Post Treatment to Biomethanated distillery spent wash by using Chitosan Powder

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Abstract-*The distillery wastewater creates cumbersome complex problem such as land pollution, ground water contamination and odour nescience etc. but at the same time it is important to produce the by product like rectified sprit, ethanol and alcohol etc which imparts the a remarkable share in the economy of rural India. The main objective of this study is to achieve maximum removal efficiency in terms of reduction of the various parameters of distillery spent wash due to which an adverse effect was observed on land, irrigation water and in public sewers.*

The main objective of this study is application of new sustainable technique of Chitosan powder for the post treatment of the Biomethanated distillery spent wash so as to achieve maximum colour and COD degradation efficiency by determining the optimum dose of Chitosan powder. Optimum COD removed by Chitosan powder is 64.5% and decolorization has been obtained 77.65%

Keywords*-*Chitosan, Adsorption Isotherm, Adsorption Kinetics, biomethanted distillery spent Wash,

I. INTRODUCTION

Distillery industries contributing the lion's contribute in the economic progress of the country. For the ethanol production,maximum Distillery industries present in the world are sugar base industries. Ethanol manufacturing in the distillery industry is just about 5 to 12 % by volume, it means 88 to 95 % effluents contain by volume of alcohol distilled [1]. Distillery spent wash contains dissolved impurities, nutrients added during the molasses fermentation, by-products of fermentation and decomposition products. The suspended impurities like dust, cellulosic fibers, etc. are frequently removed before the deliberation of the juice. However, water soluble hemicelluloses, proteins, gums, organic non-sugars and minerals present in the cane juice are present in the still age in the original or converted forms exerting an oxygen demand during its treatment [2]. Representative BOD and COD standards for a batch distillery effluent are 35,000–50,000 and 80,000–100,000 mg/L, respectively, whereas for a continuous process, they are in the range of 60,000–100,000 and 160,000–200,000 mg/L, respectively. These industries required large amount of water for the production of alcohol and also create a huge amount of spent wash. Spent wash is the effluent generated during the alcohol production. Spent wash is dark brown, highly acidic, having very high chemical oxygen demand and biochemical oxygen demand. For treating such highly polluted waste efficient treatment is required [3].

II. THE NEED FOR TREATING DISTILLERY EFFLUENT

The distillery sector is one of the seventeen categories of major polluting industries in India. These units generate large volume of dark brown colored wastewater, which is known as spent wash. Liquid wastes from breweries and distilleries possess a characteristically high pollution load and have continued to pose a critical problem of environmental pollution in many countries.India produces around 2.75 billion litres of alcohol per annum. Separator Distillery Spent Wash Treatment Distillery spent wash refers to the effluent generated from alcohol distilleries. On an average 8–15 lit of effluent is generated for every liter of alcohol produced [1, 4, 5]. The alcohol distilleries are extensively growing due to widespread industrial applications of alcohol such as in pharmaceuticals, food, perfumery, etc. It is also used as an alternate fuel. Pollution caused by it, is one of the most critical environmental issue. There are 319 distilleries in India alone, producing 3.25 billion liters of alcohol and generating 40.4 billion liters of wastewater annually. As per the Ministry of Environment and Forests (MoEF), alcohol distilleries are listed at the top in the “Red Category” industries. Onsite anaerobic (Biomethanated) treatment has been given to treat the distillery which removes the Chemical oxygen demand (COD) and Biochemical oxygen demand (BOD) up to 70% and 80% but still 30% COD and 20 % BOD persist. To dispose the effluent safely on terrestrial and aquatic further post treatment is must as day by day rules and legislation are mandatory for disposal of distillery effluent

III. OBJECTIVES OF INVESTIGATION

Distillery units in India are in a considerable number, where molasses and impure alcohol are still being used as raw materials for production of liquor. The wastewater from such distilleries contain huge amount of dissolved organic matter, heavy metals, dyes etc. Despite distillery spent wash is large amount of waste produced from distillery industry, but if it treated in sustainable manner then pollution due to waste is reduced in much amount. There are certain lot of methods where developed so for treating the distillery spent wash but this are costly as it simple i.e. use in farm for crop but it effect on crop yield and land. For treatment of distillery spent wash. Following are the main objectives of the investigation:

1) To develop low cost treatment of distillery spent wash.
2) Easy and simple technology for sustainable treatment.
3) Reduce severity of effluent from industry for recycling of spent wash.
4) Use of ecofriendly material for treatment.
5) To prepare and run working model for efficient working and treatment.

