OPEN ACCESS Freely available online

ISSN: 2090-4568
Journal of Advanced Chemical Engineering

Commentary

A Brief Note on Uptake of Carbon Dioxide from the Atmosphere Causing Decrease in pH Value of Earth's Ocean

Miang Chew*

Department of Chemistry, Kobe University, Hyogo, Japan

DESCRIPTION

The kinetics of the dissolution of carbon dioxide in water and posterior chemical reactions through to the conformation of calcium carbonate, a system of reactions integral to carbon sequestration and anthropogenic ocean acidification, is mathematically modeled using the mass action law. This group of responses is expressed as a system of five coupled nonlinear ordinary differential equations, with 14 independent parameters.

Oxygen and carbon dioxide are involved in the same natural processes in the ocean, but in opposite ways; photosynthesis consumes CO_2 and produces O_2, while respiration and corruption consume O_2 and produce CO_2. At the surface, photosynthesis consumes less CO_2 so CO_2 levels remain fairly very low. In addition, organisms that use carbonate in their shells are common near the surface, further reducing the volume of dissolved CO_2.

In deeper water, CO_2 concentration increases as respiration exceeds photosynthesis, and decomposition of organic matter adds fresh CO_2 to the water. As with oxygen, there's frequently more CO_2 at depth because cold bottom water holds more dissolved gases, and high pressures increase solubility. Inside the deep water Pacific Ocean contains more CO_2 than the Atlantic Ocean because Pacific Ocean's water is older and accumulated more amount of CO_2 from the respiration of benthic organisms.

But the behavior of CO_2 in the ocean is more complex. When this CO_2 gas is dissolved in ocean, it interacts with water to produce a large number of different composites according to the reaction below.

$CO_2+H_2O \leftrightarrow H2CO_3 \leftrightarrow H++HCO_3- \leftrightarrow 2H++CO_3^2$

CO_2 reacts with water to produce carbonic acid (H_2CO_3), which also dissociates into bicarbonate (HCO_3-) and hydrogen ions [H^+]. The bicarbonate ions can be further dissociated into carbonate (CO_3^2).

Large amount of CO_2 is dissolved or produced in the ocean is instantly converted into bicarbonate. Bicarbonate accounts for about 92 of the CO_2 dissolved in the ocean, and carbonate represents around 7, so only about 1 remains as CO_2, and little gets absorbed back into the air. The rapid conversion of CO_2 into other types prevents CO_2 from reaching equilibrium with atmosphere, and in this way, water can hold 50-60 times as much CO_2 and its derivations as the air.

CO_2 and pH

The equation above also illustrates carbon dioxide's part as a buffer, regulating the pH of the ocean. Recall that pH reflects the acidity or basicity of the solution. The pH scale measures from 0-14, with 0 represents veritably strong acid and 14 representing largely introductory conditions. A solution with a pH of 7 is considered neutral, as this is called as pure water. The pH value is calculated as the negative logarithm with hydrogen ion concentration according to the equation

$pH=-log10 [H^+]$

Thus, a high concentration of H ions leads to a low pH and acidic condition, while a low H^+ concentration indicates a high pH and basic conditions. It should also be derived that pH is described on a logarithmic scale, so every one point change on the pH scale actually represents an order of magnitude (10x) change in solution strength. So a pH of 6 is 10 times more acidic than a pH of 7, and a pH of 5 is 100 times more acidic than a pH of 7.

Carbon dioxide and the other carbon composites listed above play an important part in buffering the pH of the ocean. Presently, the average pH for the global ocean is about 8.1, meaning seawater is slightly basic. Because utmost of the inorganic carbon dissolved in the ocean exists in the form of bicarbonate, bicarbonate can respond to disturbances in pH by releasing or incorporating hydrogen ions into the various carbon compounds. However, bicarbonate may dissociate into carbonate, and release further H^+ ions, if pH rises (low [H^+]).

Correspondence to: Miang Chew, Department of Chemistry, Kobe University, Hyogo, Japan, E-mail: michew@kbu.jp

Received: 08-Feb-2022, Manuscript No. ACE-22-15884; **Editor assigned:** 10-Feb-2022, PreQC No. ACE-22-15884(PQ); **Reviewed:** 24-Feb-2022, QC No ACE-22-15884; **Revised:** 28-Feb-2022, Manuscript No. ACE-22-15884(R); **Published:** 07-Mar-2022, DOI:10.35248/2090 4568.22.12.214.

Citation: Chew M (2022) A Brief Note on Uptake of Carbon Dioxide from the Atmosphere Causing Decrease in pH Value of Earth's Ocean. J Adv Chem. 12:214

Again, if pH gets too low (high [H^+]), bicarbonate and carbonate may incorporate some of those H^+ ions and produce bicarbonate, carbonic acid, or CO_2 to remove H^+ ions and raise the pH. By shuttling H^+ ions back and forth between the colorful composites in this equation, the pH of the ocean is regulated and conditions remain favorable for life.

CO_2 and ocean acidification

The anthropogenic sources of atmospheric CO_2 have increased since the Industrial Revolution, the oceans have been absorbing an adding amount of CO_2, and researchers have proved a decline in ocean pH from about 8.2 to 8.1 in past 100 years. This may not seems to be much of a change, since pH is on a logarithmic scale; this decline represents a 30 increase in acidity. It should be noted that indeed at a pH of 8.1 the ocean isn't actually acidic; the term “acidification” refers to the fact that the pH is getting lower, i.e. the water is turning more to acidic conditions.

Not only does a declining pH lead to increased rates of dissolution of calcium carbonate, it also diminishes the amount of free carbonate ions in the water. The relative proportions of the different carbon composites in seawater are dependent on pH. As pH declines, the amount of carbonate declines, so there's less available for organisms to incorporate into their shells and configurations. So ocean acidification both dissolves being shells and makes it harder for shell formation to occur.