

An Investigation for Removal of Phenol from Aqueous Solution by Using Natural Sources & Activated Carbon

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Abstract – This investigation exhibits removal of phenol from aqueous solution utilizing the carbons arranged from the normal sources, i.e., olive-pit, date-pit, and pomegranate-piece in a batch framework. For correlation reason, the adsorption tests were likewise completed on a commercial activated carbon. Phenol is a natural contamination; the present examination was led to look at the adsorption of phenol. Level of expulsion of phenol expanded as the adsorbent portion increment. Level of evacuation of phenol expanded as the adsorbent portion increment.

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I. INTRODUCTION

Pollution by phenols is a significant natural issue. Phenolic compounds are normal contaminant in wastewater. Phenol is soluble in water and its quality in water supplies is seen as terrible taste and smell in concentration as low as 5 µg/L. Phenols as a class of organics are comparative in structure to the more typical herbicides and bug sprays in that they are impervious to biodegradation. They are generally utilized for the commercial generation of a wide assortment of saps including phenolic gums, which are utilized as development materials for autos and machines, epoxy tars and cements and polyamides for different applications. As per US Environmental Protection Agency (US EPA) phenol establishes the eleventh of the 126 chemicals, which has been assigned as need contaminations. In the meantime, the World Health Organization (WHO) prescribes the passable phenol concentration in consumable waters to 0.001 mg/L. They are hurtful to living beings even at low concentrations. Human utilization of phenol-debased water may prompt protein degeneration, tissue erosion, damaged central nervous framework and eventually hurt significant organs, for example, kidney, liver and pancreas. It is in this manner important to expel phenol totally from wastewater before being released into conduits.

Phenol causes antagonistic consequences for public health and condition. According to United States Environmental Protection Agency (USEPA) the reasonable concentration of phenol in surface water ought to be under 1.0 µg/L. Phenolic compounds are unsafe even at extremely low concentrations due to their harmful and cancer-causing properties. They cause harm to the eyes and the tissue under the skin,

inward breath, or ingestion, can harm the respiratory and gastrointestinal tracts, and can prompt hereditary harm. Phenol is assigned as the eleventh of the 126 need poisons by the United States Environmental Protection Agency. Thusly, it is an imperative prerequisite to treat the phenol from mechanical effluents before releasing into the water stream.

Different treatment techniques, for example, biodegradation, biosorption, layer division, pervaporation, dissolvable extraction, refining, and adsorption utilizing activated carbon arranged from different antecedents had been checked on to expel phenolic compounds from aqueous solution. Adsorption on activated carbon is the most broadly utilized and the best adsorbent in treating phenolic wastewaters. It was clarified that activated carbon can be framed from any carbonaceous strong antecedent material. The ideal physical and chemical properties that can be achieved in the last activated carbon can be overseen by the choice of the beginning material. A wide scope of various materials has been explored as potential adsorbents for phenol expulsion in wastewater treatment. The unmistakable among them involves silica gel, activated alumina, zeolites and red mud.

Aqueous phenolic squanders have been treated for a long time by various strategies including chemical oxidation, chemical coagulation, and extraction with solvents, film innovation, particle trade and adsorption. Among them, physical adsorption strategy is commonly viewed as the best, viable, prudent and most every now and again utilized technique for the expulsion of phenolic pollutions. Various kinds of manufactured and characteristic

adsorbents have been utilized to treat the phenolic wastewater. Consideration has been centered around regular adsorbents (microscopic organisms, growths, yeast, green growth, farming side-effects, and wood side-effects), which have great retention limits because of huge surface area, homogeneous pore size, very much characterized basic properties, specific adsorption capacity, simple recovery, and different employments. Adsorbent strategies has been additionally connected for expulsion of DDT, cyanide, copper, mercury, shading colour and so on. Among them squander biomass consider to be effectively accessible in practically all area with sensible cost. The significant part of biomass like lignin, cellulose and hemicellulose gives huge surface zone and better connection with fragrant natural compound.

In this investigation, olive-pit (OP), date-pit (DP), pomegranate-part (PK), and commercial activated carbon (AC), for examination intentions, were picked as adsorbents for the expulsion of phenol from aqueous solutions in a batch framework. Impacts of the various parameters, for example, pH, adsorbent dosage, contact time, phenol beginning concentration, and temperature on the adsorption rate were tentatively researched. Some adsorption isotherm models were picked to assess the adsorption limit. The phenol adsorption process was examined utilizing the motor, thermodynamic, and spectroscopic (FT-IR) information.

