TRANSPORT OF REACTING MOLECULES ACROSS THE AIR-WATER INTERFACE

The theory of mass transport across the air-water interface is important in a number of environmental problems, for example, CO2 uptake by the oceans and emissions from wastewater treatment facilities. We have applied the theory in our recent work on emissions from produced water evaporation ponds. The theory becomes more complex when molecules associate or dissociate in the aqueous phase. Three examples are frequently cited: (1) HCl dissociates almost completely into H+ and Cl-  in solution, (2) CO2 associates with H2O to become carbonic acid, (3) formaldehyde associates with H2O to become methanediol. To treat all three examples, it is customary to invoke a generic mechanism involving molecules A and B that interconvert in the aqueous phase but that can cross the air-water interface and exist in the gas phase only in the A form. However, there is ample evidence that both carbonic acid and methanediol can cross the interface as intact molecules. A more appropriate mechanism has interconverting A and B molecules in both phases, albeit with different interconversion rates. The reaction-diffusion equations can be solved exactly for both mechanisms. The solutions to these equations are examined to understand the quantitative differences between the two mechanisms.

A screenshot of a cell phone

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