IV. MATERIALS

Chitin, the second-most abundant biopolymer, and its deacetylated product, chitosan, are high molecular-weight biopolymers and are recognized as versatile, environmentally friendly raw materials [6, 7]. The chitin isthe major component in the shell of the shrimps, and crabs, cartilage of the squid, and outer cover of insects [8]. In present work Spent wash was collected from a VikhePatil distillery, LoniAhmednagar. As per the distillery laboratory, characteristics of spent wash are mentioned in table no.1.

TABLE I
Spent Wash Parameters

Parameter	Untreated (Raw spent wash)	Biomethanated spent wash
pH	3.5-4.20	6.6
Temperature	35 - 40^{0}C	40^0 C
Total Volatile Acid	2500-3500 mg/l	15,000 mg/l
COD	80,000-1,44,200 mg/l	35,000-45,000 mg/l

Batch adsorption experiments were carry out to determine the adsorption capacity of chitosan at different effluent concentrations ranging from 100 to 250 ppm and a fixed amount (50 g) of chitosan in order to calculate the adsorption constant using isotherms. 250 ml of distillery effluent were used. The chitosan (40 g) was added to flasks and agitated at 250C and 100 rpm for 360 min. The initial and final concentrations of the solutions were measured were determined by spectrophotometer at the maximum adsorption wavelength and the adsorption capacities of the adsorbent were calculated.

Distillery effluent was treated with chitosan with the following weight (10, 20, 30, 40, and 50) gm.

The physicochemical parameters were determined such as pH, Conductivity, Settleable solids, TDS, turbidity, total hardness and alkalinity. Anions determined were chloride, sulphate, phosphate and nitrate. All samples including replicates were analysed for settleable solids. Jar test is the most commonly used method for determining the efficiency of a coagulant, since it is easy to perform. The equipment used in this study was jar test apparatus with 6 beakers. Each jar was filled with 1L of raw water with identical turbidity level, and the initial stirring rate was set to 110 rpm.

V.TEST RESULTS

The chemical parameters analyzed by keeping the all physical parameters as constant, as the all the chemical parameter varies accordingly. Thus out of nine chemical parameters three parameters were analyzed, the effect of chitosan dose was applied for removal of Total dissolved solids (TDS), Sulphates and Chlorides.

The TDS of distillery effluent is greatly reduced (58.32%) by the Chitosan adsorption process with respected to the time. Adsorption process includes two steps, particle destabilization and accumulation hence during the adsorption process the dissolved Chitosan particle are react with the distillery effluent creates the gelatinous layer which not only destabilized the dissolved solids in the distillery wastewater but the accumulate the destabilized particle and thus such partials can easily float and hence they are caught by flock formed.

Along with the TDS, two more chemical characteristic of distillery wastewater were analyzed and the data is tabulated as shown in fig no.1 and table no.II, from the graph, the fact came forward that up to certain dose of chitosan removal rate is gradually increased after the that removal rate is decreases may be due to more concentration of chitosan ingredients.

