CO_2 Separation Using Soap Films

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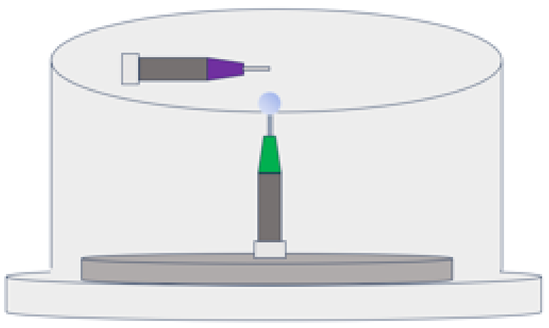
Introduction

The separation of carbon dioxide (CO2) is a critical process in mitigating climate change and enhancing industrial efficiency. This study investigates the use of soap films as a novel medium for CO2 separation.

Experiment and Method



Videos of the bubble deflating were recorded to analyze the dynamics of the process. videos were analyzed by tracking the radius of the bubble over time using the Reslice function in ImageJ. The data extracted from this analysis provided insights into the temporal evolution of the bubbleâs radius during deflation.

Preliminaries

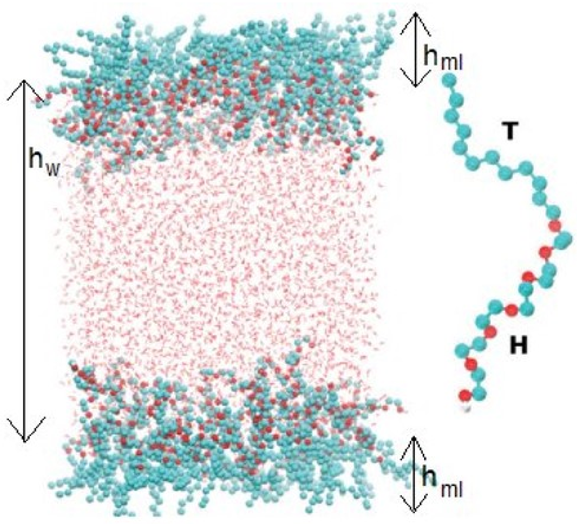
Gas Transfer in (Liquid)

$$\vec{J} = -D\vec{\nabla}C$$

MEANWHILE, in soap films (complex system)

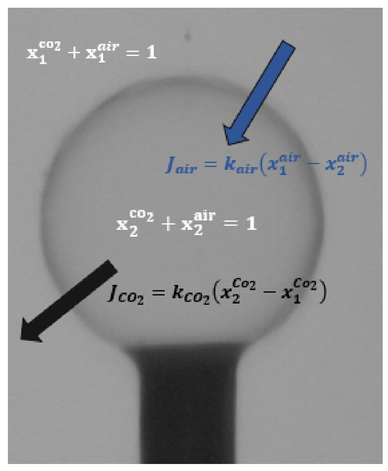
$$\vec{J} = -\kappa\Delta C$$

$$\kappa = \frac{DH}{\frac{2D}{\kappa_{ml}} + h_w}$$



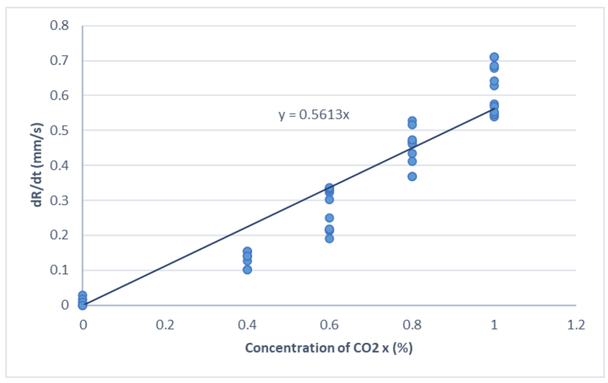
Model

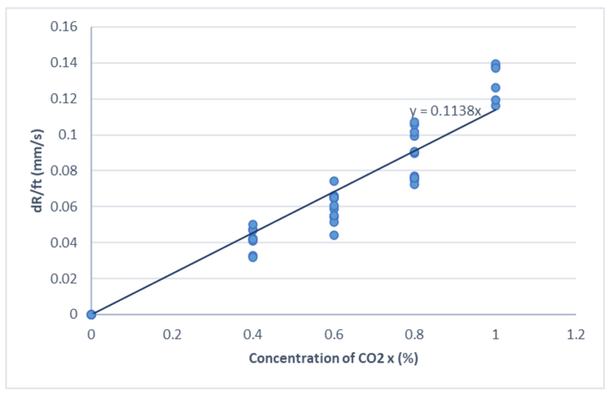
1-Initial difference in concentration $C_2 - C_1$
2-Ideal Gas Law $PV = nRT$
3-Spherical Bubble Volume: $V = \frac{4}{3}\pi R^3$
4-Constant Permeability



$$-\frac{dR}{dt}|_{t=0} = (\kappa_{\mathrm{CO_2}} - \kappa_{\mathrm{air}})x_{\mathrm{CO_2},i}(t=0)$$

Results

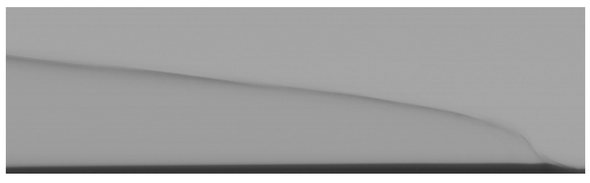




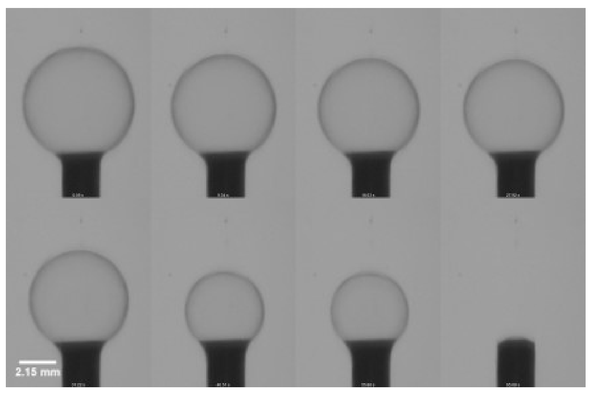
Surfactant	$\Delta\kappa$ m/s
SDS	0.5613
Aspiro	0.1138

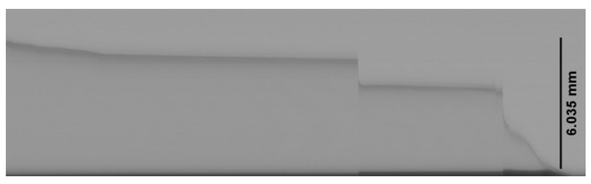
Interesting behaviours with CO_2

the usual reslice of the bubble



In the case of CO2 bubbles, an unusual deflation dynamic is observed.





-Not unique to SDS
-Not observed for a specific CO2 concentration
-Not associated with any specific condition

Conclusions

-Controlled environment with precise regulation is needed
-Sodium Dodecyl Sulfate (SDS) exhibits superior potential as a membrane for gas separation compared to Aspiro.
-Comprehensive understanding from a chemical perspective.
- Further experiments can be made for different surfactants and upgrading to foam system not a single bubble for more detailed exploration.

References

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