Characterization of Biomethanated distillery Spent wash.

INTRODUCTION

Molasses a by-product from sugar industry is used as a substrate for ethanol fermentation in distillery. The fermented broth is later subjected to distillation process for recovery of ethanol. The bottoms of distillation process are dark coloured concentrated waste water known as spent wash. For each litre of ethanol distilled 8-15 litre of spent wash is discharged (1). According to latest reports, there are 397 operating distilleries in India discharging 40 billion liter of spent wash annually (2). Such a voluminous **s**pent wash is acidic in nature and possess high chemical oxygen demand (COD) of 80,000- 1,20,000 mg/l. The characteristic black brown colour and an offensive odour makes spent wash a potential threat to land and water ecosystem (3). Therefore, they are at top in the list of "Red Category" industries as per the Ministry of Environment and Forest.

The dark colour of the spent wash is because of a natural pigment known as melanoidins (4). It is formed during the distillation process where the unutilized proteins and carbohydrates in the fermented broth undergo a Maillard reaction at high temperature. Although the percentage of melanoidin is as low as 2%, it imparts a significant colour to the spent wash (5). The melanoidins from spent wash have empirical formula of $C_{17\text{-}18}H_{26\text{-}27}O_{10}N$ with molecular weight distribution between 5-40 KDa (6). The structure and elemental composition of melanoidins is not constant since it is influenced by the type of reactants and reaction conditions (7). Mainly the Maillard product of sucrose–aspartic acid is the major forms of melanoidin in spent wash (8). The nature of spent wash does not allow us to dispose or reuse and it has become a major concern worldwide. With increasing pressure from authorities and pollution control board, the distilleries are in a dire requirement of a solution for spent wash treatment and disposal. The treatment, reuse, and disposal are only possible when we are aware of the composition, properties, and nature of the spent wash. Therefore, in this paper we have studied the physico-chemical, biological and nutritional characteristics of spent wash. These properties can be used as a basis for spent wash reuse and disposal.

MATERIAL AND METHODS

Biomethanated distillery spent wash (BDSW) was collected from a reputed distillery in Karnataka. Colour of the spent wash was recorded by direct observation method, pH was determined by pH meter, optical density (OD) was measured by UV visible double beam spectrophotometer (Shimadzu Analytical, India), and Specific Gravity was estimated using specific gravity bottle. COD was determined by open reflux method, Total Solids, Total Dissolved Solids, and Total Suspended Solids were estimated by gravimetric method. Conductivity was measured by conductivity meter, temporary and permanent hardness was determined by EDTA method. Total Nitrogen, Total Phosphorus, Total Potassium, Total Calcium, Total Magnesium, Total

Sulphur, Total Iron, Total Manganese, Total Zinc, Total Copper were estimated as per Jackson M.L, Soil Chemical Analysis, 1973 (Prentice Hall of India Pvt. Ltd, New Delhi) and Piper, C.S, Soil and plant analysis, 1966 (Hans Publishers; Bombay). Total number of microbial colonies were counted using Quebec colony counter. Fourier-transform infrared spectroscopy (FTIR) was used to obtain an infrared spectrum of absorption/emission analysis of the functional group present in BDSW.

RESULTS AND DISCUSSION

pH of BDSW was slightly alkaline (4.5) and showed an OD of 0.069 at 475 nm after 100 times dilution. BDSW is black-brown in colour and smell slightly like molasses. Total Solids, total dissolved Solids and total suspended Solids were found to be 89.5 mg/l, 67.05 mg/l and 36.42 mg/l respectively. BDSW showed a conductivity of 55 µM and found to be denser than water with specific gravity of 1.022. COD was found to be 93 mg/l (500 times diluted BDSW) and a significant positive relationship was found between colour and COD, which means colour is responsible for high COD of BDSW. Studies reflect very high levels of Nitrogen, Potassium and a good proportion of Phosphorus, Calcium, Magnesium, Sulphur, Iron, Manganese, Zinc and Copper, the details are presented in table 1. The total microbial count was found to be 32×10^8 CFU/ml of BDSW. The FTIR graph shows two peaks as indicated in figure 1, the first peak at 3313.87 cm^{-1} and second one at 1635.04 cm^{-1}. The first peak indicate C-H stretch of Alkyne group and second peak indicate the C=C stretch of Alkene group.

BDSW was found to be rich in many macro as well as micro-nutrients. It can be used as an additional source of plant nutrients along with the fertilizer. Since the organic load of BDSW is very high it has to be diluted first before its use. BDSW could be used for recovery of Potassium and Nitrogen, since their levels are very high. BDSW has a huge potential as a soil fertilizer if used appropriately. So the strategy should be on its proper use and recycle rather than its treatment and disposal.

Table 1: Nutritional composition of BDSW

Nutrients	Value in BDSW
Total Nitrogen	2500 mg/l
Total Phosphorus	15 mg/l
Total Potassium	2500 mg/l
Total Calcium	34 mg/l
Total Magnesium	90 mg/l
Total Sulphur	20 mg/l
Total Iron	300 mg/l
Total Manganese	mg/l
Total Zinc	6 90 mg/l
Total Copper	5 mg/l