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Physico-chemical characteristics of sugar factory and distillery effluents

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ABSTRACT

Present work is based on the physico-chemical analysis of effluents released from Saraya sugar factory and distillery. It was found that both the industry consume huge amount of water and throw back almost and equal amount of effluent containing highly toxic material in solid and dissolved form. Comparably distillery effluent was more worst than sugar factory having lower pH (4.89±0.007) and higher temperature (56.2±0.027 ^{0}C), electrical conductivity (3910±0.0032 µS/cm), free CO_2 (986±0.05 mg/ml), alkalinity (3912±0.0012 mg/ml), chloride (6213±0.0029 mg/ml), total hardness (4477±0.015 mg/ ml), calcium (2676±0.011 mg/ml), magnesium (1828±0. 007 mg/ml), total solid (91876±0.01 mg/ml), total dissolved solid (88265±0.008 mg/ml), total suspended solid (3611±0.03 mg/ml), nitrate (32.8±0.009 mg/ml), phos phate (1.2±0.0019 mg/ml), sulphate (803±0.02 mg/ml) and oil and greases (202±0.05 mg/ml). Conclusively it is quit unsafe for domestic and agricultural purposes. Therefore, it should be recycled and utilize further for industrial purpose only.

Key words: Industrial effluent, Saraya sugar factory**,** distillery, free CO_2**,** pH

INTRODUCTION

Recently great concern has been universally raised regarding environmental pollution as a side effect of rapid industrialization and subsequent urbanization [1]. Today, the main concern with environmental pollution is with it's impact on the health of the present generation and the coming ones [2]. Our culture is completely river oriented and most of our important towns and urban areas are located on the bank of Major River. Unfortunately, untreated industrial wastes have been drained into the rivers and by river it is spreading over a large area [3,4]. Therefore, it directly affects lives of flora and fauna not only in the industrial area but also in agricultural fields, river and river beds, thereby creating secondary source of pollution [5]. Various industries have been continuously adding lot of waste water containing high level of nutrients, heavy metals and hazardous substances to the cultivable land [6]. However, effluents containing various metallic and nonmetallic elements act as nutrients but at the higher concentration they show toxic effects on seed germination and seedling growth, ultimately adversely affecting plant growth and yield in cultivated land [7]. Moreover, deaths of domicile animals of such polluted water have been reported increasingly [8].

Saraya sugar factory and distillery is the centre of north-east Uttar Pradesh in production of sugar and beverage and positively affect the rural economy. It is situated 20 km east to Gorakhpur city on Gorakhpur-Deoria road. During the production of sugar and beverage it flows out large amount of effluents with suspended solids, organic and inorganic

matters that have worst physico-chemial characteristics. These effluents run over a large area by river and river canal and disastrously affect the live of both the flora and fauna. In the present investigation physico-chemical characteristics of effluents released from Saraya sugar mill and distillery was analyzed.

MATERIALS AND METHODS

The effluents from Saraya sugar mill and distillery was collected during the beginning of winter season (November-December 2011) in glass bottles from the discharge channel and properly sealed. It was preserved by adding chemicals to analyze in the laboratory. For the assessment of various physico-chemical characteristics published protocol of APHA [9] was used.

RESULTS AND DISCUSSION

The results of the various physico-chemical analyses of effluents collected from Saraya sugar mill and distillery are presented in Table-1 having badly altered water quality. Temperature is basically important for its effect on certain biochemical reactions taking place in water for aquatic organisms [10]. Generally in the month of November-December temperature of this area varies from 20 ^{0}C to 25 ^{0}C, but sugar mill and distillery throw out liquid having 44.1±0.03 ^{0}C and 56.2±0.027 ^{0}C temperature respectively. Rise in temperature accelerate the chemical reactions that affect crop land adversely [11]. pH is one of the important biotic factor that serves as an index for pollution. The factors like photosynthetic exposure to air, disposal of industrial water and domestic sewage affect pH. The wide alteration in the pH value of effluent can affect the rate of biological reaction and survival of various microorganisms.

Table 1: Physico-chemical properties of Saraya sugar factory and distillery effluents

Parameter	Values	
	Saraya Sugar Factory	Saraya Distillery
Temperature (^{0}C)	44.1±0.03	56.2±0.027
pH	6.7±0.011	4.89±0.007
Electrical conductivity (µS/cm)	925±0.009	3910±0.0032
Free CO_2 (mg/l)	402±0.032	986±0.05
Alkalinity (mg/l)	1047±0.045	3912±0.0012
Chloride (mg/l)	866±0.01	6213±0.0029
Total hardness (mg/l)	576±0.05	4477±0.015
Calcium (mg/l)	365±0.003	2676±0.011
Magnesium (mg/l)	214±0.0096	1828±0.007
Total solid (mg/l)	2452±0.027	91876±0.01
Total dissolved solid (mg/l)	1915±0.012	88265±0.008
Total suspended solid (mg/l)	537±0.023	3611±0.03
Nitrate –N (mg/l)	0.8±0.004	32.8±0.009
Organic-N	36.3±0.03	75.24±0.0012
Ammonical-N (mg/l)	4.2±0.07	10.89±0.02
Total Nitrogen (mg/l)	40.5±0.02	85±0.03
Phosphate (mg/l)	9.5±0.011	1.2±0.0019
Sulphate (mg/l)	51.7±0.006	803±0.02
Oil and greases (mg/l)	88.7±0.01	202±0.05

Value are expressed in mean±SE of 6 replicates (n=6)

The presence or absence of various ionic special can have direct relation with pH of the effluent. Subsequently such effluent can influence the quality of soil. The reaction between effluent flowing from open drainage system with the soil has direct relevance to the pH effluent. In the present investigation the pH value of the sugar factory and distillery effluents was 6.7±0.011and 4.89±0.007 respectively, which is acidic in nature. Similarly, Matkar and Gangotri [12] have observed the pH of sugar mill effluent is 4.5. The electric conductivity value was found much high in effluents released from the distillery (3910±0.0032 µS/cm), which is badly affecting the germination of almost all crops and resulting reduced yield [13]. Effluents from distillery has larger free CO_2 (986±0.05 mg/ml) load than that of sugar factory (402±0.032 mg/ml). Probably, this is due to huge carbonate content in the effluent which on hydrolysis releases free CO_2 [14]. Further, a continuous increase in free CO_2 create a high altitude of alkalinity, as in this study distillery released more CO_2 (986±0.05 mg/ml) with subsequent elevation in alkalinity (3912±0.0012 mg/ml). Besides this, presence of large amount of chloride, magnesium, nitrate-N, organic-N, ammonical-N, phosphate, and sulphate constitute the total solid matter in the effluents either in suspended or dissolved form, which influence the turbidity,

transparency and hardness causing a sterling parallelism in plankton with suspended solid [15]. Remarkably oil and grease is present in valuable amount in both the effluents (88.7±0.01 and 202±0.05), extracted in petroleum ether and separated by separatory funnel from aqueous phase. The solvent layer was then evaporated and residue was weighed as oil and grease. Manal [16] reported oil and grease in sugar mill effluent in a range between 14mg/L-11mg/L. Summarily the sugar and distillery industry untreated effluent containing high temperature, EC, TH, free inorganic ions, CO_2, TSS, TDS, TS oil and grease and low viable conditions have toxic and hazardous impact on both plant and animal life. So, it should not be permissible for irrigation. Effluents which are released from sugar/distillery industry should be treated and then may be utilized for industrial processing again. Recycle rise of waste water is possible in sugar industry and it is economically profitable for sugar industry.

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