

**Study of Adsorption Effect of Soil and Sand on Spent Wash Quality for Industrial  
Application****Bharat Kumar<sup>1</sup>, Mehtab Singh Dhaliwal<sup>2</sup>, Prashant Singh Rawat<sup>3</sup>, Sakshi Rana<sup>4</sup>**<sup>1</sup> Department of Chemistry Doon International School, Dehradun, 248001, U.K., India  
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**ABSTRACT:** Adsorption treatment of distillery effluent 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 soil, sand and soil + sand (1:1) For this, the study encompassing 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 soil, sand and soil + sand(1:1). The distillery effluent was acidic (pH 4.7) and dark brown in color which often cause psychological fear in farmers for utilization. Soil 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 soil + sand(1:1) Treated spent wash showed a good growth of wheat seeds and this method can be used for purification of industrial spent wash at commercial level.

**Keywords:** “Spent wash”, “Absorbent”, “Sand”, “Soil”, “Chemical parameter”, “Irrigation”.

**1. INTRODUCTION****2.**

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 conducive 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 effluent (spent wash).
2. To study the effect of Soil and Sand as adsorbent on spent wash quality for industrial application.

## 2. SOIL'S PHYSICAL PROPERTIES AND PROCESSES

As water moves through soil, suspended particles are removed by filtration and the filtrate may be diluted with soil water. The rate of these processes is affected by soils physical properties, i.e. the relative proportion of mineral particles of different sizes present in the soil. Sandy soils are said to be 'light' and clayey soils to be 'heavy'. Sandy soils are porous, have high filtration rates and retain less water. While, clayey soils have low infiltration rates, retain much water and may be poorly drained.

## 3. SAND'S PHYSICAL PROPERTIES AND PROCESSES

The physical aspects of waste treatment through sand systems involve the processes of filtration and dilution. As water moves through sand, suspended particles are removed by filtration. The rate of these processes is affected by sand's physical properties. Soily sand is less porous, have low filtration rates and retain more water.

## 4. MATERIAL AND METHODS

### 4.1 Sample collection

Effluents waste water (spent wash) was taken from a distillery, located in Dehradun. The factory uses molasses as the raw material. The effluent flows out into "River Song" that passes through nearby villages. Samples were collected at main outlet of distillery on date 02.11.2016. Samples were collected five times at weekly from November to December 2016 in clean sterile plastic container and stored at 4°C in a refrigerator.

### 4.2 Effect of sand as adsorbent on various physiochemical Characteristics of distillery effluent

Four plastic pots were filled with 2 kg soil, four with sand and four with soil + sand (1:1). Wheat was grown (*Triticum aestivum*) Variety UP 2329, after 20 days of growth, three pots of each were irrigated with 72 hour, 48 hour and 24 hour treated spent wash respectively and the 4<sup>th</sup> pot of each was used as control. On each irrigation date one liter 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.

### 4.3 Physico Chemical Parameters Selected for analysis :

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

**4.3.2 Chemical parameters:** COD, Ca, Mg, Na & K.

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

**4.4.1 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).

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

**4.6 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.

**4.7 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.

**4.7.1 Calculations:** COD (mg/l) = (A-B) x M x 1000 / 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.

**4.8 Determination of Ca and Mg:** It was measured by complexometric titration using ethylene diamine tetra acetic acid (EDTA).

