

Acidity Effect of Mineral Water

Equipment:

pasteur pipette with rubber cap
bowl
hot plate stirrer
large beaker or similar

Chemicals:

clear-glass bottle of plain seltzer water with cap
(without natural or artificial colorings)
alcoholic solution of bromocresol green (0,1 %)
crushed ice
tap water

Safety:

bromocresol green solution ($C_{21}H_{14}Br_4O_5S$) (in ethanol):



H225, H319

P210, P241, P280, P303 + P361 + P353, P305 + P351 + P338, P501

The usual precautionary measures for handling ethanol should be observed.

Procedure and Observation:

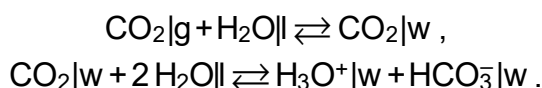
In preparation for the experiment, the sealed bottle is strongly cooled ($0\text{ }^{\circ}\text{C}$) in the refrigerator (or in an ice bath during the demonstration). The bottle is then opened, and—as quickly as possible—about one third of the seltzer water is poured out. 3 drops of bromocresol green solution are added to the remaining liquid and the bottle is sealed again. The solution turns clear-yellow.

Subsequently, the bottle is allowed to warm to room temperature for about 10 minutes. The bottle is then shaken vigorously, and the cap is opened cautiously to vent the pressure of the excess carbon dioxide. This process is repeated until little pressure remains. The solution is now clear-green.

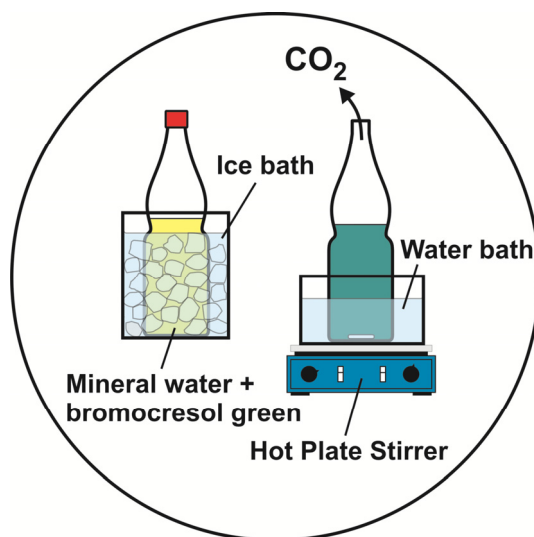
Finally, the open bottle is heated in a bath of almost boiling water. After a few minutes, the solution should turn completely blue.

Explanation:

Bromocresol green is an indicator acid with a standard value of the proton potential μ_p^{\ominus} of -28 kG . Below a proton potential μ_p of -22 kG in the solution, it turns yellow. This is caused by bicarbonate ions formed by the dissolution of CO_2 in water, a process, which provides sufficient H_3O^+ ions when the mineral water is cold and under pressure,



When the bottle is opened, a large part of the CO_2 escapes. The corresponding change in the proton potential can be made visible as the indicator moves into its transition range between -22 kG and -31 kG and turns to the mixed color green.



When the contents of the bottle are heated to a higher temperature, the residual dissolved gas is driven out; the proton potential drops below -31 kG and the indicator color changes to an intense blue.

Disposal:

The mineral water can be added to the waste water.

References:

H. W. Roesky, K. Möckel: „Chemische Kabinettstücke“, VCH Verlagsgesellschaft, Weinheim, 1996, S. 130-131

C. A. Snyder, D. C. Snyder: “Simple Soda Bottle Solubility and Equilibria”, J. Chem. Educ., 1992, Bd. 69, S. 573