Characterization and utilisation of buffing dust generated by the leather industry

G. Sekaran [*], K.A. Shanmugasundaram, M. Mariappan

Department of Environmental Technology, Central Leather Research Institute, Adyar, Madras, 600 020, India

Abstract

Buffing dust is a proteinous solid waste impregnated with chromium, synthetic fat, oil, tanning agents and dye chemicals which is generated during the manufacture of leather. About 2–6 kg of buffing dust is liberated as a solid waste per ton of skin/hide processed. The concentration of chromium in the dust is 27 g/kg of dust. Dumping of solid waste as landfill accounts for soil and groundwater contamination. The maximum concentration of the chromium in the contaminated soil and groundwater were 714 mg/kg of soil and 0.25 mg/l, respectively. A method to generate activated carbon from the buffing dust is discussed. The adsorption capacity of activated carbon obtained from buffing dust was 6.24 mg/g at pH 3.5, temperature 30°C for dye concentration of 6.25 mg/l and activation temperature 800°C. The rate constant for removal of dye was 0.026 min^{-1}. The effect of initial dye concentration, pH, temperature and particle size on adsorption of dye are also determined. © 1998 Published by Elsevier Science B.V. All rights reserved.

Keywords: Buffing dust; Leather industry; Leachates; Activated carbon; Adsorption

1. Introduction

The tanning industry is one of the most highly polluting and growth-oriented industries in India. There are about 3000 leather manufacturing industries in India with

processing capacities of 600 000 ton per year. Tamilnadu, WestBengal and Uttar Pradesh are the states in India having major clusters of tanneries.

The solid wastes generated (presented in Table 1) from leather industry can be broadly classified as untanned collagenous, tanned collagenous and non-proteinous wastes. Among the tanned collagenous waste, the one resulting from the finishing operation called buffing dust draws the most attention from the public and pollution control authorities. Bufffing dust appears in a considerable proportion with processing of raw hides/skins (i.e. 2–6 kg per ton of raw hides/skins). Buffing dust is a microfined solid particulate impregnated with chromium, synthetic fat, oil, tanning agents and dye chemicals. Buffing dust carries about 2.7% chromium on dry weight basis. This is carcinogenic in nature and it causes clinical problems like respiratory tract ailments [1], allergic dermatitis, ulcers, perforated nasal septum, kidney malfunctions [2] and lung cancer [3] in humans exposed to the environment containing buffing dust particulates. Hence, it is cautioned by pollution control authorities to collect the buffing dust for safety disposal.

The current practice of disposing of buffing dust consists of: (i) incineration in incinerators, (ii) land co-disposal [4–12]. Incineration causes serious air pollution problems because of release of toxic So_x and No_x gases [13], and it has been observed that at 800°C, about 40% of Cr(III) is converted into Cr(VI) during the incineration of Cr laden solid waste [14].

Land co-disposal method pose a threat to groundwater resources. Reports indicate that groundwater sources were contaminated with Cr(III) and organic residues when

Table 1
Solid wastes generated per ton of raw hide/skins

Non-proteinous	
Dusted salt	30 kg
Sludge from lime pit.	30 kg
Collagenous untanned	
Raw hide trimings	100 kg
Fleshing	25 kg
Hair	25 kg
Tanned	
Blue sheetings	115 kg
Chrome shavings	15 kg
Vegetable trimings	15 kg
Chrome trimings	85 kg
Buffing dust	2–6 kg

Characteristics of buffing dust

Carbon	461 mg/g
TKN	93 mg/g
Chromium	28 mg/g
Ash	88.49 mg/g

leachates from land co-disposal mass enter the aquifers [14]. Cr(III) in the groundwater is converted into Cr(VI) when it is chlorinated prior to disposal [14].

The objective of the present investigation was three-fold: (i) to assess quantitatively the extractables from the buffing dust; (ii) interaction of extractables with the soil matrix; and (iii) evaluation of the conversion of buffing dust into activated carbon for use in removal of dye from waste water.