**4.9 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 characteristic radiation is proportional to the concentration of Na/K and can be read at 529/768nm by using suitable optical filter device (Tondon 1998)

## 5. RESULT

Table 1.1 shows that visible color of distillery effluent was dark brown having foul smell, with acidic nature (pH 4.7) and contain TS-10000mg/l, TDS-7600mg/l, pH-4.7, COD-8200mg/l, Ca-2200mg/l, Mg-1730mg/l, Na-800mg/l, and K-1700mg/l. Table 1.2 and 1.3 reveals the removal of pollutants from distillery spent wash, which is seen maximum after 72 hour treatment with soil followed by 48 hour and minimum in 24 hour treatment while minimum changes are seen with sand treatment. After treatment with soil at various time intervals, pH of spent was increased significantly from 4.7 to 5.9 after 72 hour treatment (Table 1.2). COD (4384 mg/l), TS (4200 mg/l), TDS (4000 mg/l) were found minimum after 72 hour treatment with soil (Table 1.2), maximum reduction in Ca (540 mg/l), Mg (440 mg/l), Na (320 mg/l), and K (480 mg/l) is seen after 72 hour treatment with soil (Table 1.2 and 1.3). 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 sand, pH changed to 5.4, TS (5800mg/l), TDS (5000mg/l), COD (5218mg/l), Ca (680mg/l), Mg (580mg/l), Na (500mg/l) and K (880mg/l). After 72 hour treatment with soil + sand (1:1) pH change to 5.7, TS (5200mg/l), TDS (4400mg/l), COD (4696mg/l), Ca (580mg/l), Mg (520mg/l), Na (520mg/l) and K (700mg/l).

## 6. DISCUSSION

Soil is a good adsorbent for color removal from spent wash and referred discoloration up to 90% while discoloration decreased with increasing concentration, reduction in COD from distillery effluent was found maximum 46.54 % by using soil while metallic ions are reduced as Ca (75.45%), Mg (74.57%), Na (60%) and K (72.25%). Changed soil characteristic result in an altered growth of wheat plant and growth of wheat was increased by irrigation 72 hour treated effluent with soil. Effluent was purified at a good level by soil.

## 7. CONCLUSION

On the basis of experimental result it could be concluded that treatment of distillery effluent by using soil 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. Soil 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.

## 8. REFERENCES

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**Table: 1.1**  
**Effect of Soil and Sand as Adsorbent on Color and Odor of Spent Wash**

Parameters	Soil and Sand (1:1)			Soil			Sand		
	24hr	48hr	72hr	24hr	48hr	72hr	24hr	48hr	72hr
<b>Color</b>	<b>Dark Brown</b>	<b>Brown</b>	<b>Light Brown</b>	<b>Dark Brown</b>	<b>Brown</b>	<b>Light Brown</b>	<b>Dark Brown</b>	<b>Brown</b>	<b>Brown</b>
<b>Odor</b>	<b>Molasses Odors</b>	<b>Molasses Odors</b>	<b>Mild molasses Odor</b>	<b>Molasses Odor</b>	<b>Mild molasses Odor</b>	<b>Mild molasses Odor</b>	<b>Molasses Odor</b>	<b>Molasses Odor</b>	<b>Molasses Odors</b>

**Table: 1.2**  
**Physico Chemical Characteristics of Distillery Spent Wash treated with Soil and Sand**

Para-meters	Original sample	Normal soil			Normal sand			Soil + Sand (1:1)		
		24hr	48rh	72hr	24hr	48rh	72hr	24hr	48rh	72hr
<b>TS</b>	10000	5400	5000	4200	6400	6200	5800	6000	5600	5200
<b>TDS</b>	7600	5800	5400	4000	5400	5200	5000	5200	4800	4400
<b>pH</b>	4.7	5.5	5.7	5.9	5.1	5.3	5.4	5.3	5.5	5.7
<b>COD</b>	8200	5412	4952	4384	5816	5464	5218	5680	5208	4696
<b>Ca</b>	2200	600	580	540	760	720	680	620	600	580
<b>Mg</b>	1730	520	480	440	800	600	580	600	580	520
<b>Na</b>	800	540	420	320	620	540	500	580	520	520
<b>K</b>	1700	720	640	480	1060	1020	880	820	780	700

