APPENDIX
List of Papers presented at seminars / National Conference symposium:


Preparation and characterization of 3A zeolite filled sodium alginate composite membrane for PV dehydration of Ethanol at different temperatures


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Sodium Alginate (SA) and 3A zeolite filled composite membranes were prepared by solution casting method by varying the zeolite content ranging from 5 to 10 wt% with respect to SA weight. Membranes were cross-linked with glutaraldehyde and tested for Pervaporation (PV) dehydration of water–Ethanol at different temperatures. These crosslinked composite membranes were characterized by Fourier Transform infrared spectroscopy. Morphology of the membranes was assessed by scanning electron microscopy. Sorption studies have been performed to evaluate the extent of interaction and degree of swelling of the membranes with pure SA and zeolite mixed membranes at different water–Ethanol content in the feed mixtures. It is observed that flux and selectivity increased systematically with increasing amount of zeolite in the SA matrix. In case of zeolite membrane containing 10 wt% highest selectivity 3858 for water – Ethanol was observed of which were attributed to the combined effects of molecular adhesion between zeolites and SA matrix as well as hydrophilicity due to the zeolite. The same reason can also be attributed to the observed higher selectivity of the composite membrane compared to plain membrane.

Keywords: Glutaraldehyde, Pervaporation, Ethanol, Arrhenius parameters, Sodium alginate
Preparation and characterization of ZSM-5 zeolite filled sodium alginate
Composite membrane for PV dehydration of Ethanol at different temperatures

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Mixed matrix membranes of sodium alginate (NaAlg) were prepared by solution casting by incorporating 5 and 10 wt.% of ZSM-5 zeolite particles. The membranes thus prepared were crosslinked with glutaraldehyde and tested for the pervaporation (PV) dehydration of ethanol at 30–50°C. The ZSM-5 zeolite, with its hydrophilic nature as well as molecular sieving effect and its favorable interaction with hydrophilic NaAlg, was responsible to enhance the PV dehydration of ethanol in terms of selectivity, flux, pervaporation separation index (PSI) and enrichment factor (β). Based on these results, permeance and driving force mechanisms were also elucidated. The changes in the dimension of pristine and mixed matrix membranes are compared to provide the influence of swelling on the stabilities of mixed matrix membranes. Arrhenius parameters for the process of permeation were calculated using these data at different temperatures to investigate their effects on the nature of the mixed matrix membrane. The plots of \( \ln J_p \) vs. \( 1/T \) were constructed and found to follow the linear trends in the studied range of 30–50°C for both the feed mixtures, indicating that flux followed the Arrhenius trend.

Keywords: Glutaraldehyde, sodium alginate, ethanol, ZSM-5 zeolite, Pervaporation, Arrhenius parameters.
Preparation of Sodium alginate /Poly (vinyl alcohol) blend microspheres for controlled release applications

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Abstract- Polymeric blend microspheres consisting of Sodium alginate (NaAlg) and poly (vinyl alcohol) (PVA) were prepared by water-in-oil (W/O) emulsion method. These microspheres were cross-linked with glutaraldehyde and loaded with Metformin hydrochloride (MHC). The microspheres were characterized by Fourier transform infrared Spectroscopy (FTIR), X-ray diffraction (X-RD), Scanning electron microscopy (SEM). X-ray diffraction (X-RD) analysis was done on the drug-loaded microspheres to confirm the polymorphism of MHC. SEM of the microspheres suggested the formation of spherical particles. Drug release data have been analyzed using an empirical equation to understand the nature of transport of drug containing solution through the polymeric matrices. The controlled release characteristics of the matrices for MHC were investigated in pH 7.4 media and from the results it is seen that the drug was released in controlled manner up to 12h.

Key words: Microspheres, Metformin hydrochloride, Drug delivery, Sodium alginate (NaAlg), Poly (Vinyl alcohol) (PVA).
Development of Triproline Hydrochloride loaded pH Sensitive Poly (Acrylamide-co-Acrylamidoglycolic acid) copolymer microspheres: *In vitro* release studies