2. Experimental procedure

2.1. Experiment A

Buffing dust collected in dust extractors in a leather manufacturing unit was received and dried at 110°C for 1 h. A total of 10 g of dried sample was introduced into soxhlet extraction unit by holding in a Whatman filter paper bag. The solid waste in the bag was leached with solvent at the rate of 4 ml/min. The leaching experiment was continued until the leachate was free from visual appearance of colour. The extracted liquor was concentrated and analysed spectrophotometrically. The residue remained in the bag was dried and weighed. The experiment was repeated for solvents acetone, methanol, ethyl acetate, *n*-heptane and water at pH 5, 6, 7 and 8. Total chromium in water extractables was determined following APHA method [15].
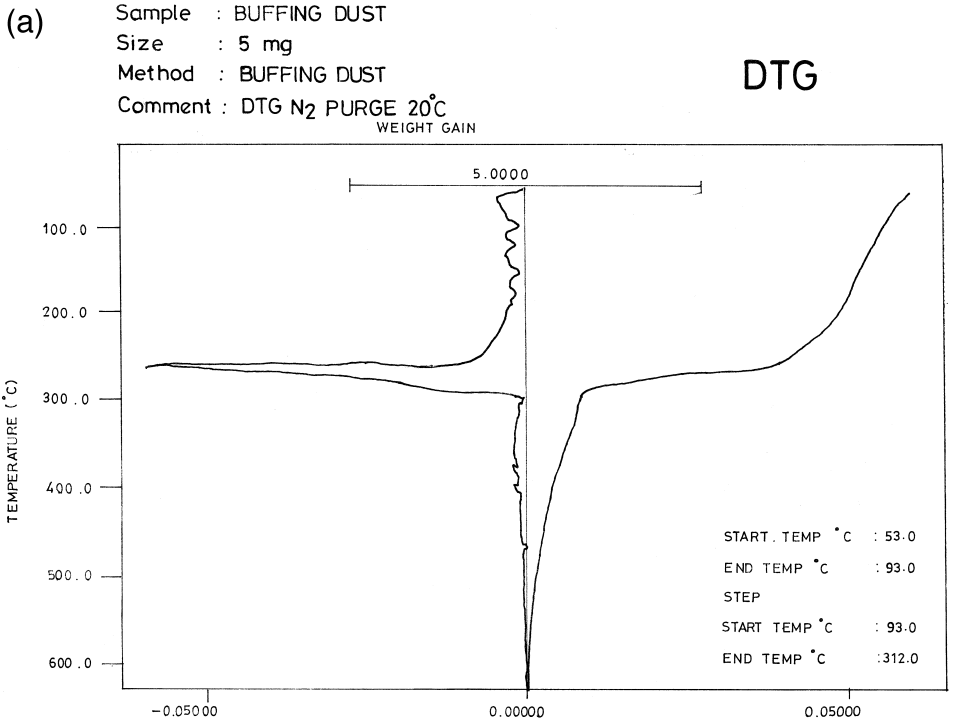
2.2. Experiment B: adsorption studies

The water extractables of buffing dust at pH 5, 6, 7, 8 were used in this study. The soil samples selected for this study were found to belong to sandy clay loam soils with component composition sand 59%, silt 19% and clay 23% by weight. The soil sample was sieved to desired size (1 mm), dried at 110°C and cooled over $CaCl_2$.

One gram of soil sample was introduced into each of the flasks 10 ml of water extractable obtained in leaching experiments was added to the soil sample. The shake flasks were agitated in a mechanical shaker at a constant rpm and at constant temperature 30°C. The aliquots of samples were withdrawn from the shaker at selected time intervals. The supernatants were separated from the soil by decantation and filtration through Whatman filter paper. The filtrate was spectrophotometrically analysed at λ max 276 nm. The optical density value was transformed into its corresponding weight obtained from a calibration graph which was prepared with known weight of water extractables of buffing dust. A small portion of the sample from the filtrate was analysed for tannin following APHA method [15].

The rates of adsorption of tannin and syntan on to soil particles were calculated by using Lagergren's equation.

2.3. Experiment C: preparation of activated carbon

Thermogravimetric Analysis (TGA) and Differential Thermogravimetric Analysis (DTG) of buffing dust was carried out to determine moisture movement, carbonisation

(a)

Sample   : BUFFING DUST
Size   : 5 mg
Method   : BUFFING DUST
Comment : DTG N2 PURGE 20°C

DTG

WEIGHT GAIN

5.0000

TEMPERATURE (°C)

100.0
200.0
300.0
400.0
500.0
600.0

START. TEMP °C   : 53.0
END TEMP °C   : 93.0
STEP
START TEMP °C   : 93.0
END TEMP °C   : 312.0

−0.05000   0.00000   0.05000

(b)

Sample : BUFFING DUST
Size   : 5 mg
Method : BUFFING DUST
Comment: TGA N2 PURGE 20°C

TGA

WEIGHT GAIN

0.0

5.000 mg

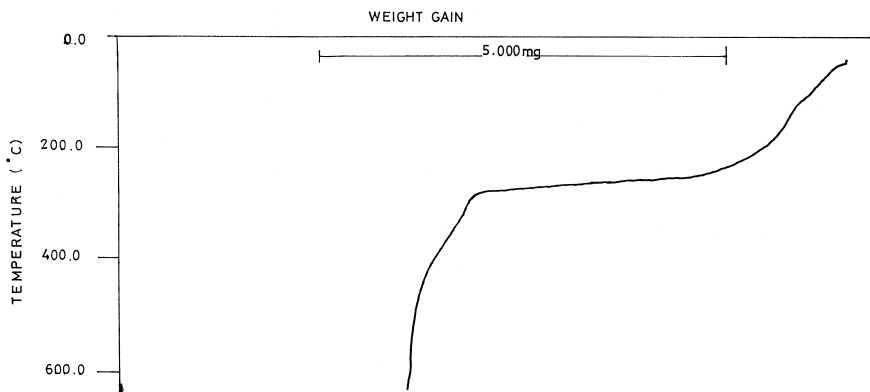TEMPERATURE (°C)

