SUMMARY
The thesis entitled, "CATION EXCHANGE AND ADSORPTION STUDIES WITH SYNTHETIC MOLECULAR SIEVE HYDROPHILITE" is divided into three chapters.

Chapter I includes the basic information regarding the class of materials known as inorganic cation exchangers, zeolites and molecular sieves. This chapter deals with discussions on structures, classification and abilities for cation exchange and adsorption of the molecular sieves of both natural and synthetic origin. These discussions are relevant to the understanding of the large number of industrial applications of zeolite molecular sieves which are briefly mentioned to justify the undertaking of the present investigations using an altogether new material, "HYDROPHILITE" developed by Ras Enterprises, Bombay. This material has already found use in paint and allied industries as a desiccant. All relevant references on the subject, from the earliest available to some of the recent ones, to understand the chemistry of zeolites are included at the end of the chapter.

Chapter II deals with the experimental work done on sample preparation and data collection with Hydrophilite and to prepare cation exchanged derivatives with eleven cations. These cations were chosen with a view to study the usefulness
of the exchanger for removing heavy toxic metals like cadmium, lead and mercury and also for introducing an organic base like tetramethyl ammonium ion, and nickel and vanadyl ions which have catalytic properties. Hydrophilite and the cation exchanged derivatives were then used to study the effect of three adsorbates like carbon dioxide, hydrogen sulphide and ammonia (as liquor ammonia) on them. This has helped to establish the utility of Hydrophilite and the cation exchanged forms as potential adsorbents for these adsorbates.

Hydrophilite has been characterised by electron microscopic, IR spectroscopic, XRD and TG studies as well as analysing it for its various constituents by quantitative methods.

All the cation exchanged and adsorbed forms were similarly subjected to structural studies by IR spectroscopic method between 4000 cm\(^{-1}\) to 650 cm\(^{-1}\), XRD method using copper radiation between 20 values 5° and 70° and TG studies upto 800°C at 10°C/min rate of heating to determine the thermal changes like dehydration, desorption and dehydroxylation as well as the thermal stability of these derivatives. The cation exchanged forms were also analysed for silica, and sodium oxide percentages so as to determine the extent of cation exchange and changes in alumina silica ratio. TG data were used to evaluate the kinetic parameters of thermal processes. The various methods used have been described from the point of view of their principles and applications. Relevant references justifying the use of these techniques in zeolite studies have been included at the end of the chapter.
Chapter III is devoted to the discussion of results obtained by the various established methods. Data have been tabulated and plots reproduced for IR, XRD and TG studies. The results of these studies lead to some interesting conclusions.

1) The exchange of the major cation, sodium(I), present in Hydrophilite, varies with the different cations and the degree of exchange follows the sequence in increasing order Ba(II), Hg(I), TMA(I), Zr(IV), Ag(I), VO(II), Ca(III), Pb(II), Ni(II), Cd(II), Bi(III). From this, it is seen that beryllium (II) ion is least exchanged and bismuth(III) the most. Hydrophilite is, therefore, a fairly good ion exchanger for most cations except perhaps beryllium(II). This exchanger can be useful in removing many potentially toxic heavy ions like lead(II), cadmium(II) and mercury(I) and (II). Some important transition metal ions like nickel(II) and vanadyl(II) can be introduced in the Hydrophilite medium for using them in catalytic processes. An organic based form of Hydrophilite can also be prepared by interacting with TMA(I) ion.

2) The material Hydrophilite and its exchanged forms can also be used to adsorb the adsorbates like ammonia, carbon dioxide and hydrogen sulphide through physical adsorption like diffusion and chemical processes like complex formation and carbonate and sulphide formations. The various adsorbents studied show varying properties and characteristic behaviours in this regard.
3) The XRD and IR studies have helped to characterize the 48 samples and the variation in their properties. Thus, vanadyl(II) and nickel(II) exchange diminishes the crystallinity of Hydrophilite while most others do not affect this property of the exchanger.

4) The thermal studies and the kinetic parameters evaluated from the TG data help to follow the sequence of events occurring on heating the 48 samples. While dehydration, desorption and dehydroxylation were the expected steps of thermal studies, most of the samples show excellent thermal stabilities by retaining the crystalline and hydrated structure even after heating. Samples like Cd(II), Pb(II), VO(II), however, show complete dehydroxylation and dehydration on TG analysis.

5) The analytical data for mainly sodium(I) and silicon (IV), reported as percentages of sodium(I) oxide and silica, help to establish the compositions of Hydrophilite and the exchanged forms. The cation exchange is due to cation hydrolysis. The hydrolysis with production of sodium hydroxide results in some side reactions with cations like mercury(I) and silver(I) ions.

The discussions have been based on earlier work on similar types of materials which are referred to at the end of the chapter. References surveyed and included with the earlier chapters are not included here.