

# ADSORPTION OF TANNIC ACID AND GALLIC ACID BY ACTIVE CARBONS

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## INTRODUCTION

Chlorination of water which is a method to purify water for domestic supply, followed by exposure to sunlight results in the formation of chloroform in quantities which are harmful to human beings when water contains small amounts of tannic or gallic acid. Thus the removal of tannic and gallic acid from domestic water supply by adsorption on carbons is an important aspect of water pollution control.

## EXPERIMENTAL

Five samples of commercial grade activated carbons have been used in this study. Three of these carbons have been prepared from coconut shells (Carbons A, B & C) and the other two (Carbons D and E) from pine wood. 0.5g of each of the carbon sample was placed in contact with 50ml solutions of tannic and gallic acid of different concentrations. The concentration of the solution before and after adsorption was determined spectrophotometrically.

## RESULTS AND DISCUSSION

The adsorption isotherms of tannic acid at 30°C from its aqueous solutions with concentration varying between 5 and 50 ppm. on different activated carbons indicate (e.g. Fig.1) that all the carbons adsorb appreciable amounts of the acid, the extent of adsorption varying with the nature of the carbon.

When the activated carbons are degassed at 700°C and 1000°C, the adsorption of tannic acid decreased in both cases. However, the extent of decrease in adsorption between the original and the 700°C - outgassed carbons is much larger compared to the extent of decrease between the 700°C and 1000°C - outgassed samples. It appears that the degassing at 700°C which results in the elimination of almost all the surface oxygen groups which are evolved as CO<sub>2</sub> (CO<sub>2</sub>- complexes) causes a larger decrease in adsorption while the removal of oxygen structures which are evolved as CO (CO-complexes) on evacuation between 700 and 1000 C result in only a small decrease in adsorption of tannic acid. These two types of surface oxygen groups are different. The former surface groups are acidic in character and render the carbon surface polar in character while the latter groups are neutral and make the carbon surface benzophilic. It is evident, therefore, that the adsorption of tannic acid which is polar in character is influenced to a larger extent by the polar oxygen structures (CO<sub>2</sub>- complexes).

This receives further support from the adsorption isotherms of tannic acid on activated carbon samples oxidised with nitric acid, hydrogen peroxide and ammonium persulphate. These oxidative treatment result in the formation of surface oxygen groups. The acidic surface groups are formed

in greater proportions compared to the non-acidic surface groups.

It is interesting to note that the adsorption of tannic acid on all the carbons increases appreciably when the carbons are oxidised. The adsorption is maximum in the case of oxidation with hydrogen peroxide although nitric acid oxidation results in the chemisorption of a larger amount of oxygen. This is probably due to the fact that oxidation with nitric acid is a very drastic oxidative treatment and causes a damage to the micro-porous structure of the carbon.

The increases in the adsorption of tannic acid on oxidised samples is much larger in the case of carbon samples, A, B and C while the increase was

smaller in the case of the carbon samples D and E although carbon D and E have a larger surface area. Incidentally the amount of associated oxygen with the oxidised carbon A, B and C is much larger compared with that associated with carbons D and E. It appears that the adsorption of tannic acid is determined by the amount of associated oxygen. As the oxidation predominantly enhances the acidic surface oxygen groups, the adsorption of tannic acid is more sensitive to the presence of acidic surface groups on carbons.

The adsorption isotherms of gallic acid on the activated carbons are similar to those obtained for tannic acid except that the extent of adsorption is different. The adsorption decreases on evacuation and increases on oxidation.

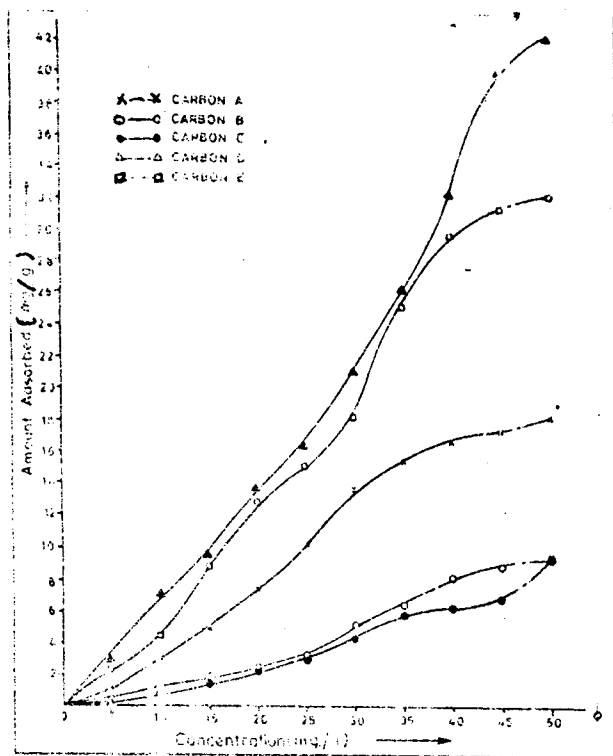


Fig.1 Adsorption Isotherms of Tannic Acid on Different Active Carbons