

Physico-chemical characterization of raw and diluted effluent from Distillery Industry

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Abstract - Effluent originating from distilleries known as spent wash leads to extensive water pollution. Knowledge on the physico-chemical characteristics of distillery wastewater is essential in the design, operation, collection and treatment as well as disposal facilities for the effective management of environmental quality. In this regard spent wash was collected from a distillery industry located in Cuddalore district. The Physico-chemical characteristics of distillery effluent samples such as colour, odour, pH, electrical conductivity (EC), total solids (TS), total dissolved solids (TDS), total suspended solids (TSS), total hardness, chemical oxygen demand (COD), dissolved oxygen (DO), calcium, chlorides, magnesium, potassium, and sulphates were analysed and it was observed that the characteristics of spent wash have high load of chemical and organic pollutants. But when the spent wash was diluted with 50% and 75% of water, all the values of physicochemical properties were decreased. The decrease in these values shows that the toxicity of distillery effluent decreases with increasing dilution. Statistical analyses of the effluent and the diluted samples were carried out to establish technological options for new treatment.

Key Words: Physico-chemical characteristics, Statistical analysis, Distillery effluent etc.

1. INTRODUCTION

Various organic wastewaters that are known to cause serious problems may be accredited to distillery effluents, pulp and paper effluents, textile effluents, and tannery effluents [1]. Among these, distillery wastewater is highly charged with organic matter. They pose a very serious threat to the environment because of the large volume of wastewater they generate which contains a significant amount of caramelized and recalcitrant compounds. These distillery wastewaters contain high level of COD and BOD, and low pH [2][3] and are dark brown in colour, with unpleasant odour. At present, there are 285 distilleries in India that are producing 2.7 billion liters of alcohol and generating 40 billion liters of wastewaters annually [4]. If these effluents are discharged to water streams, the suspended solids present in the effluent would impart turbidity in water, reduce light penetration and impair the

biological activity of aquatic life. Hence an economically viable and environmentally safe means of disposal is needed to handle such large volumes of waste water [5].

Various studies dealing with the treatment of distillery wastewater are increasing rapidly. In recent years, there has been an attempt to conduct a survey and provide strategies to determine the role played by various distillery industries to this issue for improving and preserving the environment. It has been considered intelligent to investigate the condition of wastewater generated from a distillery industry. Hence, it is necessary to determine the physicochemical characteristics of any typical wastewater [6][7]. This rapid analysis assists in assessing the quality of the wastewater for effective management and treatment strategies [8].

The present study aims to assess the physicochemical characteristics of distillery effluent and their dilution effect at various concentrations was also assessed.

2. MATERIALS AND METHODS

Samples were collected at a monthly interval from a distillery industry situated in Cuddalore District, Tamilnadu.

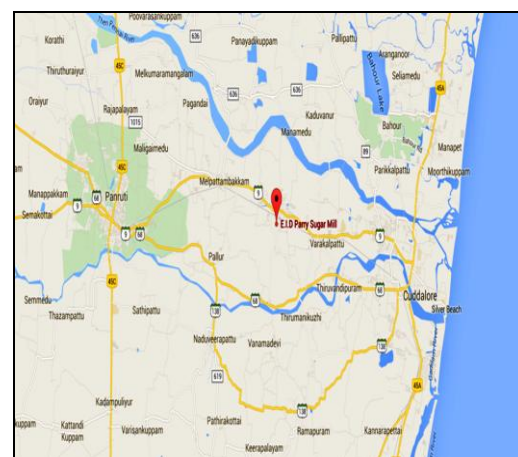


Fig -1: Location map of the study area including sampling sites of effluent

The sampling, preservation, physico-chemical characterization and the effect of dilution (50% and 75%) on the effluent were carried out as per the prescribed procedure [9]. The samples were analyzed for the various parameters such as colour, odour, pH, electrical conductivity (EC), total solids (TS), total dissolved solids (TDS), total suspended solids (TSS), total hardness, chemical oxygen demand (COD), dissolved oxygen (DO), calcium, chlorides, magnesium, potassium, and sulphates etc. The various statistical parameters such as mean, standard deviation, Variance have also been established. Fig 1 shows the location of the study area.

