SUMMARY AND CONCLUSIONS

The present study deals with the preparation and characterisation of alumina membrane for microfiltration application prepared by tape casting process. Accordingly the first chapter of the thesis describes the classification of membranes, use of ceramic membranes and their advantages and disadvantages.It also describes the commercial availability of different types of membraneas.

As the present work deals with alumina membranes and their preparation by tape casting process, a detailed review on the fundamental membrane properties, permeation theories, different types of membranes along with a detailed review on tape casting process are described in this thesis.

The research contribution of the thesis has been made under four major aspects (i) preparation of membrane (ii) control of pore size, porosity and micro-structure (iii) design and fabrication of membrane holder (iv) permeation and separation characteristics of the fabricated membrane.

Preparation of membrane : Alumina membranes have been prepared by tape casting process. Tape casting is a low cost process, normally used for preparation of dense substrate. As it is known that thinner the membrane lower is membrane resistance, single layer membranes having thickness of 150 - 300μm have been prepared by tape casting technique using different alumina powders as the starting material. Usually porous filters have been prepared by the use of combustible filler such as carbon black, graphite etc. and also by firing them at a temperature below the densification temperature. In case of tape casing process, the polymeric binder acted as the combustable filler, although it behaved in a slightly different manner than the conventional fillers.

The most important properties of the membrane viz. pore size and porosity can be controlled to a large extent by independent experimental parameters such as initial particle size, firing temperature and binder content of the green tapes. Among them the particle size of the starting powder is the key factor for controlling the pore size of the membrane. From the range of particle size distribution defined by the term "quartile ratio", uniformity of the pore size distribution can be estimated. Lower the value of "quartile ratio" narrower is the pore size distribution. It becomes bimodal beyond a certain value of this ratio. For powders with same average particle size but different size distribution, pore volume is lower for a powder of wider distribution.

The influence of firing temperature and binder content of the green tape on the porosity and pore size distribution has also been investigated. Initial binder content of the green tape has a strong influence on the porosity and pore size distribution of the fired membrane. However,there is no marked effect of the binder content on the average pore size which is primarily determined by the starting particle size of the alumina powder. significant pore growth takes place during high temperature firing.

The mechanism of pore formation does not change with initial particle size of the alumina powder. However, the ultimate pore size decreases with reduction in particle size.

High binder contents lead to formation of particle agglomerates in the green tape which in turn increase the tendency of closed pore formation in the fired membranes. It also widens the pore size distribution.

The membranes prepared by the tape casting technique, are very thin and therefore mechanically very weak and cannot be used as such under vaccum or high fluid pressure. For this purpose, a perforated ceramic holder has been designed and fabricated also by the tape casting process by multilayering of suitably punched green tapes formed with 96% alumina powders which on firing give rise to a fully dense structure. Thin membrane discs are sealed to the holder using glass seals applied in the form of thick film paste..

The ultimate test of a membrane is its ability to separate the desired species from a liquid media with a considerably high speed. Water permeability through this membrane under suction condition and under positive pressure shows that the permeability of the membrane is comparable to that of the other ceramic membranes prepared by conventional methods. The rate of permeation through unit area of membrane surface which is known as permeate flux increases linearly with trans-membrane pressure. On the other hand, with increasing time, the flux, as expected, decays slowly. This is due to pore clogging of the membrane. This rate of decaying decreases with reduction in pore size. It has been shown in this investigation that these membranes can be used under drastic condition like in the pH range of 1 to 11 and upto a pressure of 2 kg/ cm^2. Results of microbial separation tests confirm the possibility of micro-organism separation through these membranes and therefore there exists a tremendous possibility of their use in biotechnological and pharmaceutical laboratories and industries for obtaining bacteria free water, which is likely to be economic due to the possibility of their repeated use.