II. EXPERIMENTAL

Materials and Apparatus

Phenol (mass fraction > 0.99) was bought from Chem-Lab NV Belgium. The commercial activated carbon was acquired from Merck Company. Deionized water was utilized in all experiments. The stock solutions of phenol (1000 mg l⁻¹) were set up by dissolving precisely weighted phenol in deionized water. The stock solutions were set up in 500 ml volumetric carafe at room temperature. The testing solutions were set up by weakening the stock solutions to legitimate concentrations. The example weighting was done with an AND electronic logical equalization (model HR-200) with a precision of ±0.0001 g.

The aqueous solutions of phenol with realized arrangements were put in a round jug cup and were disturbed by a shaker at a steady speed of 150 rpm. A temperature controlled water shower shaking was utilized for all experiments. An advanced pH meter Genway model 3505 was utilized for assurance of pH. All experiments were performed at room temperature. The lingering phenol concentration was investigated utilizing a Cary 100 UV-Vis twofold shaft spectrophotometer at room temperature at 270 nm. FTIR of adsorbent was resolved utilizing a BrukerAlpha spectrophotometer by the KBr plate strategy.

Preparation of the Carbon

Gathered cores of olive, date and pomegranate were first washed a few times with deionized water to wipe out the debasements. The shade of pits was evacuated by dunking in CH₂CO (Merck) for 4 days. Then, the pits were washed well with water and dried at 110 °C for 6 h. The spotless and dried examples were pounded and put in a fixed clay stove independently. The pomegranate, olive, and date pits were warmed to 400, 500 and 600 °C for 2 h, individually. Arranged carbon was processed and sieved through a 30-work size, and were put away in a vacuum desiccator.

III. EXPERIMENTAL PROCEDURE

The aqueous phenol solutions were set up with realized concentrations by weakening the stock solution in 50 ml volumetric flagons. The underlying concentrations of phenol were in the scope of 25-300 (mg l⁻¹). The test phenolic tests were researched and the acquired experimental information were utilized to compute the adsorption isotherm models. The pH of the solutions was balanced with sodium hydroxide and hydrochloric corrosive. The impact of pH on phenol adsorption was performed in the different pH estimations of 2 to 12. The subsequent stage was expansion of exact weighing of every adsorbent in the testing solutions. The adsorbent dosage was considered in various qualities: 0.05, 0.2, 1, 1.5, 2, 2.5 and 3 g.

The readied batch frameworks were unsettled at a steady rate (150 rpm) in a temperature-controlled shaker. The contact times or mixing times were set to be 15, 30, 45, 60, 90, 120, 150, 180 min. The experimental information were then used to decide the equilibrium time, which will be utilized in assurance of adsorption models. After the ideal occasions (blending times), the strong materials (adsorbent) were isolated from their solutions with channel paper and axis. The last concentration of every solution was spectrophotometrically decided. The adsorption limit of phenol q (mg of adsorbate/g of adsorbent) was determined utilizing the accompanying equation

$$q = \frac{(C_0 - C_e)V}{m}$$

where V is the volume of the solution in terms of L, C₀ the initial concentration (mg l⁻¹), C_e the equilibrium concentration (mg l⁻¹), and m is the weight of the adsorbent (g). The phenol removal percentage was calculated by

$$\text{Removal\%} = \frac{(C_0 - C_e)}{C_0} \times 100$$

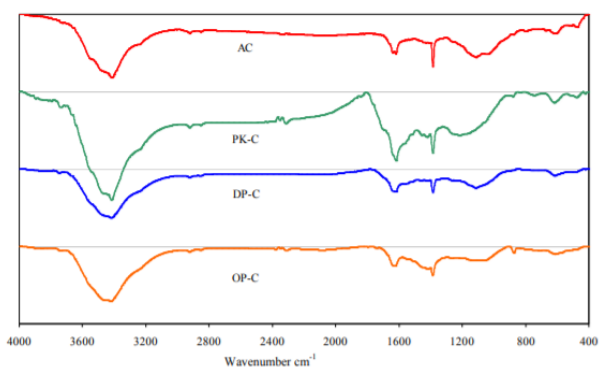


Figure 1. FTIR spectra of the studied adsorbents

IV. RESULTS AND DISCUSSION

Characterization Result

In this work, Fourier change infrared (FT-IR) and scanning electron microscopy (SEM) were utilized to describe the adsorbents (olive-pit, date-pit, pomegranate-piece carbons and commercial activated carbon).

