# UTILIZATION OF CHERRY (CHRYSOPHYLLUM ALBIDIUM) SEED SHELL POWDER FOR THE TREATMENT OF WASTEWATER

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## ABSTRACT

*Cherry seed shell (Chrysophyllum albidium) was de-shelled, air-dried, grounded, and sieved . The powder obtained was characterized in terms of the pH, bulk density, volatile content, ash content, moisture content and surface area. Palm oil mill effluen was characterized and treated using cherry seed shell powder. The result of the powder characterization (pH, 6.4, bulk density, 0.45g/ml, moisture content, 12.5%, volatile content, 4.38%, ash content, 1.27%, and surface area 0.02g/mgI2) revealed that the powder can favourably compete with some commercial grade biomass residues . The result of the parameter studied before and after treatment of the effluent shows that there was a reduction in turbidity values from 17.54mg/l-11.53mg/l, Total solids values from 6748mg/l-5326mg/l, the centrifuged raw effluent had Total solids value of 3124mg/l – 1101mg/l, Total suspended solids raw effluent value of 6396mg/l-5012mg/l, the Total dissolved solids values of raw effluent was 352mg/l-314mg/l. There was also a decrease in the Biochemical Oxygen Demand and Chemical Oxygen Demand values from 6100.43mg/l, 12000.43mg/l-5400.67mg/l, 11400.53mg/l respectively .This results show that cherry seed shell powder is effective in the treatment of waste water such as palm oil mill effluent.*

**Keywords**: POME, cherry seed shell, and adsorption.

## INTRODUCTION

Environmental studies have revealed widespread contamination of water by different chemicals used in the chemical industry during manufacturing process,[1]. These chemicals include organic compounds, heavy metals and other pigments like dyes in the textile industry. Efficient removal of these pollutants from the environment is still a problem. Over the years attempts have been made to provide decolourizing type carbon from raw materials like coal, groundnut husks, coconut shells, palm kernel shell, plantain peel, walnut shells, oil palm empty fruit bunches, Bamboo culms, maize cobs, cocoa pods, saw dusts etc, [4-8]. A wide range of physical and chemical processes is available for the treatment of wastewater, such as electro-chemical precipitation, ultrafiltration, ion exchange and reverse osmosis [6-8]. The problem associating with the use of precipitation is sludge production. Ion exchange, being a better alternative method is not economically appealing because of high operational cost. Adsorption using commercial activated carbon (CAC) from petroleum based materials can used for the treatment of waste water, However, CAC remains an expensive material for wastewater treatments, which has caused interest to be shifted to the use of other low cost and readily available agricultural products as precursor for the preparation of activated carbon. Several workers have reported on the potential use of agricultural by–products as good substrates for the treatment of wastewaters such as fly ash (Nascimento et al., 2009), lignite (Ucurum, 2009), phosphate rock (Saxena and D"Souza, 2006), kaolinite-based clays (Hizal and Apak, 2006), red muds (Wang et al., 2008), sawdust (Sciban et al., 2007), loess soil (Wang et al., 2009), green algae (Gupta et al., 2001), and husk of wheat and rice (Aydin et al., 2008) etc.

This process attempts to put into use the principle of using waste to treat waste and become even more efficient because these agricultural by–products are readily available and often pose waste disposal problems. Hence, they are available at little or no cost, since they are waste products. This makes the process of treating wastewaters with agricultural by–product adsorbents more cost effective Palm Oil Mill Effluent (POME) treatment is an important issue for the minimization of pollution. POME is a highly polluting effluent containing various forms of organics and inorganic suspended solids and characterized by low pH, high Biological and Chemical Oxygen Demands (BOD and COD, respectively) and suspended solids. This waste, if not disposed of properly, will pollute the surrounding environment [3].The palm oil mill effluent comprises a combination of waste water from three main sources in the course of production:

sterilizer condensate, hydrocyclone waste and separator sludge. Cherry seed shell (Chrysophyllum albidium) is a dominant canopy tree of low land mixed rain forest, sometimes riverine. It is widely distributed from West Africa to the Sudan with an east limit in Kakamega forest, Kenya. In Nigeria, Chrysophyllum albidium is distributed throughout the southern part. This present study is aimed at investigating the potentials of cherry seed shell powder in the treatment of palm oil mill effluent. To the knowledge of the authors, there are no reports of previous attempt to produce activated carbon from cherry seed shell for the treatment of palm oil mill effluent

