



Short Communication

Preparation of Low Cost Activated Carbon from Tea Waste using Sulphuric Acid as Activating Agent

Wankhade Amey A. and Ganvir V.N.

Department of Petroleum Refining and Petrochemical Technology, Laxminarayan Institute of Technology, Nagpur, MH, INDIA

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Abstract:

Adsorption is an important surface operation in unit operation and unit processes. Among many type of adsorbent material activated carbon are the most widely used, because of their large adsorptive capacity. Cost is an important parameter for comparing the adsorbent material. Among many such materials like turmeric waste, ferronia shell waste, Jatropha curcus seed shell waste, delonix shell waste and ipomea carnia stem, Tea waste is one such alternatives which is cheap easily available. Activated carbons tea waste prepared by chemical activation with sulphuric acid as an activating agent. The effect of activation parameter such as carbonization temperature, sulphuric acid concentration; contact time on the final products was studied by varying the H₂SO₄ to tea waste ratio, activation temperature and preheat temperature.

Keywords: Tea waste, activated carbon, adsorption, unit operation, unit processes.

Introduction

Comprising over two third of the earth surface, water is the most precious natural resource that exist in our planet. We humans, recognize this fact, on the contrary polluting our rivers, lakes and oceans. As a result we are harming our planet and organism die at very alarming rate. Today, the idea of utilizing biomass from agricultural and livestock waste as a raw material for the production of activated carbon is the topic of interest for most of the researchers specially from agricultural base. Many agriculture residues such as coconut husk, turmeric waste, ferronia shell waste Jatropha curcus seed shell waters, delonix shell waste, ipomea carnia stem, rice husk, jack fruit peel, bamboo, cow dung have been prove suitable for the production of activated carbon¹.

Activated carbon is particularly useful and commonly used owing to their large adsorption capacity, fast adsorption kinetics, relative ease of regeneration. Inexpensive source and cost effective preparation method are in demand because of the importance of adsorption in pollution control².

Activated carbon has been recognize as a highly effective adsorbent for the treatment of heavy metal in waste water but is readily soluble under extreme pH condition.

In recent years, tea waste is also gaining grounds due to its potential to overcome heavy metal pollutants. The cell wall of tea consist of cellulose and hemicelluloses, lignin, condensed tannins and structural proteins. In short, tea waste have a good potential as metal scavengers from solution and waste water since its constituents contain functional group. Wasewar et .al studied the adsorption of Zn on Indian TFW³.

Malkoc and Nuhoglu et.al studied the feasibility of tea factory waste (TFW) as an adsorbent for removal of chromium in fixed bed⁴.

Amarasinghe and Williams⁵ use tea waste as a low cost adsorbent for the removal of Cu and Pb from waste water.

In this paper a review is made on potential of tea waste as a low cost adsorbent for the removal of toxic metal were discussed.

Material and Methods

Material: The raw material used for preparation of activated carbon is tea waste.

Method: Activated Carbon preparation: This includes preparation method of activated carbon from tea waste. Tea waste was taken from the waste tea leaves after tea making process. The tea waste was washed several times with distilled water to remove surface impurities and dried at 100°C. This tea waste were directly collected from houses, cafetries, tea stalls, hotels. This tea waste are then dried and digested by using sulphuric acid followed by carbonization in muffle furnace.

Preparation of sample: All the tea waste are collected from house, cafes. This tea waste is first dried in the sunlight for 20 days. This naturally dried material then kept in the oven for 12 hours at the temperature 50°C.

Digestion of the sample: 100gms of sample is crushed manually. Dil. Sulphuric acid solutions are prepared. 70 ml of acids are utilized to digest the tea waste. This is kept at 30°C for 12 hours.

Washing of the Digested sample: The digested tea waste were washed using distilled water, 10 to 12 washings were given.

Determination of pH: The determination of pH of the carbonized material had been done.

Carbonization of the sample: The whole sample is taken in a container and kept at 500°C in muffle furnace for 15 minutes. Then oversize and undersize particle is separated by using 300 meshes.

Feed container: The feed container was a Crucible which could sustain temperature 500°C and above.

Desiccators: The activated carbon was collected in air tight packets kept inside the desiccators. It keeps activated carbon moisture free.

Sieving: The carbon obtain from above procedure was crushed manually and passed through the 300 mesh sieve plate to produce carbon of uniform size.

Results and discussion

The studies were carried out with potential adsorbent obtained from tea waste to evaluate its properties as an adsorbent.

The parameter chosen for the study and their variations on the adsorption are depicted in the following manner.

The parameters are: carbonization temperature, pH of the adsorbent, XRD Analysis

Effect of carbonization temperature: One of the most important parameter affecting the surface characteristics of the carbon is the carbonization temperature. The carbonization carried out at 400°C to 550°C. At 400°C incomplete carbonization takes place, at 450°C complete carbonization takes place and at 550°C the material gets converted into complete ash form while at remaining temperature carbon formation occurred. On sieve analysis two particle sizes obtained i.e. through and above 300 mesh sizes. It is observed that with the increasing temperature from 400°C to 550°C the tea waste get converted into carbon and nitrogen packing has been provided.

The optimum carbonization temperature for the preparation of the adsorbent was found to be 500°C. The results are shown for adsorbent with carbonization temperature 500 °C.

pH of the adsorbent: pH of the adsorbent is one of the most important factors as we treat the feed with acids and other chemicals therefore it is necessary to maintain the neutral pH.

