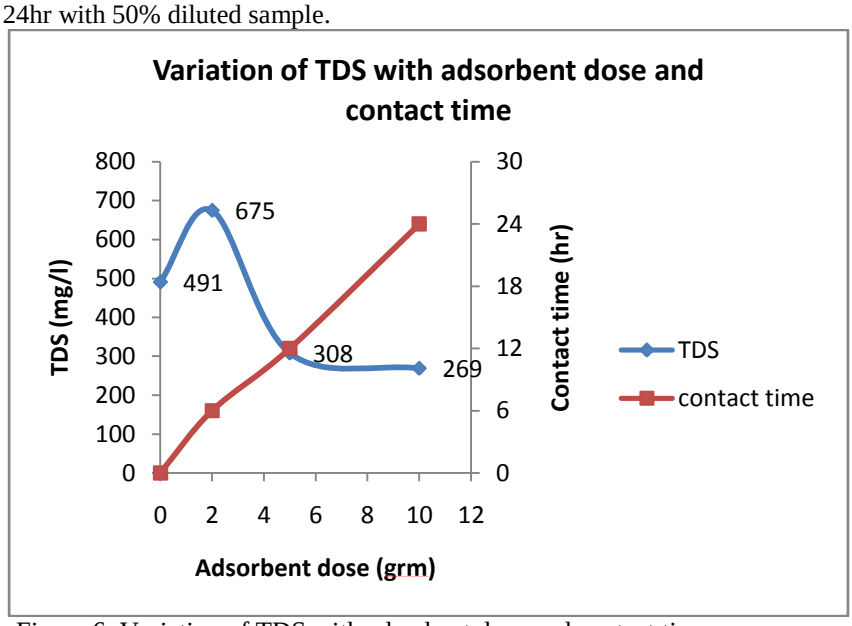

Figure 6: Variation of TDS with adsorbent dose and contact time

In Figure 6 TDS increases with increase in adsorbent dose up to 2gm and contact time of 6hr and then decreases with increase in adsorbent dose and contact time. The maximum percent removal 45.21% has been observed at an adsorbent dose of 10 gm / 200 ml, contact time of 24hr with 50% diluted sample.

For 100% effluent dilution

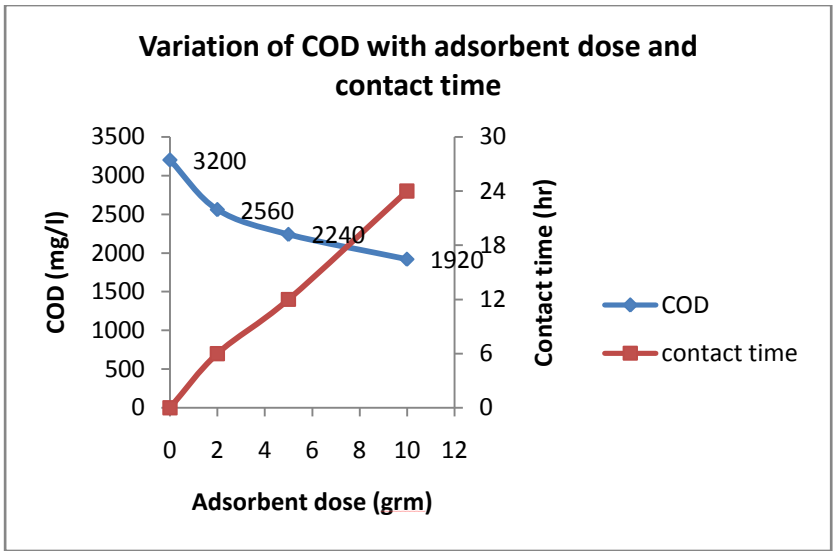

Figure 7: Variation of COD with adsorbent dose and contact time

In Figure 7 COD decreases with increase in adsorbent dose up to 10gm and contact time of 24hr and then attains a constant value with increase in adsorbent dose and contact time. The maximum percent removal 40% has been observed at an adsorbent dose of 10gm/200ml, contact time of 24hr with 100% diluted sample. The result can also be summarized in Table 5.

