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Evaluation of the Dimensional Stability of Chitosan Membranes Subjected to Different Alkaline Media for PEM Electrolyzer Applications

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Introduction

Water electrolysis using PEM electrolyzers is a promising route for sustainable hydrogen production. Chitosan is a low-cost, renewable, and biodegradable material with potential for membrane applications; however, its hydrophilicity can lead to water uptake and dimensional changes. Thus, this study evaluated the stability of chitosan membranes subjected to different alkaline media.

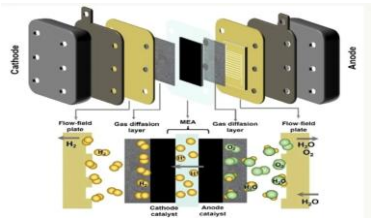


Figura 1. PEM Electrolyzer.

Objectives

To evaluate the dimensional stability of chitosan membranes subjected to different alkaline media by analyzing mass retention and degradation resistance, aiming to identify favorable conditions for their application in PEM electrolyzers.

Methodology

Chitosan membranes were initially weighed and measured and then immersed in NaOH, Na_4OH, and $Ca(OH)_2$ solutions for 1 and 5 days. After each treatment, the membranes were weighed and subsequently kept in distilled water for 30 days. Finally, their mass and dimensions were measured to evaluate dimensional stability.


A)

B)

C)

Figura 2. A) Ready chitosan membrane; B) Untreated chitosan membrane; C) Treated chitosan membrane

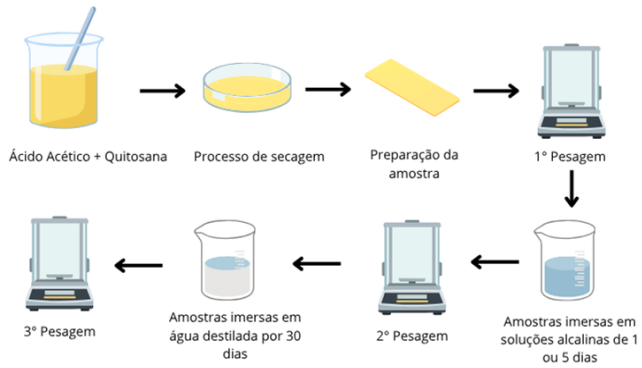
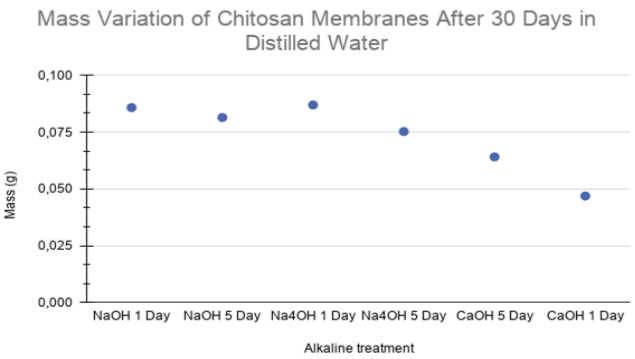


Figura 3. Flowchart of chitosan membrane fabrication, alkaline treatments, and sample weighing

Results and Discussion



Graphic 1. Mass variation of chitosan membranes after 30 days in dislled water.

ALKALINE TREATMENT	ΔMASS (g)	ΔMASS (%)
NaOH 1 Day	0,0858	149,43
NaOH 5 Day	0,081433333	138,25
Na4OH 1 Day	0,086966667	155,36
Na4OH 5 Day	0,075266667	132,98
CaOH 5 Day	0,0641	136,06
CaOH 1 Day	0,0469	107,14

Table 1. Mass variation of chitosan membranes after 30 days in dislled water.

The $Ca(OH)_2$ treatment for 1 day showed the lowest mass variation after 30 days in distilled water (Δm = 0.0469 g), indicating lower water retention among the evaluated conditions. This behavior may be associated with changes promoted by the alkaline medium in the chitosan structure, since alkaline treatments can modify interactions between polymer chains and consequently affect swelling and water uptake.

Conclusion

The results indicated that alkaline treatment influenced the stability of chitosan membranes. Among the evaluated conditions, $Ca(OH)_2$ treatment for 1 day showed the lowest mass variation after 30 days in distilled water, representing the most favorable condition regarding mass retention in the neutral medium. The analysis of dimensional changes will complement these results and provide a more comprehensive evaluation of membrane stability.

References and Acknowledgments

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