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Impact of Sulphide on Irrigation, Generated from Anaerobically Treated Tannery Effluent at Jajmau, Kanpur

Richa Gupta[1], Prateek Srivastava[2], Ambrina Sardar Khan[3], Ajay Kanaujia[4]
[1, 2, 3] *Amity Institute of Environmental Sciences, Amity University, Noida (UP), India-201303*
[4] *Ganga Pollution Control Unit, Jal Nigam, Kanpur- 208001 (U.P.), India*

Abstract: ***Huge amount of effluents generated from tanning. Tannery industries discharged their effluents on land for irrigation purposes. These effluents contained high concentration of Sulphate (SO_4) and sulphide (H_2S, HS^-, S^{2-}) ions and heavy metal mainly chromium. Sulphide concentration is increasing after treatment by conversion of sulphate into sulphide, in UASB treatment plant. In winter season, sulphate and Sulphide is 3430 ppm and 75 ppm on S1 (TANNERY EFFLUENT) and 891 ppm and 186 ppm on S2 location (UASB EFFLUENT) and 672 ppm and 62 ppm on S3 location. In summer season Sulphate is 2644 ppm on S1 and 416 ppm on S3 (MIXED EFFLUENT USED FOR IRRIGATION) and Sulphide is maximum on S2 location i.e. 159 ppm in summer season. In rainy season sulphate and sulphide concentration is less than other seasons. Hence the characteristics of effluents do not permit its disposal for irrigation purposes. The effluents directly affect the ground water as well as surface water quality and also affect the crop.***

Keywords: Waste water, Treatment, effluent, Irrigation.

I. INTRODUCTION

Tannery is a important industry in the country. Tanning or Leather processing industries occupies the significant place in an economy as it provides massive employment opportunities to people [1]. Tanning is the chemical process that converts animal hides and skin into leather and related products [2]. The Process of tanning consumes huge amount of water and generates the large volume of wastewater which contains various harmful chemicals and toxic trace elements. These have adverse effect on plant growth, health of animals and people existing in that area [3]. During tanning of leather, various chemicals are used mainly lime, sodium carbonate, bicarbonate, common salt, sodium sulphate, Basic Chrome sulphate, fat liquors, vegetable oils and dyes. The transformation of hides into leather is usually done by means of tanning agents and the process generates highly turbid, colored and foul smelling waste water [4]. The major components of the effluent include sulphide, chromium, volatile organic compounds, large quantities of solid waste, suspended solids like animal hair and trimmings [5]. The Tannery waste have a strong reddish- dull brown colour, High BOD, High COD, High pH, Obnoxious Odour and High Dissolved solids [6]. These industries are characterized as highly polluting industries which generates high strength of wastewater that is difficult to treat [7] [1]. The various components present in the effluent affect human beings, agriculture and livestock besides causing severe ailments to the tannery workers such as eye diseases, skin irritations, kidney failure and gastrointestinal problems [8]. Industrial effluents from leather tanneries discharged untreated, if allowed to percolate into soil to ground water for a prolonged period seriously affect soil profile and the ground water table which is unfit for drinking, irrigation and for general consumption. It has been established that a single tannery can cause pollution of ground water around a radius of 7 to 8 km [9-10]. Tannery industry contains several organic and inorganic chemicals which are toxic metals and they cause soil, water and surface water pollution. The maximum concentration of waste material absorbed by bioaccumulation process in cultivated crops irrigated by tannery effluent. Most of industries discharge their effluent without proper treatment into nearby open pits or pass through unlined channels. If effluent if discharged untreated in to river or stream, it results in to reduction of dissolved oxygen level [11]. In India, state of Uttar Pradesh alone responsible for over 50% of pollutants that affecting the ground water quality, soil profile due to irrigation of treated and partially treated waste water. In Uttar Pradesh, Kanpur is a big tanning industrial city. It also known as Leather city. Pollution becomes acute when tanneries are concentrated in clusters in small area like Kanpur, India [12]. The industrial area of Jajmau Kanpur having 400 tanning industry. 99% of industries are performing chrome tanning process. There is CETP operating for treatment of tannery waste water. The treated tannery effluent is being used for irrigation nearby area which is 1800 hectare. Tannery wastewater contains high COD, BOD, TSS and Sulphide. Sulphide is one of the major components of waste water of tannery effluent and found in form of H_2S, HS^-

