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A degassing instrument for analysing CO_2 dissolved in natural water

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Arising from our EGU 2017 presentation (http://meetingorganizer.copernicus.org/EGU2016/posters/20564, X2 352), interest has been expressed in its application to the analysis of the hydrocarbonate ion [HCO_3^-] in atmospheric water.

Arising from the historic difficulty in analysing the aqueous [HCO_3^-] ion ('it is in all our reagents', pers. comm. UK laboratory) the classic determination has been to measure a suite of other anions and cations including [H^+] via pH, and to treat the balance of negative charge as a measure of [HCO_3^-].

From this balance, dissolved CO_2 can be inferred via the dissociation constant as published for pure water.

$$CO_2 + H_2O \Downarrow \diamondsuit [HCO_3^-] + [H^+] \; K_1 = 4.2 \text{ x } 10^{-7}$$

Our EGU 2016 presentation sought to determine how the ionic environment in 263 UK rain samples can influence the above equilibrium, which is work in progress. In the mean time we have received the following expression of interest from an atmospheric science advisory group.

…….. is very interested in the role of H-carbonate in the ion balance of precipitation. They have had some discussions recently about the best approach to infer H-carbonate currently discussing the possibility of sending you samples from other locations for analysis.

We have duly offered to use our degassing instrument to corroborate current analyses in a batch of 'blind' samples, and to provide a design for a basic degasser that water quality laboratories could evaluate in house. This paper therefore presents a circuit for degassing CO_2 from water samples irrespective of whether in atmospheric equilibrium or supersaturated, including a prototype 4-way distribution and collection valve which it is hoped will make the analysis intuitive and therefore open to automation.