## MATERIALS AND METHODS

Palm oil mill effluent was sourced from a local oil palm mill in Igueben, Edo State, Nigeria. The representative samples were obtained using the composite sampling techniques. The dissolved oxygen was fixed by adding to the sample the winkler solution. Cherry seeds were obtained from Igueben market in Igueben Local Government area of Edo State and air-dried. The air-dried agricultural residue was cut into small pieces and grounded into powder, sieved with a 150µm mesh size. The powdered cherry seed shell was characterized in terms of pH, bulk density, (Ahmedna et al, 1997), surface area, (Okieimen et al 1991), ash content, volatile content, and moisture content. The detailed experimental procedures for the characterization of cherry seed shell powder were given in a previous publication. The palm oil mill effluent (POME) was characterized in terms of the pH, dissolved oxygen (DO), Chemical oxygen demand (COD), Biological oxygen demand (BOD), Electrical conductivity, Total dissolved solids (TDS), Total suspended solids (TSS), Total solids (TS), Turbidity, oil and greases, heavy metals, calcium, Magnesium, Nitrogen and ammonia, using standard methods. The adsorptive properties of the cherry seed shell powder were determined from the treatment of the palm oil mill effluent. The method involved the determination of the listed parameters before and after treatment with the powder using standard procedures (APHA 1971). In a typical experiment, a carefully weighed amount of the powder (about 5g) was mixed with 100ml of raw palm oil mill effluent in a bottle and shaken for thirty minutes after which the mixture was centrifuged to separate the powdered chrysophyllum albidium seed shell from the effluent, filtered and the treated effluent was analyzed.

**RESULTS AND DISCUSSION**

**Table 1**: The characteristics of the powdered cherry seed shell.

| pH | Bulk Density ($g/cm^3$) | Surface Area ($mgI_2/g$) | Ash(%) | Volatile(%) | Moisture (%) | Surface charge ($MmolH^+g^{-1}$) |
|---|---|---|---|---|---|---|
| 5.4 | 0.45±0.01 | 0.02±0.01 | 1.27±0.004 | 4.38±0.04 | 12.50±0.011 | 0.21±0.003 |

The values of the pH of cherry seed shell powder are within the generally acceptable range or values (6-8) in many applications. Biomass residues with extreme pH values are capable of increasing or decreasing pH of slurry to induce undesirable physical/ chemical changes; for instance in cane sugar refining, residues with low pH values could cause the inversion of sucrose to non-crystallisable sugars causing lower yields, while alkaline residues could cause decolouration through alteration of molecular structure of sugar impurities. The values of pH of cherry seed shell powder reported here are comparable with the values reported for rubber seed shell powder (Okieimen et al 2005) and rice husk powder (Okieimen et al 2005). Bulk density is important when biomass residue is to be removed by filtration, because it determines that amount of residue that can be contained in a filter of given solids capacity. Biomass residues with an adequate density also help to improve filtration rate by forming an even cake on the filter surface (Ahmedna et al 2000). The values of bulk density of cherry seed shell powder reported in this study are well within the acceptable range for powdered biomass residues in many applications (B.D 0.45g/cm3). The surface area of cherry seed shell powder was determined by the iodine adsorption method: which is a widely used routine procedure for the determination of surface area of powders. Large surface area is a requirement for good adsorbent. Surface area is a single most important characteristic of biomass residues designed for adsorption of compounds from liquid media. Report of previous studies (Okieimen et al 1991) that attempted to correlate surface area measurements by different methods suggests that the values of iodine number obtained for cherry seed shell powder represent a fairly large surface area. The values of surface area of cherry seed shell powder are comparable with those reported for rubber seed shell (Okieimen et al 2005) and rice husk (Okieimen et al, 2005)