and S^{-2}inos. Sulphide has high oxygen demand of 2 moles O2/mol sulphide causes depletion of oxygen in water [13]. It causes the acid deposition on water and soil and also causes the several diseases. Sulphide level in effluent makes external environment corrosive by making the treatment of effluent difficult [1]. Sulphide is highly toxic for human being. It directly affect the central nervous system even at low level of concentration..It causes an irritating, rotten-egg smell above 1 ppm, and at concentrations above 10 ppm, the toxicological exposure limits are exceeded [14-15]. It causes death within 30 min at concentrations of on 800–1000 mg/l, and instant death at higher concentrations [16]. The corrosive properties of sulphide are apparent. Soluble sulphide ranging from 50 – 100 mg/L can be tolerated in anaerobic treatment with little or no acclimate ion [17]. The corrosive properties of sulphide are apparent in the damage done to concrete walls of reactors, sewer systems and steel pipelines. In an Effluent Treatment Plant if, sulphide is carried to biological aerobic basin it makes it inefficient. So, it is imperative to remove sulphide before aerobic biological system [18]. Treated and partially treated waste water is being used for irrigation purposes which having high concentration of sulphite. Sulphide is very toxic in nature sometimes its high concentration also causes death. Hence the aim of the study to know the impact of sulphide on irrigation generated from an aerobically treated tannery effluent at Jajmau Kanpur.

II. SCOPE AND OBJECTIVES

The volume of untreated industrial effluent discharge is increasing day by day. Sewage and tannery treated, semi treated or untreated effluent discharge are using for irrigation purposes and affecting the agricultural, soil, ground water and river water. In Jajmau area of Kanpur city CETP constructed in 1994. One CETP and two STP are operational since 1995(36 mld UASB Tannery waste water Treatment Plant,130mld ASP Sewage Treatment Plant, 5 mld UASB Sewage Treatment Plant). CETP is constructed for treatment of tannery effluent with the help of UASB (Up flow Anaerobic Sludge Blanket) technology.

UASB is a single tank process. Wastewater enters the reactor from the bottom, and flows upward. A suspended sludge blanket filters and treats the wastewater as the wastewater flows through it. Initially there were two process commonly used for tanning, Chrome tanning and vegetable tanning process. Chrome tanning which contains appreciable amount of chromium and vegetable tanning does not contain chromium [19]. The ratio was 60**:**40. Later on, industry sifted towards chrome tanning process. In chrom tanning process, high amount of sulphate produces by using of numbers of chemicals and reduction of sulphate converts in to sulphide. Despite the inherent advantages of high rate anaerobic system, the presence of sulfate (SO_4) represent a serious risk for the system, since the Sulfate Reducing Bacteria (SRB) can reduce sulfate to sulfide through a process denominated dissimulator sulphate reduction [20-21]. Therefore the sulfate reduction in UASB reactors has been considered a negative side effect, since the production of sulfide causes several problems, such as toxicity [22], induced corrosion [23], aggressive odours [21], increase of effluent COD and lowering the methane in biogas production [24] and due to this, Use of effluents in large quantities for irrigation, may have significant harmful impact on surface water, subsurface water and also on agricultural.

III. OBJECTIVES

A. Analysis of Sulphate and sulphide from Influent and effluent of tannery Waste water.
B. Analysis of Effluent which is being used for irrigation.
C. Impact of high sulphide content effluent on irrigation and water body.

IV. MATERIALS AND METHODS

A. Study Area

The district Kanpur lies between 80^0 21” East longitudes and 26^0 28’’North latitude in Uttar Pradesh, India. It is situated on the left bank of Ganga River. In Kanpur, Jajmau is a leather industrial area. It is one of the biggest exporting centres of tanned leather. About 400 tanneries are located at Jajmau (Kanpur). The treated and partially treated wastewater is being used more than two decades for the irrigation and for the present study location of effluent channel was selected.

B. Sampling Sites

The sites identified for the sampling are extensively used for irrigation purposes. Seasonal Sampling (summer season, rainy season and winter season) was done in the year 2016-2017. And the time of sample collection was between 9AM to 4 PM. I was applied the grab sampling. A grab sample is an ordinary sample which is taken from a particular place representing the whole water quality. I was selected major 03 points of effluent channel from 36 mld UASB based tannery waste water treatment plant (C.E.T.P.). Name of sites were Tannery effluent (S1), UASB effluent (S2) and Final Treated effluent (S3) which was diluted with STP effluent.