FTIR

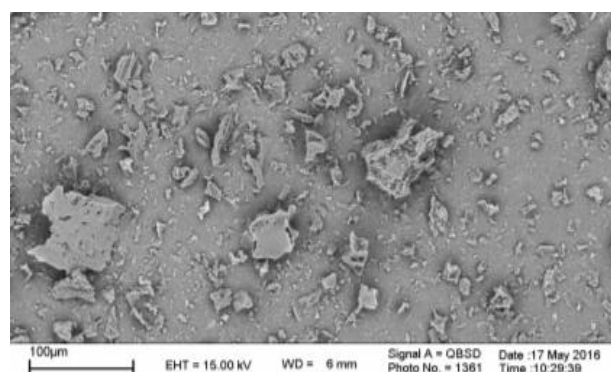
So as to acquire a qualitative analysis of the fundamental functional groups that are associated with the adsorption procedure, the FTIR transmission spectra of the examples were recorded on a Bruker-Alpha spectrophotometer utilizing the KBr circle strategy. The FTIR spectra of the adsorbents are thought about and appeared in Fig. 1. As it tends to be seen from the figure, the wide band at around 3400 cm^{-1} can be credited to the extending vibrations of the surface hydroxyl groups or the adsorbed water. The

band saw at around 1630 cm^{-1} compares to the $\text{C}=\text{C}$ extending vibration in the fragrant ring. This band additionally could be credited to the H-O-H extending vibration of consumed water. The watched frail band at 2920 cm^{-1} is doled out to the C-H extending mode, began from the surface. The oxygen-containing functional groups can give various adsorption destinations, and therefore, increment the adsorption limit with regards to phenol atoms.

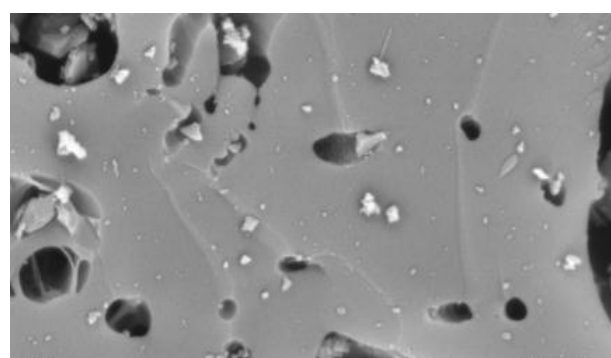
SEM

In this work, scanning electron microscopy (SEM) imaging was utilized to describe the surface morphology of the adsorbents. The pore structures of OP-C, DP-C, PK-C, and AC are appeared in Fig. 2, 3 & 4, individually. The pictures were recorded at various amplifications so as to envision the general example and the morphology of the carbon. It very well may be seen from the micrographs that the surface of the adsorbents is around harsh and are moderately composed with pores of various sizes and shapes. Fig. 4 shows that the outside surface of the AC is heterogeneous with permeable structure that giving

enormous surface zones. The pictures caught from AC surface affirm the high porosity of AC particles and shows diverse pore structures contrasted and the other adsorbents surface. From the SEM pictures, it very well may be seen that DP-C is exceptionally permeable and its morphology is progressively like the commercial AC contrasted with OP-C and PK-C. Along these lines, DP-C may be relied upon to demonstrate a higher productivity in phenol evacuation. The porosity of OP-C is lower than that of the other adsorbents.

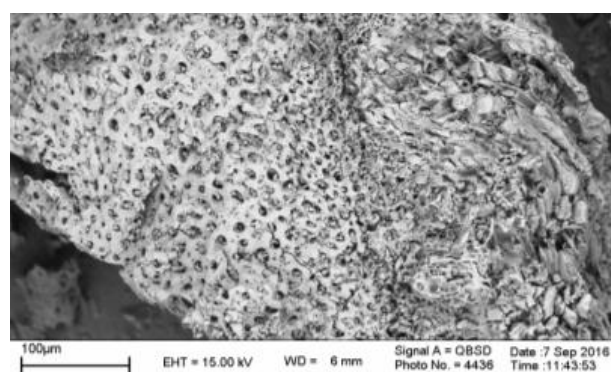


(a)

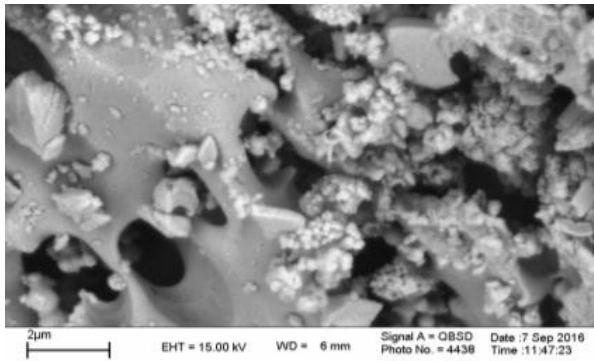


(b)

