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Effect of Different Textures of Activated Charcoal and Wood Ash on Distillery Spent Wash Physico Chemical Characteristics

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Abstract: **Adsorption treatment of distillery spent wash has great potential as a sustainable method as it is a low cost method. The aim of this investigation is to study the treatment method for purification of distillery spent wash by using Activated charcoal and Wood ash. For this, the study comprising evaluation of reduction of various physical chemical parameters (Color, Odor, pH, COD, TS, TDS, Ca, Mg, Na and K) of distillery spent wash was checked by passing through the columns of Activated charcoal and Wood ash. The distillery effluent was acidic (pH 4.7) and dark brown in color which often cause psychological fear in farmers for utilization. Activated charcoal treatment of spent wash exhibited good reduction in COD, TS, TDS, Mg, Na, Ca, after 72 hour treatment and increase in pH toward pH 7 followed by Activated charcoal + Wood ash (1:1).**

Keywords: **"Absorbent", "Activated charcoal", "Chemical parameter", "Distillery Spent wash", "Irrigation", "Wood ash".**

1. INTRODUCTION

Increasing industrialization and ever increasing population is damaging the environment same is done by the disposal of untreated effluents. Various pollutants produced in industries directly or indirectly are accumulating in our environment. These pollutants cause severe degradation in pedosphere, hydrosphere, atmosphere and thus causing a potential menace to the health and welfare of mankind.

Wastes generated from various industries include the effluents from textile, chemical fertilizers, pulp and paper, petro chemical and breweries, metal processing, automobile manufacturing, power–plant including leather and tannery industries and thermal and nuclear power plant etc.

Improper disposal methods and inadequate treatment of toxic constituents from different industries have led to the widespread contamination of surface and ground waters and have made the water resources unfit for usage. Hence there is an urgent need for waste water treatment.

Environmental pollution by distillery industry has recently been the subject of much research. Distillery waste is one of the major wastes of ecological concern. It is a complex, caramelized and recalcitrant waste containing high percentage of organic matter and heavy metal ions (Nemade and Shri vastava, 2000). This causes pollution in receiving waters as well as in land.

To safeguard humanity, we require conductive and congenial environment for which the industrial pollution need to be minimized substantially. To achieve this, several physical, chemical and biological methods/techniques have been developed and being practiced in very few industries along with distilleries (Lin et al 2003). The reason of limited scope of these techniques lies with their adhered economical solution of the pollution abatement problems, adsorption treatment has been one of the cost effective method and being practical unintentionally during crop irrigation. Once the industrial effluent is suitably treated, it could be applicable for crop irrigation. The application of effluent to short rotation forestry crop is a treatment system which if properly designed and maintained could both increase the productivity of the crops and reduce the waste disposal problem (Sims and Riddell 2001). Keeping this in view, the present study therefore is planned to investigate the land treatment of distillery effluent with following objectives

1. To characterize physico-chemical characteristics (pH, Color, Odor, COD, TS, TDS, Na, K, Mg, and Ca) of distillery spent wash.
2. Effect of Different Textures of Activated Charcoal and Wood Ash on Physico Chemical Characteristics of Distillery Spent Wash.

Activated Charcoal:

Activated charcoal, also called active carbon, is a form of carbon processed to have small, low-volume pores that increase the surface area available for adsorption. Activated is sometimes substituted with active. Activated charcoal is commonly used on the laboratory scale to purify solutions of organic molecules containing undesired colored organic impurities also used in sugar industries for color removal.

Wood Ash:

Ash produced in small dark flecks by the burning of powdered coal or other materials and carried into the air is known as wood ash. It is mostly produced from thermal power plants.

2. MATERIAL AND METHODS

2.1 Sample collection:

Effluents waste water (spent wash) was taken from a distillery, located in Dehradun. The factory uses molasses as the raw material. Samples were collected at main outlet of distillery in the first week of November 2016. Samples were collected five times at weekly from November to December 2016 in clean sterile plastic container and stored at 4^{o}C in a refrigerator.

