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PART A:

Journal Name:	British Journal of Applied Science & Technology
Manuscript Number:	MS: 2012/BJAST/1216
Title of the Manuscript:	<i>ADSORPTION KINETICS FOR THE REMOVAL OF BIOCHEMICAL OXYGEN DEMAND (BOD) FROM DYE EFFLUENT ONTO POULTRY DROPPINGS ACTIVATED CARBON</i>
Manuscript received on (Date)	
Review comment submitted (Date)	



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	Reviewer's comment
General comment:	The author should be consistent on the way the units are presented either using a slash or negative superscript (ex. mg/L or mg. L ⁻¹)
Specific comments:	
Title and abstract Objective corrected in the introduction.	Aims/Objectives: The author may choose which one, either to retain the title and change the objective or the other way around. Please see sample publication to give you an idea how to make aims and objectives that should jive to your title. Please see British journal of applied Science and Technology 2(1): 48-57, 2012 and 2(1): 1-15, 2012.
Corrected.	Study Design: "Effectiveness of the activated carbon at various contact time." Is not a study design. I suggest the author may change it to either "Experimental study or may be Laboratory experimentation"
Corrected.	Methodology: Batch adsorption experiments were carried out for the removal of BOD from dye effluent using poultry droppings as an adsorbent. A two-step process was adopted with H ₃ PO ₄ as an activating agent. The rate of adsorption was carried out at various contact time. The adsorption kinetic were analysed using pseudo first-order, pseudo second-order, Natarajan and Khalaf first order and Elovich model
Corrected.	Results: The ash content of poultry droppings was low which is an indication of high carbon yield. It is known that as the activation burn off increases the percentage of carbon yield decreases, this is so because more volatiles are released from the char at higher burn off. The lower conductivity values obtained in this study implied that the activated carbon contain less leachable waste that are considered impurity and undesirable. Equilibrium contact time was indicated at short contact time corresponding to 30 minutes for PD/ H ₃ PO ₄ /10 and at long contact time or 120 minutes for PD/H ₃ PO ₄ /5 adsorbent. Furthermore, the pseudo second-order kinetic model was found to be the most appropriate model that best describes the adsorption kinetics.
Defined in the appendix.	Note: PD/H ₃ PO ₄ /5, PD/H ₃ PO ₄ /10, PD/H ₃ PO ₄ /15 must be defined somewhere,
Corrected.	Conclusion: The findings indicated that the poultry droppings could be good raw material for the preparation of activated carbon that could be effectively used for the removal of BOD from dye effluent. The kinetics involved in the adsorption process was intraparticle diffusion control mechanism.



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Introduction The introduction should have a good flow of ideas.. Lines 37 -38 are the same statements in lines 46 to 48. Thus, I am suggesting that the first 3 paragraphs of the induction will be as presented. Suggestion follow. I am also suggesting the corrections for the last part of the introduction as shown in the other column.	Man made activities on water use by domestic, industrial, agriculture, shipping, burning of fuels, that correspondingly brought suspended particulate matter in a form of domestic wastes, industrial wastes, agricultural chemicals and fertilizers, and animal wastes. These wastes have negative influence on natural ecosystems. Activated carbon are widely used to purify wastewater for drinking water processes. It is very valuable because of its variety of applications such as gas purification, water purification, metal extraction, gold recovery, and sewage treatment. Activated carbon is also useful for the deodorization of closed spaces such as refrigerators, adsorption of ethylene to prevent premature ripening of fruits and vegetables, and decolouration of sugar, juices and liquors. Activated carbon is a form of carbon that has been processed to make it extremely porous and thus having a very large surface area available for adsorption or chemical reactions. Due to its high degree of porosity, just one gram of activated carbon has a surface area in excess of 500 m² as determined typically by nitrogen gas adsorption. Sufficient activation for useful applications may come solely from the high surface area, though further chemical treatment often enhances the adsorbing properties of the material (Emmanuel and Badmus, 2008). Additionally, activated carbon is manufactured from a wide variety of materials. Poultry droppings, coal, peat, wood, coconut shell, grape seeds, shell of nuts, extracted oil palm fibres have been found to be suitable precursors for producing activated carbon owing to their high carbon and low ash contents (Activated carbon, 2010). The removal of pollutant (specify here what type/kind of pollutant) using adsorption process provides an alternative means of (what) since the raw materials are inexpensive and readily available. The study would provide a cheaper method for control of pollution resulting from the discharge of industrial effluents (specify what of industrial pollutant) and could also motivate local industries in sourcing for activated carbon locally which will help to conserve foreign exchange. Therefore, the study is aiming at investigating the adsorption capacity of poultry dropping as an alternative means of controlling water pollution by removing BOD from dye effluents. The contact time between the dye effluent and the adsorbent that gave the highest rate of adsorption as well as the adsorption kinetics and adsorption mechanism using intraparticle diffusion model were also considered in the study.
Review of literature (Heading may differ in the case of review paper) Litrature review included.	There is no review of literature
Materials & methods (Heading may differ in the case of review paper) Corrected.	2.1 Sample Collection and Preparation. 59 The poultry droppings used as precursor were collected from Kure farms Chanchaga, Minna The collected samples were immediately dried, ground, and sieved with a 2 mm mesh size sieve. The sieved poultry droppings with particle size less than 2 mm sample were stored in an airtight container. The dye effluent were obtained from local dye industry, Ja'faru Mairiga Street, F-Layout Minna, Niger State,