C. Samples Collection and Analysis

Effluent Waste water Samples from three locations of treatment plant which is being used for the irrigation were collected with minimum aeration. The method described by APHA 22nd Edn 2012 were followed during field and laboratory work. Wastewater Samples were taken in plastic cans and preserve the samples with Zinc acetate and sodium hydroxide solution into sample bottles before filling the samples. This was done for fix the total sulphide concentration. Tannery effluent (S1) collected from equalization tank, UASB effluent (S2) collected from just after UASB reactors and Mixed effluent (S3) collected from where tannery treated effluent water mixing with STP water and using for irrigation purposes. For further analysis, Samples were kept in ice box and transported to laboratory. I was selected only two parameter i.e. sulphate and Sulphide. Gravimetric method was followed foe analysis of sulphate concentration which referred from APHA 22ndedn 2012, 4500 $SO4^{2-}$ E and Idometric method (titremetric method) was followed for analysis of sulphide concentration which referred from APHA 22ndedn 2012, 4500 S^{2-} F.

D. Reagents for Sulphate Testing

Ion exchange column, 1:1 hydrochloric acid, methyl red indicator hotplate, barium chloride (10%), whatman No 42 filter paper, Silica crucible and Muffle Furnace.

E. Reagents for Sulphide Testing

Conc. hydrochloric acid, Iodine standard solution (0.01N), Potassium Iodide, sodium thiosulphate standard sol.(0.01N) and starch indicator.

V. RESULT AND DISCUSSION

The quality of water samples depends on the process management of treatment system. The samples were collected considering the Hydraulic Retention Time (HRT) in different season.

The result of sulphate and sulphide concentration of selected locations given in Table no 1 with standard deviation. Maximum concentration of sulphate was found on tannery effluent (S1) location in winter season and sulphide is 75 ppm and in same season Sulphide is increasing in UASB effluent (S2) i.e. 186 ppm by conversion of sulphate into sulfide in anaerobic conditions by sulfate reducing bacteria (SRB). Hydrogen sulfide (H_2S) is an inhibitor for the biological activity.

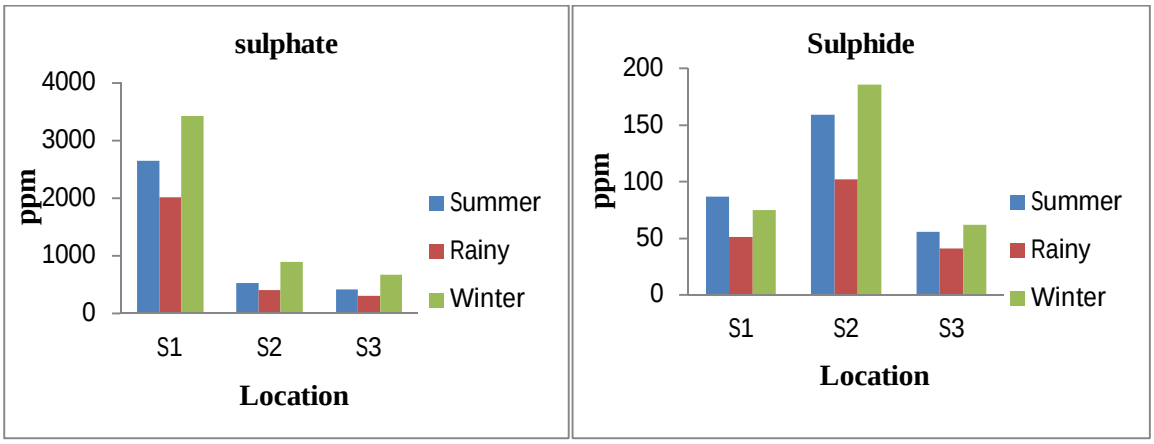
Due to very favorable conditions for sulfate reduction in anaerobic reactors, it has been studied especially when the affluent is naturally enriched with sulfate forms (Kalyuzhnyi et al., 1997; Lens et al., 2002) and On S3 location sulphate and sulphide concentration decreases because STP treated water is mixing with tannery treated water due to this concentration of sulphate and sulphide decreasing by dilution. In rainy season,

Sulphate concentration is 2015 ppm on S1, 413ppm on S2 and 305ppm on S3 location. In summer season, Sulphide concentration is 159ppm on S2 site i.e.increasing after treatment and Sulphate is 2644ppm on S1 site. Sulphide concentration is increasing in winter season on S2 location in comparison to summer season.