200.0
400.0
600.0

Fig. 1. Thermogravimetric Analysis (TGA) of Buffing dust. (a) Differential Thermogravimetric Analysis (DTA) of buffing dust.

temperature and activation temperature. DTG and TGA curves (Fig. 1) illustrate that moisture movement occurs up to 93°C with percentage loss of mass 6.59% and carbonisation process occurs in the temperature range of 93°C to 312°C with percentage loss of mass 80.6%. Carbonisation was followed by activation at temperature beyond 600°C. The activation temperature was fixed to be 800°C based on adsorption studies. The solid waste was treated with mineral acid and carbonised for 6 h at 310°C. The carbonised material was activated at 800°C for 1/2 h. The activated carbon thus obtained was washed with 2 N HCl until the last traces of bound and loose chromium were removed. The surface area of activated carbon was determined using BET method and it was found to be 126 m^2/g. Adsorption isotherms of acid brown dye on activated carbon were prepared at pH 2, 3.5, 5.0 and 6.5 and at temperatures 20, 30, 40 and 48°C.

3. Results and discussion

3.1. Experiment A

Table 2 shows the characteristics of extractables from buffing dust by the solvents acetone, methanol, ethyl acetate, n-heptane, water at pH 5, 6, 7 and 8.0. The common feature of the UV–Visible spectra obtained for all these extractables was that λ max did fall in the range of 276–331 nm. Acetone, methanol and ethyl acetate leached the compounds with λ max 281 nm. Water at pH 5, 6, 7 and 8 leached out the compounds having maximum wavelength 276 nm. The data obtained from spectrophotometric analysis of extractables illustrate that finished leather matrix has very varied nature of impregnated chemicals that were leached by chemically and structurally different solvents. Water at pH 5 to 8 leached water soluble acidic, neutral and basic compounds that have maximum wavelength of 276 nm. Leather matrix contains hydrophobic and hydrophillic compounds having acidic, neutral and basic characteristics. There is likelihood of stagnant water in the land co-disposal area acquiring weakly acidic to weakly basic conditions which can leach the components into groundwater sources through soil matrix.

Table 2
Characteristics of leachates from buffing dust

Solvent	% Matter leached	% Chromium in leachate	λ Max. of leachate (nm)
Ethyl acetate	23.86		291
Acetone	29.97		331
Methanol	28.29		308.04
n-Heptane	26.09		282.35
Water			
pH 5.0	11.09	0.012	276.8
pH 6.0	10.46	0.011	276.76
pH 7.0	9.49	0.003	276.00
pH 8.0	7.87	0.001	276.00

3.2. Experiment B

The adsorption of organic components present in water leachates at pH 5–8 was investigated under the following study.

The plot of (X/M, Q_e) vs. time rises sharply, followed by a smooth curve and after 5 h, it reached the plateau value (Figs. 2 and 3). This indicates that the contaminants follow two mechanisms for adsorption of organic compounds to soil particles, i.e. surface adsorption and pore diffusion. Soil particles contain hydrophillic and hydrophobic groups with acidic and basic characteristics. The soil particles carry negatively and positively charged groups which attract the opposite groups depending on the pH of the environment. This accounts for surface adsorption. Moreover, the porosity of the soil particles facilitates pore diffusion. The rate of adsorption of contaminants on soil particle was calculated by using Lagergren equation [16].

$$\log (q_e - q) = \frac{-k_{ad}\, t}{2.303}$$

K_{ad} adsorption rate constant in min^{-1}.

The organic portions of the leachates such as tannin and non-tannin components are adsorbed at different rates. The tannin portion has an adsorption rate of 2.83×10^{-3}
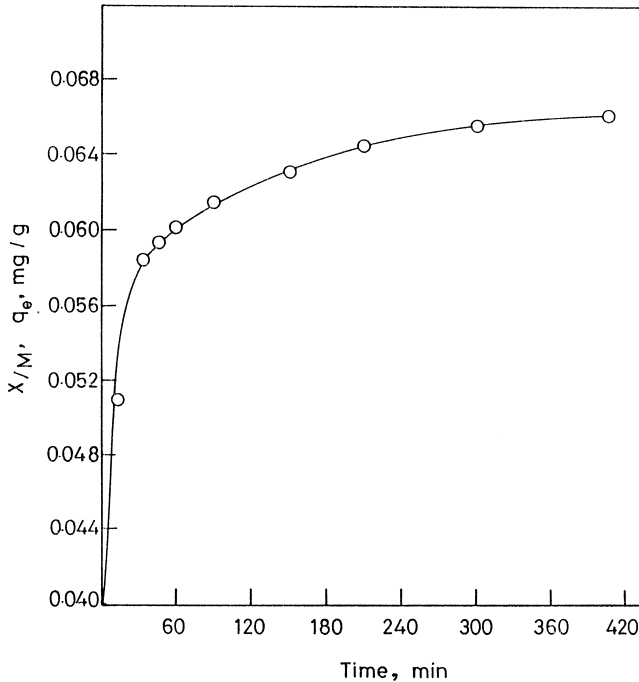