2.2 Research Design:

Twelve plastic pots were filled with 2 kg soil in each, and wheat was grown (Triticum aestivum) Variety UP 2329 .After 20 days of growth, three pots of each group were irrigated with 72 hour, 48 hour and 24 hour treated spent wash respectively and the 4^{th} pot of each was used as control. On each irrigation date 500 ml of treated effluent (24 hour treated, 48 hour treated and 72 hour treated) was poured in each pot as previously discussed. Same time treated samples were collected in sterile reagent bottles for physical and chemical tests and stored at 4^{o}C.

Twelve columns of activated charcoal, wood ash and activated charcoal + wood ash (1:1) were prepared for treatment of distillery spent wash as follows:

Table: 1.1 Designs of Columns of Activated Charcoal, Wood Ash and Activated Charcoal + Wood Ash (1:1)

Columns filled with	Set-1	Set-2	Set-3	Set-4
	(24 hr treatment)	(48 hr treatment)	(72 hr treatment)	CONTROL (C)
Activated Charcoal (AC)	AC-1	AC-2	AC-3	AC-C
Wood Ash (WA)	WA-1	WA-2	WA-3	WA-C
Activated Charcoal + Wood Ash (1:1)	AC+WA (1:1)-1	AC+WA (1:1)-2	AC+WA (1:1)-2	AC+WA (1:1)-C

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Table: 1.2: Initial Physico Chemical Characteristics of Distillery Spent Wash before Treatment

Parameters	Value
Color	Dark Black Brown
Odor	Foul Molasses
TS	10000 mg/l
TDS	7600 mg/l
pH	4.7
COD	8200 mg/l
Ca	2200 mg/l
Mg	1730 mg/l
Na	800 mg/l
K	1700 mg/l

Table: 1.3: Effect of Activated charcoal and Wood ash on Color and Odor of Spent Wash

Parameters	Activated Charcoal			Wood Ash		
	24hr	48hr	72hr	24hr	48hr	72hr
Color	LB	LB	CL	B	LB	LB
Odor	MO	MM	OL	MO	MO	MM

LB: Light Brown, B: Brown, CL: Colorless, MO: Molasses Odor, MM: Mild Molasses, OL: Odorless

Table: 1.4: Physico Chemical Characteristics of Distillery Spent Wash treated with Activated Charcoal and Wood Ash

Para-meters	Original Sample	Activated Charcoal			Wood Ash			Activated Charcoal+Wood Ash (1:1)		
		24hr	48rh	72hr	24hr	48rh	72hr	24hr	48hr	72hr
TS	10000	4800	4200	3600	6250	5625	5000	5530	4890	4250
TDS	7600	4400	3800	3400	4897	4701	4505	4640	4225	4130
pH	4.7	5.6	5.8	6.2	5.0	5.3	5.9	5.3	5.5	6.0
COD	8200	5012	4552	4184	5615	5307	5095	5300	4900	4600
Ca	2200	540	500	420	574	557	510	560	530	480
Mg	1730	480	420	380	709	688	688	590	554	530
Na	800	420	360	320	377	347	317	395	345	320
K	1700	560	500	420	752	734	698	650	600	560

NOTE: All values in mg/lit except pH

TABLE: 1.5: Percent Change in Physico Chemical Characteristics of Distillery Spent Wash Treated with Activated charcoal and Wood ash

Para-meters	Original Sample	Activated Charcoal			Wood Ash			Activated Charcoal+Wood Ash (1:1)		
		24hr	48rh	72hr	24hr	48rh	72hr	24hr	48hr	72hr
TS	10000	-52.00	-58.00	-64.00	-37.50	-43.75	-50.00	-44.70	-51.10	-57.50
TDS	7600	-42.11	-50.00	-55.26	-35.57	-38.15	-40.72	-38.95	-44.41	-45.66
pH	4.7	+19.15	+23.40	+31.92	+6.38	+12.77	+25.53	+12.77	+17.02	+27.66
COD	8200	-38.88	-44.49	-48.98	-31.52	-35.28	-37.87	-35.37	-40.24	-43.90
Ca	2200	-75.45	-77.27	-80.91	-73.91	-74.68	-76.82	-74.55	-75.91	-78.18
Mg	1730	-72.25	-75.72	-78.04	-59.02	-60.23	-60.23	-65.90	-67.98	-69.36
Na	800	-47.50	-55.00	-60.00	-52.88	-56.63	-60.38	-50.63	-56.88	-60.00
K	1700	-67.06	-78.59	-75.30	-55.77	-56.82	-58.94	-61.77	-64.71	-67.10