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The ash content fall under the correct heading since it is for the poultry dropping and not the activated carbon.	61 Nigeria. It was stored (in what container) at room temperature without further purification. Ash content of poultry droppings was determined using the method described by AOAC (1990). – transfer this to the subsection of the characteristics of activated carbon
Corrected.	2.1.1 Preparation of the adsorbent 65 Two step activation process was adopted following what standard method (Reference, year). 5 g of ground and sieved raw sample of poultry droppings was weighed into clean and weighed crucibles. The crucibles were introduced into a muffle furnace at 600±66 C for 5 minutes after 67 which they were poured from the crucible into a bath of ice water. Excess water was drained off. The 68 carbonized sample was washed, using 0.1 M HCl to remove surface ash, followed by hot water, 69 and further washing with distilled water to remove residual acid. The sample was then sun dried, and further dried in the oven at 100±70 C for one hour. This process was repeated until a substantial amount 71 of carbonized sample was obtained.
Corrected.	Thereafter, 5g of already carbonized sample was mixed with 5cm³ of 1M H₃PO₄ as the activating agent. 73 The sample was allowed to stand for 2 hours, after which it was introduced into a furnace and heated at 800±74 C for 5 minutes. The activated sample was cooled with ice water, excess water was drained off 75 and the sample dried at room temperature. The above procedure was repeated for different residual 76 time (10 min and 15 min) until substantial amount of activated carbon was obtained. Washing of the 77 activated sample was done with 0.1M HCl to remove surface ash, followed by hot water and 78 rinsing with distilled water to remove residual acid. Washing was completed until the pH of 6-7 was obtained, then the sample was dried in oven at 110±79 C overnight and stored in air tight container 80 (Rahman et al., 2005; Fan et al., 2005; Ahmedna et al., 2000). 2.2 Characteristics of Activated Carbon
Corrected.	Make an introductory statements before giving the different equations.
Corrected.	95 The pH and conductivity of the resulting activated carbon were determined using a pH meter (model) and a conductivity meter (model) , respectively at 96 room temperature (Okiemen et al., 2004).
Corrected.	97 2.3 Adsorption Process Using Batch Method (Start this paragraph by mention the standard method used or the reference of the Batch method used)

Corrected.	2g of activated carbon was interacted with 40cm³ 98 of industrial dye effluent in a beaker and covered. 99 This was allowed to stand for 30 minutes. It was then filtered using whatman filter paper (No. 42) and 100 the filtrate collected. The process was repeated at pre-set time (60,90,120 and 150 minutes). Each mixture was separately filtered and the filtrate were collected. This was continued until 500 cm³ 101 of each 102 filtrate was obtained. The collected filtrate from each batch at varied adsorption times were analyzed for BOD determination (Hameed <i>et al.</i>, 2007).
Corrected.	2.4 Determination of BOD. (State here the standard method you used in the BOD analysis) 200 cm³ of the filtrate above was measured into a conical flask and added with 1cm³ each of 2.24M manganese (II) 106 sulphate solution and alkali-iodide-azide solution. The resulting solution was well shaken and then the precipitate was allowed to settle. The clear liquid above the precipitate was decanted. 2 cm³ 107 of conc. H₃PO₄ and some water were added to 108 dissolve the precipitate. The sample was titrated against 0.025M sodium thiosulphate. The titre value 109 was recorded as the initial dissolved oxygen (Initial DO).
Corrected.	The remaining 200 cm³ of the filtrate above was measured into an incubation bottle and added with 1cm³ each 110 of 2.24M manganese 111 (II) sulphate solution and alkali-iodide-azide solution. The resulting solution was then well shaken and incubated for 5 days at 20°C. The clear liquid above the precipitate was decanted and . 2 cm³ 112 of conc. H₃PO₄ and some water 113 was added to dissolve the precipitate. The sample was titrated against 0.025M sodium thiosulphate. 114 The titre value was recorded as the final dissolved oxygen (Final DO) (Udo and Ogunwale,1986).
Corrected.	The BOD concentration was then calculated using the following equation: BOD (mg/L) = Final DO – Initial DO 116 The BOD of the dye effluent before interaction with the adsorbent was also determined using the same procedure. 117 % BOD removed = BOD_i - BOD_f(4) 118 BOD_i 119 where..... 2.5 Determination of the Adsorption Capacity. Introduce the equation first