Fig. 2. Sorption kinetics of tannin component of water extractable from buffing dust on soil matrix.
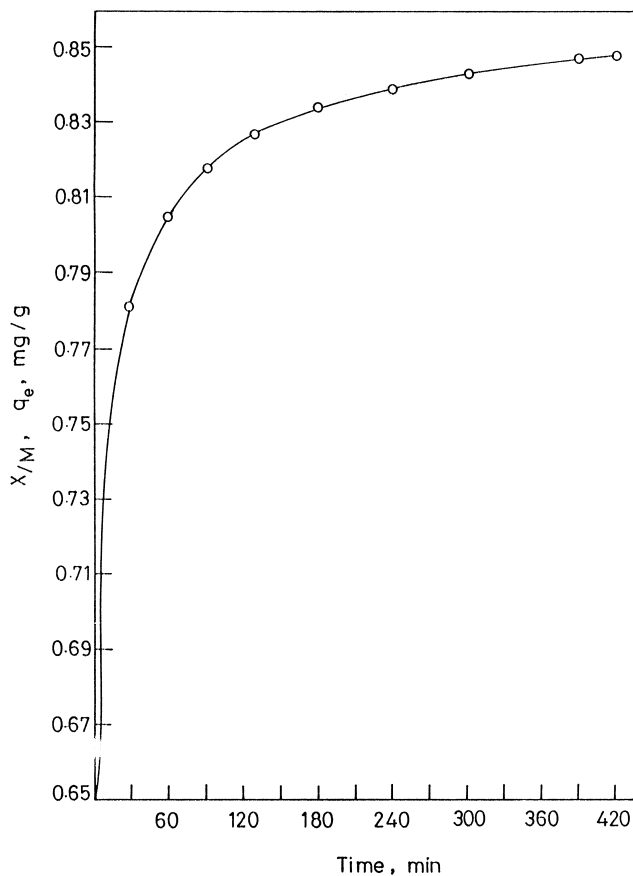
Fig. 3. Sorption kinetics of syntan component of water extractable from buffing dust on soil matrix.

min^{-1} (Fig. 2) while syntan has an adsorption rate of 1.5×10^{-3} min^{-1} (Fig. 3) which is nearly half of the former. The tannin molecules are known to possess hydroxyl groups that form anchoring points on the hydrophillic sites of the soil particles leading to establish a 3-dimensional expanded film on the soil particles. On the other hand, non-tannin molecules having hydrophobic and hydrophillic parts anchor on the soil particles at only hydrophillic end consequently lies normal to the adsorbent surface and thus, adsorption process resulted with poor removal rate. More importantly, it has to be viewed that syntan component removal was 41.04% and that of tannin was 63% on to the soil matrix.

The contaminants may interact with the aquifer solids encountered along the flow path through adsorption, particularly ion exchange and other processes. These interaction result in the contaminants distribution between the aqueous phase and retardation of the movements of the contaminants relative to groundwater flow. The higher the fraction of the contaminant sorbed, the more retarded is the transport. In addition, the adsorption of organic molecules on the soil matrix block the exchange site or active sites of the soil

particles leading to a decrease in exchange capacity of the soil. This is clearly evidenced from the characteristics of the soil collected at the land co-disposal site presented in Table 3.

The contaminated sites have pH in the range of 4.9–7.5. Electrical conductivity of the soil is at minimum 1.3 and maximum 7.3 ds/cm, mainly contributed by the cations, anions and charged organic mass present in the soil. Percentage organic matter of the soil was in the range of 0.35–1.49. Cation exchange capacity of the soil under study varied between 11.8 and 23.6 C mol(P +)/kg of soil. Exchangeable sodium in the soil was in the range 3.4–14.0 C mol(P +)/kg of the soil. Chromium concentration of soil under investigation was between 216 and 714 mg/kg of soil.

If the soil is polluted by organic and inorganic substances to such a degree that its adsorptive retardation power is exceeded, the most diverse materials can be released to water and can be detected in the groundwater sources [17]. In other words, the groundwater quality is much deviated from their normal characteristics. To illustrate the above fact, groundwater samples from the land co-disposal site were collected and analysed. The results are given in Table 4.

