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Modeling Gas Transfer Across Facilitated Liquid Membranes

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Session:
Transport Modeling

We have constructed mathematical models to describe the transport of reactive and non-reactive gases across thin liquid membranes in the presence and absence of chemical facilitators. The models, with some idiosyncratic modifications, are applicable to a number of different transport facilitators. We are particularly interested in the movement of acid gases, especially carbon dioxide (CO_2). Testing in the same permeator device and under the same test conditions we compared the predicted and actual separation performances of different facilitating agents. The efficacy of the model was validated by the accuracy of the predicted values vs. those that were observed.

We will provide model and experimental data that compares the ability of the enzyme catalyst, carbonic anhydrase (CA), and the secondary amine, diethanolamine (DEA) to extract CO_2 from feed streams ranging in concentration from 1%-20%. DEA was 20% or 30% and CA 3g/l + 1M bicarbonate. At all CO_2 concentrations, save 20%, CA performed better than did DEA, independent of concentration. In the best of circumstances, the CA was >100% better than 20% DEA. These data confirm literature reports, using supported liquid membranes or immobilized liquid membranes that showed that CA mixtures performed well, demonstrating high permeance and good selectivity.

The specific test apparatus design maximizes facilitated uptake while relying on a pressure swing (PSA) for the desorption step. The performance data are now being used in process engineering models as a basis for design optimization.