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Assessment of Suitability of Distillery Liquid Effluent for End use Applications

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ABSTRACT

The present study is aimed to characterize the liquid effluent generated from a distillery industry to assess its suitability for application. The parameters analyzed include pH, EC, TDS, Total Hardness, Calcium, Magnesium hardness, Total alkalinity, Chloride, Fluoride, nitrite, Nitrate, Phosphate, Sulphate, Ca^{+2}, Mg^{+2}, DO, COD, BOD and TOC. The pH is observed to be 7.5. The levels of EC, TDS, Chloride, Sulphate, Phosphate, Hardness, COD and BOD are on the higher side of the permissible limits of irrigation, aquaculture and drinking water standards. Total organic carbon is abnormally high, indicating extensive organic carbon load in waters. The results revealed that liquid effluent is contaminated and not suitable for drinking purposes, which needs further treatment even for employing it for irrigation purposes.

Key words: Effluent, irrigation, drinking, aquaculture

INTRODUCTION

Distillery industries have become a major source of pollution, because 88% of the raw materials employed in the manufacturing process are converted into waste and discharged into the water bodies creating water pollution and the waste water generated from the distillery units contain appreciable organic load (Ghosh *et al*., 2003). Survey of literature (Bhattacharya *et al*., 2008) suggested that industries like textiles, distilleries, pulp and paper are the major polluters of water and environment, by generating large quantities of wastewater with high organic load. A bio augmentation technology has also been suggested for minimizing the contents of total suspended solid and COD.

The studies of Kumar *et al*. (1995) on bioassay of distillery effluent on common guppy, Levistes Reticulates revealed that they were adversly effected by the distillery effluent. The effect of polluted water on seeds of *Phesiolus radiants* L. has been studied by Naidu *et al*. (1994) and the studies revealed that in 25, 50 and 100% of effluent the catalyse activity and chlorophyll content were decreased. To investigate the effect of brewery effluent, studies (Ogunwenmo *et al*., 2010) were carried out to assess the suitability of industrial wastewater for irrigation purposes, germination of seeds etc. The experimental results revealed that the effluent become toxic beyond a fixed time and also harmful if not properly treated or diluted.

Sharma *et al*. (2002) carried out studies to assay the toxicity of distillery effluents carried out to assess the toxicity of distillery effluent on seeds germination, seedling growth and

pigment contents and the studies revealed that higher concentrations (>5%) of effluent were found to be toxic but can be employed for irrigation purposes after proper distillation. Effect of distillery effluent on root knot nematode *Meloidoge incognita* in growth of tomato and brinjal was investigated (Nagaraju *et al.*, 2009) and the investigations revealed that the plants tomato and brinjal when treated with different percent levels of diluted distillery effluent, a minimum of shoot length over control was observed with 2% dilution of distillery effluent. The phytotoxic effects of distillery effluent on the cells of *A. cepa* L. was studied by Shobha (2004). The studies revealed that the mitotic index was significantly reduced with the increase in concentration of the effluent and duration. An investigative study (Umebese *et al.*, 2009) revealed that the undiluted combined industrial effluent has good agro potential in the cultivation of red cowpea. Physicochemical characterization of the waste water generated from Nawabgang distillery has been carried out by Yadav *et al.* (2004). The research findings of the study revealed that the parameters N, NH_3, PO_4^{-3}, SO_4^{-2}, Ca^{+2}, BOD, pH exceeded the recommended standard limits. An attempt has been made (Rao *et al.*, 2009) to correlate chemical characterization of distillery effluent. A study (Ehi Robert *et al.*, 2007) has been carried out to investigate the influence of brewery effluent on some chemical properties of soil and on the growth of *Dialium guineense* seedlings with five rates viz., 0, 25,000, 50,000, 75,000 and 1,00,000 L ha^{-1}. The studies revealed that effluent application enhanced the soil pH and N, P, K, Na and organic matter content but soil Ca and Mg nutrient uptake and leaf production did not affect soil texture or plant growth.

The studies of Olajumke *et al.* (2010) on impact of bravery effluent on water quality in majawe, Ibadan of South Western Nigeria. Water quality assessments was carried out at four different effluent discharge points 500 m away and two other discharge point down stream. The parameters analyzed include pH, Alkalinity, EC, TSS, TDS, BOD, COD, DO, Cl^-, Mg, Ca, Cd, Pb etc. The results of the study indicated that the surface water were contaminated by to recovery effluent. The distillery effluent is a non toxic, biodegradable and found to have the characteristics pH range from 4.3-5.3; TSS 1200-1400; TDS 4500-7500; BOD 40,000-50,000, COD 80,000- 1,00,000. Studies (Raju *et al.*, 2007) were carried out on fungi isolated from the soil samples around textile and distillery industries of Nanjangud, Karnataka to verify their efficacy in decolorizing the dyes and the study results revealed that the fungal species *A. flavus* was more efficient compared to other species.