The results of chemical analysis of well-water collected at land co-disposal site showed that pH ranged between 7.2–7.9. Total hardness was in the range 488–2440 mg/l. Sulphate ranged between 150 to 1500 mg/l. Chloride concentration in well-water is in the range 350–2128 mg/l. Well-water had organic impurities estimated in terms of COD was in the range 41–164 mg/l. Total dissolved Solids in the range 1390–7392 mg/l. The heavy metal, chromium, concentration was in the range 0–0.25 mg/l. The present investigation of well-water analysis indicated that the water was alkaline in nature. Though it has no direct effect on the human health, all bio-chemical reactions are sensitive to the variation in pH. The limit for pH value for drinking water is specified at 6.5–8.5 [18].

Total dissolved solids indicate the general nature of water quality. Water containing more than 500 mg/l of TDS is not considered desirable for drinking water supplies. Maximum permissible limit suggested for drinking water is 1500 mg/l [18]. TDS value in the present investigation falls beyond the maximum permissible limit.

Chloride imparts a salty taste to water. This causes a laxative effect in humans who are not accustomed to high chlorides in water. Hence, the limit for chloride has been fixed at 250 mg/l. In the present study, the well-waters have high chloride content maximum of 500 mg/l.

Table 3
Physico-chemical characteristics of soils collected around land co-disposal site of buffing dust

Parameter	Min.	Max.	Average	S.D.
pH	4.9	8.0	6.94	0.725
EC ds/m	103	7.3	4.81	1.72
Organic matter %	0.20	1.66	0.873	0.433
CEC C mol (P+)/kg of soil	11.8	30.4	19.30	5.61
Ex Na C mol (P+)/kg of soil	2.4	14	6.97	3.34
Total chromium mg/kg of soil	216	714	471	148.5

Table 4
Characteristics of groundwater sources around the areas of land co-disposal site of buffing dust

Parameter	Min.	Max.	Average	S.D.
pH	7.23	7.88	7.47	0.2049
Alkalinity	248	588	401.33	125.12
COD	41	164	99	38
Total solids	1390	7392	3970	2006
Total hardness	488	2442	1179	662
Chloride	350	2128	1104	700
Sulphate	150	1500	633	416
Chromium	0	0.25	0.16	0.1028

All the values except pH are expressed in mg/l.

Sodium and magnesium sulphates are associated with respiratory diseases [19]. Therefore, the recommended content of sulphate in drinking water is limited to 200–400 mg/l. COD is an important pollution parameter which indicates the degree of pollution in the water. High COD value reflects the presence of oxidisable organic matter in the groundwater sources.

3.3. Preparation of activated carbon: Experiment C

The buffing dust collected from the tannery was dried at 95°C. The temperature of furnace was increased to 310°C to remove volatile organics. The contents were cooled and impregnated with activated MgO in the ratio 1:1. The mixture was homogenised and activated at elevated temperature for 2 h in muffle furnace. The contents were cooled and soaked in 2 N H_2SO_4 for removing ash and the activant used during carbonisation. The experiment was repeated at other activation temperatures 600, 700, 800 and 900°C.

3.3.1. Effect of contact time on adsorption

Fig. 4 shows that adsorption of acid brown dye onto buffing dust based activated carbon increased with time and reached equilibrium in about 25 min. A very little percentage removal was recorded beyond the equilibrium time. However, the time required for establishment of equilibrium and % removal of dye at equilibrium varied with concentration of dye in water. Geundi [20] found that the mechanism of colour removal from the bulk solution involves migration of dye molecules from the bulk solution to outer surface of activated carbon and diffusion of dye molecules into pores of it. The transport of adsorbate from solution into the pores of the adsorbent is the rate limiting step [21,22]. Thus, the saturation of dye molecules on activated carbon surface took place, after a contact time of 60 min. The amount of dye removal increased from 2.84 to 6.13 mg/g, respectively, for the initial dye concentration from 50 to 125 mg/l at pH 3.5 and at temperature 30°C.

