MAINTENANCE OF WATER THROUGH THE DEVELOPMENT OF ACTIVATED CARBON FILTER FROM LOCAL RAW MATERIALS.

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The aim of this work is to develop activated carbon filter from local raw materials such as bamboo and coconut shells to maintain quality water for human consumption, by removing odours, colour, taste and chemicals. To achieve the stated aim, an anaerobic furnace of 9kg capacity was designed and developed for amaximum operating temperature of 1000°C. The raw materials used for activated carbon are bamboo and coconut shells. A quantity of 6kg bamboo was measured and fed into the furnace for four hours of heating in the absence of oxygen a ta temperature of 900°C. The experiment was repeated with the same quantity of coconut shells as of bamboo. The activated carbon of the materials was ground separately in a mortar with a pestle, and sieved using British auto sieve shaker of different sizes, which was used to analyse muddy water. The result showed that the level of contaminants were significantly reduced, coconut activated carbon was found to be better than bamboo and activated with finer particles is more efficient in water filtration. It can then be concluded that activated carbon from local raw materials like coconut shells and bambos, which are common in Africa, can be used to maintain quality water for human consumption.

1 INTRODUCTION

Water is undoubtedly one of the world's most important natural resources. It plays a vital role in the development of communities; hence a reliable supply of water is essential. Its quality needs to be maintained all the time for human and industrial use. The maintenance of water becomes necessary because it has been polluted naturally or artificially by industrial activities. As a result of this, many governments at local, state or national levels spend millions of dollars on the maintenance of water to make it acceptable for human and industrial consumption.

Water pollution is any contamination or change in the quality of water through contact with chemical, physical and biological elements, obviously, the effect of such water will be harmful [1]. When humans drink polluted water, it can have serious effects on their health; they may contact such diseases like typhoid, dysentery and cholera [2].

There are several classes of water pollutants. There are disease causing agents such as bacteria viruses, protozoa and parasitic worms that enter sewage systems and untreated waste. Another category of water pollutants is oxygen demanding wastes which can be de-composed by oxygen-requiring bacteria. When large populations of decomposing bacteria are converting these wastes, they can deplete the oxygen levels in the water and cause other living organisms in the water such as fish to die. There is yet another class of pollutants: It is constituted by water-soluble inorganic pollutants in form of acids, salts and toxic metals. Large quantities of these compounds will make water unsuitable to drink and will cause the death of aquatic life [3]. Other classes of water pollutants, will not be discussed in this paper.

Since pollution seems inevitable in every society , good quality water must be maintained for human consumption. This need is reflected in the growing market for domestic water filters which are designed to remove objectionable tastes, odours and organic contaminants from water. The material in these activated carbon filters is recognised as effective and reliable in removing impurities [4]. Activated carbon has a tremendous absorbing capacity for a wide variety of dissolved organics and chlorine and can be custom-tailored to suit specific applications [5].

The aim of this work is to develop activated carbon filter from local raw materials such as bamboo and coconut shells to maintain quality water for human consumption by removing odours, colour, taste and chemical.

2 METHODOLOGY

To achieve the aim of the work, a 9kg anaerobic furnace capacity was designed and developed for a maximum operating temperature of 1000°C. The raw materials used are coconut shell and bamboo all obtained from the South West of Nigeria. The furnace was designed in such a way that the heat generated would reach the raw material through radiation and conduction. Thermocouple was incorporated into the furnace for teperature measurements. The furnace was test-run for 3 days before the production of the activated carbon materials.

A quantity of 6kg of coconut shell was measured and placed in the furnace for four hours heating in the absence of oxygen at a temperature of 900°C. The experiment was repeated with the same quantity of bamboo as coconut shell. The activated carbon of the materials was ground separately in a mortar with a pestle. Thereafter, activated bamboo and coconut were sieved separately also using the British auto Sieve Shaker of different grades mounted together and powered electrically.

A jar of 1 litre of muddy water from the pond in the industrial area of Ota, Ogun State Nigeria, was collected for analysis. The muddy water was analysed for turbidity, odour, colour, pH, alkalinity and chemical contaminants such as Lead, Cadmium, Manganese, Iron, Cobalt, Mercury, Nickel, Copper, Chlorine, Chromium, Arsenic and Zinc. The results are shown in Tables 1 and 2.

Table 1: Physical properties of the Raw Water.

S/N	Physical Properties Determined	Results
1	PH	7.6 - 8.45
2.	Turbidity	6.0 - 12.3 (N.T.U.)
3	Colour	Slightly Cloudy
4	Conductivity	160 - 180
5	Ackalinity	86.5 mg/L - 95 mg/L

Table 2: The Analysed Contaminants in the Raw Water

S/N	Elements Analysed	Results (ppm)
1.	lead	0.081001
2.	Manganese	0.171001
3.	Cadium	0.091001
4.	Iron	0.051015
5.	Chlorine	0.011000
6.	Arsenic	0.281001

The collected muddy water was filtered using the method of pour-through [5]. This method entailed the insertion of Whatman filter paper of 110mm diameter into the filtration funnel. The sieved activated carbon of coconut and bamboo was poured into the filter paper in turn. The experiment was repeated three times, and an average result was recorded. When the muddy water was poured into the activated carbon in the filter paper, the filtrate was collected into the beaker and analysed for the level of the contaminants causing pollution of the water. Contaminants such as Lead, Cadmium, Manganese, Iron, Chlorine, Arsenic were analysed and the results are presented in.

