CHAPTER 5

SUMMARY AND CONCLUSION

5.1 SUMMARY

A systematic study on the preparation, characterisation and application of inorganic membranes was attempted. The two routes viz., sol-gel and anodization processes were used for the synthesis of the inorganic membranes. Titania and zirconia membranes were prepared by sol-gel route since the sintering behaviour in terms of reduction in surface area with temperature was quite good with these materials compared to alumina. The alumina membrane was prepared by anodization technique because of the ease of control of the preparation parameters for obtaining tailor made membrane.

Sol-gel route

The scheme of preparing the membranes by sol-gel route involves filtration of viscous colloidal sol through microporous support followed by gelation and sintering. The optimum condition for preparing the stable sol of titania and zirconia was identified by measuring the zeta potential. Polyvinyl alcohol was chosen as binder in view of its good binding characteristics based on good wettability and its good adhesive nature over the support as evidenced from the IR frequency shift when bonded to the support. The optimum time of contact and pressure of filtration for the membrane layer formation was determined using the filtration characteristics. SEM analysis of the membranes showed that the mean pore size increased and the pore density decreased with sintering temperature.
At the lowest sintering temperature used for zirconia (470°C) and for titania (400°C), the mean pore size were found to be 543 nm and 649 nm respectively. Accelerated corrosion tests and irradiation experiments showed that the membranes were less prone to corrosion and radiation effects.

The permeability of the titania and zirconia membranes in L/m²/h of water was found to be 1400-4000 and 1800-4500 respectively in the pressure range 1-5 Kg/cm². The thickness of the titania and zirconia membranes from the membrane volume and the membrane pore volume was found to be 3 µm in both the cases. The membrane pore charge density of titania and zirconia membrane as determined from the zeta potential, the particle size of the coated particles and the thickness of the layer were found to be 3 to -0.9 micro coul./cm² and 7 to -3 micro coul./cm² respectively when contacted with effluents of pH 1-12. The application of the titania and zirconia membrane formed and sintered to the lowest sintering temperature for the treatment of ¹³⁷Cs and ⁹⁰Sr activity of the order 10⁻³-10⁻⁵ m.Ci/L at 10-50 % plant scale dosings of the chemical addition indicated removal to the extent of 10-40 DF for both cesium and strontium.

Anodization

The preparation of alumina membrane was carried out using anodization technique. Phosphoric acid and oxalic acid were chosen as pore forming electrolytes. The process of preparing membrane in phosphoric acid as electrolyte was found to be more efficient than oxalic acid from the estimation of the coating ratios in the two media. The thickness of the alumina membrane formed in phosphoric acid and oxalic acid were found to be in the range 19-67 µm and 7-19 µm in the current strength 0.1-0.5 A. The mean pore size of the alumina membrane formed in phosphoric acid and oxalic acid were found to be 89-228 nm and 1160-2400 nm in the voltage range 200-325. The pore density of the alumina membrane formed in phosphoric acid and oxalic acid as pore forming electrolytes at 325 V/0.5 A