The rate constant for the adsorption of acid brown dye on activated carbon was calculated by using Lagergren equation. The plot of log $(q_e - q)$ vs. time gives a straight line. This confirms the validity of the equation to our experimental observation. The
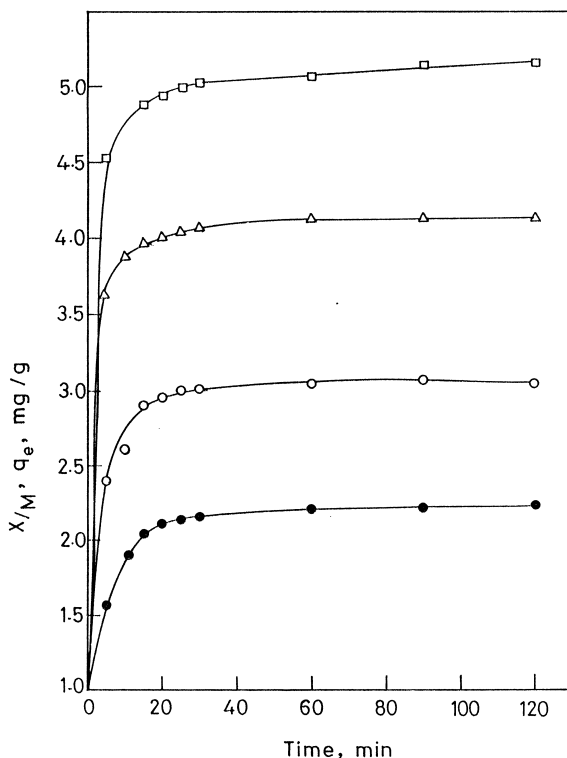
Fig. 4. Effect of contact time and acid brown dye concentration on the removal of dye by buffing dust based activated carbon; -○- 50 mg/l -◐- 75 mg/l -△- 100 mg/l -□- 125 mg/l; conditions: pH 3.5; temperature 30°C; particle size 300 μ; activation temperature 800°C.

slope of this line gives the rate constant for adsorption, K_{ad}. The values of K_{ad} at different temperatures given in Table 5 possess the same order of magnitude, indicating that the dye removal follows first order kinetics.

3.3.2. Adsorption isotherms

Adsorption isotherms were analysed according to the linear form of the Langmuir isotherms $C_e/q_e = 1/Q_0 b + C_e/Q_0$.

Plots of the isotherms are shown in Fig. 5 and are seen to be linear over the whole concentration range 50–125 mg/l, the parameters Q_0 and b of the Langmuir isotherm have been calculated for temperature 20, 30, 40 and 48°C and are listed in Table 6. The ratio of Q_0 and b gives a measure of maximum adsorption capacity (q_{max}) of the adsorption [20]. The q_{max} was found to decrease with rise in temperature. The rise in temperature affects the solubility and the chemical potential of the adsorbate, the latter being the controlling factor for the adsorption processes [23]. It has been reported earlier that the solubility of the adsorbate increased and chemical potential decreased with increase in temperature causing a decrease in the adsorption capacity of carbon.

Table 5
Sorption kinetic parameters of acid brown dye on buffing dust based activated carbon at different experimental conditions

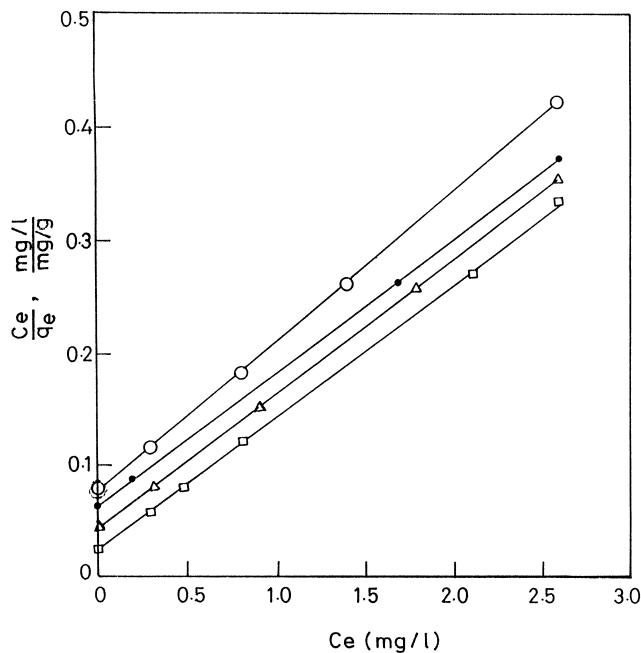| Sl. no.	Parameter	Time to attain equilibrium (min.)	Adsorption capacity (mg/g)	Percentage removal	Rate constant for K_{ad} (min^{-1})	Experimental conditions
1	Particle size					
	1.0 mm	120	5.94	95.04	0.012	pH 3.5, dye concentration 125 mg/l,
	0.5 mm	120	6.19	99.02	0.016	temperature 30°C, carbonisation temperature 900°C
	0.3 mm	15	6.248	99.97	0.026	
2	pH					
	2.0	60	6.247	99.94	0.050	Dye concentration 125 mg/l, temperature 30°C,
	3.5	60	6.235	99.76	0.026	carbonisation temperature 900°C, particle size 300 μ
	5.0	90	6.143	98.29	0.024	
	6.5	120	6.140	98.24	0.023	
3	Temperature of adsorption					
	20°C	90	6.238	99.84	0.026	Dye concentration 125 mg/l, pH 3.5, particle size 300 μ,
	30°C	90	6.2388	99.82	0.023	carbonisation temperature 900°C
	40°C	120	6.233	99.73	0.023	
	48°C	120	6.22	99.52	0.083	
4	Dye concentration					
	50 mg/l	120	2.27	88.42	0.054	pH 3.5, temperature 30°C, carbonisation temperature 900°C,
	75 mg/l	90	3.078	82.09	0.037	particle size 300 μ
	100 mg/l	90	4.25	85.00	0.025	
	125 mg/l	120	5.33	85.25	0.023	
5	Carbonisation temperature					
	600°C	120	6.13	98.06	0.014	Dye concentration 125 mg/l, pH 3.5, temperature 30°C,
	700°C	120	6.227	99.63	0.013	particle size 300 μ
	800°C	90	6.226	99.72	0.013	
	900°C	120	6.2465	99.94	0.026	

