

8.

S U M M A R Y :

## 8. SUMMARY :

1. The sulphates of four major cinchona alkaloids ( as  $Q_2 \cdot H_2SO_4 \cdot n H_2O$  , where Q is the alkaloid base ), quinine , quinidine, cinchonine and cinchonidine, have been studied for their exchange behaviour with styrene-divinylbenzene copolymer based sulphonic acid cation exchange resins of different degrees of cross-linking ( % nominal divinyl benzene content ) and of different particle diameters.
2. Several analytical methods for the estimation of alkaloid sulphate in dilute aqueous solution in the absence and presence of sulphuric acid have been explored.
3. A study has been made of the ultra-violet absorption spectra of aqueous solutions of alkaloid sulphates of different pH ( adjusted by addition of sulphuric acid or sodium hydroxide ) and the ultra-violet absorption at invariant wave-lengths has been used to analyse the dilute aqueous solutions containing alkaloid sulphate and sulphuric acid.

4. The cation exchange equilibria of the various cation exchange resins with aqueous solutions of sodium sulphate and potassium sulphate have been studied for comparison with results for alkaloid sulphates. The selectivity coefficients have been obtained and discussed as a function of relative degree of cross-linking of the resin, the particle size of the resin and the mole fraction of the counter-ion in the resin phase.

5. The exchange equilibria with quinine sulphate and cinchonidine sulphate in dilute aqueous solution with various cation exchange resins have been studied. The variables studied are, the relative degree of cross-linking of the resin, the particle size of the resin and the ratio of resin concentration to alkaloid sulphate concentration. The behaviour noted with alkaloid sulphates is of different type as compared to that of simple alkali cations. For resins of higher degree of cross-linking, the same fraction of resin capacity is exchanged irrespective of the ratio of resin concentration to the alkaloid sulphate concentration. This value varies with the relative degree of cross-linking of the resin. For low cross-linked resins, the effective exchange capacity is, to a small extent dependent on the ratio of

resin concentration to alkaloid sulphate concentration.

6. The exchange of quinine sulphate and quinidine sulphate in the presence of added sulphuric acid of different concentrations has been studied with resins of relative degree of cross-linking equal to 4 and 8.

7. The uptake of the four bases, quinine, quinidine, cinchonine and cinchonidine, in alcoholic solution and of quinine in aqueous alcoholic solution has also been studied.

8. The exchange rates for dilute aqueous solution of quinine sulphate, quinidine sulphate, cinchonine sulphate and cinchonidine sulphate with various resins have been studied at two temperatures. A simplified procedure has been adopted by applying the second order law to the exchange process. For low cross-linked resins the rate of exchange, over a good part of the exchange reaction, is uniform and the rate constants have been evaluated. For higher cross-linked resins, the exchange is by two exchange rates ; one relatively fast and of shorter duration, and the other relatively slow and of longer duration. The second order law has been

applied to the slower rate and the relative rate constants have been evaluated. The rate constants are a function of relative degree of cross-linking and particle size of the resins. The temperature coefficients and the apparent energies of activation have been evaluated for the four alkaloid sulphates.

9. A preliminary study of the column exchange behaviour of aqueous quinine sulphate has been carried out and compared with the column exchange behaviour of sodium sulphate. Elution has been studied with aqueous sulphuric acid of different concentrations and then by liberation of the alkaloid with caustic soda solution and eluting with distilled ethanol.

10. The results obtained are discussed in terms of plausible mechanisms and their value to practical application.