

Evaluation of Spent Wash for Irrigation Purpose

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Abstract

In agro-sector of many different kind of industries are operating all over country. The safe disposal of the effluents produced in large quantities by these industries is a big problem of disposal. Sugarcane is the main crop of western Uttar Pradesh. Many sugar industries are operating in the region and producing effluents in large quantity. Accumulation of these effluents may be a threat to environment. Therefore, safe disposal of these effluents is a major issue. Utilization of these effluents as an irrigation source can be a solution for their safe disposal. But, before using the effluent for the above mentioned purpose, their physio-chemical properties and impact on soil and ground-water must be known. Therefore, in the present study spent wash of Kinauni Sugar Mill, Meerut, UP was analyzed for the various properties. Data suggest that the pH is 7.6 with electrical conductivity of 3.7 ds/m. Fe, Cu, Mn, Zn, Pb and As were found to be 11, 2.1, 4.8, 12.4, 1.8 and 0.02 ppm respectively. Phosphorus and potassium concentrations were 12.8 and 512, respectively. Concentrations of ammonia, nitrate and nitrite were 100, 10 and 1 ppm respectively. In comparison to recommended value of BOD (80 mg / liter) as prescribed by National Environmental Quality Standards (NEQS), the observed BOD was 544.4 mg/liter, which was exceptionally higher.

Key words : Spent wash, Irrigation, Effluent.

With the growing competition for water and declining freshwater resources, the utilization of marginal quality water for agriculture has posed a new challenge for environmental management. In water scarce areas there are competing demands from different sectors for the limited available water resources. In India, the supply of freshwater resources is almost constant and the agriculture sector draws the lions share, 80–90% (1, 2). Hence, with the growing demand for water and its rising scarcity, the future demands of water for agricultural use cannot be met by freshwater resources alone, but will gradually depend on refuse water from industrial sectors (3). Water quality is a key environmental issue facing the agricultural sector today. Meeting the right quantity and desirable quality of water for agriculture is not only essential for food security but also for food safety. A water accounting study conducted by MIDS (4) for the lower Bhavani River Basin, Tamil Nadu shows that industrial water use 45 million cubic meters (Mm^3) is almost 2% of total water use in the basin ($2,341 Mm^3$) and agriculture has the highest share, more than 67% or $1,575 Mm^3$. Industry is a small user of water in terms of quantity, but has a significant impact on quality. The use of treated industrial efflu-

ents has been widely advocated by experts and is practised in many parts of India, particularly in water scarce regions. However, the environmental and socio-economic impact of reuse is not well documented,

Table 1. Chemical properties of the PMDE and standard of irrigation water.

Parameter	Observed values	Recommended values in irrigation water
pH	7.6	6.5–8.5
Conductivity	3.7 ds/m	0–3
Color	Brownish	–
Odor	Objectionable	Nil
Temperature (C)	27 C	Moderate
BOD (ppm)	544.4	20
P (ppm)	12.8	
K (ppm)	512	
Fe (ppm)	11	5
Cu (ppm)	2.1	1
Mn (ppm)	4.8	0.5
Zn (ppm)	12.4	5
As (ppm)	0.02	0.25
Pb (ppm)	1.8	0.1
NH ₄ ⁺ (ppm)	100	–
NO ₃ ⁻ (ppm)	10	–
NO ₂ ⁻ (ppm)	1	–

particularly for a developing country like India where the irrigation requirements are large. In India mostly urban diffused industrial units dispose their untreated effluents in public sewers as a regular practice to avoid the costs of effluent treatment. In India only 24% of wastewater is treated (primary only) before it is used in agriculture (5). Sugar industries operating in Uttar Pradesh at large scale play an important role in Indian economy. With the upcoming sugar industries, the amount of effluent discharged by these industries will also increase. The safe disposal of this effluent is a great problem. The solution lies in judicious use of the effluent may be a threat to environment. Therefore safe disposal of these effluents is a major issue. Present study was carried to explore the possibility of effluent of Kinauni Sugar Mill for its irrigation quality, which can be of a greater significance.

Methods

The study was conducted at village Kinauni in the district Meerut (UP) India where a distillery with spent wash generation capacity of 1,280 KI / day from molasses is operating since February, 2006. Study area falls under Indo-Genetic plains of North India between 29°02' N latitude, 77°28' E longitude and at an altitude of 227 m above mean sea level (MSL). The climate of the region is semi-arid subtropical, with dry hot summers and cold winters. The average annual rainfall of the region is about 805 mm of which 75% received during monsoon season.

Effluent was collected from Kinauni Sugar Mill, Meerut, UP for analysis of various, physical and chemical parameters like temperature, pH, EC, TSS, TDS, and macronutrients, heavy metal contents from the effluents outflow. Sample was collected in clean dry plastic bottles in such a way that no bubbles were formed in the bottles. After collection, the sample was analyzed in the laboratory of Soil Science Department, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (UP).

Analytical Procedures

Temperature. Temperature was noted using thermometric method at the site of sampling using portable calibrated mercury thermometric (6).

pH. The pH of the sample was recorded using potentiometric method using pH meter already standardized by using buffer solutions of known value before analysis.

Electrical Conductivity (EC). EC is the measure of the ability of an aqueous solution to convey an electrical current. This ability depends upon the presence of ions, their total concentration, mobility, valence and temperature. EC was determined by conductivity meter following the procedure of Richard (7).

Biological Oxygen Demand (BOD). It is expressed as weight of oxygen consumed per unit volume of water during a definite period of time at a defined temperature. For this, sample of water was incubated for 5 days at 20 C in the dark. The reduction in dissolved oxygen concentration during the incubation period yields a measure of BOD.

Analysis of Macronutrients. Nitrogen (N), phosphorus (P), and potassium (K) were determined using automatic nitrogen analyzer, spectrophotometer and flame photometer, respectively.

Heavy Metal Analysis. For the analysis of heavy metals viz. copper (Cu), zinc (Zn), iron (Fe), manganese (Mn), arsenic (As) and lead (Pb), samples were analyzed on atomic absorption spectrophotometer (GBC, Avanta PM Model). AAS was calibrated for each element using standards solution of known concentration before sample injection (8, 9).

Results and Discussion

The chemical properties of post methanated distillery effluents (PMDE) and standard value of irrigation water are presented in Table 1. The pH of the effluent was found 7.6 while its EC 3.7 ds/m. Effluent was brownish in color with objectionable odor. It has high BOD content of 544.4 ppm compared to value of 20 ppm which is a recommended value in irrigation waters.

Contents of Fe, Cu, Mn, Zn, As and Pb in effluent were 11, 2.1, 4.8, 12.4, 0.02 and 1.8 ppm, respectively while the recommended values for irrigation are 5, 1, 0.5, 5, 0.25 and 0.1 ppm respectively. Effluent had high amounts of P and K i.e. 12.8 and 512 ppm respectively. Concentrations of NH_4^+ , NO_3^- , NO_2^- were 100, and 10, and 1 ppm respectively.

Conclusion

Exceptionally high BOD and Pb contents in industrial effluent are matter of concern. At the same time, high amount of N, P and K contents makes it soil friendly. So, apart from its resource value as water, the high nutrient content of spent wash will help the farmers to fertilize their crops without spending substantial amounts on additional fertilizers, so irrigation with this effluent will be low cost option for its disposal ; reliable, assured and cheap source for irrigated agriculture, especially in water starved arid and semi-arid parts ; an important economic resource for agriculture due to its value. However, safe utilization of effluent for irrigation requires dilution and treatment.

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