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Abstract

Poly(Acrylamide-co-acrylamidoglycolic acid) copolymeric microspheres crosslinked with N,N-methylene bisacrylamide have been prepared by free radical emulsion polymerization using varying amounts of Acrylamide (AAm), Acrylamidoglycolic acid (AGA) and N,N-methylene bisacrylamide (NNMBA). Triproline hydrochloride (TPH) was loaded into these microspheres during *in situ* polymerization. The microspheres have been characterized by Fourier Transform Infrared Spectroscopy (FTIR), to know the formation of copolymer. Differential scanning calorimetry (DSC) and X-Ray diffractometry (X-RD) techniques are used to understand about the drug dispersion in these microspheres. Scanning electron microscopy (SEM) was used to assess the surface morphology of particles prepared. *In vitro* release of TPH has been studied in terms of composition, amount of crosslinking agent and amount of TPH in the microspheres. The microspheres with different copolymer compositions have been prepared in yields ranging 75-80%. DSC and X-RD techniques indicated a uniform distribution of TPH particles in microspheres, whereas SEM suggested the formation of distinct spherical shape microspheres. The *in vitro* drug release indicated the release kinetics depending upon copolymer composition, amount of crosslinking agent used and amount of TPH present in the microspheres. Prolonged and controlled release of TPH was achieved when drug was loaded in the copolymer and the drug was released in a controlled manner up to 12 h.

**Key words:** Microspheres, Acrylamidoglycolic acid (AGA), Acrylamide (AAm), Triproline hydrochloride (TPH), Drug delivery, Control release.
pH Sensitive Poly (vinyl alcohol)/ Sodium carboxymethyl cellulose IPN microspheres for In-Vitro release studies of an Anti cancer drug


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Abstract

Interpenetrating network microspheres (IPNMs) consisting of poly (vinyl alcohol) (PVA) and NaCMC (Sodium carboxymethylcellulose) were prepared by water-in-oil (W/O) emulsion method and were cross-linked with glutaraldehyde. 5-Fluorouracil (5-FU) an anticancer drug was loaded into IPNMs via in-situ method. These IPNMs have been characterized by Fourier transform infrared spectroscopy (FTIR), which confirms the crosslinking of IPNMs through glutaraldehyde. DSC and X-RD analysis of the drug loaded IPNMs have confirmed uniform molecular dispersion of 5-FU in the IPNMs. Particle size measured using optical microscopy gave an average size of 80-250 μm. Scanning electron microscopy (SEM) also confirmed the formation of microspheres with smooth surface and spherical shape. Encapsulation efficiency of 5-FU was achieved up to 62%. In-vitro drug release studies have been performed at acidic (pH=1.2) followed by basic (pH=7.4) buffer medium. It has been analyzed with an empirical equation to understand the diffusion nature of drug through the IPNMs. Both encapsulation efficiency and release patterns are found to depend on the nature of the cross-linking agent as well as amount of drug loading. In-vitro release studies indicated the release of 5-FU for more than 10 hrs.

Keywords: Sodium Carboxymethylcellulose (NaCMC), Poly (vinyl alcohol) (PVA), Microspheres, Drug delivery
Study of Polymer Blend Miscibility of Sodium Alginate with Polyvinyl Pyrrolidone by Various Characterization Methods

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Abstract

The blends of Sodium Alginate (SA) with polyethylene-pyrrolidone (PVP) have been prepared by solution method and their miscibility has been investigated by measuring the viscosity, density, refractive index and ultrasonic velocity at 35°C. The plots of absolute viscosity, ultrasonic velocity and refractive index verses composition of the polymer blend solution indicates compatible if they are linear and incompatible if they are non-linear. Using viscosity data, the interaction parameters $\mu$ and $\alpha$, based on Chee and Sun et. al approaches, were determined. Basing on the sign of these values the compatibility nature of sodium alginate (SA)/poly (vinyl pyrrolidone) (PVP) up to 50% of SA the blends are miscible and beyond this composition the blends are immiscible. This further conformed by the spectral analysis like DSC and FTIR techniques.

Key words: Ultrasonic velocity, refractive index, viscosity, Sodium Alginate, poly (vinyl pyrrolidone) and compatibility.
List of papers communicated to various journals for publications:


Preparation and characterization of ZSM-5 zeolite filled sodium alginate Composite membrane for PV dehydration of Isopropanol at different temperatures

Department of Polymer Science & Technology, Sri Krishnadevaraya University, Anantapur

Abstract:

Mixed matrix membranes of sodium alginate (NaAlg) were prepared by solution casting by incorporating 5 and 10 wt.% of ZSM-5 zeolite particles. The membranes thus prepared were crosslinked with glutaraldehyde and tested for the pervaporation (PV) dehydration of isopropanol at 30–50°C. The ZSM-5 zeolite, with its hydrophilic nature as well as molecular sieving effect and its favorable interaction with hydrophilic NaAlg, was responsible to enhance the PV dehydration of isopropanol in terms of selectivity, flux, pervaporation separation index (PSI) and enrichment factor (β). Based on these results, permeance and driving force mechanisms were also elucidated. The changes in the dimension of pristine and mixed matrix membranes are compared to provide the influence of swelling on the stabilities of mixed matrix membranes. Arrhenius parameters for the process of permeation were calculated using these data at different temperatures to investigate their effects on the nature of the mixed matrix membrane. The plots of ln Jp vs. 1/T were constructed and found to follow the linear trends in the studied range of 30–50°C for both the feed mixtures, indicating that flux followed the Arrhenius trend.