(+Increase,-Decrease)

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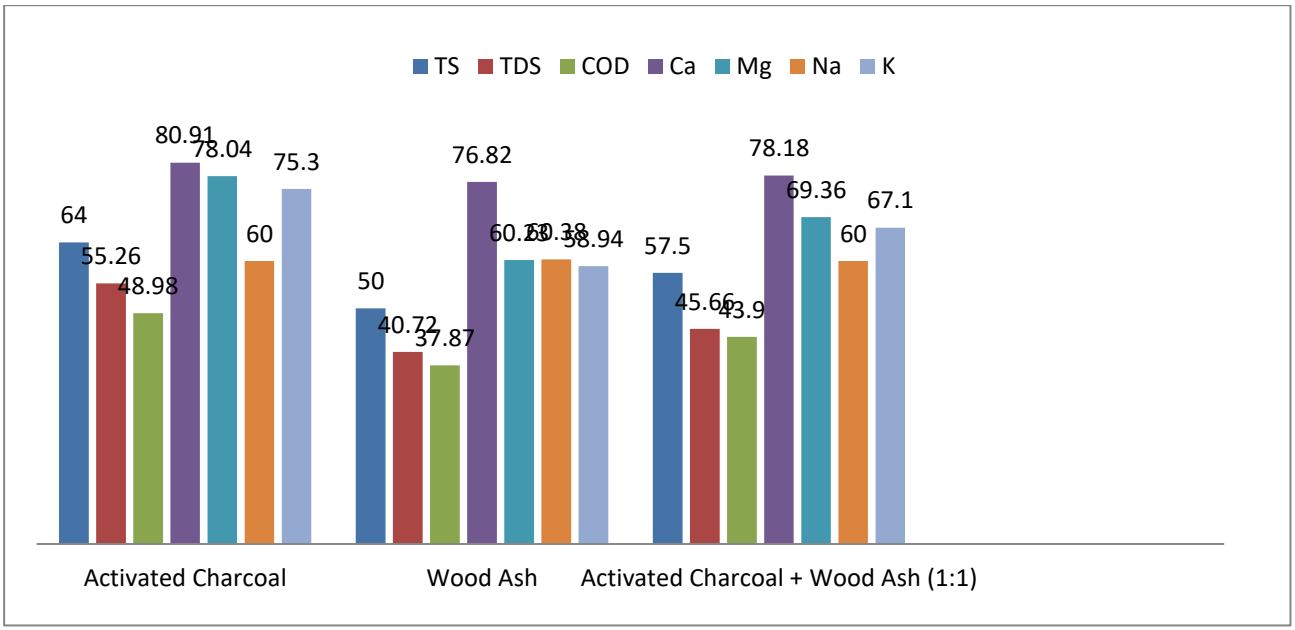
Percentage Decrease in Physico Chemical Characteristics of Distillery Spent Wash Treated with Activated charcoal, Wood ash and Activated charcoal + Wood ash (1:1) after 72 hour Treatment:



All values are in mg/l.

2.3 Physico Chemical Parameters Selected for analysis:

2.3.1 Physical Parameters: Color, Odor**,** pH, TS, TDS.

2.3.2 Chemical parameters: COD, Ca, Mg, Na & K.

2.4 Measurement of Total Solids (TS): Total solids were determined by measuring the residue left after evaporation of unfiltered samples (APHA 1995).

2.4.1 Calculations Total Solids (mg/l) = (A-B) x 1000 / Vol. of sample (ml).

Where A= Dry weight of residue + Dish (mg)

B=Weight of Dish (mg).

2.5 Total Dissolved Solids (TDS): Total dissolved solids are determined by measuring the residue left after evaporation of filtered sample (APHA 1995).

2.6 Measurement of pH: The pH of effluent was measured by pH meter using a glass electrode pH meter and also by using universal pH indicator solution.

2.7 Measurement of COD: It is the maximum amount of oxygen that can be consumed by the organic matter in the sample for complete oxidation. It is measured by method described in APHA (1995).

In this ferrous ammonium sulphate (0.25M) and potassium dichromate ($K_2Cr_2O_7$) of 0.04167 M are used for titration.