Fig. 5. Linearised plot of Langmuir for the adsorption of acid brown dye on buffing dust based activated carbon; -○- 48°C -○- 40°C -△- 30°C -□- 20°C; conditions: pH 3.5; dye concentration 125 mg/l; particle size 300 μ; activation temperature 800°C.

The validity of the Langmuir model was further confirmed by regression analysis of the equilibrium data at different temperatures and the following relations in the form of a straight line equation were obtained.

$C_e/q_e = 0.112587 \, C_e + 0.02443$ at 20°C
$C_e/q_e = 0.113848 \, C_e + 0.05062$ at 30°C
$C_e/q_e = 0.115959 \, C_e + 0.06488$ at 40°C
$C_e/q_e = 0.127250 \, C_e + 0.08269$ at 48°C

Table 5 contains adsorption capacity, % removal and rate constant for adsorption of acid brown dye on to buffing dust based activated under different experiments. The

Table 6
Langmuir constants at different temperature for adsorption of acid brown dye on buffing dust based activated carbon

Langmuir constants					
Temperature	Graphical	Values	Regression	Values	q max (mg/g)
	Q_0 (mg/g)	b (l/g)	Q_0 (mg/g)	b (l/g)	
20°C	7.69	1.64	7.86	1.54	4.689
30°C	8.343	1.93	8.62	1.79	4.316
40°C	8.66	2.58	8.78	2.25	3.356
48°C	8.71	4.48	8.89	4.30	1.800

maximum adsorption capacity is a useful criterion in assessing the greater uptake tendency of a given adsorbent. The maximum adsorption capacity values were used to assess the quantity of adsorbent required to remove 1 kg of dye. These quantities have been used for calculating cost of the adsorption process with the selected adsorbent. Fig. 6 depicts the comparison of adsorption capacity of activated carbon obtained from buffing dust (6.2475 mg/g) with commercial activated carbon supplied by a chemical company, Purex (6.225 mg/g) and rice bran based activated carbon (6.135 m/g at temperature 30°C, pH 3.5 and dye concentration 125 mg/l. The comparative study reveal that the buffing dust based activated carbon has adsorption capacity is 0.36% more than commercial activated carbon and is 1.8% more than rice bran based activated carbon.
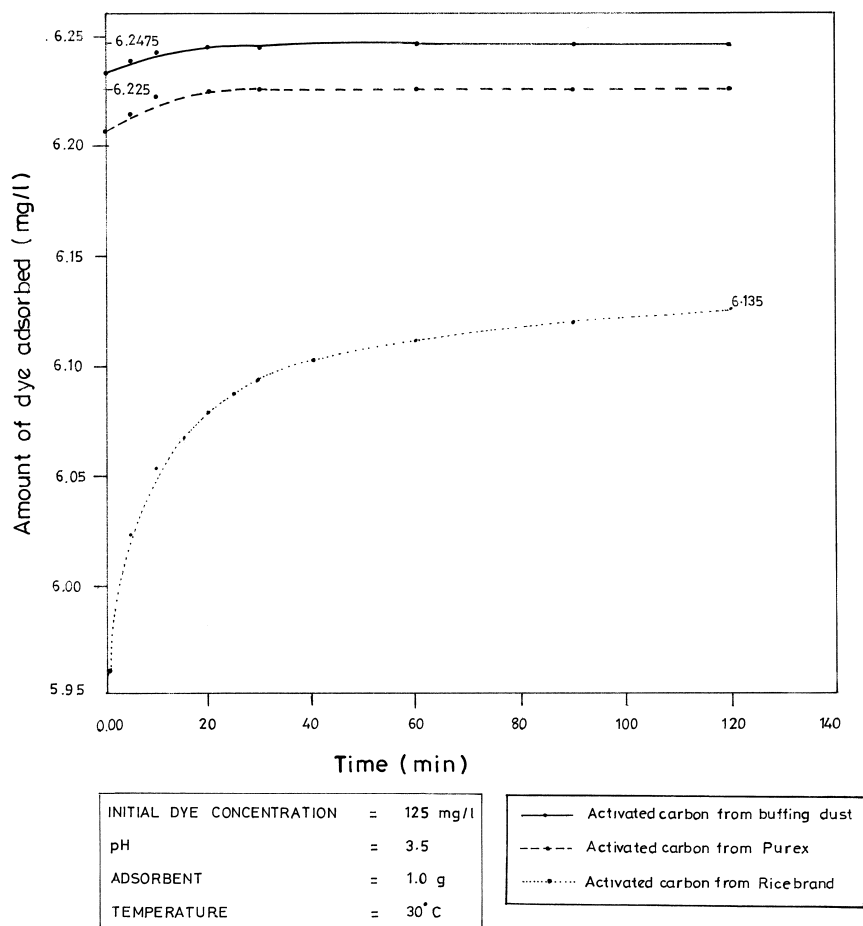