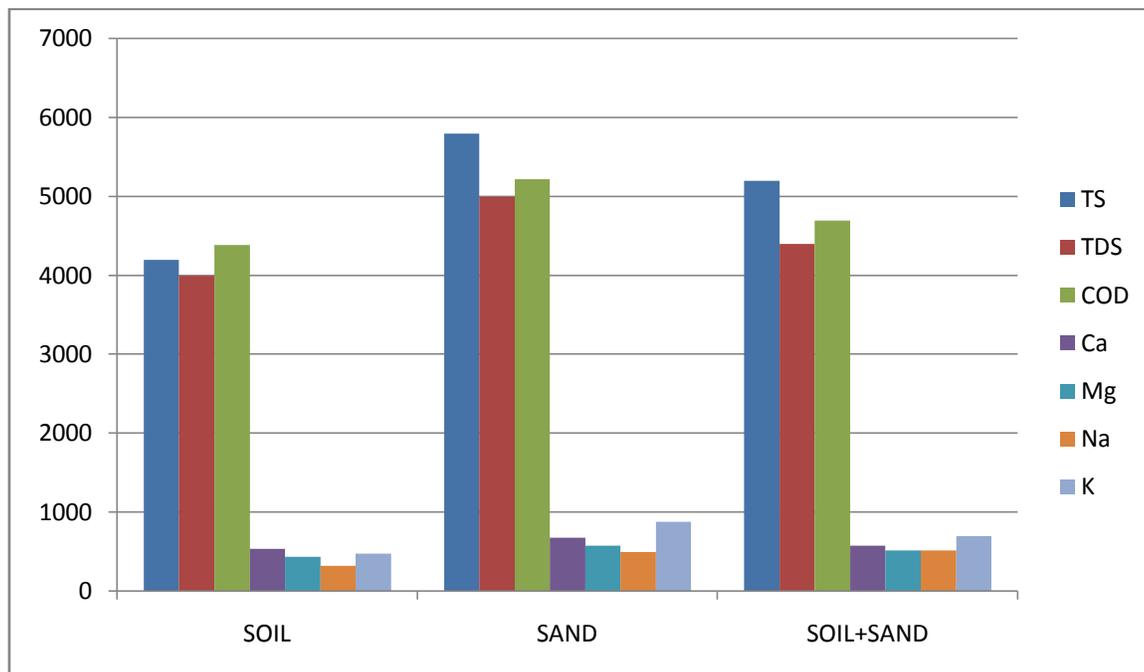
**NOTE:** All values in mg/lit except pH

**TABLE 4.3:**  
**Percent Change in Physic Chemical Characteristics of Distillery Spent Wash Treated with Different soil and Sand**

Para-meters	Original sample	Normal soil			Normal sand			Soil + Sand		
		24hr	48rh	72hr	24hr	48rh	72hr	24hr	48rh	72hr
TS	10000	-46	-50	-48	-36	-38	-42	-40	-44	-48
TDS	7600	-36.84	-28.36	-47.37	-28.95	-31.58	-34.12	-31.58	-36.84	-42.11
pH	4.7	+17.02	+21.27	+25.53	+5.51	+12.77	+14.89	+12.77	+17.02	+21.28
COD	8200	-34	-39.61	-46.54	-29.07	-33.36	-36.36	-30.73	-36.49	-39.40
Ca	2200	-72.72	-73.64	-75.45	-65.45	-67.27	-69.09	-71.82	-72.73	-73.64
Mg	1730	-69.94	-72.25	-74.57	-53.76	-65.31	-66.47	-65.31	-66.47	-69.94
Na	800	-32.5	-47.5	-60	-22.5	-32.5	-37.5	-27.5	-35	-35
K	1700	-57.65	-63.00	-72.25	-37.65	-40	-48.24	-51.76	-54.11	-58.82

(+Increase,-Decrease)

**Graphical Representation of Physico Chemical Characteristics of Distillery Spent Wash Treated with Soil, Sand and Soil + Sand (1:1) After 72 hour Treatment**



All values are in mg/l.