Coconut Shell Charcoal: A Resource in Teaching the Concept of Adsorption

DIKE, JOHN WORLU
Department Curriculum Studies and Educational Technology
Faculty of Education
University of Port Harcourt, Nigeria
Jwdike2015@gmail.com

AMADI, REGINALD OKECHUKWU
Department of Curriculum Studies & Instructional Technology
Ignatius Ajuru University of Education,
Rumuolumeni, Nigeria

ABSTRACT
The study investigated the adsorptive capacity of coconut shell charcoal as a teaching resource. A population of 1450 SS2 chemistry students in Obio/Akpor Local Government, was targeted. 120 students drawn from an intact classes of 60 students each were used. A question and a null hypothesis were formulated. Chemistry achievement test (CAT) validated with a reliability coefficient (r=0.78) using Pearson Product correlation made the instrument suitable for the study. A pretest post-test non randomized design was adopted. The data analyzed using mean and t-test statistic. The findings revealed a mean difference in achievement when exposed to coconut shell charcoal as adsorbent. Based on this, coconut shell charcoal is recommended for use in teaching the concept of adsorption.

Key words: *Coconut shell, Charcoal, resource, Adsorption*

Introduction

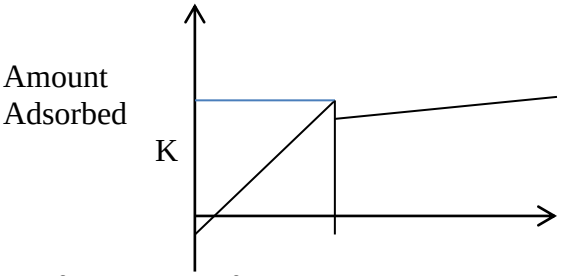
From the scientific perspective, charcoal is of great interest considering detailed picture of its atomic structure. For example, the activated type produced from organic based materials such as palm kernel, saw dust, wood chips and so on, are valuable industrial adsorbents. The raw material is carbonized to obtain the char or carbon, which is activated to yield the highly porous products (Diblin, 1994). Two types of pores (macro-pores and micro pores) are produced. The macro pores create passage way to the interior, while the micro pores are responsible for the large surface area. Adsorption, therefore takes place at the micropores.

Pedagogy is recommended to understand this, through practical work using local material as resource (Dareng, 1997 and Okebukola, 2002). The dynamism of the National Policy on Education (2004), usher in scientific and technological advancement which the local environment sustain at the present era.

Although, faced with a major constraint of harnessing the local resources resulting from personnel and material, the Nigeria nation is still dragging foot. Meanwhile, the Western World is taking advantage of the local environment and it has become a leverage to their technological growth.

Nigeria, like all other countries, is striving towards technological and scientific development. But has since the inception of 6334 education system remained stereotyped. In this premise, the recent scientific research has a focus on local materials. This work, as a matter of necessity hinges on the use of charcoal from Agricultural waste (coconut shell) as a resources for demonstration of adsorption concept. Adsorption is the adhesion of molecules of liquid or gas, solute or dissolve substance or particles to the surface of a solid substance. It could be a process in which atoms or molecules move from a bulk phase onto a solid or liquid phase. This is in contrast to absorption as the penetration of molecules into the interior of the adsorbent.

Applying the Langmuir sorption isotherm, the amount adsorbed by a stationary phase has depended on concentration of bulk solution (Brain, 1997). The relation is graphically represented in figure 1.



Conc. of solute (gm) fig. 1

The distribution coefficient (k) varies with concentration. The knowledge of which could be harnessed in the classroom at appropriate methodology (Olarewaju, 1994). Many factors as chemical/physical properties, chemical composition, temperature and exposure time have played a role in understanding the adsorption rate.

The teaching of chemistry has been handicapped and traceable to unavailability of teaching and learning resources. The available one has been inadequate to teach in Public Schools (Nwosu, 2000 and Bassey, 2002). In this case, the classroom teachers have to be creative as to make improvise. An improvisation is a substitute to unavailability of real equipment which is a correlate to students' performance in science. This has been observed as hampering the growth of science education in Nigeria. In the studies carried out by Okafor (1998) and Bajah (2000), a correlate exists between the use of materials and performance of improvised students in science.

On this background, Onwioduokit (2000), has encouraged a total re-orientation of attitude in favour of improvisation of resource materials. The study is therefore hinged on a possible way the charcoal produced from coconut shell by traditional farmers and dumped as waste after removing the nut could be used to teach adsorption. Sequel to great demand for charcoal adsorbent in industries, it could still be applied for teaching resources in the classroom.

Purpose of Study

The study investigated the use of local improvise charcoal from agricultural waste (coconut shell) in teaching the concept of adsorption and enhancement of students' performance in chemistry.

Research Question

To what extent will the use of adsorptive properties of agricultural waste (coconut shell) charcoal influence student's performance in chemistry?

Hypothesis

There is no significant difference in the mean post test scores of students exposed to locally prepared charcoal and commercially activated charcoal in their performance in chemistry.