3. RESULTS AND DISCUSSION

The physicochemical characteristics of distillery spent wash, spent wash diluted with 50% water and spent wash diluted with 75% water were studied. The analysis results of distillery wastewater for various physico - chemical parameters, mean, standard deviation and variance are presented in Table 1.

Table-1:Physicochemical characteristics of distillery effluent

Parameters*	Spent wash	Dilution 50%	Dilution 75%	Mean	SD	Variance
Colour	Dark brown	Brown	Light brown	-	-	-
Odour	Unpleasant	Offensive	Offensive	-	-	-
pH	3.8	3.9	4.0	3.90	0.10	0.01
EC	45.5	29.2	18.1	30.93	13.78	189.94
TS	140260	74220	33558	82679.3	53851.6	2899999441.
TDS	112400	57840	26542	65594.0	43451.0	1887992428.
TSS	27860	16380	7016	17085.3	10439.8	108991205.
Total Hardness	23400	14400	5500	14433.3	8950.05	80103333.33
COD	162000	114480	92654	123044.	35457.4	1257232065.
DO	Nil	Nil	Nil	Nil	Nil	Nil
Calcium	2975	1692	684	1783.6	1148.25	1318472.33
Chlorides	10650	7806	3954	7470.0	3360.62	11293776.00
Magnesium	2384	1436	788	1536.0	802.69	644304.00
Potassium	10821	7121	3823	7255.0	3500.92	12256468.00
Sulphates	3015	1785	690	1830.00	1163.15	1352925.00

*All values except pH, and EC (dS/m) are in mg/L. SD-Standard deviation.

3.1 Colour

The colour of spent wash was found dark brown. When it was diluted with 50% of the water, it turned brown colour and changed to light brown colour when diluted with 75% of water.

3.2 Odour

The odour of spent wash was unpleasant. Odorous compounds from distillery wastewater mainly consist of volatile fatty acids such as butyric acids and Valeric acids that have a high odour index [10]. The distillery wastewater has distinct organic compositions. Various anaerobic bacteria

ferment these compounds and generate volatile fatty acids. The odour of the spent wash diluted with 50% and 75% of water was found to be offensive.

3.3 pH

The pH of the raw spent wash was acidic in nature. i.e. 3.8 but when it was diluted at different dilution the acidic nature reduced slowly but remained within the acidic range.

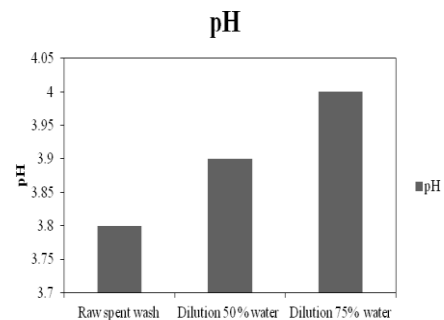


Chart -1: pH of distillery effluent at different dilution levels

3.4 Electrical Conductivity (EC)

The electrical conductivity of the spent was 45.5 dS/m. The electrical conductivity of distillery effluent at different level was 29.2 and 18.1 dS/m at diluted 50% and 75% of water. The electrical conductivity of distillery effluent was high, but when it was diluted value decrease with increased dilution.

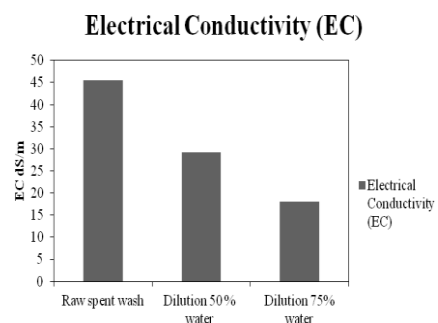


Chart -2: Electrical Conductivity of distillery effluent at different dilution levels

3.5 Total Solids (TS)

The total solids of spent wash were 140260 mg/L. Total solids are the residues that include both dissolved and suspended solids. Distillery effluent contains huge amount of solids. The total solids of the distillery effluent at different levels decreased with dilution i.e. 74220 mg/L in dilution 50% of water and 33558 mg/L in dilution 75% of water.

