SUMMARY & CONCLUSION
Summary & Conclusion

The use of two different samples of activated carbon as adsorbents for following ten common textile dye solution of varying concentration were studied: -

Green B
Olive BGL
Acid Violet 90 (MB)
Acid Blue MTR
Reactive Blue 221
N Blue RGB
Eosin YWS
Metanil Yellow
Acid Yellow 2GLN
Acid Yellow RR

It is was found that:

- Adsorption was better in low dye concentration.
- More amount of dye was adsorbed on activated carbon sample C₁ as compared to that on C₂.
- Adsorption was higher at an acidic pH.
- Adsorption followed both Langmuir and Freundlich isotherms.
- Adsorption was higher in static-batch process as compared to that in dynamic-continuous process.
- In the continuous process, adsorption was higher at a slower flow rate as compared to that at a faster flow rate.

It was observed that percentage removal of dye decreased with increasing initial concentration from 10mg/L to 100mg/L with a constant activated carbon dose of 1gm/50ml of dye solution. Where it was seen to be as high as 91% at 10mg/L concentration it fell down to 36% at 100mg/L concentration as was seen in the case of the dye Acid Violet.
Different samples of carbon or any adsorbent for that matter can have different amounts of pores or adsorption sites. This was true for the activated carbon samples C1 and C2 used in this experiment. Dye adsorption on activated carbon sample C1 was higher as compared to adsorption on carbon sample C2. This behavior can be attributed to the relationship between the effective surface area of the adsorbent particles and their sizes. C1 had a smaller particle size. The effective surface area increased as the particle size decreased and consequently the saturation capacity per unit of mass adsorbent increased. For small particles a large external surface area is presented to the dye molecules in solution which results in a lower driving force per unit surface area for mass transfer than when larger particles are used [97A, 42A].

Al-Degs et al. [6] have also explained that differences in capacities of adsorbents for same adsorbate are caused by their surface properties. The surface of adsorbent materials can contain not one but at least five markedly different types of surface groups such as carboxylic, lactonic, phenolic, carbonyl, and etheric types. Different samples of activated carbon can show higher or lower adsorption capacity towards a range of organic dyes/pollutants. This reactivity arises from the complexity of the chemical surface.

The maximum removal of dyes was observed at acidic pH. At acidic pH values, the adsorbent tends to form an aqua complex to yield a positively charged surface. The ionic dye consequently releases colored dye anions/cations in solution, which in turn is influenced by the solution pH agents [124]. At acidic pHs there is an increase in concentration of the H⁺ ions in dye solution. The OH⁻ ions on adsorbent surface tend to be neutralized by protonation which facilitates the diffusion of dye molecules in the vicinity of the adsorbent.

The positively charged surface sites on the adsorbent favor the adsorption of dye anions due to the electrostatic attraction. Thus the surface charge on the adsorbent and the solution plays a significant role in influencing the capacity of an adsorbent towards dye ions. Having an excess positive charge on their surface activated carbon had a greater capacity to adsorb dyes when the solutions were made acidic.

Lower adsorption at alkaline pH is due to the presence of excess OH⁻ ions competing with dye anions for adsorption sites. As the pH of the system decreases number of negatively charged surface sites increases.
It was seen that the adsorption followed both Langmuir and Freundlich isotherms although considering the value of $r^2$ Freundlich equation gave a better fit [17A]. It symbolized monolayer and a favorable adsorption.

This study can be the basis of the amount and brand of carbon to be used, the time of contact with the carbon and the stage at which the carbon should be introduced in the technological process. When the breakthrough point has been reached and the adsorption efficiency of the carbon has decreased, the spent carbon can be replaced or reactivated for reuse.

Thus, it is seen that carbon has good potential for adsorbence of dyestuffs. Being less expensive and easily available it can be used effectively in a commercial system.