Methodology

One hundred SS2 chemistry students were selected from two intact classes, a target of 1450 students' population in Obio/Akpor Local Government. The study adopted a pre-test post test non randomized design. The intact classes of 60 students each were randomized to experimental and control groups.

The experimental group was exposed to titration using coconut shell carbon (adsorbent); while the control group was taught using standard activated carbon. Both groups were pre-tested with the instrument validated with a reliability coefficient of r = 0.78. Thereafter, the instrument was rearranged and the sample post-tested.

Procedure

The raw material availability was linked to the production of the main coconut oil by the small scale production. Coconut shells were crushed to suitable sizes and dried under oven at 10°C for 6 hours to remove moisture. The dried shell (180gm) was stacked to form a hemispherical heap which was covered with a local kiln of iron cooking pot with opening at the top. The shell alight with the pot closed with a small opening at the base to regulate the air. The shell smouldered and gradually converted to charcoal, a process which took 5 hours. The carbonized shell cooled and ground into powder of a specific mesh. 2.0gm of charcoal transferred into 250cm^3 flask containing 50cm^3 (0.1M NaoH/4.0gm/litre) standardized using 01/M KH($C_6H_4O_4$) containing 0.20gm/100cm^3 with phenolphthalein indicator, Using (CH_3COOH) of 0.02M to 0.09M concentrations as adsorbate on coconut charcoal (adsorbent) for experimental group. While the control group used the commercial activated charcoal. The scores obtained from pretest and post-test were used for data analysis.

Results:

Research Question:

To what extent will the use of adsorptive properties of agricultural waste (coconut shell) charcoal influence students performance in chemistry.

Table 1: Summary of mean gain and standard deviation of pretestposttest scores of experimental and control groups.

Group	**Resources Materials**	**N**	**Pretest Score**		**Posttest Score**		**Mean gain**
			X	SD	X	SD	Score

Experiment	Coconut shell	30	56.03	6.29	64.29	8.28	8.26
Control	activated charcoal	30	56.17	6.59	59.60	7.93	3.43

Table I shows that the mean post test score of those taught with coconut shell charcoal is more than the mean post test score of students taught with activated charcoal. It was equally observed that both groups were equivalent in terms of entry knowledge of chemistry (pretest scores; 56.03 and 56.17 for experimental and control) groups respectively.

Hypothesis

There is no significant difference in mean post test scores of student expose to locally prepared charcoal and commercially activated charcoal in their performance in chemistry.

Table 2: Summary of t-test analysis of mean difference between (experimental and control groups).

Group	**Variable**	**N**	**Mean**	**SD**	**t-value**	**Df**	**Decision at P<O.O5**
Experimental Control	Pretest Pretest	30 30	55.97 54.83	6 5	0.45	58	Ns
Experimental	Post-test Pretest	30 30	64.29 56.03	8 6	4.45	58	*
Control	Post-test Pre test	30 30	59.60 56.13	7 4	2.03	58	*
Experimental	Post test	30 30	64.29 59.60	8 7	2.20	58	*

*Significant, Ns — Not Significant, t-critical 1.671.

Table 2 shows equality of groups (t-O.45) of pretest scores. Experimental group (t-4. 54) shows a significant result. An indication of effects of treatment using coconut shell charcoal. While control group equally shows a significant difference with respect to resource used. This is an indication of the relevance utilization of commercial activated charcoal. When compared the treatment (coconut shell) and control (activated) a significant difference existed (t-2.20). The null hypothesis is therefore upheld.

Discussion

There are potential raw materials for the production of carbon to meet local industries and practical need in schools. The charcoal sample from coconut specie has been prepared and their performance titrated with organic acid. Apart from the activated carbon, coconut shell carbon has

identified as suitable for use in teaching adsorption. Besides, the gold mining industries, the breweries and soft drink industries that use activated charcoal, other potentials users such as the textile industries, soap manufacturing industries, vegetable oil nulls and classroom application can also be sensitized to use this commodity (coconut shell) thereby creating room for local improvisation.

The coconut shell charcoal as improvisation in the teaching of adsorption will suitably enhance the practical knowledge of students in chemistry. This is observed in (table 1) as the mean gain of 8.26 was noticed in the experimental group and higher than the control group (3.43). A clear indication that the use of local improvise material such as coconut shell charcoal leads to interest in learning.

The result is further shown in table 2 and proved significant with (t=4.54 at P> 0.05 df 58). This concretizes the very important role in the use of improvisation in learning as a stimulant in thinking.

This agrees with (Okafor, 1998 and Bajah, 2000) who found in their various studies that a correlation exist between the use of improvisation and performance in science. The hypothesis is therefore upheld.

Conclusion and Recommendation

The improvisation of charcoal adsorbent results to a less expensive means of measuring adsorption in the classroom. The waste (coconut shell) charcoal by local farmers could be made familiar to classroom teaching of practical chemistry. The suitability of the charcoal is recommended for use in practical chemistry of adsorption, besides its industrial application.

The study to use coconut shell as a substitute for activated charcoal will among several benefits contribute to measures for abating the environmental degradation by dumping of agricultural wastes (coconut shell).

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