The sample of the raw water was subjected to atomic absorption spectrophotometric procedure (Solar 969 model) for the determination of the metals. The instrument was set at appropriate wave lengths current, flame types and then calibrated by the use of standard solutions for each metals (ASTM, 1980) [6].

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3 RESULTS AND DISCUSSION

The developed activated carbon filters from local raw materials such as bamboo and coconut shells were used to filter the sample muddy water. The filtrate was subjected to further examination. The results are as shown in Tables 3 and 4, for the bamboo and coconut shells.

Table 3: The Results using Bamboo Activated Carbon Filter.

S/N	Elements Analysed	Results (ppm)
1	Lead	0.052001
2		0.122001
3	Manganese	0.071001
4	Cadium	0.025002
5	Iron	0.001001
6	Chlorine	0.141001
	Arsenic	

Table 4: The Results using Coconut Shell Activated Carbon Filter

S/N	Elements Analysed	Results (ppm)
1	Lead	0.042001
2	Manganese	0.110001
3	Cadium	0.0501001
4	Iron	0.002002
5	Chlorine	0.0001001
6	Arsenic	0.121001

Table 5: Variation of Sieve Size and Contaminants Removed (Bamboo).

S/N	Sieve Size (m)	%Contaminant
1	800	3.2601
2	425	4.4400
3	300	5.3400
4	212	11.4050
5	75	37.0891
6	< 75	38.5401

Table 6: Variation of Sieve Size and Contaminants Removed (Coconut shell).

S/N	Sieve Size (Um)	%contaminant
1	800	3.1301
2	425	3.2004
3	300	5.5410
4	212	12.0021
5	75	38.0001
6	< 75	39.0020

The results of the physical properties of the raw muddy water confirmed expectations since the pond is situated in an industrial area where waste water is discharged into the pond. The pollutants changed the physical properties. Thus the raw muddy water is not suitable for human use. The conclusion is valid for the elements analysed in Table 2. However the activities of the industrialists in thet area may have been responsible for high level of elementals.

The results of Tables 3 and 4 of the analysed bamboo and coconut activated carbon filter used to filter the muddy water, showed the efficiency of the materials in removing the pollutants from water.

The activated carbon materials used in these filters are effective and reliable in removing pollutants [7]. It may be stated that activated carbon has tremendous capacity for absorbing a wide variety of dissolved organics and chlorine and an ability to be custom-tailored to suit specific application [5].

Tables 5 and 6 indicate that the finer the particles of the activated carbon the more effective it is. The result shows that the coconut shell activated carbon is more effective than the bamboo activated carbon because of its high level of porosity which is due to the iodine strength of about 1000 mg/g [8]. The density of coconut which is higher than that of the bamboo is also a factor [9].

It can be seen from the tables that for coconut shell activated carbon, the contaminants removed are more than those of the bamboo. It is also evident that the coconut shell activated carbon filters the water better, clearer and removes more contaminants, odours and taste more effectively than the bamboo activated carbon. It is also indicated that the smaller the size of the sieve, the finer the particle size, the better the entry to the surface area and the faster the rate of absorption.

4 CONCLUSION

It can then be concluded that activated carbon from local raw materials like coconut and bamboo which are common in Africa can be used to maintain good quality water for human consumption. The work reported in this paper is still going on to study other materials and species on African continent to be activated for carbon filters. This will help the continent in resolving the problem of shortage of potable water.

REFERENCES

[1] Nikoladze, E.D, Nits .M . and Kastalsky A, (1994). Water Treatment for Public and Industrial supply. pp. 14-16.

[2] Wells, R.J. (1977), "Water Quality Criteria and Standards", Water pollution Control, 77, pp.25-30.

[3] Hammer, J.M. (1977), Water quality and pollution waste and Water Technology 2nd Edition, John Wiley and Sons, New York, pp.143-168.

[4] Aeppli; J and Dyer-Smith, P, (1999) "Ozon and Granular activated filtration, the solution to many problems, Ozonia Limited Duebendorf, Switzerland, pp.12.

[5] Robert; T.D., and Mazzoni, A.F., TIGG Corporation, Water filtration, (2008), pp6-15.

[6] ASTM (1980) "American Society for testing and materials". Annual Bron of ASTM Standard Race Street. Philadelphia, U.S.A. pp. 547 - 549.

[7] Bruce, I.D, and Sharon, O.S., (2008), University of Nebraska-Lincoln Extension, Institute of Agriculture and Natural Resources, Drinking Water Treatment, Activated Carbon Filtration, Lincoln, pp 1 - 4.

[8] Michigam State University, (2003), extension bulletin WQ 23, Home Water Treatment Using Activated Carbon U.S.A.

[9] Sokale, A.A. (2009), "Production of Activated carbon in Designed and constructed Anaerobic Furnace, Unpublished Final Year Project Report, Covenant University, Canaanland, Ota.