Table 2: The characteristics of the raw and treated palm oil mill effluent using powdered cherry seed shell.

| Parameters | Raw POME | Raw centrifuged POME | Raw POME treated with carbon | Raw centrifuged POME treated with carbon |
|---|---|---|---|---|
| pH | 4.2±0.1 | 4.4±0.2 | 4.5±0.1 | 5.0±0.2 |
| EC, µs/cm | 812±32 | 2573±112 | 758±64 | 1208±164 |
| TDS, mg/1 | 352±89 | 1270±78 | 314±15 | 612±50 |
| TSS, mg/1 | 6396±281 | 1854±167 | 5012±115 | 489±11 |
| TS, mg/1 | 6748±315 | 3124±189 | 5326±215 | 1101±108 |
| Turbidity, mg/1 | 17.54±0.11 | 14.76±1.25 | 12.85±1.18 | 11.53±1.05 |
| Ammonia, mg/1 | 0.175±0.012 | 0.621±0.034 | 0.151±0.061 | 0.574±0.076 |
| Nitrogen, % | 0.45±0.08 | 0.81±0.11 | 0.09±0.01 | 0.54±0.05 |
| Oil/Grease, mg/1 | 690.45±67 | 610.60±41 | 403.53±55 | 408.45±15 |
| DO, mg/1 | 0.00 | 0.00 | 0.00 | 0.00 |
| BOD, mg/1 | 6100.43±278 | 1900.75±101 | 5400.67±544 | 1200.75±178 |
| COD, mg/1 | 12000.43±188 | 4000.22±159 | 11400.53±254 | 2300.42±165 |
| Ca, mg/1 | 2.86±1.04 | 5.47±0.98 | 2.11±0.67 | 4.16±0.77 |
| Mg, mg/1 | 1.97±0.61 | 3.66±0.71 | 1.98±0.78 | 2.75±0.88 |
| Fe, mg/1 | 2.97±1.01 | 3.96±0.55 | 2.36±1.00 | 2.12±1.02 |
| Zn, mg/1 | 0.74±0.05 | 1.03±0.11 | 0.61±0.12 | 0.52±0.25 |
| Mn, mg/1 | 0.21±0.02 | 0.33±0.05 | 0.26±0.11 | 0.27±0.22 |

Table2 shows the treatment levels of the POME by cherry seed shell powder measured in terms of the parameters listed. The pH increases as the level of treatments increases from 4.2 for the raw POME to the 5.0 for the POME treated with the powder. The increase in pH is due to increased surface area of the effluent water. The pH of the raw POME shows that it is not fit for disposal into the immediate environment as it could cause certain environmental hazard or pollution. The treatment shows the ability of the cherry seed shell powder to effectively treat effluent water. The TS, TSS and TDS decrease as the treatment increases as shown in Table 2, this show that there is a considerable reduction of dissolved solids. The results were better with the centrifuged treated effluent. It was observed that nitrate ion was present in the raw POME in a relatively minute percentage, which is capable of causing metheamoglobinanca in infant and as such should be treated. On treatment with the powder, the nitrate ion reduces drastically to 0.03% which is insignificant. The BOD and the COD reduces substantially on treatment with the powder which is an evidence of improved water quality. Also worthy of note is the fact that dissolved and suspended substances contributes to high turbidity values of any waste water, hence the turbidity values the centrifuged palm oil mill effluent gave better result compared to the raw. The ability of powder to remove organic compounds from aqueous solution depends on the structure/surface chemistry of the powder and the polarity of the organic compound (Okieimen et al ,2005). The results in Table 2 show that the cherry seed shell powder is capable of effectively reducing the levels of heavy metals and inorganics from the effluent.

## CONCLUSION

Cherry seed shell powder has been characterized and evaluated in terms of adsorption of POME. The results show that the powder is effective in the treatment of effluents

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