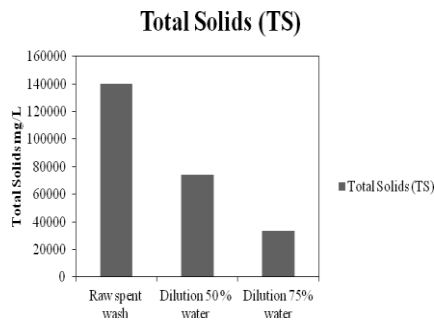


Chart -3: Total Solids of distillery effluent at different dilution levels

3.6 Total Dissolved Solids (TDS)

The total dissolved solids of spent wash was 112400 mg/L whereas the total dissolved solids (TDS) level of the distillery effluent at 50% and 75% dilution levels were 57840 mg/L and 26542 mg/L respectively. Selvamurugan et al. 2012 reported total dissolved solids of spent wash as 92800mg/L.

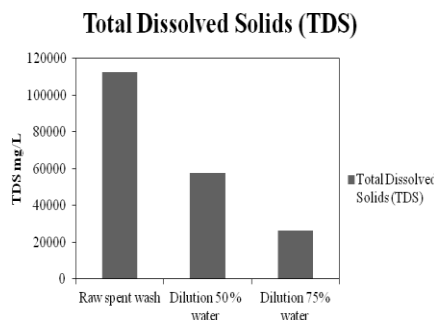


Chart -4: Total Dissolved Solids of distillery effluent at different dilution levels

3.7 Total Suspended Solids (TSS)

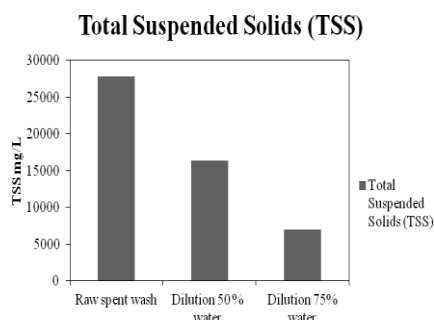


Chart -5: Total Suspended Solids of distillery effluent at different dilution levels

The total suspended solid of spent wash was 27860 mg/L. The total suspended solids of the distillery effluent at 50% dilution was 16380 mg/L and 7016 mg/L for spent wash dilution with 75% of water.

3.8 Total Hardness

The total hardness of the spent wash was 23400 mg/L. The term total hardness indicates the concentration of calcium and magnesium ions. The total hardness of the effluent at different dilution levels was 14400 mg/L in spent wash dilution 50% of water and 5500 mg/L spent wash dilution with 75% of water.

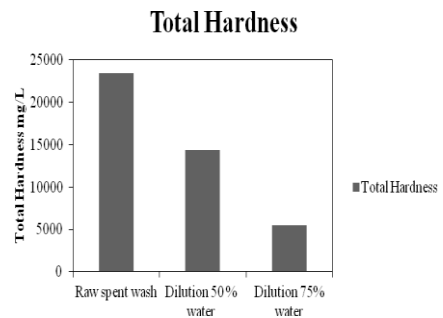


Chart -6: Total Hardness of distillery effluent at different dilution levels

3.9 Chemical Oxygen Demand (COD)

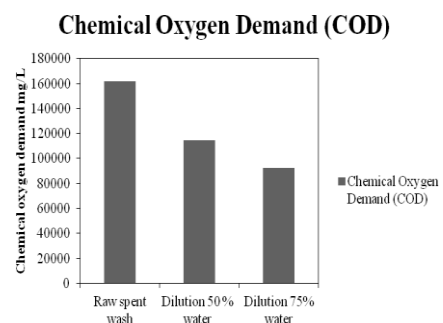


Chart -7: Chemical Oxygen Demand of distillery effluent at different dilution levels

The chemical oxygen demand of spent wash was very high as 162000 mg/L. The COD content of distillery effluent at 50% and 75% dilution levels was found to be 114480 mg/L and 92654 mg/L respectively. Selvamurugan et al. 2012 reported the COD level of spent wash in is study to be 122000mg/L.

3.10 Dissolved Oxygen (DO)

The dissolved oxygen of spent wash was Nil and it was found to be the same for the spent wash diluted with 50 % of water and spent wash diluted with 75% of water.

3.11 Calcium

The concentration of Calcium in spent wash was 2975mg/L. The calcium content of distillery effluent at different dilution level decreased to 1692 mg/L and 684

mg/L for spent wash diluted with 50 % of water and spent wash diluted with 75% of water respectively.