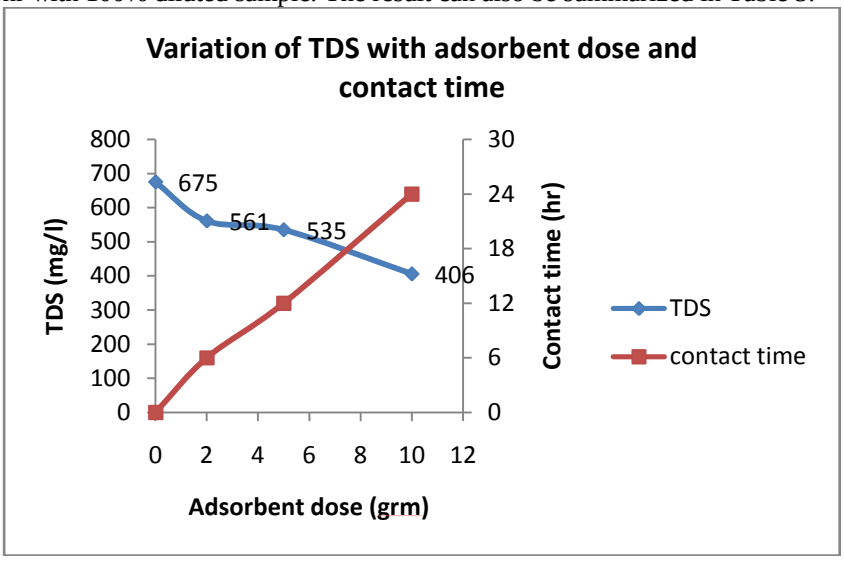

Figure 8: variation of TDS with adsorbent dose and contact time

In Figure 8 TDS decreases with increase in adsorbent dose up to 10gm and contact time of 24hr and then attains a constant value with increase in adsorbent dose and contact time. The maximum percent removal 39.85% has been observed at an adsorbent dose of 10 gm / 200 ml, contact time of 24hr with 100% diluted sample.

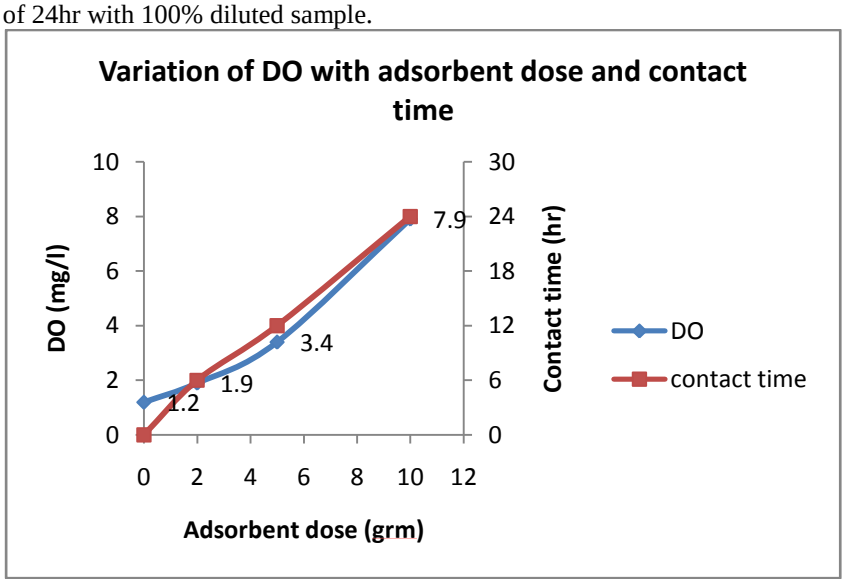

Figure 9: Variation of DO with adsorbent dose and contact time

In Figure 9 DO increases up to a maximum value of 7.9 with increase in adsorbent dose up to 10gm and contact time of 24hr. The maximum percent removal 84.8% has been observed at an adsorbent dose of 10gm/200ml, contact time of 24hr with 100% diluted sample.

