The last thirty years has witnessed great progress in most branches of chemistry, and parts of the subject that once appeared to have little connection with each other have converged. Indeed, many of the more remarkable discoveries have occurred on the borderlines of different fields. After a long time it has been realised that the most important properties of siliceous matter can be explained on the basis of colloid science, just as colloid science is needed to explain the most important phenomena of many high molecular organic compounds. More surprising is the fact that, even today, attempts are made to explain some of the properties exhibited by siliceous matter on the basis either of laws which apply only to fully ionisable simple inorganic salts or of rules which apply only to organic chemistry.

Thus the silicic science affords enormous possibilities of experimentation. The simple question, what happens when solutions of sodium silicate and sodium aluminate are mixed together under various experimental conditions has not yet been fully answered. A simple answer to be given to the question is that it precipitates the whole science of colloid chemistry, the kingdom of macromolecules.
The interesting cation exchange property of the mineral zeolite and the pioneering synthesis of the siliceous cation exchanger\(^1\) developed by Gans and of late the hydrothermal synthesis of Barrer\(^2\) are the great stimulating incentive to the scientific workers for further research in this fascinating field of synthesis of inorganic ion exchange materials. The present work with the experimental details as embodied in this thesis is the outcome of such incentive.

The structure of the aluminosilicate hydrosol, the material for the present investigation is perfectly amorphous. About the structural disposition this type of aluminosilicates are built of tetrahedral units each having oxygen atoms at the four corners and a silicon or aluminium atom at the centre. The tetrahedra are linked in such a way that all four oxygen atoms are shared by neighbouring tetrahedra and in this way a crossed linked negatively charged network is formed. The aluminosilicate framework built up of \(\text{SiO}_4\) and \(\text{AlO}_4\) tetrahedra is three dimensional in nature. A development of negative charge is due to the replacement of \(\text{Si}^{4+}\) ions from the centre of the tetrahedron by \(\text{Al}^{3+}\) ion. The balancing alkali or alkaline earth cation lies entirely outside the fixed oxygen anionic framework and does not occupy fixed position but moves freely in the channels of the lattice framework and in contact with the polar water there is a tendency of the exchangeable cations to achieve a certain degree of independence in the \(\text{Si}-\text{O}-\text{Al}\) framework and it can do the exchange.
A sufficiently large volume of work has been done on the adsorption of vapors and gases, cation exchange characteristics etc taking the solid hydrated aluminosilicate product. The above mentioned properties are very much dependent on the textural characteristics of the solid.

The recognition and study of the large molecules has been one of the great developments in chemistry in the last forty years. The ever growing application of synthetic polymers has caused a development in the method of their proper characterisation. Once the existance of the large molecules had been recognised the need for new methods for determination of molecular weight became apparent. In addition to molecular weight of a macromolecule, the determination of shape, size and interaction with other molecules are often questions of primary importance. In the recent years there has been a rapid development in the application of light scattering method to solutions of macromolecules. This method has already been applied to a wide variety of high polymeric substances and has provided results, which have been greatly assisted in the understanding of the behaviour of long chain molecules.

Now a days there are number of compounds which show ion exchange properties. Most of the materials of this type are granular, insoluble solids. Amongst the inorganic exchangers zeolites, natural and artificial, are widely used for various purposes.
The present work embraces the synthesis and study of the colloidal properties of the stable alkali and alkaline earth cation substituted aluminosilicate hydrosol. Though many approaches both theoretical and practical to the synthesis and colloidal properties of silicic acid have been developed and applied but the findings with the exchanging sol appear to be very much interesting and afford a newer field of colloid research. The literature regarding the aluminosilicate hydrosol is practically nil as all the ideas were directed to the dried product, the important siliceous exchanger. The negative charge and hydrophobic nature of the synthesised colloidal aluminosilicate sol bring about many similarities with polysilicic acids which have been studied earlier. Moreover both contains silica as main network former in their structure.

The striking features of the synthetic aluminosilicate hydrosol was the significantly high viscosity at lower concentration (indicative of the macromolecular nature), ability to exchange cations in the aqueous phase and stability under normal condition. They have actually induced to study the colloidal properties of the hydrosol which have been associated with the structural characteristics. The first important variable was the nature of the exchangeable cations. In the present investigation this interchange of counterions was restricted to alkali and alkaline earth cations and this strongly influenced the magnitude of the colloidal interaction as revealed here.

Shape, size and molecular weight, the important characteristics of the hydrosol upon which the colloidal chemical interaction
depends were determined by adopting the technique of light scattering. The shape and aggregation were confirmed by electron microscopy. The above observations regarding the nature of the hydrosol, led to study the electrolytic interaction, the most interesting changes the colloid faces before its stability is completely destroyed. The various changes i.e. partial flocculation accompanied by thixotropy (an isothermal self-building sol-gel-sol transformation), complete flocculation and subsequent charge reversal in some special cases reflected the importance of cation exchange capacity of the hydrosol.

Rheologically the hydrosols during interaction with the electrolytes behave in a manner completely different from that of a true liquid. The addition of electrolytes to this active alumino-silicate hydrosol brings about various interesting changes including thixotropy which is not a common phenomenon with all types of colloids. For this reason the rheological study was undertaken which can throw some light on the nature of the particle interaction during addition of electrolytes.

Though various studies have already been made with alumino-silicate hydrogel but the synthetic hydrosol of this composition appears to offer a new field of research which can open up many interesting colloid chemical phenomena because of its higher ion activity compared to the other hydrosols. Moreover the properties of the hydrosol can be tailor made by substituting proper cations in the exchange position without affecting the internal structure. From
the practical point of view this ion active aluminosilicate hydrosol has all the possibilities as those common with the solid product but with higher activity and also the utilisation as liquid exchanger may lead to newer technological advances in inorganic polymers.

Thus the present investigation is an attempt to study systematically the colloid chemical characteristics of highly active aluminosilicate hydrosol synthesised under specific experimental conditions. The optimum experimental conditions are very much important for the generation of the highly active hydrosol.