

# Preparation of Activated Carbon from Bitter Orange Peel (Citrus Aurantium) and Preliminary Studies on Its Characteristics

Roopa.D

Student M.E.Environmental Engineering (Department of Civil Engineering)  
Gnanamani College of Engineering, Namakkal

**Abstract**— Bitter orange, Seville orange, sour orange, bigarade orange, or marmalade orange refers to a citrus tree the botanical name for bitter orange is Citrus aurantium. It is a hybrid between Citrus maxima (pomelo) and Citrus reticulata (mandarin). Many varieties of bitter orange are used for their essential oil, and are found in perfume, used as flavouring or as a solvent. The Seville orange variety is used in the production of marmalade. Bitter orange is also employed in herbal medicine as a stimulant and appetite suppressant, due to its active ingredient, synephrine. This work explores the feasibility of bitter orange, a biomass as an alternative precursor for preparation of activated carbon with sulphuric acid activation ( $H_2SO_4$ ) as activating agent at relatively low temperatures such as 90, 120, 150 were used to produce different activated Carbons and finally 150C for 30min were used for the study purposes. The effects of the operational parameters were investigated with reference to the CAC value. In addition to this, physical characterization of the same was done to determine its bulk density, ash content, moisture content, ion exchange capacity, matter soluble in water and matter soluble in acid. Further this activated carbon is used to remove the heavy metal that is present in water.

**Index Terms**— Citrus aurantium peel, Chemical activation, Commercially activated carbon (CAC), Muffle furnace, concentrated Sulphuric acid,.

## 1 INTRODUCTION

Activated carbon also called activated charcoal or activated coal, is a form of carbon processed to have small, low-volume pores that increase the surface area available for adsorption or chemical reactions. Activated is sometimes substituted with active. Due to its high degree of micro porosity, just one gram of activated carbon has a surface area in excess of 500 m<sup>2</sup>(5,400 sq ft), as determined by gas adsorption. An activation level sufficient for useful application may be attained solely from high surface area; however, further chemical treatment often enhances adsorption properties.

Activated carbon is usually derived from charcoal and, increasingly, high-porosity bio char. Activated carbon is used in gas purification, decaffeination, gold purification, metal extraction, water purification, medicine, sewage treatment, air filters in gas masks and respirators, filters in compressed air and many other applications.

### 1.1 Production of Activated Carbon

Activated carbon is carbon produced from carbonaceous source materials such as nutshells, coconut husk, peat, wood, coir, lignite, coal, and petroleum pitch. It can be produced by one of the following processes:

### 1.2 Physical reactivation:

The source material is developed into activated carbons using hot gases. Air is then introduced to burn out the gasses, creating a graded, screened and de-dusted form of activated carbon. This is generally done by using one or a combination of the following processes:

- Carbonization: Material with carbon content is pyrolyzed at temperatures in the range 600–900 °C, usually in inert at-

mosphere with gases like argon or nitrogen

- Activation/Oxidation: Raw material or carbonized material is exposed to oxidizing atmospheres (oxygen or steam) at temperatures above 250 °C, usually in the temperature range of 600–1200 °C.

### 1.3 Chemical activation:

Prior to carbonization, the raw material is impregnated with certain chemicals. The chemical is typically an acid, strong base, or a salt [12] (phosphoric acid, potassium hydroxide, sodium hydroxide, calcium chloride, and zinc chloride 25%). Then, the raw material is carbonized at lower temperatures (450–900 °C). It is believed that the carbonization / activation step proceeds simultaneously with the chemical activation. Chemical activation is preferred over physical activation owing to the lower temperatures and shorter time needed for activating material.

## 2 OBJECTIVE

The present study is aimed at preparing carbon from bitter orange peel by chemical activation procedure and will be tested to study the carbon characteristics of converted material.

1. The bitter orange peel is removed from fruit and dried for 6 to 7 days and washed to remove the impurities present in the bitter orange peel and again dried for 2 to 3 days.
2. The concentrated sulphuric acid will be added to the peel to turn it has activated carbon.
3. Now, the peel is subjected to heat in the furnace for 150C for 30 min for the complete conversion of activate carbon.
4. Carbon characteristics & CAPC will be found out to understand the potential of the carbon using ISI procedure 877-1976.

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### 3 METHODOLOGY

#### 3.1 Preparation of Carbon

The bitter orange is obtained from nearby market was peeled off and sun dried for period of 6 to 7 days and washed with water to remove impurities present in it. Again it is sun dried for another 2 to 3 days to remove moisture in it. The dried peel is again oven dried to remove additional moisture in it. Now the peel is taken in the crucible and conc sulphuric acid is added to it and heated in the electrical furnace and maintained the oven temperature range in 100 to 150°C. the peel is subjected to heat for 10 to 15 min and converted into carbon. This chemically activated carbon was transferred to a beaker and cooled to room temperature and washed with distilled water several times to remove the acid content in it and dried in hot air oven to remove moisture in it.

#### 3.2 Step by Step Illustration of Activate Carbon Preparation from Bitter Orange Peel

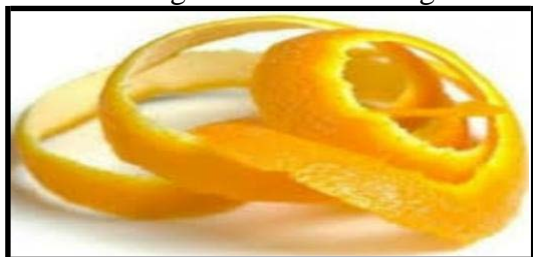
Bitter orange



Collection of bitter orange



Peeling off the bitter orange



Drying of Bitter orange Peel



Dried Bitter orange peel



Addition of Concentrated sulphuric acid to bitter orange peel



Activated bitter orange peel carbon from furnace



### Characteristics of Activated Carbon from Bitter Orange Peel and Comparison from Commercially Activated Carbon

Sl.No	Control tests	CAPC	CAC
1	Bulk Density (gm/ml)	0.61	0.62
2	Moisture (%)	17.5	5.85
3	Ash (%)	6.40	2.00
4	Solubility in water (%)	2.1	0.44
5	Solubility in (0.25M) HCL (%)	16.90	2.24
6	PH	5.90	8.00

## 4 CONCLUSION

1. Hence the activated carbon from bitter orange peel by chemical activation process has been successfully completed and the carbon characteristics of activated bitter orange have been studied.
2. It has been identified that the concentrated sulphuric acid when added to the peel and heat in the furnace for 150oC for 30 min it turns to activated carbon.
3. Activated carbon of the bitter orange peel showed the similar characteristics to that of carbon arc cutting which is commonly used for waste water treatments.
4. Hence the further study may be done for the removal of heavy metals from the waste water by using the bitter orange peel activated carbon.
5. Hence the waste bitter orange peel may be effectively used to remove the heavy metals from waste water.

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