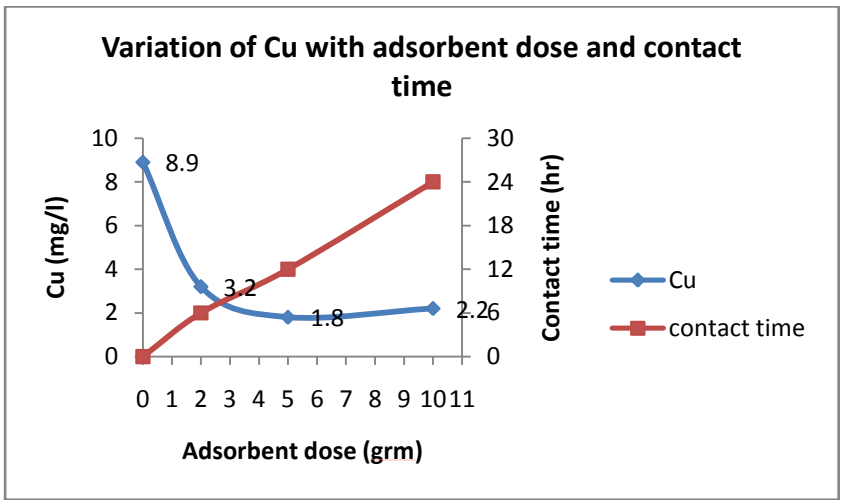

Figure 10: Variation of Cu with adsorbent dose and contact time

In Figure 10 Cu decreases with increase in adsorbent dose up to 5gm and contact time of 12hr and then increases with increase in adsorbent dose and contact time. The maximum percent removal 79.77% has been observed at an adsorbent dose of 5 gm / 200 ml, contact time of 12hr with 100% pure sample.

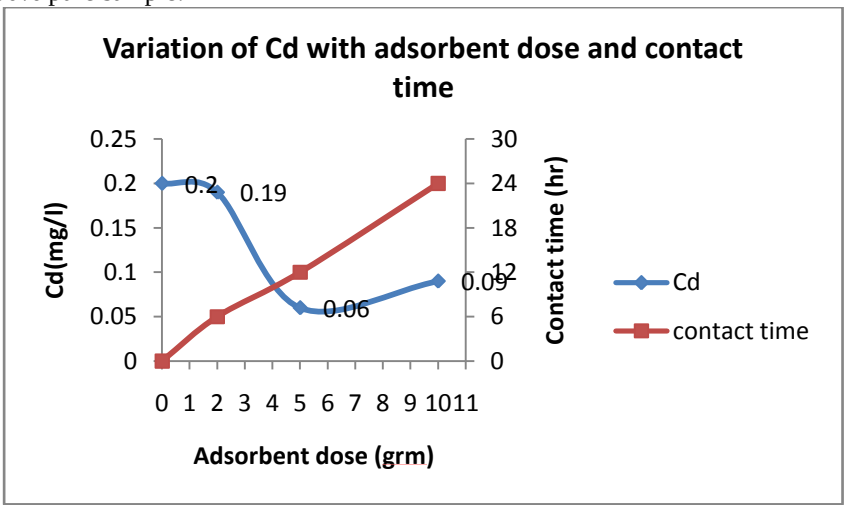

Figure 11: Variation of Cd with adsorbent dose and contact time

In Figure 11 Cd decreases with increase in adsorbent dose up to 5gm and contact time of 12hr and then increases with increase in adsorbent dose and contact time. The maximum percent removal 70% has been observed at an adsorbent dose of 5gm / 200 ml, contact time of 12hr with 100% pure sample.

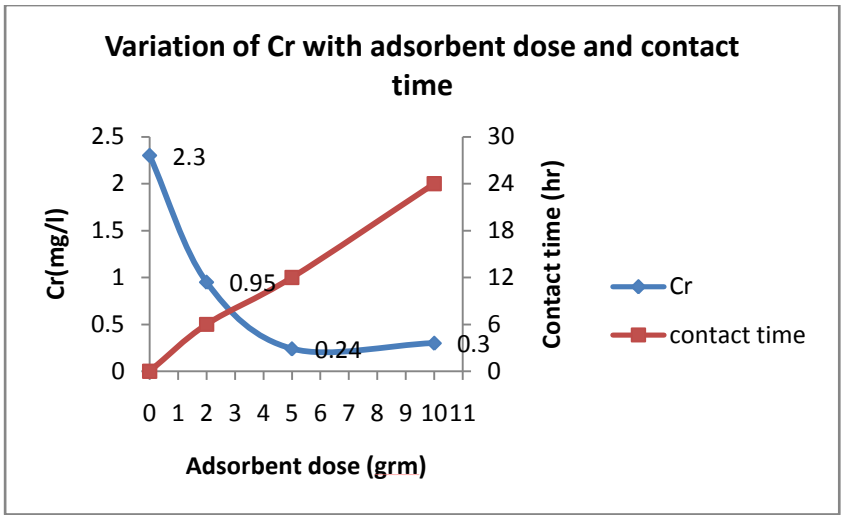

Figure 12: Variation of Cr with adsorbent dose and contact time

In Figure 12 Cr decreases with increase in adsorbent dose up to 5gm and contact time of 12hr and then increases with increase in adsorbent dose and contact time. The maximum percent removal 89.56% has been observed at an adsorbent dose of 5gm / 200 ml, contact time of 12hr with 100% pure sample.