The literature related to the influence of industrial waste water on seed and seedling quality characters irrespective of crops are reviewed (Kalaiselvi *et al.*, 2010). The investigative studies (Rameshwari and Karthikeyan, 2005) on distillery yeast sludge indicate that it can be employed as an alternative feed resource in poultry industry. The field experiments (Selvamurugan *et al.*, 2011) to study the affect of different levels and methods of bio methanated distillery spent wash and press mud bio compost application on soil microbial and enzymatic activity revealed that the utilization of distillery spent wash could improve the microbial population and enzymatic activities in the soil. The studies (Saliha *et al.*, 2005) revealed that the conversion of by products like press mud and distillery spent wash into value added eco-friendly organic manure will be an option for improving the soil fertility and crop production. Studies (Mokolensang *et al.*, 2003) on utilizing Shochu distillery products for culturing the common crop *Cyprinus carpiol* L. revealed that by product has potential in giving growth to fish.

Keeping in view the agricultural background of East Godavari region of Andhra Pradesh, it is proposed to characterize the liquid effluent generated from the distillery industry in order to evaluate its suitability for consideration for end use applications.

MATERIALS AND METHODS

Study area: The study area includes East Godavari District of Andhra Pradesh where the Distillery industry is located between the latitudes 16°30' N to 18°20' N and longitude 81°30' and 82°30'.

The samples of the effluent waters before and after treatment were collected and preserved for analysis as per the standard procedures by Ramteke and Moghe (1998), NEERI, India. The measured parameters include pH, Electrical conductivity, total dissolved solids, chloride, sulphate, phosphate and fluoride, Total hardness as well as calcium and magnesium hardness, concentrations of met allic calcium and magnesium, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD). Standard analytical procedure (Ramteke and Moghe, 1998, NEERI, India) were followed for the determination these parameters.

RESULTS AND DISCUSSION

The data related to the characterized parameters is presented in the Table 1-3.

Table 1: Characterized parameters of distillery liquid effluent

Parameter	Effluent (BT)	Effluent (AT)	CPCB Standards IS 10500 (1992)
pH	5.1	7.5	6.5-8.5
Conductivity (μ mhos cm^{-1})	56.900	15600	--
Total dissolved solids (mg L^{-1})	67.320	20400	500
Chloride (mg L^{-1})	6548	2749	250
Fluoride (mg L^{-1})	22	BDL	1.0
Sulphate (mg L^{-1})	1498	333	200
Nitrate (mg L^{-1})	40	30	45
Phosphate (mg L^{-1})	0.59	14.5	--
Nitrite (mg L^{-1})	28.6	3.9	--

Table 2: Analytical data of alkalinity, total hardness

Parameter	Effluent (BT)	Effluent (AT)	CPCB Standards IS 10500 (1992)
Alkalinity (mg L^{-1})	1.050	3600	200
OH (mg L^{-1})	BDL	BDL	--
CO_3^{-2} (mg L^{-1})	BDL	BDL	--
HCO_3^{-2} (mg L^{-1})	1281	4392	--
Hardness (mg L^{-1})	9000	4200	300
Calcium hardness (mg L^{-1})	8000	1500	--
Magnesium hardness (mg L^{-1})	1000	2700	--
Ca^{+2} (mg L^{-1})	3200	600	75
Mg^{+2} (mg L^{-1})	244	659	30

Table 3: Analytical data related to DO, BOD, COD and TOC

Parameter	Effluent (BT)	Effluent (AT)	Irrigation standards CPCB:1995	Inland surface water standards CPCB:1995
DO (mg L^{-1})	BDL	BDL	--	5.0
COD (mg L^{-1})	76.752	11872	--	250.0
BOD (mg L^{-1})	36.000	4600	100	30.0
TOC (mg L^{-1})	27.215	6239	150	--

DO: Dissolved oxygen, COD: Chemical oxygen demand, BOD: Biological oxygen demand, TOC: Total organic carbon

The pH value of the effluent is 5.1 before treatment and 7.5 is within the no problem range of 6.5 to 8.5 (Ayers and Westcot, 1976; IS 10500, 1992). Higher values of EC (15600 μ mhos cm^{-1}) indicate the excessive saline nature of Regional Salinity Laboratory US (1954). TDS levels (20,400 mg L^{-1}) indicate the presence of total dissolved salts. Fluoride level is at below detectable limit, Nitrate and Nitrite levels are with in the permissible limits while sulphate level is marginally higher than the IS: 105900 standards of drinking waters. DO is at below detectable limit. BOD (4600), COD (11872) and TOC (6239 mg L^{-1}) levels are more than the permissible limits indicating excess load of organic carbon.

CONCLUSION

Higher levels of EC, TDS and Chloride of the treated effluent indicate the saline nature of the effluent waters and confirmed its unsuitability for drinking and irrigation purposes. Higher levels of hardness indicate its unsuitability of its use for domestic purposes even after treatment. DO at Below Detectable Limit indicate that the effluent waters are not suitable for aquaculture purposes. Excessive levels of COD and TOC confirm higher organic carbon load in the effluent water. Extensive BOD levels of effluent reveal its unsuitability for aquaculture purposes. Further, intensive treatment of the effluent waters is necessary for considering them even for irrigation purposes.

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