**Mass transfer characterization of calcium alginate membrane containing bionanofiber and mechanical strength**

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**Highlights**

* Bionanofiber composited membrane was successfully prepared.
* Maximum stress was increased in chitosan nanofiber composited membrane.
* The chitosan nanofiber composted membrane was dramatically decreased compared with alginate-Ca membrane.

**1. Introduction**

Oceanic bio-polymer have been expected as environmental compatible materials for medical, food and industrial application. Sodium alginate was a typical oceanic bio-polymer and it was sustainably and abundantly produced from kelps. It was widely cultivated in worldwide ocean. Gelling character of sodium alginate by the aid of metal ion exchange was extensively applied to form gel particles and membranes. Molecular size of alginate chain was hardly controlled because of natural bio-products. Biomass nanofiber have been researched for their use in biodegradable packaging due to their renewable, low cost and low density. More recently, this have been reinforced into biopolymers to produced green nanocomposite membrane, with improved thermal, mechanical and oxygen barrier properties.

Membrane separation processes are attractive because of their low energy cost and contaminant-free final product. Interest in using natural materials for the membrane body has increased because of their biocompatibility and environment-friendly disposal.

**2. Methods**

**2.1 Preparation of bio-nanofiber composited membrane**

Calcium alginate based composite membrane was cooperated with Chitosan nanofiber (Chi-NF). Aqueous solution of sodium alginate (10 g/L) was prepared by dissolving in pure water. Desirable amount of chitosan nanofiber (Chi-NF) or carboxymethyl cellulose nanofiber (CMC-NF) was added into alginate aqueous solution and mixed magnetic stirrer. The solution was poured into a glass petri dish, and then dried in a thermostat-controlled oven for 12 h at 333 K. Dried sodium alginate with mixed Chi-NF in the petri dish was immersed into the CaCl2 solution (0.1 mol/L) for 20 min. The membrane was washed with pure water to remove excess metal ion.

  

(a) Alginate-Ca membrane (b) Chi-NF composited membrane (c)CMC-NF composited membrane

Figure 1 Image of alginate-Ca membrane composited nanofiber.

**2.2 Mechanical strength**

A rheometer was used to measure the mechanical strength of the swollen membranes. The swollen membranes were cut into sample pieces (1 × 4 cm), which were then stretched at a speed of 1 mm/s using the reheometer. The mechanical properties were evaluated in terms of both the maximum stress (*δ*) when the membrane ruptured.

**3. Results and discussion**

Figure 2 shows the effect of the maximum stain with the mass fraction of chitosan nanofiber and carboxymethyl cellulose nanofiber in the algnate-Ca membrane. The maximum stress was slightly increased with increasing of mass fraction of chitosan nanofiber until fNF=30%. In contrast, the maximum strain was gradully decreased. The clearance between alginate polymer chains and chitosan nanofiber became narrow with increasing the mass fration of ChiNF. Chitosan is in higher deacetylation, and has by many amino groups. Deacetlyation contributed to making many hydrogen bonds and prducing stronger mechanical characterics of chiotsan.



**Figure 2** Effect of mass fraction of nanofiber on maximum stress.

**4. Conclusions**

A stable membrane made of calcium alginate with multiple domains of bio nanofiber was successfully prepared. Maximum stress of membrane a rupture for Chi-NF composited membrane was increased.