Figure 2: SEM images of the carbons produced from (a, b) olive-pit

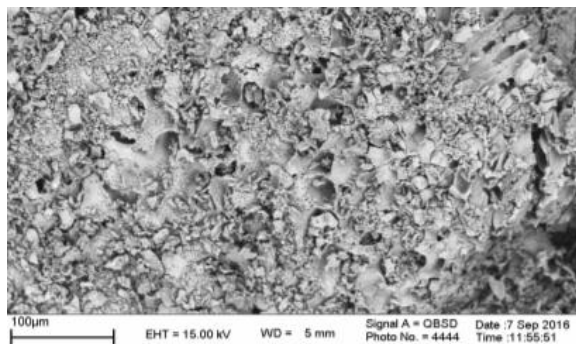


(a)

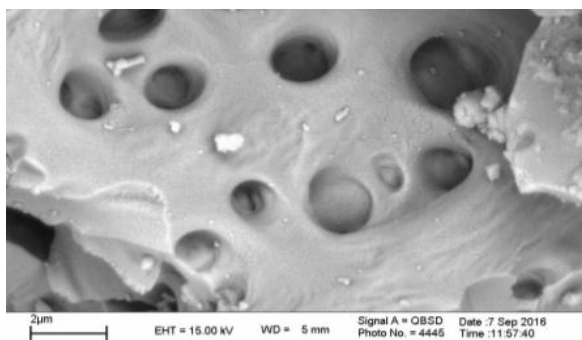


(b)

Figure 3: SEM images of the carbons

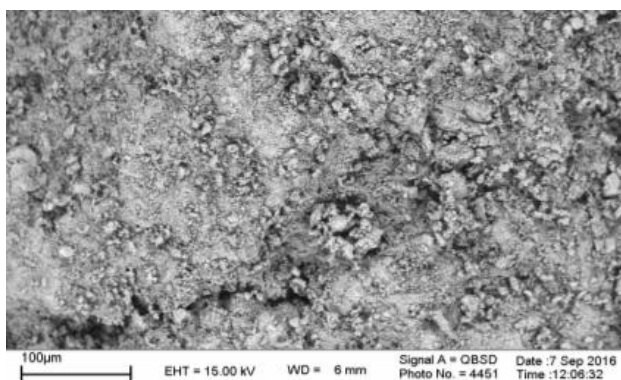


(a)

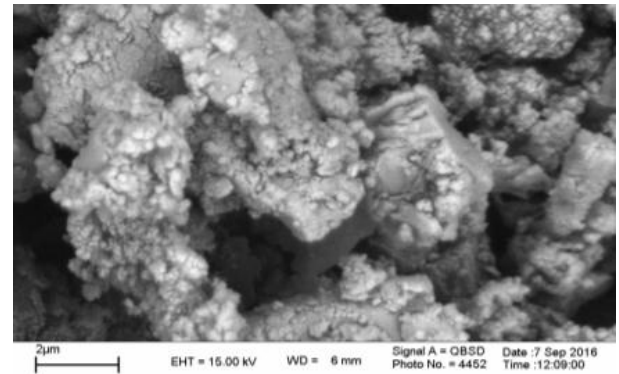


(b)

Figure 4: (a&b) SEM images of the carbons produced from pomegranate-kernel



(a)



(b)

Figure 5: SEM images of the carbons produced from (g, h) the commercial activated carbon at the two different magnifications

V. CONCLUSIONS

The viability of carbons arranged from olive-pits, date-pits and pomegranate-part for the expulsion of phenol from aqueous solution was assessed and contrasted and that of commercial activated carbon. The ideal pH for the maximum phenol adsorption onto delivered carbons and commercial activated carbon was acquired 2 and 5, individually. The ideal adsorbent dosages were seen at the amount of 2.5 g and 1.5 g for OP-C, PK-C, separately, and 0.5 g for DP-C and AC. The kinetics and equilibrium information for the adsorption of phenol were acquired and fitted to the two sorts of active and isotherm models. The experimental information was fitted to a pseudo second-request model well and the equilibrium information pursued the Freundlich isotherm. Thermodynamic examinations exhibit that the phenol adsorption is unconstrained and exothermic, and the adsorption procedure is physical in nature. It was discovered that among the delivered adsorbents, the carbon from date-pit has higher productivity than that of the other adsorbents. The present investigation presumes that olive-pit, date pit and pomegranate-part carbons arranged under these conditions can be utilized adequately for the expulsion of phenol from aqueous solutions as a result of ease and locally accessible adsorbents. The result of this examination proof that biosorbent (activated sawdust) can be utilized in tertiary treatment for the adsorption of phenol from mechanical effluents release. The utilization of reaction surface philosophy gives significant data on co-operations between the components and furthermore serves to the acknowledgment of conceivable ideal estimations of the contemplated variables.

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