2.7.1 Calculations: COD (mg/l) = (A-B) x M x1000/ volume of Sample in ml.

Where A = Volume of FAS used for blank in ml.
B = Volume of FAS used for sample in ml.
M = Molarity of FAS.
FAS = Ferrous Ammonium Sulphate.

2.8 Determination of Ca and Mg: It was measured by complexo metric titration using ethylene di amine tetra acetic acid (EDTA).

2.9 Determination of Na and K : A characteristic light is produced due to excitation of electrons when the samples with Na/K sprayed into a flame. The intensity of this characteristics radiation is proportional to the concentration of Na/K and can be read at 529/768mm by using suitable optical filter device (Tondon 1998)

2.10 Wood ash was prepared by burning Lantana camara which is growing in Dehradun at high scale everywhere and becoming a major problem.

3. RESULT

Table 1.4 shows that visible color of distillery effluent was dark brown having foul smell, with acidic nature (pH 4.7) and contain TS-10000 mg/l, TDS-7600 mg/l, COD-8200 mg/l, Ca-2200 mg/l, Mg-1730 mg/l, Na-800 mg/l, and K-1700 mg/l. Table 1.4 reveals the removal of pollutants from distillery spent wash, which is seen maximum after 72 hour treatment with Activated charcoal followed by 48 hour and minimum in 24 hour treatment while minimum changes are seen with Wood ash treatment. After treatment with Activated charcoal at various time intervals, pH of spent was increased significantly from 4.7 to 6.2 after 72 hour treatment (Table 1.4). COD (4184 mg/l), TS (3600 mg/l), TDS (3400 mg/l) were found minimum after 72 hour treatment with Activated charcoal (Table 1.4), maximum reductions in Ca (420 mg/l), Mg (380 mg/l), Na (320 mg/l), and K (420 mg/l) are seen after 72 hour treatment with Activated charcoal (Table 1.4).Maximum reduction in TS, TDS, COD, pH and metallic ions is observed after 72 hour treatment following by 48 hour treatment and minimum change after 24 hour treatment. While after treatment with Wood ash, pH changed to 5.9 ,TS (5000 mg/l),TDS (4505 mg/l),COD (5095 mg/l) ,Ca (510 mg/l),Mg (688 mg/l),Na (317 mg/l) and K (698 mg/l). After 72 hour treatment with Activated charcoal + Wood ash (1:1) pH change to 6.0,TS (4250 mg/l), TDS (4130 mg/l),COD(4600 mg/l),Ca (480 mg/l),Mg (530 mg/l),Na (320 mg/l) and K (560 mg/l),Table 1.4.

4. DISCUSSION

Activated charcoal is a good adsorbent for color removal from spent wash and referred discoloration up to 99% while discoloration decreased with increasing concentration, reduction in COD from distillery effluent was found maximum 48.98% by using Activated charcoal while metallic ions are reduced as Ca (80.91%), Mg (78.04%), Na (60%) and K (75.30%) after 72hour treatment. While with wood ash reductions are seen as COD (37.87%), TS (50%), TDS (40.72%), Ca (76.82%), Mg (60.23%), Na (60.38%), K (58.94%) after 72 hour treatment. With (activated charcoal + wood ash (1:1)) following reductions are seen as COD (43.90%),TS (57.5%),TDS (45.66%),Ca (78.18%), Mg (69.36%), Na (60%) and K (67.10%) after 72 hour treatment. Changed distillery spent wash characteristic result in an altered growth of wheat plant and growth of wheat was increased by irrigation with 72 hour treated effluent treated with activated charcoal and activated charcoal + wood ash (1:1). Effluent was purified at a good level by Activated charcoal.

5. CONCLUSION

On the basis of experimental result it could be conclude that treatment of distillery effluent by using Activated charcoal is one of the best adsorption methods for removal of pollutants from distillery spent wash and it can reshape the effluent characteristics so it could be used as irrigation water to reduce the pressure of application of chemical fertilizers and normal water irrigation. The study revealed that the diluted effluent could be beneficial for better growth of wheat plant which also enhances wheat seed germination. The adsorbent treatment method could be profitably practiced for removing the pollutants from distillery effluent and can reduce the ground water contamination. Activated charcoal can be used for this purpose successfully at commercial level in industries. Solid waste adsorbed by adsorbent can be used to produce organic manure which needs further research.

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