MACRORETICULAR CATION EXCHANGERS: STUDIES ON PHENOLIC RESINS AND THEIR COMPOSITES

BY

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CERTIFICATE

This is to certify that the thesis entitled " MACRORETICULAR PHENOLIC CATIONITES : STUDIES ON PHENOLIC RESINS AND THEIR COMPOSITES " being submitted by Mr. N.L.N. Sarma to the Indian Institute of Technology, Delhi, for the award of the Degree of Doctor of Philosophy of the Indian Institute of Technology, Delhi, is a record of bonafide research work carried out by him under my supervision and to my knowledge it has reached the standard fulfilling the requirement of the regulations relating to the degree.

The results contained in this thesis have not been submitted in part or in full to any other University or Institute for the award of any degree or diploma.

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A B S T R A C T

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ABSTRACT

An ion exchanger is essentially made up of a polymeric matrix carrying ionogenic groups. Recently new types of exchangers for special applications have been synthesised using suitable matrix modifications. Also with the ever increasing cost of polymers it may be desirable to replace part of the polymer matrix by cheaper materials provided the composites retain the properties of pure resin. It was proposed to form and study macroreticular structures based on sulfonated phenol formaldehydes, and their composites with cheaper materials.

The phenol formaldehyde exchangers were prepared under both acidic and basic media using distilled as well as undistilled phenol, sulfonation was carried out either with concentrated sulfuric acid or oleum. Some samples were subjected to ultrasonic vibration, adding phenol in excess during polymerization. The physical properties such as density, swelling, stability, particle size and infrared spectra were determined. Macroreticularity of the matrix was examined by measuring the surface area by PNP adsorption, B.E.T-N_2 adsorption and porosity by mercury porosimetry, cetane-CCl_4 adsorption, and electron microscopy. Ion exchange properties like capacity, equilibrium, kinetics and selectivity were studied.

The resins were found to be porous with pore diameter ~ $\leq$ 4000 Å and exhibiting a capacity of 1.8 meq/g for small ions like Na^{+}, Ca^{2+}, and Mg^{2+} as well as large ions like NR_4^{+}. When phenol was distilled before condensation the capacity of the resin increased up to 3.6 meq/g probably due to the elimination of impurities. The densities of the resin were greater than one making them suitable for exchange in columns in aqueous media. Also the kinetics of exchange was fast enough for the break-through capacity to be high.

For preparing composites, coals from Assam mines, lignite, cellulosic materials like sawdust, paper pulp and cellulose powder were treated with phenol sulfonic acid and polymerised. All the properties were studied as in the case of pure resin. It was found that up to 30 - 40% of substitution, the composites retain all the desirable properties of the polymer indicating that there is a possibility of economically substituting the polymeric matrix to this extent. The composites also exhibit macroreticularity with pores of ~ 4000 Å, and can be used for the exchange of macroions and dye adsorption.

CONTENTS