Table 3: Results analyzed from graphs for 25% sample dilution after adsorption

Parameters	**For 25% effluent dilution**						
	Initial concentration	Final concentration after			Removal(%) after		
		6hr	12hr	24hr	6hr	12hr	24hr
COD(mg)	1200	480	160	80	60	86.66	93.33
TDS(mg/)	361	276	210	106	23.54	41.82	70.6
DO(mg/l)	3.0	4.9	6.3	9.2	38.77	52.38	67.39

Table 4: Results analyzed from graphs for 50% sample dilution after adsorption

Parameters	**For 50% effluent dilution**						
	Initial concentration	Final concentration after			Removal(%) after		
		6hr	12hr	24hr	6hr	12hr	24hr
COD(mg/l)	2560	1920	960	640	25	62.5	75
TDS(mg/l)	491	675	308	269	27.25	37.27	45.21
DO(mg/l)	1.7	2.76	4.6	8.5	38.4	63.04	80

Table 5: Results analyzed from graphs for 100% pure sample after adsorption

Parameters	**For 100% sample**						
	Initial concentration	Final concentration after			Removal(%) after		
		6hr	12hr	24hr	6hr	12hr	24hr
COD(mg/l)	3200	2560	2240	1920	20	30	40
TDS(mg/l)	675	561	535	406	16.88	20.74	39.8
DO(mg/l)	1.2	1.9	3.4	7.9	36.84	64.70	84.8
Cu	8.9	3.2	1.8	2.2	64.04	79.77	75.2
Cd	0.2	0.19	0.06	0.09	5	70	55

Table 6: Final results in a tabular form

Pollutants	Sample Dilution%	Adsorbent dose (gram)	Contact time (hr)	% Removal
COD	25%	10	24	93.33
TDS	25%	10	24	70.6
DO	100%	10	24	84.8
Cu	100%	5	12	79.77
Cd	100%	5	12	70
Cr	100%	5	12	89.56

CONCLUSIONS

- The activated carbon is found to be effective adsorbent.
- It has been observed that adsorbent dose of 10 gram and contact time of 24 hr for 200ml of sample is found to be most effective for different dilutions for removal of most pollutants.
- While for removal of heavy metals, adsorbent dose of 5 gram and contact time of 12 hr found to be most effective.
- On increasing the adsorbent dose and contact time after this limit there is not much effect on the removal of pollutants and heavy metals.
- This is because of the adsorptive capacity of the adsorbent is reached to an end.
- The adsorbent dosage, contact time and initial concentration of organic matter have significant effect on the COD removal and dissolved oxygen.
- The maximum removal (79.77%) of copper has been observed at 5gm/200ml of adsorbent dose and a contact time of 6hr for 100% pure sample.
- The maximum removal (70%) of cadmium has been observed at 5gm/200ml of adsorbent dose and a contact time of 6hr for 100% pure sample.
- The maximum removal (89.56%) of chromium has been observed at 5gm/200ml of adsorbent dose and a contact time of 6hr for 100% pure sample.
- The maximum removal (93.33%) of COD has been observed at 10gm/200ml of adsorbent dose and a contact time of 24hr for 25% diluted sample.
- The maximum removal (70.6%) of TDS has been observed at 10gm/200ml of adsorbent dose and a contact time of 24hr for 25% diluted sample.
- The maximum removal (84.8%) of DO has been observed at 10gm/200ml of adsorbent dose and a contact time of 24hr for 100% pure sample.
- It is also found that there is a certain limit for increasing the adsorbent doses for given amount of effluent. This has to be carefully controlled. An excess use can leads to uneconomical process. The initial concentration plays an important role throughout the adsorption.
- Regeneration and disposal depends on the amount and the availability of the adsorbent.

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