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Corrected.	2.6 Adsorption Kinetics 132 The kinetics of adsorption were investigated using pseudo first-order (Lagergren, 1898), pseudo second-order (Ho <i>et al.</i>, 2000), Natarajan and Khalaf first order (Raji <i>et al.</i>, 1986), and Elovich model (Chien and Clayton, 1980; Sparks 1986) as shown in the following equations. Pseudo first-order (Lagergren, 1898). Log ($q_e - q_t$) = log $q_e - K_1 t$(134 6) 135 2.303 136 Pseudo second-order (Ho <i>et al.</i>, 2000). $t/q_t = 1/k_2 q_e$ 2 137 + t/q_e ----- (7) 138 Natarajan and Khalaf first order (Raji <i>et al.</i>, 1986). 139 Log (C_i/C_t) = $K_1/2.303 t$ ----- (8) 140 Elovich model equation: (Chien and Clayton, 1980; Sparks 1986) 141 $q_t = 1/\beta \ln(\alpha \beta) + 1/\beta \ln(t)$ ----- (9) 142 Where 143 q_e (mg/g) = amount of BOD adsorbed at equilibrium. K_1 (min⁻¹144)= Adsorption rate constant for first-order. K_2 (g.mg⁻¹min⁻¹145) = Adsorption rate constant for second-order. α (mg. g⁻¹min⁻¹146) = Initial adsorption rate. β (g.mg⁻¹147) = desorption constant during any experiment. Corrected. The Intraparticle diffusion was used to describe the mechanism of the adsorption 156 process using the 157 following equation.
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Results & discussion
(Heading may differ in the
case of review paper)

Corrected.

Defined in the appendix.

162 3.1 Characteristic of the Activated Carbon

Table 1 shows the characteristics of the resulting activated carbon derived from the poultry droppings.

163 The percent ash content (3.65 ± 0.01) of the precursor is low which is an indication of high carbon
164 yield (Reference). The pH of the adsorbent is within the range of $6.3 \pm 0.03 - 6.7 \pm 0.11$ which is in accordance
165 with Ahmedna *et al.* 1997, that activated carbons produced from precursors with low ash content have
166 been found to have low pH (less than 7.0). Percentage activation burn off increase with increase
167 activation dwell time as the percentage yield decreases. It was evident that at longer dwell time, more
168 volatiles are released from the char, thereby, resulting into higher burn off and corresponding lower
169 yield. Carbons with an adequate bulk density also help to improve the filtration rate by forming an
170 even cake on the filter surface. Bulk density of the sample is within the range of $0.51 \pm 0.11 - 0.52 \pm$
171 0.02 g/cm^3 which revealed better adsorption for the adsorbent. The sample conductivity values shows
172 that the adsorbents has low leachable waste which is consider impurity and undesirable (Table 1).