Fig. 6. Comparison of adsorption capacity of different activated carbon. Conditions: pH 3.5; temperature 30°C; dye concentration 125 mg/l. Particle size 300 μ; activation temperature 800°C. —●— Activated carbon from buffing dust; - - ● - - activated carbon from Purex; ....●.... activated carbon from Ricebran.

3.3.3. Effect of dye concentration

Specific adsorption of acid brown dye onto activated carbon increased from 5.2 mg/g to 6.25 mg/g and rate of adsorption increased from 0.0125 to 0.0256 min^{-1}, while particle size decreased from 1 mm to 300 μ, while the time required for adsorption equilibrium to be attained decreased from 120 min to 20 min at temperature 30°C, pH 3.5 and dye concentration 125 mg/l. This is based on the fact that a decrease in particle size increased the surface area available for adsorption of dye molecules from aqueous solution [24,25].

3.3.4. Effect of temperature

The adsorption capacity of acid brown dye on to activated carbon was found to decrease from 6.238 mg/g to 6.216 mg/g and the rate constant for adsorption decreased from 0.026 min^{-1} to 0.0183 min^{-1} for an increase in temperature from 20°C to 48°C. For every 10°C rise in temperature, adsorption density was decreased by 0.0003 mg/g up to 40°C, while the decrease in adsorption density was 0.00195 mg/g temperature beyond 40°C. This indicates that the process must be exothermic in nature [6]. This may be due to a relative increase in escaping tendency of dye molecules from the solid phase to the aqueous phase with increase in temperature of the adsorption process [26].

3.3.5. Effect of pH

The hydrogen ion concentration (pH) primarily affects the degree of ionisation of the dye sorbate and the surface properties of the activated carbon. These in turn lead to alteration in the kinetic behaviour of the adsorption process [27]. From Table 6 it is clear that the removal rate of dye decreased with increase in pH from 2 to 6.5. It showed that at pH 2, percentage removal of dye was 99.8 and at pH 6.5, it was about 98.2% at 125 mg/l dye concentration, temperature 30°C and 0.5 mm particle size of activated carbon.

3.3.6. Effect of activation temperature

Adsorption capacity of activated carbon increased from 6.13 to 6.2465 mg/g with increase in carbonisation temperature 600 to 900°C. The percentage dye removal was 98.06% and 99.94% for activation temperatures 600°C and 900°C, respectively.

4. Conclusion

Buffing dust generated in leather manufacturing industries forms 2–6% of the raw material used. The dust carries organic compounds that can be leached by solvents and water at pH 5–9. The leachates from buffing dust interact with soil particles to a level affecting physico-chemical characteristics of soil. The main components of leachates, tannin and syntan, adsorbed on soil particles at rates 2.83×10^{-3} min^{-1} and 1.5×10^{-3} min^{-1}, respectively. The leachates from buffing dust enter the groundwater sources and deviate their characteristics from normal value. The well-water characteristics in the area around land co-disposal of buffing dust reveals that well-water does not meet the drinking-water standard. Conversion of buffing dust into activated carbon is a rational

idea of combating solid waste pollution caused by this mass as activated carbon obtained from buffing dust generated in leather industry as a solid was able to remove 6.247 mg of dye per gram at a concentration of 125 mg/g at pH 3.5 and a temperature of 30°C compared to the commercial activated carbon which has only 6.225 mg/g as adsorption capacity.

A crude economic analysis made on the solid waste disposal shows that about 12 ton of buffing dust containing 54 kg of chromium in the trivalent form is produced per day from Indian Tanneries. About 5 ton of activated carbon can be derived on following activation process for the solid waste. This will yield a net profit of approximately Rs. 120 million per annum and thus, tanners will certainly justify their attention in collecting the buffing dust and convert it to activated carbon. Activated carbons with high adsorption capacity have good market potential used for the tertiary treatment of wastewater. Hence, conversion of buffing dust into activated carbon is a recommendable strategy to check the solid waste pollution due to buffing dust in the leather industry.

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