Table no 1 showing Seasonal Concentration of Sulphate and Sulphide in different location of tannery waste water treatment (CETP) Plant

Parameter / Season	Sulphate (SO_4),ppm			Sulphide (H_2S),ppm		
	S1	S2	S3	S1	S2	S3
Summer Season	2644	530	416	87	159	56
Rainy Season	2015	413	305	51	102	41
Winter Season	3430	891	672	75	186	62
Standard Deviation	708.95	249.16	188.21	18.33	42.88	10.81

Fig 1.Graphical representation of Sulphate and Sulphide concentration in different season



VI. CONCLUSION

Tannery waste water is difficult to treat because it has high COD, BOD, chromium and sulphide. Anerobic treatment of tannery waste water gives better results but formation of sulphide in anarobic reactors ristrict its application.The high sulphide concentration affect the crop and vegetable at irrigation field while in rainy season it reaches to river creates instantenious Oxygen Demand(IOD). The odour and corrosive problem is common in surrounding areas. The anerobically treated industrial waste shows, should not be used for irrigation pruposes.

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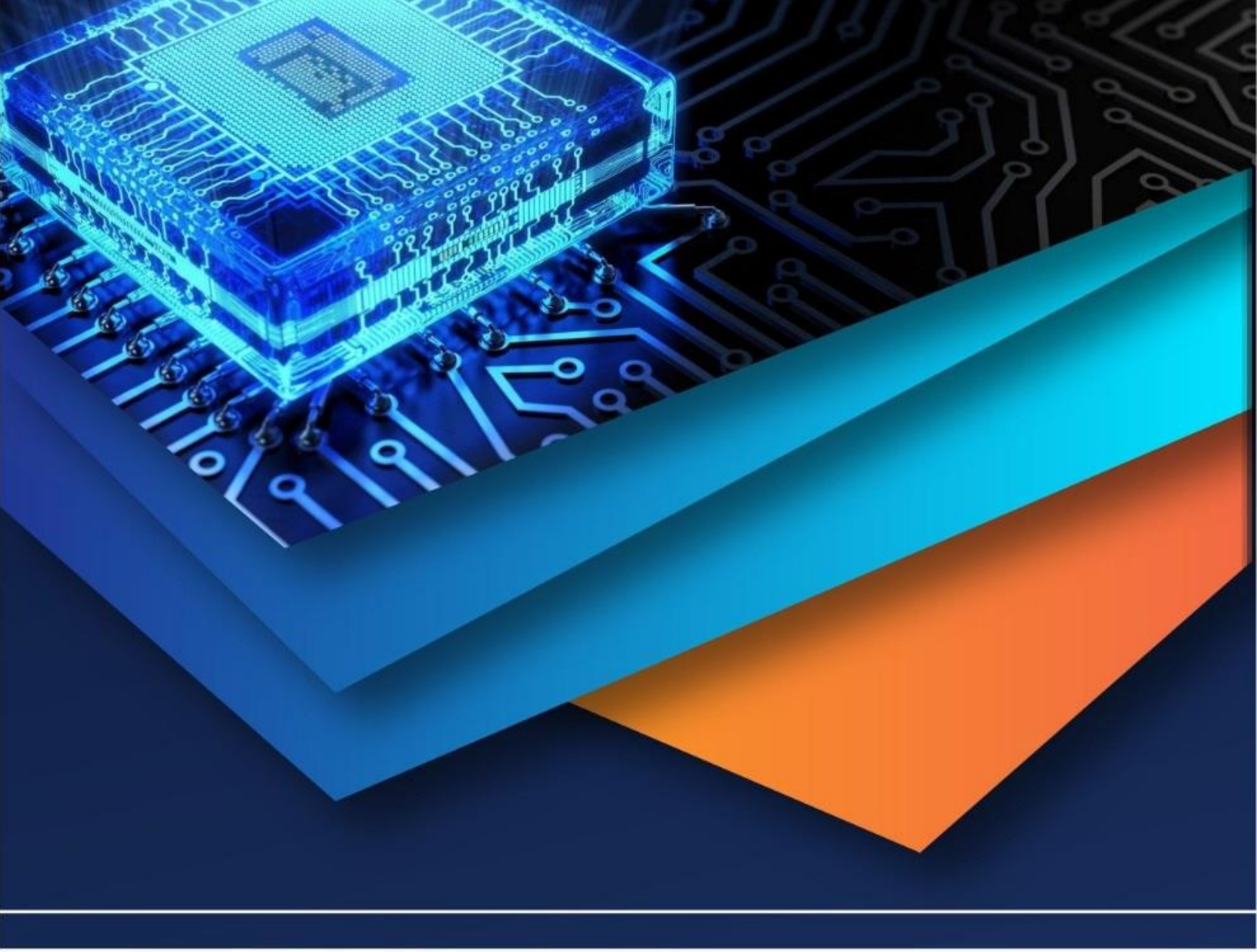

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