177 **Table 1: Characteristics of the activated carbon**

178	Parameter	PD/H ₃ PO ₄ /5	PD/H ₃ PO ₄ /10	PD/H ₃ PO ₄ /15
179	Activation burn off(%)	14.12 ± 0.01	20.01 ± 0.11	28.15 ± 0.01
180	Yield (%)	86.12 ± 0.01	80.05 ± 0.03	72.23 ± 0.02
181	Bulk density (g/cm^3)	0.52 ± 0.01	0.52 ± 0.02	0.51 ± 0.11
182	pH	6.5 ± 0.01	6.3 ± 0.03	6.7 ± 0.11
183	Conductivity ($\mu\text{S/cm}$)	1.6 ± 0.02	1.5 ± 0.11	1.9 ± 0.01

184 **Make a legend here to show what is meant by PD/H₃PO₄/5, PD/H₃PO₄/10, PD/H₃PO₄/15.**

185 3.2 Effect of Contact Times



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Corrected.	186 The result shown in Figure 1 indicated that the adsorption rate of PD/H₃PO₄/5 was rapid for the first 90 minutes, reach 187 equilibrium at 120 minutes, that is 37.29% removed thereafter decrease at 150 minutes while for 188 PD/H₃PO₄/15 the equilibrium time was attained at faster rate of 60 minutes, that is 47.85% adsorbed 189 then desorption occur at 90 minutes. For PD/H₃PO₄/10 the adsorption rate was higher at the initial 190 contact time of 30 minutes then decrease between 60-150 minutes contact time respectively (Figure 191 1). The initial faster rate may be due to the availability of the uncovered surface area of the 192 adsorbents, since the adsorption depend on the surface area of the adsorbents. The BOD adsorption 193 takes place at the more reactive sites. As these sites are progressively filled the more difficult the 194 sorption becomes, as the sorption process tends to be more unfavourable. This is general 195 characteristic of adsorption (Johnson, 1990; Appel and Lena, 2002; Abdus-Salam and Adekola, 196 2005; Qadeer and Akhtar, 2005).
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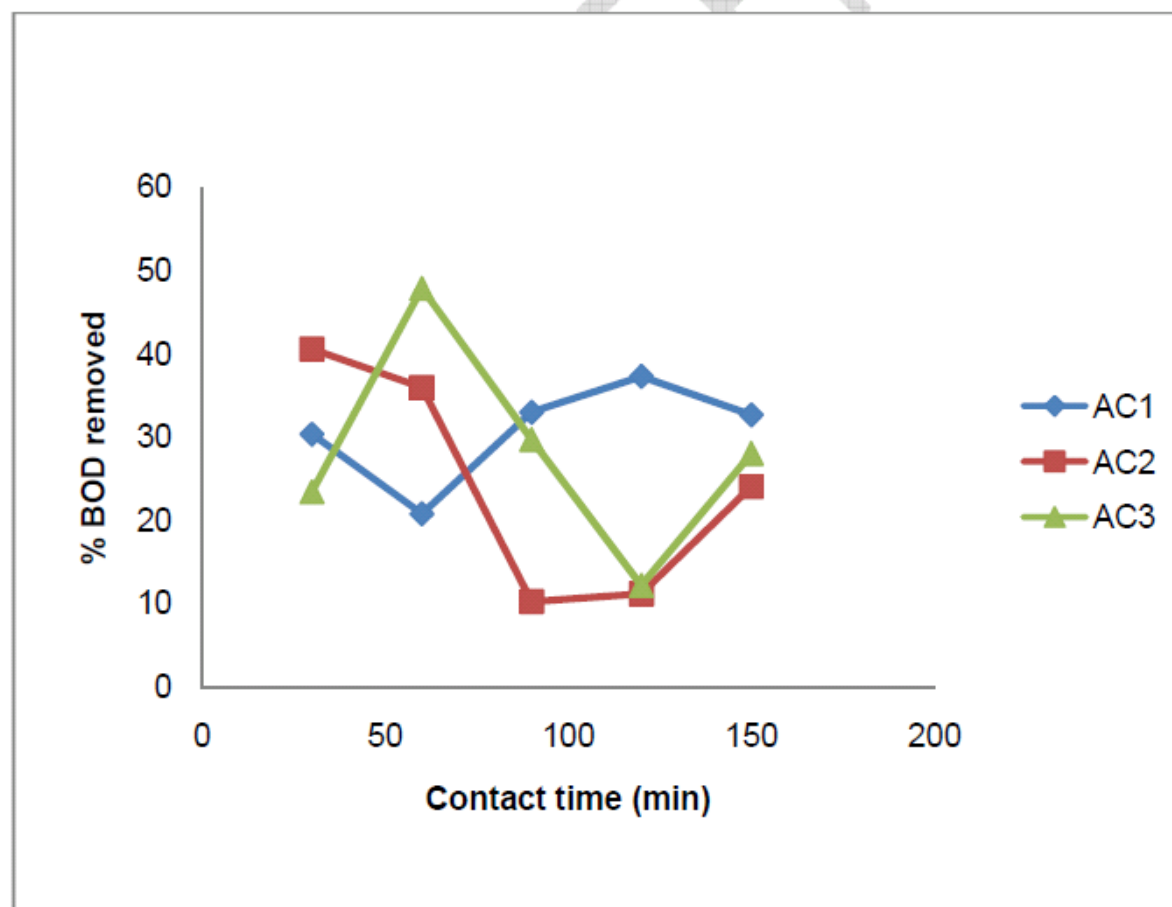


Figure 1: Effect of contact time on BOD removed by poultry dropping adsorbent.