Calcium

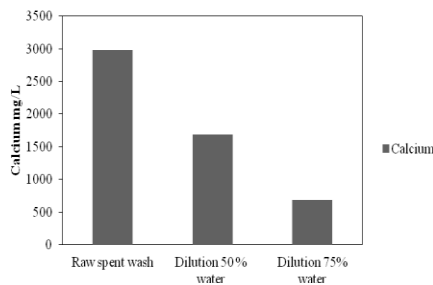


Chart -8: Calcium of distillery effluent at different dilution levels

3.12 Chlorides

The concentration of chlorides was 10650 mg/L for spent wash. The chloride content of distillery effluent at 50% dilution levels was 7806 mg/L and 39 mg/L at spent wash diluted with 75% of water respectively.

Chlorides

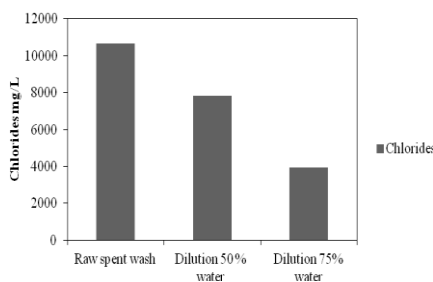


Chart -9: Chlorides of distillery effluent at different dilution levels

3.13 Magnesium

Magnesium

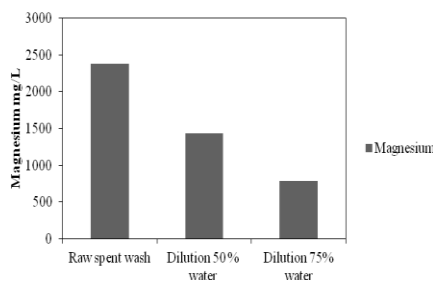


Chart -10: Magnesium of distillery effluent at different dilution levels

The concentration of Magnesium in spent wash was 2384 mg/L. The magnesium content of distillery effluent at 50% and 75% dilution levels were 1436 mg/L and 788 mg/L

respectively. Selvamurugan et al. 2012 reported the Magnesium level of spent wash in is study to be 2500mg/L.

3.14 Potassium

The Potassium content in spent wash was 10821mg/L. The potassium content of distillery effluent at 50% and 75% dilution levels were 7121 mg/L and 3823 mg/L respectively.

Potassium

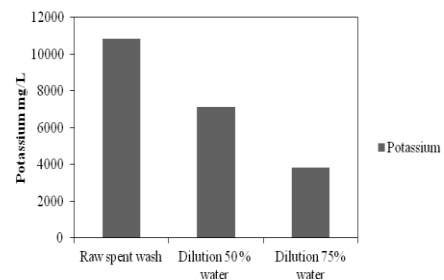


Chart -11: Potassium of distillery effluent at different dilution levels

3.15 Sulphates

The Sulphates of spent wash were 3015 mg/L. The potassium content of distillery effluent at different dilution levels was 1785 mg/L and 690 mg/L at spent wash diluted with 50 % of water and spent wash diluted with 75% of water respectively.

Sulphates

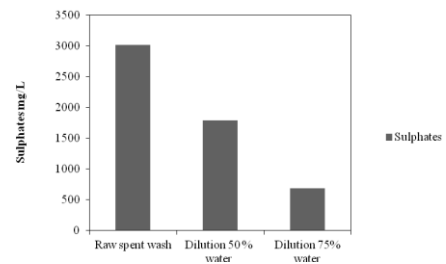


Chart -12: Sulphates of distillery effluent at different dilution levels

3. CONCLUSIONS

The present study reveals that the physicochemical characteristics of distillery effluent have a very high load of pollutants. The spent wash was dark brown coloured and highly acidic in nature. It is one of the most composite and unwieldy waste having very high value of solids, electrical conductivity, hardness, calcium and magnesium compounds, chlorides, BOD and COD content and highly acidic pH, while DO was found Nil and contains high organic load of nutrient elements such as, potassium and Magnesium. When the spent wash was diluted with 50% and 75% of water, all the values of physicochemical properties were decreased. The

decrease in these values show that the toxicity of distillery effluent decreases with increasing dilution. The statistical analyses are used in the rapid analysis of wastewater and it helps in establishing technological options for new treatment technologies.

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BIOGRAPHIES



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