CHAPTER VI

CONCLUSION
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Hydroxyl-ion concentration has been found to be a significant factor in the adsorption-desorption of ionic species (dyestuffs) from aqueous solution. A partial explanation of this effect is afforded by the fact that the mobility and adsorptive properties of the ionic species are affected by pH. However, studies on the uptake of dyestuffs by chromatographic alumina of varying pH have indicated that pH effect is more than what can be explained in terms of simple variations in sorbate species.

The studies reported in the Thesis have focussed on more complete elucidation of the nature of the interaction between the hydroxyl-ion and hydroxyl-ion on chromatographic alumina. Both the rate and extent of the process have been studied as a function of several variations to obtain data which should contribute to a meaningful interpretation of pH effects on the adsorption-desorption of dyestuffs by alumina (Chapter III & IV).

From the account of chromatographic separations of certain mixtures of dyestuffs (Chapter V) using alumina of varying surface pH as adsorbent, an analytical application of the adsorption-desorption investigated could partly be demonstrated, besides of course, the
attempt of unfolding the mechanistic part of the phenomena in the cases studied. The chromatography-oriented studies are bound not only to be of analytical use but also equally useful in the development of surface science. The fresh approach in the column chromatography of the dyes described may be treated as a departure from our present trend of trial & error.

Some of the characteristic observations of the present investigation may be concluded as follows.

(1) **Ion-exchange properties of chromatographic alumina pre-treated with an acid or alkali.**

Oxides usually contain some adsorbed water, and hydration of the oxide surface invariably occurs upon immersion in the aqueous solutions from which ion-exchange reactions are studied. The effect of the pretreatment (hydrochloric acid or aqueous sodium hydroxide), however, is not to convert the amphoteric oxide to ion-exchanger but simply to convert the substrate from the H⁺ and OH⁻ forms to respectively the Na⁺ and Cl⁻ form. The mechanism of adsorption of organic electrolytes (dye stuffs) by alumina of varying pH is primarily of ion-exchange. Of course, the other sorptive mechanisms cannot be ruled-out completely. By the experimental procedure adopted (Chapter II) alumina of pH 3.5 - 11.5 could be prepared. As alumina of pH < 3.5 & pH > 11.5 could not be possible, the investigations are restricted to the pH range. The ion-exchange properties are favoured by low pH (Chapter III), whereas
at high pH (Chapter IV) cation-exchange characteristics result.

The kinetics of adsorption is markedly dependent on pH of the substrate and nature of the sorbate molecule. Thus, in general, at pH \(< 5.6 \& 8.6\), the exchange reactions appear to occur in two stages, rapid exchange at sites on the alumina surface followed by slow exchange at sites within the alumina i.e., film diffusion.

(2) Micro-porous nature of alumina

The micro-porous nature of chromatographic alumina, although recognised, has not been paid much attention. The solid substrates (alumina of varying pH) have very fine pores which are penetrated only slowly and with difficulty by large organic dye-molecules. It may be said that these fine pores give the conditions for the C-isotherm (practically linear) over some part of the concentration range \(^2,^3\). It has been observed that the dyes J R, BB & BV show linear portion in the adsorption isotherms at certain pH values of the substrate e.g., J R at pH 11.3 (Fig 11), BB at pH 10.6 (Fig 12), BV at pH 11.0-11.3 (Fig 13). It is, therefore, likely that diffusion of the dye-stuffs into the micro-pores affects the kinetics & degree of adsorption. The degree and rate of desorption also appear to be affected by the micro-porous nature of alumina. The desorption data recorded in Chapter III & IV indicate that the systems investigated in many cases are not completely reversible.
at certain pH values, during 24 hr contact with the desorbents. It is likely that they may be reversible, but only very slowly, because of the marked porosity of the substrates.

(1) Temperature effects:

Adsorption is essentially an exothermic process, and hence should be favoured by low temperature. If, however, the heat of adsorption is low e.g., in ion-exchange or van der Waal's adsorption, then the effect of temperature is less marked. The temperature-variation studies of the dyestuffs conducted (30°C-60°C) have shown (Chapter III & IV) that in many cases the adsorption is anomalous in being greater at high than at low temperature. This appears to be due to aggregation of the dyes in solution. The behaviour is also reflected by the greater \(Y_m\) values, as discussed under the heading 'Results & Discussion' of Chapter III & IV.

It is rather well known that high temperatures favour disaggregation of dye molecules in solution, and it is likely that the dye molecules are reaggregated on adsorption. In the present investigation, in which the adsorption is rather rapid in the initial stages the monodispersed dye-species will tend to be preferentially withdrawn from solution, since their smaller size will enable them to pass more easily and more quickly than micelles through the pores. The action of high temperature
Dehydration

During the dehydration process, the surface area decreases. This is due to the decrease in the proportion of water adsorbed on the surface. The decrease in surface area may also contribute to the decrease in the proportion of water adsorbed. The decrease in the proportion of water adsorbed leads to a decrease in the proportion of water adsorbed at the same time. This suggests that the proportion of water adsorbed decreases with time.

(5) Rehydration

During rehydration, the proportion of water adsorbed increases. The increase in the proportion of water adsorbed increases with time. The increase in the proportion of water adsorbed is due to the decrease in the proportion of water adsorbed at the same time. This suggests that the proportion of water adsorbed increases with time.

In the study of the equilibrium, the proportion of water adsorbed at the equilibrium decreases with time.
great potential.

interested in this field and has

in an attempt to depart from our present standpoint of this error.

loss of power. These separations show

explanation and description to effect separation of the

the explanation of differences in the amount of

(6)

very little power

surface at high pr values, and the salt's susceptance have

be assured that the effort to separate-out from the oxalate

desorption behavior of the oxalate can be explained to

In short, it may be said that partial desorption

investigated (Chapter 4-

a number of factors. Again, the less such factors

cutaneous desorption of flavonoids and other substances.

explanation for desorption of flavonoids.

appearance of toothpaste. In the use of

desorption of the oxalate have an effect on study of

the literature reveal the use of such desorptions for

enzymatic-degradation (enzymes, the catalytic desorption) (2)

to carry the desorptions. The amount of oxalate

been able to separate (enzymes) without much effort in a

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