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It is not possible to insert the subscript of the activating agent inside the figure due to this, AC1, AC2 and AC3 were used which were define below the figure. It is not possible to combine these Tables because Table 2 to Table 5 represent each model use to study the adsorption kinetics. Suggestion follow. Corrected.	Note for the Figure 1 & 2: Do not use AC1, ac2, and ac3 anymore, I would suggest use directly PD/H₃PO₄/5, PD/H₃PO₄/10, PD/H₃PO₄/15. 200 Adsorption Kinetic I suggest the author will combine Tables 2 to 5. Instead of this paragraph: 201 Kinetic models like pseudo first-order, pseudo second-order, Natarajan and Khalaf first order and Elovich model were tested for the adsorption process. Sample with correlation coefficient (R^2) values close or equal to 1 is accepted for a given model or with R^2 values within the range $0.5 \leq R^2 \leq 1$ successfully describe the adsorption kinetics. Pseudo second-order showed higher R^2 values than the 205 other kinetic model tested (Table 2- Table 5) with the accepted value greater than 0.980 (Figure 2). 206 The result indicated that pseudo second-order fitted the BOD adsorption onto poultry dropping 207 activated carbon. Badmus <i>et al.</i>(2007) reported a pseudo second-order kinetic adsorption model. I would suggest to have this: Table 2 shows the kinetic parameters of the 4 models tested in the study. The highest R^2 value (insert values here) were obtained using the pseudo second-order model. It must be noted that sample with correlation coefficient (R^2) values close or equal to 1 is accepted for a given model or with R^2 values within the range $0.5 \leq R^2 \leq 1$ successfully describe the adsorption kinetics (insert reference here). Figure 2 shows the regression lines and the corresponding R^2 values obtained in the pseudo second-order kinetic model. As shown the R^2 values ranged between 0.984 to 0.993. This range of R^2 values are greater than the acceptable R^2 value of 0.980 (Insert reference here). This result indicated that pseudo second-order fitted the BOD adsorption onto poultry dropping activated carbon. 234 3.4 Test of Kinetic Models 235 The applicability of pseudo first-order and pseudo second-order were tested using percentage sum of error square (% SSE). The higher the value of R^2 236 and the lower the values of % SSE, the better will 237 be the goodness of the fit. Also sample with least % SSE is accepted for a given model (Reference here). The lower 238 values of % SSE of pseudo second-order model than that of pseudo first-order support the suitability 239 of pseudo second-order kinetic model to explain the adsorption onto carbonized poultry droppings 240 (Table 2 and Table 3). Similar result was reported by Senthilkumaar <i>et al.</i> (2010). 3.5 Intraparticle Diffusion Model
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Corrected.	242 Adsorption is a multi-step process involving transport of the solute molecules from the aqueous phase 243 to the surface of the solid particulate, followed by diffusion of the solute molecules into the pore 244 interiors. If the value of C is zero, then the rate of adsorption is controlled by intraparticle diffusion for 245 the adsorption process (Hameed, 2009). As shown in Table 6, the values of C ranging from 0.121 to 0.319 that 246 when approximated to the nearest 247 a whole number it give zero indicating that the adsorption is intraparticle diffusion dependent. Similar 248 result was obtained by Ofomaja (2006).
Conclusion Corrected.	256 4. CONCLUSION 257 Poultry droppings has been successfully used to produce high quality activated carbon because of 258 high carbon content. Batch adsorption method was adopted at the different contact time. The highest 259 BOD removal was 47.85% at contact time of 60 minutes. Adsorption kinetic data were analysed using 260 the pseudo first-order, pseudo second-order, Natarajan and khalaf first order and Elovich model. The 261 results revealed that the process can be best described by a pseudo second-order model. The 262 advantage of using this model is that the adsorption capacity and the rate constant of pseudo second 263 order can be predicted from the equation.
References	