Key words: glutaraldehyde, pervaporation, isopropanol, Arrhenius parameters, sodium alginate
Preparation and characterization of 3A zeolite filled sodium alginate composite membrane for PV dehydration of Isopropanol at different temperatures

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Abstract:

Sodium Alginate (SA) and 3A zeolite filled composite membranes were prepared by solution casting method by varying the zeolite content ranging from 5 to 10 wt % with respect to SA weight. Membranes were cross-linked with glutaraldehyde and tested for Pervaporation (PV) dehydration of water-Isopropanol at different temperatures. These crosslinked composite membranes were characterized by Fourier Transform infrared spectroscopy. Morphology of the membranes was assessed by scanning electron microscopy. Sorption studies have been performed to evaluate the extent of interaction and degree of swelling of the membranes with pure SA and zeolite mixed membranes at different water-Isopropanol content in the feed mixtures. It is observed that flux and selectivity increased systematically with increasing amount of zeolite in the SA matrix. In case of zeolite membrane containing 10 wt % highest selectivity 3858 for water-Isopropanol was observed of which were attributed to the combined effects of molecular adhesion between zeolites and SA matrix as well as hydrophilicity due to the zeolite. The same reason can also be attributed to the observed higher selectivity of the composite membrane compared to plain membrane.

Key words: Glutaraldehyde, Pervaporation, isopropanol, Arrhenius parameters, Sodium alginate
Preparation and characterization of HY zeolite filled sodium alginate 
Composite membrane for PV dehydration of Ethanol at different temperatures

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Plain sodium alginate (NaAlg) and 5 wt % and 10 wt % HY zeolite incorporated NaAlg membranes have been fabricated by solution casting followed by solvent evaporation. The membranes formed were crosslinked with glutaraldehyde and tested for PV dehydration of ethanol from their aqueous feed mixtures at water concentrations (5, 10, 15 and 20 wt %) at 30°C. The crosslinking reaction was confirmed by Fourier transform infrared (FTIR) measurements. The selectivities of Ethanol - water feed mixtures were 1075 and 1241 with fluxes of 0.2276 and 0.2746 kg/m2 h for 10 wt % water in the feed mixture for filled membranes containing 5 wt % and 10 wt % of HY zeolite particles. For Ethanol - water feed, selectivity values are considerably lower. Flux data also improved considerably for both the feeds. However, the virgin crosslinked NaAlg membrane has selectivity and flux values of 653 and 0.067 kg/m2 h, respectively. It is demonstrated that addition of HY zeolite particles as fillers into the NaAlg matrix has improved both flux and selectivity values over that of the crosslinked virgin NaAlg membrane. Such improvements in the selective nature of the filled matrix membranes are attributed to the water absorbing capacity of the filler particles. The zeolite-incorporated membranes exhibited lower activation energy compared to that of a pure membrane, indicating that the permeants require less energy during the process because of molecular sieving action attributed to the presence of sodalite cages and supercages in the framework of zeolite.

Key words: Glutaraldehyde, Pervaporation, Ethanol, Arrhenius parameters, Sodium alginate
Preparation and characterization of HY zeolite filled sodium alginate composite membrane for PV dehydration of isopropanol at different temperatures

Department of Polymer Science & Technology, Sri Krishnadevaraya University, Anantapur

Plain sodium alginate (NaAlg) and 5 wt % and 10 wt % HY zeolite incorporated NaAlg membranes have been fabricated by solution casting followed by solvent evaporation. The membranes formed were crosslinked with glutaraldehyde and tested for PV dehydration of isopropanol from their aqueous feed mixtures at water concentrations (5, 10, 15 and 20 wt %) at 30°C. The crosslinking reaction was confirmed by Fourier transform infrared (FTIR) measurements. Flux data also improved considerably for both the feeds. However, the virgin crosslinked NaAlg membrane has selectivity and flux values of 653 and 0.067 kg/m² h, respectively, for isopropanol – water. It is demonstrated that addition of HY zeolite particles as fillers into the NaAlg matrix has improved both flux and selectivity values over that of the crosslinked virgin NaAlg membrane. Such improvements in the selective nature of the filled matrix membranes are attributed to the water absorbing capacity of the filler particles. The zeolite-incorporated membranes exhibited lower activation energy compared to that of a pure membrane, indicating that the permeants require less energy during the process because of molecular sieving action attributed to the presence of sodalite cages and supercages in the framework of zeolite.

Key words: Glutaraldehyde, Pervaporation, isopropanol, Arrhenius parameters, Sodium alginate