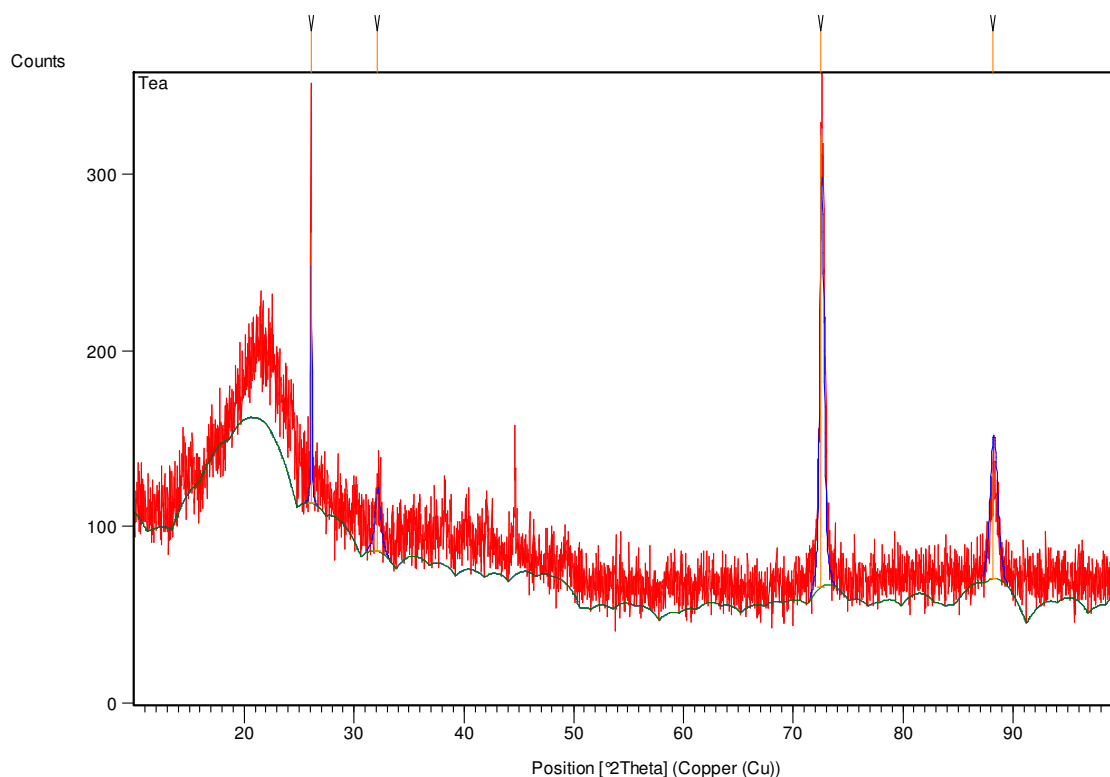


Figure-1
XRD of tea waste (Feed)

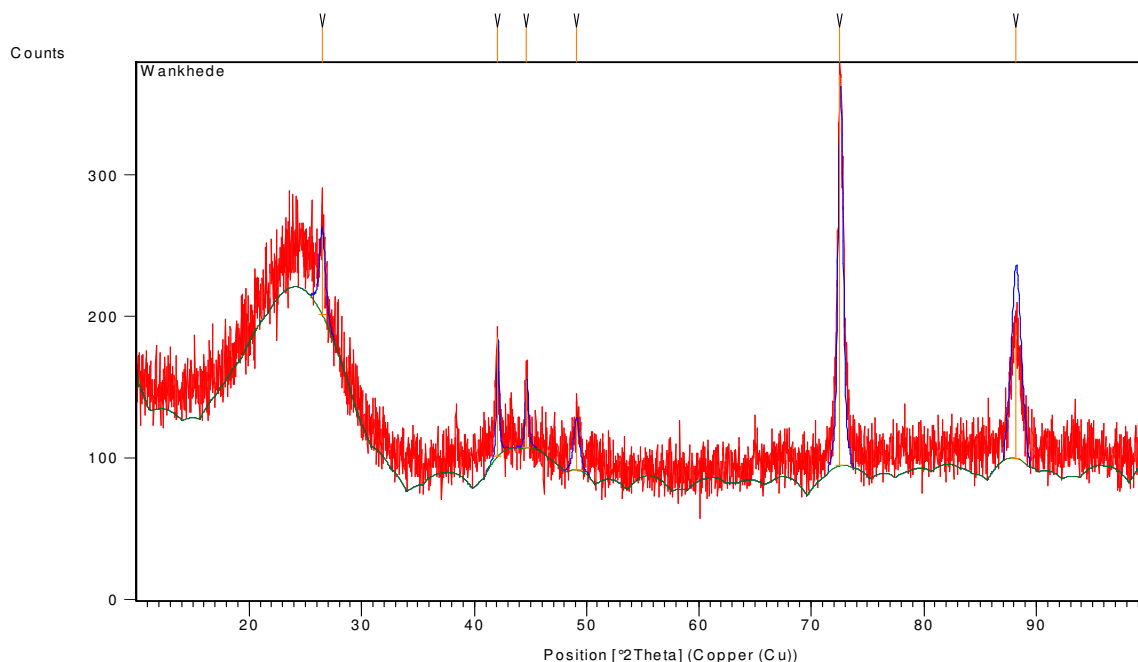


Figure-2
XRD of Product activated carbon(tea waste)

The above graph shows the phase change from amorphous to crystalline form by the change in peak height.

Conclusion

The activated carbon prepared at carbonization temperature 500°C, carbonization time 15 mins and sulphuric acid as an activating agent gives the good surface area and also shows the crystalline phase in the activated carbon.

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