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# Treatment of Distillery Spent Wash for Irrigation Purpose by Using Soil as Adsorbent

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***Abstract:*** **Soil 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 soil treatment method for purification of distillery spent wash. For this, the study encompassing evaluation of reduction of various physical chemical parameters (pH, COD, TS, TDS, Ca, Mg, Na and K) of distillery spent wash was done by passing through the soil column. The distillery effluent was acidic (pH 4.7) and dark blackish brown in color which often cause psychological fear in farmers for utilization as soil treatment of spent wash exhibited maximum reduction in COD (48.98%), TS (48 %) , TDS (47.37%), Mg (74.57%), Na (60%), Ca (75.45%),K (72.25%) and pH increased from 4.7 to 5.9.Treated spent wash showed a good growth of wheat seeds.**

***Keywords:*** **"Spent wash", "Soil", "Irrigation", "Adsorbent", "Chemical parameter".**

## 1. INTRODUCTION

Rapid industrialization for sustaining economic growth and ever increasing population is leading to the pollution of the environment due to the disposal of untreated effluents. Various pollutants produced in industries directly or indirectly and result in cumulative pollution of 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 effluent from textile, chemical fertilizers, pulp and paper, petro chemical and breweries, metal processing, automobile manufacturing, leather and tannery industries and power plants including nuclear, thermal, 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 Shrivastava, 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 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 is planned to investigate the land treatment of distillery effluent with the following objectives

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1. To characterize physico-chemical characteristics (pH, color, COD, TS, TDS, Ca, Mg, Na, K) of distillery effluent.
2. To study the impact of Soil as adsorbent on spent wash quality.

## 2. SOIL'S PHYSICAL PROPERTIES AND PROCESSES

The physical aspects of waste water treatment through land systems involve the processes of filtration and dilution. 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. In contrast, clayey soils have low infiltration rates, retain much water and may be poorly drained. Soils of intermediate texture such as looms are also intermediate in porosity, drainage and water tension (Foth & Turk 1992).

## 3. MATERIAL AND METHODS

### *3.1 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 $4^{o}$C in a refrigerator.

### *3.2 Effect of soil as adsorbent on various physiochemical Characteristics of distillery effluent:*

Five plastic pots were filled with 2 kg soil each and wheat was grown (Triticum aestivum) Variety UP2329, after 20days of growth, pots were irrigated with spent wash and the $5^{th}$ pot was used as control. On each irrigation date one liter of treated effluent was poured in each pot. 24 hour treated, 48 hour treated and 72 hour treated spent wash was used in pot 1, pot 2, pot 3 and pot 4 for irrigation. Same time treated samples were collected in sterile reagent bottles for physical and chemical tests.

### *3.3 Physico Chemical Parameters Selected for analysis:*

***3.3.1 Physical Parameters*** pH, TS, TDS.

***3.3.2 Chemical parameters*** COD, Ca, Mg, Na & K.

### *3.4 Measurement of Total Solids (TS):*

Total solids were determined by measuring the residue left after evaporation of unfiltered samples (APHA 1995).

***3.4.1 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).

### *3.5 Total Dissolved Solids (TDS):*

Total dissolved solids are determined by measuring the residue left after evaporation of filtered sample (ALPHA 1995).

### *3.6 Measurement of pH:*

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

### *3.7 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.

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***3.7.1 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.

***3.8 Determination of Ca and Mg:***

It was measured by complexo metric titration using ethylene di amine tetra acetic acid (EDTA). (Schwazenbach) .

***3.9 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)

## 4. RESULT

Tab 1.1 shows that visible color of distillery effluent as dark brown having foul smell, with acidic nature(4.7) and contain TS-10000mg/l, TDS-7600mg/l, COD-8200mg/l, Ca-2200mg/l, Na-800mg/l, Mg-1730mg/l and K-1700mg/l. Tab 1.2 and 1.3 reveals the removal of pollutants from distillery spent wash, which is seen maximum after 72 hours treatment with soil followed by 48 hours and minimum after 24 hours. After treatment with soil, pH of spent wash was increased significantly from 4.7 to 5.9 after 72hours (Table1.2 and 1.3). COD (4184mg/l), TS(4200mg/l), TDS(4000mg/l) were found minimum after 72 hours of treatment with soil (Table1.2), maximum reduction in Ca (75.45%), Mg (74.57%), Na (60%), and K (72.25%) is seen after 72 hours treatment with soil (Table 1.3).

**Table: 1.1 Effect of Soil as adsorbent on color and odor of spent wash.**

| **Parameters** | **Original Sample** | **Soil Treatment** | | |
|---|---|---|---|---|
| | | **24hr** | **48hr** | **72hr** |
| **Color** | **Dark brown** | **Dark brown** | **Brown** | **Light brown** |
| **Odor** | **Offensive Molasses odor** | **Molasses odor** | **Mild molasses odor** | **Mild molasses odor** |

**TABLE 1.2: Physico chemical characteristics of distillery spent wash treated with soil at various irrigation periods**

| **Para-meters** | **Original sample** | **Soil Treatment** | | |
|---|---|---|---|---|
| | | **24hr** | **48rh** | **72hr** |
| TS | 10000 | 5400 | 5000 | 4200 |
| TDS | 7600 | 4800 | 5400 | 4000 |
| pH | 4.7 | 5.5 | 5.7 | 5.9 |
| COD | 8200 | 5412 | 4952 | 4184 |
| Ca | 2200 | 600 | 580 | 540 |
| Mg | 1730 | 520 | 480 | 440 |
| Na | 800 | 540 | 420 | 320 |
| K | 1700 | 720 | 640 | 480 |

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

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**TABLE 1.3: Percent Change in physic chemical characteristics of distillery spent wash treated with soil at various irrigation periods.**

| Para-meters | Original sample | Soil Treatment | | |
|---|---|---|---|---|
| | | 24hr | 48rh | 72hr |
| TS | 10000 | -46 | -50 | -48 |
| TDS | 7600 | -36.84 | -28.36 | -47.37 |
| pH | 4.7 | +17.02 | +21.27 | +25.53 |
| COD | 8200 | -34 | -39.61 | -48.98 |
| Ca | 2200 | -72.72 | -73.64 | -75.45 |
| Mg | 1730 | -69.94 | -72.25 | -74.57 |
| Na | 800 | -32.5 | -47.5 | -60 |
| K | 1700 | -57.65 | -63.00 | -72.25 |

**(+Increase,-Decrease)**

## 5. DISCUSSION

Soil is a good adsorbent for color removal from spent wash and referred discoloration up to 90% while discoloration decreased with increasing concentration of spent wash. Reduction in COD in distillery effluent was found maximum 48.98%, TS 48%, TDS 47.37%, and increase in Ph is 25.53% by using soil as adsorbent. Changed soil characteristics resulted in an altered growth of wheat plant and growth of wheat was increased by irrigation with effluent treated for 24 hr, 48 hr and 72 hour respectively. Effluent was purified at a good level by soil.

## 6. CONCLUSION

On the basis of experimental result it can be concluded that treatment by soil is one of the best method for removal of pollutants from distillery spent wash and we can reshape the effluent characteristics so it could be used as irrigation water to reduce the pressure of application of fertilizers and normal water irrigation. The study also revealed that the treated effluent could be beneficial for better growth of wheat plant which also enhances wheat seed germination. The adsorbent treatment method of effluent could be profitably practiced for removing the pollutants and thus avoiding the ground water contamination and its environmental impacts and soil can be used for this purpose successfully.

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