TABLE II
Chemical Characteristic of Distillery Wastewater

Dose	Final Value (mg/L)			Percentage removal (%R)		
	TDS	Sulphate	Chloride	TDS	Sulphate	Chloride
0	8365	654	681	0	0	0
10	5526	510	582	35.94	22.02	14.54
20	4526	389	551	45.89	40.52	19.09
30	4056	248	548	51.51	62.08	19.53
40	3486	231	542	58.32	64.67	20.41
50	3510	245	545	58.04	62.54	19.97

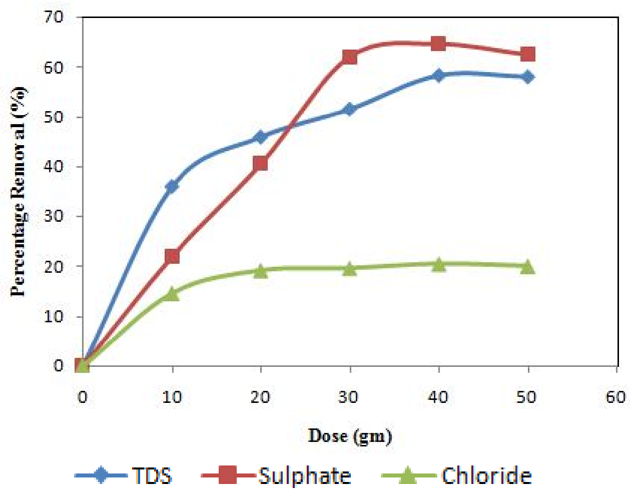

Fig 1. Analysis of Chemical characteristic of distillery effluent

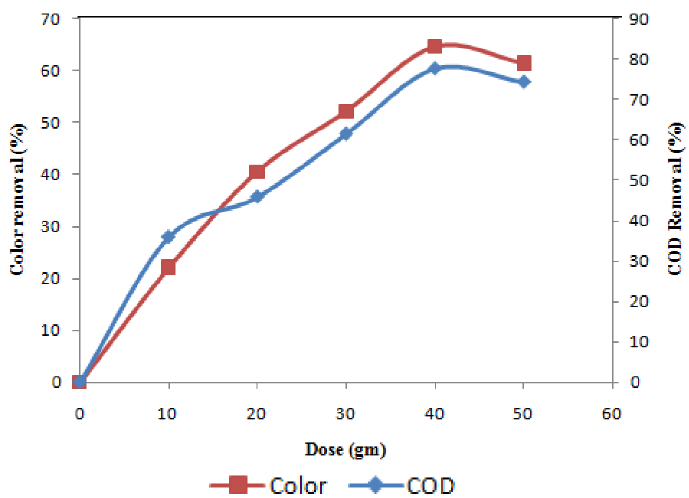

Fig.2 COD and Color removal

Figure 2. Indicates by applying dose of chitosan optimum color removal is up to 77.65 % and Chemical oxygen demand up to 64.5 % can be removed. All the experiments are performed at pH 3 to 6. Acidic pH is more suitable for COD and color removal by using chitosan powder, as acidic condition important factor which influence the rate of adsorption.

VI. RESULTS AND DISCUSSION

1. Chitosan are effective for removal of TDS, it removes optimum TDS up to 58.32% for dose of 40 gm of chitosan.
2. Sulphate removes up to 64.67 % for dose of 40 gm of chitosan.
3. Chitosan are less effective for removal of chlorides, as due to presence of chitosan conductivity of the solution is increases rapidly.
4. Maximum COD removes up to 64.5% and decolorization has been achieved up to 77.65%.

VII. CONCLUSION

1. The decolorization by chitosan which is decrystallized by citric acid is efficient, fast, and cost effective, and appears to be a promising method for the treatment of distillery effluent
2. The decrystallized chitosan with low crystalline has a high binding capacity for effluent probably due to the high penetration of the complex ingradients. The efficiency of decrystallized chitosan for effluent binding at basic pH is a very important characterics because it allows the application of this polymer at a pH where normal chitosan cannot work efficiently.
3. Chitosan, a biological cationic polymer, can treat distillery wastewater at pH values up to 5.25 by coagulation.Treatment efficiencies vary with the quality of wastewater, but the results with chitosan indicate a nearly 60%removal of TDS and COD and over 90% removal of particles.
4. Chitosan can efficiently function at pH ranges even as high as 5.25, while other commercial polymers functioned only at pH below 4.5.

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